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What Makes Farmers Follow the Standard? The Role of Regional Characteristics, Local Alternatives, and Policy Support in Non-State Market Driven Governance in the Arava, Israel

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Supermarkets have become a major actor in driving a shift to more sustainable agricultural practices throughout the agri-food value chains, using certification schemes and other instruments known as non-state market driven (NSMD) governance. This paper explores what factors may affect farmers' willingness to join such mechanism once it is in place, based on the case study of pepper growers in the Arava region in southern Israel. Based on an extensive farmers survey and interviews with other stakeholders in the region, we find that regional characteristics such as export dependency, homogeneity in regional production patterns, prior experience and farm level awareness are tied with NSMD adoption. Adoption is also made possible by the availability of services offering alternative practices to the farmers, and the different ways public policy supports the shift, and in turn is affected by it.

Keywords: *sustainable farming, GlobalGAP, NSMD, IPM, Israel*

Food supply chains are the heart of some of the world's most challenging environmental problems: they generate approximately 26 percent of anthropogenic GHG emissions, with food production responsible for 32 percent of global terrestrial acidification and 78 percent of eutrophication, potentially altering local species composition and undermining biodiversity (Poore and Nemecek, 2018). This impact is expected to expand with global trends of population growth, dietary shifts and addi-

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tional demand for agri-food products in other sectors, for example, for biomass for the energy sector. The sector contributes to climate change not only through direct greenhouse gas emissions, but through its impact on the availability of carbon storage in vegetation and soil. Unsustainable agricultural practices may exacerbate land conversion and habitat loss, wasteful water consumption, soil erosion and degradation, pollution and genetic erosion, including the contribution to environmental feedbacks such as loss of pollinators due to high input of chemicals in crop protection pesticide application (FAO, 2015; Notarnicola et al., 2012; Aktar et al., 2009).

While these impacts are expanding, the diffusion and development of sustainable agriculture practices and products has gained momentum in OECD countries and elsewhere over the past two decades. In conjunction with governments promoting a host of measures to limit agriculture's environmental impact, large food retailers have leveraged their ever-growing market power to enforce change in agricultural production processes throughout the world through non-state market driven (NSMD) mechanisms such as third-party certification schemes.

For example, in 2021 Whole Foods launched its "Sourced for Good" label, based on third party certification of its suppliers' practices. The program is a continuation of their sourcing program previously coined "Whole Trade Guarantee". Initiated in 2007, the program focuses on fair trade, community investment, and environmental practices through partnership with Fair Trade USA, Fair Trade International, Rainforest Alliance, Fair Food Project, and the Equitable Food Initiative (Cann, 2021). Similarly, Walmart announced that by 2025, their seafood products will be completely sourced from fisheries certified by the Marine Stewardship Council, Best Aquaculture Practices, or other programs following the Food and Agriculture Organization's guidelines. By that year, the company plans to source 100 percent of its fresh produce from suppliers certified as using integrated pest management to reduce farmers' pesticide use (Walmart, 2022).

This growing use of certification has allowed in recent years for public and private standards to proliferate throughout the global food system, changing food supply chain governance across regions and sectors (Brunori et al., 2016). Henson (2008) even suggested that private standards have become the predominant driver of agri-food systems, creating "soft law" that not only helps suppliers position themselves competitively, but is de-facto mandatory for producers to adopt even if it is not legally binding.

Much attention has been given in literature to the emergence, legitimacy, and growth of non-state market driven mechanisms in general, and in the food system in particular. However, while some papers look at the impact of certification on individual producers (Van Rijsbergen et al., 2016), and others on regional differences in attitudes toward NSMDs (Schlyter et al., 2009), there is a methodological need to bring the two levels together--examine the regional factors impacting willingness and ability to adopt environmental practices through an NSMD from the farmers' perspective, as well as other stakeholders in the region.

This paper addresses this gap by examining the motivations and conditions that allowed and propelled pepper farmers in the Arava region in the south of Israel to achieve a GlobalGAP certification, the prominent certification scheme for supermarket chains in Europe. We focus specifically on its requirement to transition from chemical pesticides to more sustainable forms of crop protection, mainly integrated pest management.

We pose three main research questions: How do different regional characteristics impact the uptake of NSMD mechanisms? What is the role of market services for alternative practices in the transition to adhere to the NSMD mechanism? And what is the role of policy in supporting the transition to the practices required by the NSMD mechanism? While we researched the Arava farmers in the context of the crisis they experienced in pepper production circa 2014, these questions arose out of the relatively rapid uptake of IPM in the Arava a few years prior.

The paper continues as follows: first we present a literature review of NSMD mechanisms and governance, their interaction with policy, and their use in agri-food supply chains. Second, we discuss the methodologies used to analyze the factors impacting the NSMD mechanisms uptake in the Arava and the case study region. Third, we present the results and discuss each of the three factors affecting NSMD uptake in the Arava, followed by conclusions.

