

## Executive Summary

# Financial Incentives to Promote Sustainable Tillage Practices: Environmental Crop Insurance

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## About the Milken Institute Fellows Program

The Milken Institute Fellows Program accelerates Israel's economic growth through innovative, market-based solutions for long-term economic, social, and environmental challenges. Our goal is to accelerate Israel's transition from a Start-up Nation to a Global Nation with solutions that others can replicate.

Directed by the Milken Institute Israel Center, the Milken Institute Fellows Program awards annual fellowships to outstanding Israeli university graduate students. Through the Milken Institute Fellows program, we train some of Israel's best and brightest young professionals in creating pragmatic financing and economic policy solutions, and they deploy them as resources to government ministries, nonprofits and other key organizations. Our applied research and Financial Innovations Labs® are a launching pad for transformative change, using innovative financing mechanisms, programs and policies to bridge social, regional, economic and productivity gaps within Israel and between Israel and the world.

In addition, Fellows craft their own policy studies during their internship aimed at identifying barriers to job creation and capital formation in Israel. The Fellows' research, carried out under the guidance of an experienced academic and professional staff, support policy makers who shape economic reality in Israel. The program offers the ultimate training opportunity, combining real-life work experience with applied research.

Throughout the year, Fellows receive intensive training in economic and financial analysis, public policy processes, and research methods. They acquire tools for communication and presentation, policy analysis, leadership and project management. The fellows participate in a weekly research workshop where they meet senior economic and government professionals, business leaders, and top academic and financial practitioners from Israel and abroad. They also participate in an accredited MBA course. The course, which focuses on financial and economic innovations, is taught at the Hebrew University School of Business Administration by Prof. Glenn Yago (Senior Director/Senior Fellow at the Milken Institute).

Fellows Program alumni can be found in senior positions in the public and private sectors. Some serve in key positions in government ministries while others work at private-sector companies or go on to advanced graduates studies at leading universities in Israel, the United States and Great Britain. Within the program's framework, more than 80 research papers have been published, catalyzing reforms, reducing barriers, accelerating economic growth, and improving the quality of life for Israel's citizens.

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Israel's agricultural industry, which accounts for an estimated 2% of the country's GDP, has significant impacts on society and the environment. 300,000 hectares of farmland generate annual revenue estimated at NIS 11 billion (2012). The vast majority of this land employs intensive agricultural methods to maximize yield. The farmer's objective is to enhance the productivity of agricultural land and the favored means include multi-crop cultivation, mechanization, and the use of chemical pesticides, herbicides, and fertilizers. These conventional methods cause land intensification and degrades farm and environment resources. For example, the negative externalities of synthetic additives are estimated at NIS 32 billion to NIS 100 billion annually and ultimately lead to declines in long-term agricultural productivity.

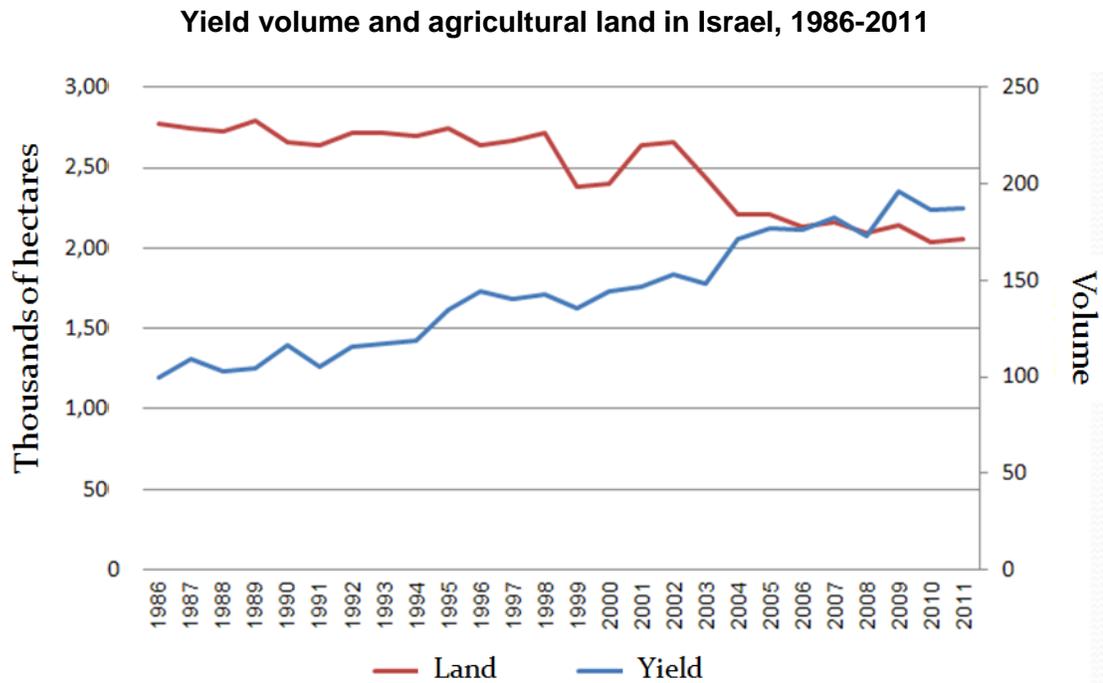
**This research aims to find an optimal incentive for farmers to adopt sustainable, innovative agricultural practices in a way that will minimize social costs and economic risks to them.**

The suggested model is a designated crop-yield insurance using an economic instrument to promote sustainable agriculture practices while protecting farmer yield from the potential risks of switching to conservative methods.

