



Circular plastic value chains

Business case:

Circular business model for greenhouse agricultural plastic waste, Israel

Baseline analysis and challenge

Growing crops in greenhouses and covered tunnels using plastic films is common in Israel. These need to be replaced every 2-3 years and, at the moment, are not recycled, which generates approximately 6,250 tons of plastic film waste annually that is illegally incinerated, disposed of in nature, or sometimes – diverted to proper landfilling. A recently published report claims that agricultural plastics are one of the major contributors to soil pollution, contributing to large quantities of microplastics¹.

According to the Israeli Ministry of Agriculture and Rural Development, the total area covered by greenhouses in Israel is approximately 100 km². The widespread use of plastic film in the country's agricultural practices and the lack of a sustainable waste management system highlight the critical need to address the issue.

The scope of the pilot project

Since 2019, the United Nations Industrial Development Organization (UNIDO) has focused on improving the circularity in Israel's plastic value chain within the framework of the regional EU-funded SwitchMed programme. Together with industry associations, government institutions and key expert organizations, UNIDO engaged stakeholders in the plastic value chain to demonstrate a circular business model that can reform the handling of plastic applications in Israel's agricultural sector.

The most commonly used material in greenhouse films is transparent Low-Density Polyethylene (LDPE). This material has significant recycling potential, which could create new economic opportunities for farmers and actors along the value chain while reducing the environmental impact at its end of life.

One of the major limitations of recycling greenhouse plastic films lies in the soil contamination generated when the plastic films are removed from the greenhouses. In this context, the objectives of the pilot project were to identify a solution that



Image: Plastic cover films rolling equipment: Tractor, Winder, and Drum

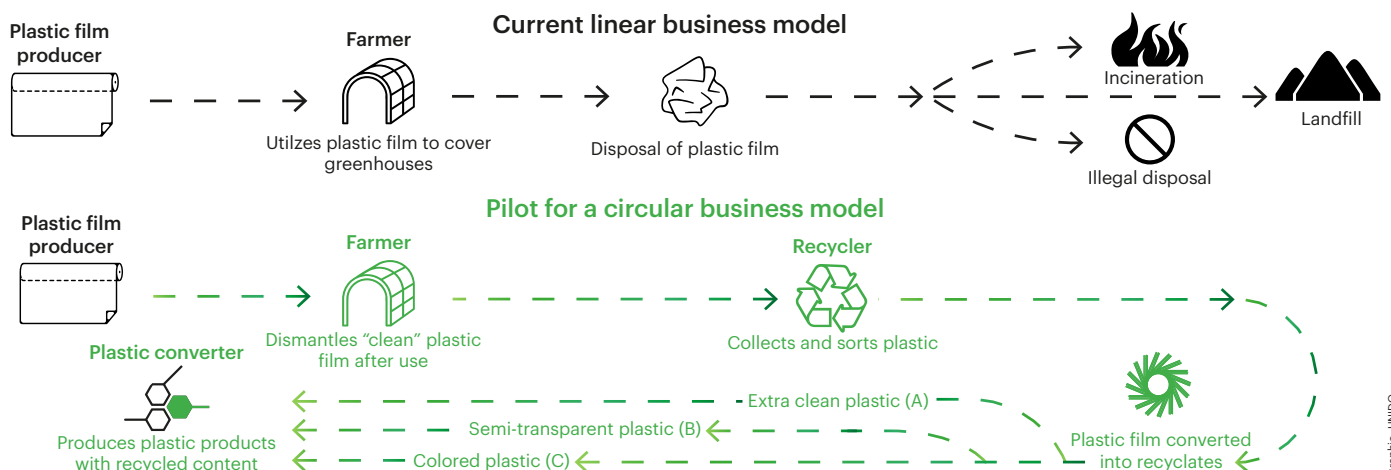
could enable the greenhouse cover to be removed cleanly while enabling a profitable business model for the collection and recycling of the films.

The pilot project and solution

The pilot project conceptualized a solution where the plastic films are dismantled from the structure by rolling them directly on an irrigation pipe drum without the films touching the ground, thus preventing soil contamination. This model was developed based on a consolidated circular practice in Israel to take back the irrigation pipes from the farmers.

Irrigation pipes' drums and their deployment tool connected to a tractor are widely spread agricultural equipment and available to most farmers in Israel. Hence, no new equipment is needed to apply this solution.

The project partnered with the Federation of Regional Councils in Israel, local farmers and Infinya Recycling to conduct a series of tests under real operational conditions for collecting LDPE greenhouse film. Once collected, three bales of 500 kg



¹ Food and Agriculture Organization (FAO), Assessment of agricultural plastics and their sustainability: A call for action (2021)

of LDPE films were transported to the recycling plant. Before entering the recycling process, visual inspections of the LDPE film were undertaken to identify the appropriate target stream out of three categories: coloured plastic (C), semi-transparent plastic (B), and extra clean plastic (A), each of them having a different market value once recycled.