LITERATURE REVIEW

In order to capture the particular dynamics of the NSMD at play in the Arava region we review a few connected strands of literature: First, the theory and experience accumulated on NSMD, how it emerges, and how companies react to its new demands and requirements. Second, we review literature on how public policy interacts with NSMD and the different roles it may pose in supporting or undermining its uptake. Third, we look at the specific domain and scheme of the NSMD adopted in the Arava region - GlobalGAP, a prominent certification scheme that European supermarkets use to regulate environmental practices used in their source farms. We conclude with describing one of the challenging demands of GlobalGAP encountered by the Arava pepper farmers: adoption of integrated pest management as a replacement to traditional use of chemical pesticides.

Non-State Market Driven Governance

Non-state market driven governance is an institutional scheme in which institutions govern certain norms through markets and supply chains, rather than through state sovereignty. Compliance is achieved and verified thanks to market incentives and mechanisms, and the source of authority is not the government's monopoly on use of force but rather evaluation by external audiences, including those who regulate the market and those who wish to impact its behavior (Cashore, 2002). NSMD mechanisms were developed in a wide range of sectors, tackling both social and environmental challenges – from a more equitable distribution of value throughout the global coffee value chain, to enhancing sustainable forestry practices and preventing destructive fishing practices in live reef fish trade (Auld et al., 2009).

NSMD schemes are characterized by five discerning features: their ability to apply policy that does not derive from the authority of the state; they comprise a governing arena where actors can dynamically steer behaviors and norms toward collective values and goals; their authority is derived by market based supply chains (meaning they're based on individual choices made by consumers and producers); they aim to reconfigure market incentives that would otherwise persist in detriment of solving the particular problem at hand; and finally they apply mechanism to verify compliance and enact consequences for those who violate the agreed terms of the system (Bernstein and Cashore, 2007).

Researchers of NSMD governance have sought to understand what conditions allow it to gain initial support and establish norms that may not be in every firm's immediate financial interest. These scholars offered strategies to trigger the 'California effect' whereby companies are pushed to adopt the industry's best performers' standards, forcing them to comply with stricter norms in order to gain access to the market (Cashore et al., 2007). Scholars have also tried to establish how NSMD mechanisms gain legitimacy, highlighting tensions between different legitimizing factors such as legality, moral justification and wider popular acceptance (Schouten and Glasbergen, 2011).

Researchers also looked at how companies may respond differently to pressures to join an NSMD scheme based on the gap between its requirements and existing policies, its costs of implementation relative to company size, available subsidies for certification, the type of product being certified, and firms' vulnerability to shaming campaigns, the level of focus of demands being presented and firms' dependence on external audiences for example through export (Auld and Cashore, 2013). Assessing the growth in uptake of NSMD mechanisms, scholars conceptualized the evolutionary logic of NSMD mechanisms design – starting with rules that are close to existing practices at least by firms that are leading with their performance (an initiation phase), continuing to gaining widespread support through a growing market in which these new standards are evermore demanded by activist groups and finally consumers (Cashore et al., 2007).

NSMD mechanisms can have varying degrees of effectiveness. An analysis of NSMD programs in Chile, for example, found that participating properties in NSMD programs targeting deforestation were able to decrease deforestation rates between 2-23 percent, with collaborative strategies outperforming confrontational strategies in achieving environmental goals (Heilmayr and Lambin, 2016). Similarly, empirical observations of NSMD mechanisms in exporting countries in the global south revealed that while growing in spread, they often fail to impact environmentally damaging land use phenomena such as deforestation due to lack of sufficient uptake as well as adequate enforceable certification criteria (Van der Ven et al., 2018).

However, effective implementation of NSMD governance has also been criticized for inherently shifting power toward multinational corporations, who through these new governance regimes assert control over what is considered "acceptable" products and work processes in expense of local producers and other actors in the supply chain (Archer, 2021). One way in which exporting governments and producers sought to undermine this dynamic and at times prevent the shift to more sustainable practices is by establishing their own certification systems, as Brazil has done, for example with its cattle industry (Guéneau, 2018). Similarly, NGOs can at once strengthen local producers' capacity to comply with lead firms' demands or subvert it, by creating alternative value chains that valorize local production in order to transfer power to the community (Bair and Palpacuer, 2015).

How Does Public Policy Interact with NSMD Mechanisms?