Compared with other OECD states, Israel uses a high amount of pesticides per 100 hectares (CBS, 2012b), with nearly 7,000 tons of active pesticide ingredients sold annually in Israel over the past few years. Currently, about 8% of agricultural inputs are chemical pesticides, herbicides, and fertilizer additives. Distributed by irrigation systems or sprayed directly on soil or crops, they are used to improve crop productivity. However, this intense use of synthetic inputs in tillage has been shown to cause a multitude of interconnected problems affecting both water and soil ecosystems:

- The top layer of the soil seals, forming a crust, and the soil's capacity to absorb water decreases.
- Water run-offs accumulate, erosion increases, and the fertile layer of soil degrades.
- Sea-bottom hypoxia by eutrophication occurs. When agricultural runoff carries fertilizer into bodies of water, delivering higher levels of nutritive compounds such as nitrogen and phosphorous, aquatic plants grow excessively, depleting the water of oxygen necessary to underwater life.
- As resistance to pesticides develops, there is a constant need to develop more toxic compounds.

Current production costs do not account for these external effects, providing an inaccurate picture of agricultural productivity. In the long term, if conventional farming practices and their destructive effects continue, this exclusion could have a devastating impact on the industry.



**Land intensification caused by using of conventional tillage methods is shown as land size generally decreasing and yield generally rising, 1986 – 2011.**

A review of existing economic instruments designed to promote sustainable farming methods has found that they are limited by their efficacy. They are primarily taxes and subsidies in the form of emission-level charges, ambient concentration charges and/or subsidies, non-compliance fees, performance bonds, liability rules, and input/output charges and/or subsidies. Their ability to address the aforementioned negative implications is narrow due to inaccurate estimation and collection costs of data, time passed between pollution practice and contamination, farmer discrimination (different amount of inputs needed by different geographical areas), reduction of agricultural supply, generate of new environmental problem by avoiding other one and insufficient incentive to farmers.

Economic instruments in the form of payments for ecosystem services were reviewed as well. A market of environmental conservation products provides payments for farmers who produce ecological benefits as part of their cultivation. This incentivize mechanism assigns property rights and the conservation of resource is credited to farmer. However, this mechanism has found to be costly, undermine ecosystem reproduction and complex as a tool to measure ecosystem functions due to its ill-bounded, inter-related and combined ecosystem services involved. The interconnected biotic and non-biotic component calculations in this instrument are found to be complicated and therefore uncertain.

For the long-term health of its ecosystems as well as its agricultural industry, Israel needs to incentivize farmers to use sustainable, innovative tillage methods by providing them with a financial safety net through the transition. Designated crop-yield insurance is a viable incentive—it can be used as an efficient mechanism to spread potential risks and therefore increase benefits of agriculture.

Insurance is coverage against a risk at a stated premium. It is an effective instrument for managing risks, relying on several methods, which are defined as follows:

- **Risk spreading:** Business pools its risk with other businesses through the purchase of an insurance policy. Therefore, loss absorbed by third party when necessary.
- **Variance reduction:** The risk associated with the loss is reduced as the number of policies grows.
- **Segregation of risk:** Discrimination among different classes of policyholders based on their profile.
- **Encouragement of loss-reduction measures:** specific loss-reduction activities, to receive coverage.
- **Monitoring and control:** the insurer monitors and controls activities of the insured to verify policy standards.

A fixed premium is collected and coverage of losses is determined according to yield triggers. Losses are transferred and indemnity for farmer losses (per unit) will be paid by the calculation of multiplying the expected future yield price by the difference between past yield (conventional method) and actual yield (conservative method) of a specific farm.

Key elements of the suggested crop-yield insurance are as follows:

- A conventional practice **check strip (control field)** shall be designated. It will be used to determine any loss in production, by comparing its results with those of the fields farmed using conservative, innovative practices.
- **Yield price** shall be determined by recent market prices and expected demand.
- **Adverse selection** (in which insurance buyers and providers have asymmetric information and low-risk policyholders subsidize high-risk policyholders) shall be dealt by specific classification of potential policyholders by area, type and species of crop.
- **Moral hazard** (when a policyholder tends to be more willing to take a risk because he has coverage) shall be discouraged by establishing deductibles and co-insurance, limits to the maximum amount of indemnity, higher premiums if insurance would have been applied, and specific mitigation measures as part of policy contracts.

With these parameters, crop-yield insurance will **ease adoption of innovative practices** and promote their implementation. Short-term effects will be an **efficient farmer's risk management** with a "business as usual" level of production, while long-term effects will be the implementation of agricultural methods that will **increase benefits to farms** (sustainable agriculture practice) **and help protect natural resources**. Eventually, these innovative practices will become **sustainable conventional practices** for farmers.

We can assume that over the years, as more farmers realize the benefits of using sustainable practices, these innovative tillage methods will become the conventional standard of farming and set valuable precedents. Consequently, crop-yield insurance will have a database on which to build an effective insurance-policy infrastructure.

The government should provide subsidies to farmers who adopt innovative cultivation practices and offer lower premiums to the most conservative farmers—that is, those who adopt the most sustainable practices.



Considering the potential risks and externalities of the agricultural industry in Israel, the limited efficacy of present economic instruments, and the effective way insurance deals with risk management, my research concludes that there is a compelling case for crop-yield insurance that will help hedge farmers' potential loss.

The importance of sustainable agriculture obligates its promotion by all stakeholders—farmers, policymakers, environmentalists, and society at large. Insurance can address this need and incentivize farmers to adopt sustainable and optimal cultivation practices with minimum risk for their own benefit, for Israeli society, and for future generations.

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