The “drum method” of collecting plastic bales resulted in LDPE films that were free of contamination and could be classified as recycled into category B. The collected LDPE films were converted into recyclates, successfully passing quality tests to ensure they meet the expected quality standards. In case after routine recycling of the collected film into category B, the recycler will see that a sufficiently high-quality product is obtained, and the collected film may be directed into category A.

The recyclates produced are currently intended to be sold to the electric and infrastructure piping sector. It is anticipated that these can be sold at a price of 25 to 30% lower than virgin material. Suppose the LDPE collection process can yield plastic films suitable for category A; the resulting recyclates can be sold at a 10% premium on the market. These recyclates can be utilized in higher-grade applications such as plastic films for secondary and tertiary packaging, benefiting the whole value chain and increasing farmers’ revenues.

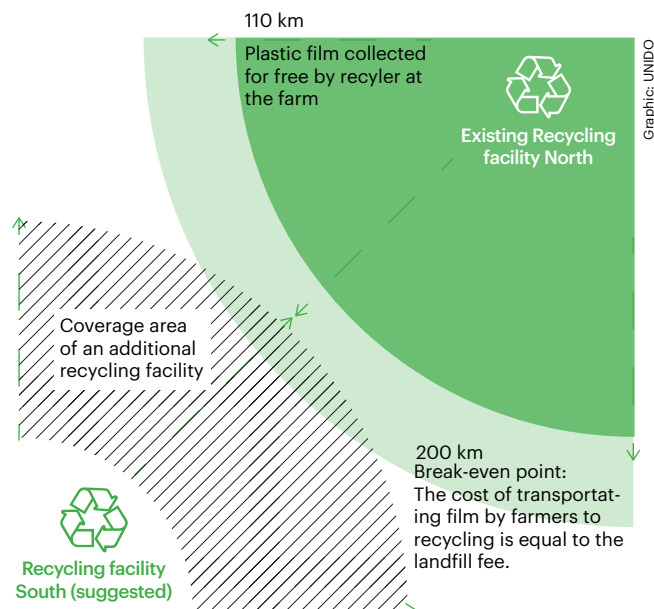
The results and key takeaways

The pilot project introduced a circular business model that enables the recycling of LDPE films used in Israel’s agriculture by applying an economically viable reverse logistic model. With widespread participation, this business model could transform the waste management of plastic films in the agricultural sector across the whole country.

The limiting factor of the recycling scheme is the distance and the resulting transport cost from the farm to the recycling plant. In the proposed model, the recycling company offers the possibility to purchase LDPE films from farmers at a price of 400 NIS (about €100) per ton at the recycling plant or to collect them for free from the farms and bear the transport cost up to 110 km. Transporting the plastic films to the recycling facility is only viable for farmers within a 200 km radius of the recycling plant, thus covering approximately all of Israel’s northern and central regions. Beyond 200 km, it remains more cost-effective for farmers to pay for the disposal of the used plastic film in landfills.

To address the transport cost variable, two alternative scenarios of the proposed circular business model were developed:

- Creating a set of collection hubs strategically located in agricultural areas that invest in a plastic compactor machine to increase the volume of plastic carried in each transport by a factor of three. This solution is cost-intensive, and while it is generally viable, it should consider the proximity of the hub to the recycling plant and the expected plastic quantity collected.
- Establishing a second recycling plant for LDPE films in the southern region of Israel to decrease transportation costs, making the suggested business model available and profitable for all regions across the country.



Upscaling recommendations

The quality of the collected films and the resulting recyclates is decisive for any upscale scenario. To ensure the quality of the material, it is recommended to establish dedicated standards, particularly focusing on factors such as cleanliness and consistency in material properties. Building on existing standards, like the Israeli SI 821-1 (2013) and the European EN 15347, national standards could be created as follows:

- A Waste Greenhouse Cover Film Handling Standard, ensuring the utmost cleanliness and purity of collected plastic, offering comprehensive guidelines for detaching, folding, compacting, baling, loading, and transportation.
- Dedicated standards introducing uniform testing protocols and reporting mechanisms for recyclate quality.
- A Greenhouse Cover Films Standard, establishing norms for plastic film producers or importers, defining critical attributes, including Design-for-Recycling principles, UV-protection requirements, polymer identification and provisions for incorporating recycled materials.

Besides standards, a nationwide expansion of this circular business model depends on several policy and regulatory enhancements that can encompass the enforcement of new rules to prevent air pollution from unauthorized agricultural waste burning, the inclusion of agricultural plastics under the Extended Producer Responsibility (EPR) law, and raising landfill fees to incentivize recycling over landfilling.

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