The state plays various roles within global value chains and production networks. Horner (2017) coined four central roles: facilitation, meaning assisting firms in confronting the challenges of the global economy; regulation, meaning restricting firms' activities to protect different local values and interests; production, meaning independent manufacturing through state firms; and acting as a buyer through public procurement. NSMD mechanisms can trigger governmental response in each of these categories, or in filling the gaps that state regulations have left unchecked. Government policy can also play a role in limiting NSMD governance, especially when states feel their sovereignty is being encroached upon. Thus, standards originating in the global north have not remained uncontested by producers and governments in the global south, who at times offered alternative schemes that represented local values more appropriately, in their view, while re-asserting their sovereignty over what should be considered legitimate and illegitimate farming practices (Schouten and Bitzer, 2015).

For example, in Indonesia, the Forest Stewardship Council (FSC) ecosystem services certification filled a gap in government policy by measuring restoration projects and impacts and built on existing regulations aimed at enhancing corporate performance beyond legal requirements. However, the state also competed with existing NSMD mechanisms such as the Roundtable on Sustainable Palm Oil (RSPO) certification standard by establishing a governmental standard, ISPO, causing possible confusion among consumers and private sector actors (Ningsih et al., 2020). Similarly, in Argentina, government secretariats first participated in formulating standards for certifying forest plantations through the Forestry Stewardship Council certification, while later shifting support to a competing more lenient certification founded by landowners and forestry companies associations – the Programme for the Endorsement of Forest Certification (Giessen et al., 2016). In the field of organic agriculture, public policies supported NSMD governance through governmental procurement and establishing codes and institutions that facilitate differentiation of organic agriculture, but at the same time public policies also narrowed down and constrained the original intent of NSMD governance so as to focus on only certain dimensions of production (Arcuri, 2015).

Cashore (2019) described four pathways through which NSMD mechanisms may gain authority over industry norms and actors through their interaction with public policy: directly setting and monitoring firms' behavior relying strictly on demand pressures from their potential customers, igniting a diffusion and learning process through which government institutions adopt new practices in the industry (for example LEED certification), symbiotic pathways in which policy makers rely on certification schemes to fill gaps in existing public policy, and hybrid pathways in which policy makers can draw on both public and private solutions to exert influence. Each pathway requires its advocates a degree of political acumen and policy analytical capacity.

The government can also impact NSMD mechanisms design as an interest group aiming to affect its rules and strengthen its legitimacy and acceptance by procuring products that adhere to it. However, once the government demands compliance with an NSMD mechanism, compliance cannot be said to depend on the market anymore. There are also hybrid situations in which the government can require certification by certain actors in the supply chain but not all (Cashore, 2002).

NSMD governance can also help support public policy by allocating private resources for policy goals traditionally requiring government investment. Private standards can help enforce existing national law and help farmers understand and implement it, leverage sector specific expertise to facilitate change in producers' practices, provide a greater incentive to comply with demands through market access than fines and other mechanisms usually employed by the government, focus on different domains than government regulations, allow governments to focus their auditing resources, and rely on government data and information for private enforcement. Governments can also mandate companies meet certain standards in engaging their suppliers and governing the supply chain, for example in tracking potential human rights abuses further upstream (Lambin and Thorlakson, 2018).

However, one of the barriers to NSMDs and public policies supporting one another is uptake by local producers. In order to participate in certification schemes, the perceived benefits for producers must outweigh the transaction costs (e.g. new management systems and documentation) in addition to the required change in behavior. These benefits can be in the form of access to new markets or gaining a market premium for their products (Gan et al., 2019). In order to overcome the barrier these transaction costs pose to small scale farmers, some programs developed dedicated tools to reduce their transaction costs. For example, the RSPO created a certification standard for groups of independent farmers rather than individual producers, which allows them to pool resources and reduce individual costs. Another obstacle is the necessary knowledge and capacities to apply the standard. While the

RSPO initiated training programs for small-scale farmers, this often requires greater resources and reach (Von Geibler, 2013). Thus, local collective institutions play an important role in exporters' response to CSR demands in global value chains. Lund-Thomsen and Nadvi (2010) found that these institutions play an especially outsized role in cases where the value chains are less visible, driving change in behavior not in response to media pressure, and allowing local governance mechanisms to emerge with possible proactive support by policy makers.

These diverging interactions between policies, multi-national purchasing firms and local producers have emphasized the need to couple NSMD governance and supply chain analysis. Grabs (2017) proposed linking these two strands of literature for three main reasons: first, in order to shed light on the different demand and supply side pressures that support NSMD mechanisms emergence or spread; second, to capture the close link between sustainability governance and supply chain governance structures and frameworks; third, the link exposes the regulatory spaces that are occupied by the state or other non-state actors over time. Thus, it is important to understand the specific supply chain at hand in this paper, whereby supermarkets in Europe import food products from around the world, and in our case – Israel.

Supermarkets Certification Schemes in the Agri-Food Supply Chains

Organized supply chains create opportunities to spread sustainable practices through testing new approaches and promoting their adoption (Naik and Suresh, 2018). This can be achieved by governing sustainability in the supply chain (for example through social corporate responsibility), governing the sustainability of the supply chains (by demanding higher standards of production and stewardship from upstream suppliers that gain knowledge and incentives through the chain), and governing through the supply chain, where chain actors interact with a wider network of actors, such as civil society organizations, to change the norms that govern the industry (Bush et al., 2015).

While its desirability and effectiveness are hotly contested, this form of intervention in global supply chains relies heavily on the ability of corporations from the global north to demand and ultimately change production practices in the global south (Bitzer and Glasbergen, 2015). This gap between where production and purchasing occurs exacerbates the challenges in social-environmental governance in highly divergent regulatory environments, social-environmental contexts, and market conditions. This is a gap which market-based governance of and through the supply chain aims to narrow (Virah-Sawmy et al., 2019).

These global supply chain governance systems often lead firms to not only demand better inputs from local suppliers, but also share technology and knowledge with them, as well as advance payments and other types of assistance that can diffuse desirable practices in local industry (Taglioni and Winkler, 2016). Private certification schemes in agricultural commodities in particular connect companies and NGOs that are based in the global north with producers often located in the global south.

They aim to change the market opportunities open to producers while improving agricultural practices upstream in the value chain (Glasbergen and Schouten, 2015).

In order to implement a private standard system, supermarkets need to meet three conditions: have a big enough market share, a centralized procurement system, and producers' capacity to meet the standards (Henson, and Reardon, 2005). In recent decades, supermarkets' power grew to an extent that allows them to impact producers' environmental behavior and choices to a large degree – either through relying on external certification schemes such as the Marine Stewardship Council's certification of sustainable fisheries, or through internal procurement policies applied to their private labels (Havice and Campling, 2017). In the UK alone, by 2006 four chains alone controlled 72 percent of the food retail market. This has shifted their perception in society from passive intermediaries in the supply chain to central actors in driving production as well as shaping consumption patterns (Jones et al., 2007).

With the major share of food now being purchased in supermarkets, retailers have the power to mediate between local consumers and global producers, shaping production standards based on consumer demands, and providing products that meet them. The retailers act as both gatekeepers, and guarantors of quality and other consumers interests (Fulponi, 2007). For example, within a few years of launching, EUREPGAP, a standard initiated by European retailers (discussed below), became known as a gateway for exporting to the UK and Europe (Hatanaka et al., 2005).

At the same time, globalization of the agri-food system has created a challenge for national regulators to control food quality and other aspects of food production, as produce in supermarkets arrives from myriad locations, each with its own regulatory environment, all out of reach for local regulators (Hatanaka et al., 2005). Supermarkets are expected to fulfill an ever greater role in food policy – from ensuring food security and supply resilience and stability, to protecting farmers and other small-scale actors along the supply chain, ensuring proper use of agro-chemicals, maintaining water and soil quality, identifying future crops and products, supporting public health and internalizing the environmental impacts of food production (Timmer, 2009; Macfadyen et al., 2015). The goal of third-party certification in this globalized value chain is to ensure traceability, allowing retailers to know the origins and quality of the food they are purchasing. Certification is vital for maintaining consumer trust in supermarkets as guarantors of health, safety, and other values consumer came to find important, but it is also dependent on the highly centralized nature of these transnational supply chains (Friedmann and McNair, 2008).

Vandergeest (2007) proposed that rather than distinguishing between state and market driven policies in analyzing food chain governance, scholars should use the notion of "environmental regulatory networks", which include a multitude of actors, both in the public and private sectors, operating to fulfill a plethora of diverging interests, including improving environmental protection as well as facilitating trade and developing new marketable food products, all working in conjunction with policies such as certification having the effect of restricting local resource use or impacting its governance. As a case in point, Erbaugh et al. (2019) conceptualized interventions toward sustainable agriculture as consisting of three stages – definition, governing, and monitoring and evaluation. They argued that in each of the stages both the private sector and the public sector, in addition to civil society, play a multitude of roles, from tailoring the definition to a local context, to providing information, incentives, and formal rules, and assessing compliance and progress by farmers and others involved in agricultural activity.

GlobalGAP

In the 1990s, European retailers sought to formalize an integrated approach to crop management. These retailers created a protocol for good agricultural practice (known then as EUREPGAP and now as GlobalGAP) that went beyond dealing with chemical residue and became a gatekeeper for producers seeking access to European markets (Campbell et al., 2006). The protocol provides auditable instructions on how to produce and handle food products, bringing together issues of food safety, worker welfare, traceability, and environmental protection. Farmers seeking certification pay an annual registration fee based on product and farm size, in addition to the costs involved in meeting the requirements of the standard (Fiankor et al., 2017; de Raymond and Bonnaud, 2014).

It is a business to business standard, which is not communicated to consumers through labeling, and allows for either individual or group certification. The latter is often preferred by small scale farmers, who must manage the complexities of the program and its various control points (Kariuki et al., 2012). GlobalGAP introduced demands that go beyond mandatory environmental and social regulations, in order to reduce retailers' risk of sourcing in an international supply chain where producers may operate in highly diverse regulatory environments, production characteristics, environmental conditions and technical expertise (Henson and Humphrey, 2010).

While GlobalGAP was created in 1997 in Europe, it spread soon thereafter to the US, becoming the dominant certification scheme in both, though more so in Europe (Mook and Overdevest, 2021). GlobalGAP's power over producers emanates not only from its ability to open up new markets for them to export to, but also from the threat of losing existing retail clients if they are found to be non-complying with the standard's requirements. Alternatively, some retailers working with GlobalGAP apply a continuous improvement strategy, turning the scheme central to learning over time (Tipples and Whatman, 2010).

GlobalGAP represents a shift from self-regulation by farm commodity associations to co-regulation, whereby retailers in association with civil society organizations and other actors shape and control production standards and their implementation (Daugbjerg and Feindt, 2017). As a case in point, in recent years, GlobalGAP has emphasized the importance of partnering with the local public sector and civil society organizations in production sites, integrating different actors in questions of standards adaptation and design, as has happened, for example in Kenya's development of a local benchmark compatible with GlobalGAP named KenyaGAP (Tallontire et al., 2011). Involving local stakeholders in the scheme may also help retailers respond to critique that the lack of transparency and inclusion in designing retailers'- led standards in general and EUREPGAP in particular, allows internal procurement offices to decide which food is grown, where and how it is grown and by whom (Konefal et al., 2005).

GlobalGAP may also require local support for building capacity to meet the standard's requirements. For example, in Nicaragua, local governments and USAID allocated 53 million dollars for a project designed to help farmers sell to Wallmart. The funding helped create new infrastructure, as well as for training farmers (Elder and Dauvergne, 2017). This was the case in the Arava region in Israel, where farmers faced the challenge of switching from chemicals-based crop management systems to integrated pest management in order to acquire GlobalGAP certification.

Integrated Pest Management

GlobalGAP requires that farmers reduce chemical use for crop protection by adopting systems for integrated pest management. An integrated pest management approach (IPM hereafter) is a "low-input" approach with a potential to significantly reduce the environmental impacts of crop protection through the reduction of chemical input of pesticides applied. Augmented biological control is a specific IPM strategy, which is especially suitable for greenhouse crops, whereby natural predators are introduced to reduce the number of pests. Despite the potential effectiveness of this low-input approach, the uptake of biological IPM continues to lag behind its potential (Van Lenteren, 2012).

The OECD offered different ways to measure the impact of IPM, including their adoption rate, their impact on yield, pesticides use and improvement of farmers' knowledge and skills (increased human capacity-based indicators). These indicators serve different levels of analysis – from policies that encourage their uptake to IPM's potential to reduce environmental risk from pesticides (Cuyno et al., 2001; OECD, 2014).

This implementation gap of biologically based IPM is attributed to various factors, including the increased knowledge requirements necessary for implementation coupled with increased labor requirements. Literature indicates that successful IPM implementation requires additional knowledge and guidance, and that providing for IPM 'management guidance' is therefore necessary since selling biological control agents as products in not enough (Van Lenteren, 2009). Van Lenteren (2009) also emphasizes the importance of working with the most progressive growers when developing IPM. He argues that with good support and guidance growers would prefer IPM regardless of regulation or incentives. Thus, providing knowledge and guidance can make the sustainable practice of biological IPM the preferred method in terms of functionality and provide for an eco-environmental win-win scenario.

One innovative approach to successfully implementing IPM and achieving environmental gains is through a more sustainable servicized IPM model. In a servicized model (SIPM) the value proposition shifts from selling products to selling product-service systems (Mont, 2002; Rothenberg, 2007). Such a model in crop protection means shifting from selling chemical and biological crop protection inputs to selling a package which includes both inputs and crop protection services (EPA, 2009; OECD, 2009; Henriksen et al., 2012). These services are crucial as prior experience with the adoption process of IPM has points to the need to support farmers through field schools and other activities to disseminate knowledge (Van den Berg and Jiggins, 2007). Several examples of servicizing exist in the agri-food sector, including for IPM (Stahel, 1998).

The ENDURE Network Social Science Insights on Crop Protection has specifically looked into the role of supermarket procurement schemes as a tool for implementing IPM through the specification of food quality attributes. These retailers and supermarkets go beyond regulation with private agri-food standards. In their review of practices in different European countries, including France, the United Kingdom, the Netherlands, Italy, Switzerland, Poland and Hungary, the ENDURE project concluded that for producer organizations, supermarket IPM schemes are mainly a commercial condition for being accepted as a supermarket supplier (Endure, 2022).

In conclusion, GlobalGAP is a retail led NSMD mechanism that aims to homogenize the quality and environmental standards for food production entering European (and North American) markets. It requires expertise in implementing IPM strategies to reduce pesticide use, which individual farmers often lack.

METHODOLOGY

In this work, we concentrated on the case study of the Arava region in southern Israel. The following section describes the region and the mix of methods we used in our analysis. The combination of methods described below enabled us to capture the multifaceted transition to more sustainable practices in agri-food systems, perceptions and choices made by different actors and levels of analysis. Lamine et al., (2019) suggested that capturing the initiatives to make ecological production more accessible to farmers should be conducted through a territorial agrifood systems approach, taking into account the different actors involved in promoting local and ecological products – from farmers and middlemen to local and national institutions. Thus, we mapped the different actors and information sources at a regional level through reports, interviews, and an extensive survey conducted among local farmers.

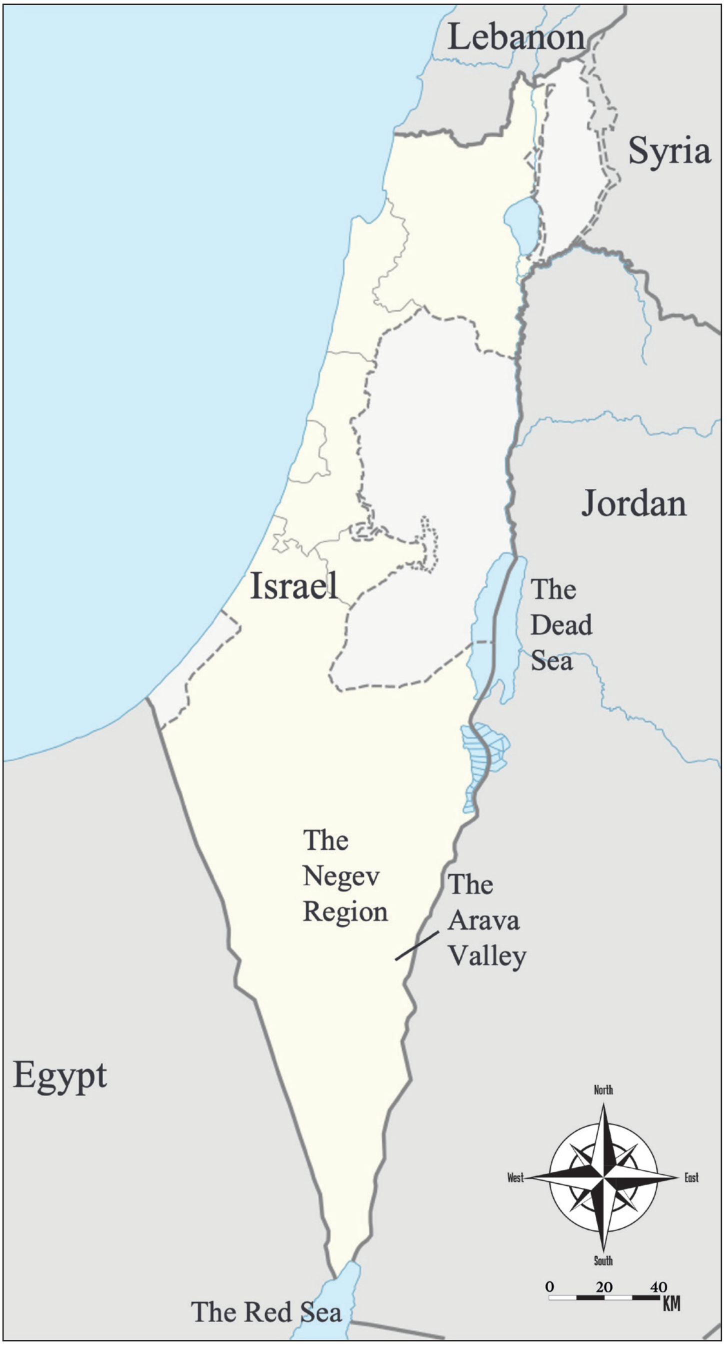
Case Study Region – The Arava

The Arava is a long and narrow valley stretching from the southern tip of the Dead Sea to the Bay of Eilat in the Red Sea (Figure 1). The Central Arava Regional Council is comprised of seven rural villages of different kinds (five agricultural co-operative villages called moshav (p. moshavim) in Hebrew, and two community townships). Despite its rather small population counting 4,000 people in 1,000 households, the council boundaries span 150,000 hecatres, equal to 6 percent of Israel's total land size. Agriculture is the Central Arava's biggest economic driver, with peppers (*Capsicum*) at the heart of its economy for many years (Central Arava Regional Council, 2022). The region is located in the Saharo-Arabian Region and has an extreme desert climate. Low precipitation levels and the lack of available water are a critically limiting factor for agriculture in the region. Still, its arable land comprised in the 2019/20 season roughly 4,000 hectares, of which about 74% vegetables, and 25% fruit trees plantation, mostly dates, as well as roughly 1% cut flowers. Pepper (*Capsicum*) is the major crop in the region, comprising roughly 25% of the total arable land and 50% of the vegetables area, with bio-organic farming comprising a growing share of roughly 10% of the growing area as of 2020.

This study was originally conducted at a time of crisis for local pepper growers, which started circa 2012 when prices were plummeting, and many growers were looking for alternative crops and sources of income. Even then, about a half of the 452 farmers in the Arava were pepper growers. The average yield per pepper grower in the Arava in 2011-2012 was estimated at 0.7 tons per hectare, with the total area of pepper production in the Arava at the time estimated at 2035.2 hectare, most of it aimed at the export market. Most of the peppers were exported to Western and Eastern Europe, with the UK comprising up to 7 percent of the exported peppers from the region during the seasons of 2011-2015 (PPIS, 2015). Even today, with the shifts in production due to the crisis described above, the Arava region is responsible for 60 percent of Israel's overall export of vegetables (Central and Northern Arava-Tamar R&D, 2022b).

Perhaps differently from other import destinations in the global south, farmers in Israel face high production costs relative to other countries in Europe. Pepper economics for the 2013-4 season data from a report conducted for the Arava Agricultural Committee estimated the farmer's cost of production per land unit, without capital recovery, being 25 percent higher than that of the Spanish market at the time. However, the farmers in the region are supported by a public Rand D center that was founded in 1986. The center employs researchers that work hand in hand with local farmers to find new solutions to facilitate agricultural production, facing environmental challenges in water and soil availability and quality, pests, changing regulatory and market demands, and new technological innovation (Central and Northern Arava and Tamar R&D, 2022a).

Figure 1: The Arava in the Negev region in Israel (map by NordNordWest, Ynhockey, adapted from Wikimedia)



Desk Research

Several different secondary and primary sources were analyzed. We reviewed: (i) economic crop seasonal reports that summarize crop protection applications (volumes, application, costs etc.); (ii) key aspects of seasonal crop management summaries and; (iii) reports by the Israeli Central Bureau of Statistics, Ministry of Health and the State Comptroller which discuss crop protection practices and pesticides.

Mapping the Key Stakeholders and their Role in the Value Chain

In-depth semi structured interviews were conducted with three pepper growers, the head of the Arava R&D center and the function responsible for crop protection in the extension service. Based on these interviews, the following key stakeholders were identified: pepper growers; relevant key players in the two companies providing IPM services (field guides, CEOs, heads of R&D and marketing); the Regional Environmental Unit, Northern and Central Arava R&D (director, head of the vegetables unit and head of the flowers unit); officers in the Ministry of Agriculture and Rural Development (Head of Plant Protection and Inspection Services, Head of the Agro-Ecology unit). Additional data was collected from different sources in Plant Protection and Inspection Services (e.g. from the pesticides database).

Semi Structured Interviews with Stakeholders

In light of the themes discussed in the literature in relation to potential environmental gains of the servicized IPM model and following the mapping of key stakeholders, a series of in-depth semi structured interviews was conducted with over 35 stakeholders, including crop protection experts, government experts from the Ministry of Environmental Protection, Ministry of Agriculture and Rural Development, Local council, settlement cooperative, marketing companies, crop protection companies, experts from academia, servicing guides and experts, key farmers and others. Through these semi-structured interviews, the value chain of the servicized model was constructed and it was possible to understand the role of the different stakeholders. The topics covered in these interviews included: (i) the development of the service offer and the value proposition for SIPM (used to gain insights into its dynamics over time); (ii) the challenges faced throughout the implementation phase of SIPM; (iii) farm attributes and management parameters that were correlated with successful implementation, and; (iv) potential implications of SIPM for efficient resource use and good practices (water, energy, etc.). In addition, several economic aspects were examined including the providers' cost structure and their use of the servicized model in other plant practices (e.g. fertilization, seeds, etc.). This element of the interview provided a broader understanding of servicizing in the region. All these elements including desk research, semi-structured interviews with stakeholders and reports and contracts reviewed, were used in the design of the farmer's questionnaire.

Farmer Survey

The farmer questionnaire was guided by the research objectives and the information obtained from the literature and from the stakeholders' interviews. Following a pilot stage, the questionnaire was refined and further developed. The Arava region consists of five agricultural moshavim. The number of farmers in these moshavim within the region was 390 and these comprise the total population of interest. Of these, 150 farmers (38% of the population) were sampled randomly through a random selection of names on a comprehensive database of all farmers in the region. The proportion of the sample belonging to each moshav resembled the proportion of the total population that came from each Moshav (i.e. a stratified random sample was obtained). The survey was conducted via phone or face-to-face interviews and achieved a response rate (of those contacted) of 87% (130 out of 150) (Table 1).

FINDINGS AND DISCUSSION

The results of the survey, the interviews, and analysis of key reports and documents allowed us to answer the three main research questions, each presented in the following subsections:

1. How do different regional characteristics impact the uptake of NSMD mechanisms?
2. What is the role of market services for alternative practices in the transition to adhere to the NSMD mechanism?
3. What is the role of policy in supporting the transition to the practices required by the NSMD mechanism?

In the following we present and discuss findings regarding each of these research questions.

Role of Regional Characteristics

Four distinct regional qualities emerged as central to facilitating adoption of IPM as part of the GlobalGAP scheme: Expert dependency, farm level awareness of environmental benefits, homogeneity of production and close social proximity, and prior experience with alternative practices.

Export Dependency

Farmers in the Arava were heavily dependent on exporting peppers to markets in Europe and thus had to meet the demands of European retailers and the GlobalGAP standard. GlobalGAP is the largest farm assurance program in the world and currently active in over 100 countries, including Israel (GLOBALG.A.P., 2022). It is the most prevalent farm assurance program in the Arava region and was repeatedly mentioned by farmers and other stakeholders as the main driver to switch from chemical use to IPM. In our interviews with farmers, respondents detailed in length the requirements of the program and indicated they are now all using it to certify their produce for the large retailers outside Israel. Therefore, farmers were left with no choice but to adopt the IPM requirements of GlobalGAP.

Table 1: Farmer questionnaire sections, topics and number of questions in each section.

Survey topic section number	Survey topic	# Questions	Focus areas
1	General questions on decision-making in the farm	10	Farm management's experience in agriculture, time in the region, continuing sons etc.
2	Personnel and sources of income	25	Employee profile, additional sources of income (e.g. agritourism) training level etc.
3	Business profile	38	Production, share of peppers, export, contracts marketing, choices of crop protection and other plant management practices, participation in cooperatives etc.
4	Level of automation and use of advanced machinery and technology	24	Type of machinery, automation, advanced technologies such as sensors, agri-food management software etc.
5	Service and outsourcing of different farm activities	8	Asked for each part of crop management e.g. land sanitation, fertilization, climate and salinity sensor management etc.
6	Crop protection	95	Comprehensive section addressing all approaches in the region: chemical, organic, IPM and SIPM, including actual practices, costs, effectiveness, transition, incentives, changes over time etc.
7	Sources of knowledge and information and training	16	Level of use of sources of knowledge and information, frequency etc.
8	New Environmental Paradigm Questionnaire	15	Validated questionnaire

64 survey participants felt economically compelled to switch to IPM in order to comply with foreign requirements (answered 3 and above to either motivated by requirements by regulation or supermarkets abroad, comprising 65 percent of participants who answered the question). This was mentioned anecdotally in some respondents' conversations with the interviewer: "We have to (switch to IPM) to sell in Europe". "I don't necessarily support the demands, but I have to meet them. This isn't about efficiency; we are subject to demands abroad". "I didn't have a choice; I don't see any advantage to IPM". "There's no other choice, it (switching to IPM) wasn't up for discussion or consideration, it was a given reality".

This feeling of having no other choice but embracing IPM as a condition to sell abroad was also reflected in other respondents' description of the economic necessity of the move. For example, one farmer said "IPM is a basic condition for entry to retail chains", while another answered: "only the customer impacts (this choice)". Some even adopted the assumption that "if there's no IPM the pepper isn't any good for export". One farmer went as far as to say that "the choice of IPM is based on customers' pressure in practice", adding that if there wasn't a demand (for IPM) farmers would use chemicals since the economic consideration comes above all else, as the farm is a business and farmers want to make a profit. One farmer mentioned having to make the move due to market competition and the need to meet quality targets: "In two years the Spanish market moved from 0 to 100 percent based on IPM because there's no choice. This whole field is based on retailers rather than customer driven, which is why there's no attempt to create a label. The English market is a bit different and gives a premium over time for quality and meeting the target".

44 farmers mentioned "opening new markets" as one of their motivations to switch to IPM (45 percent). In fact, until 2011 there was an institutional capacity to drive farmers to adopt practices required to open new markets through Agrexco. Agrexco used to be a governmental company in charge of promoting agricultural export abroad. Before the company was privatized and sold in 2011 the company was able to influence farmers' practices and choices by finding new markets for their produce and help the farmers meet the necessary demands to enter them. Agrexco knew that the demands in Europe would only become stricter and so it had required the farmers to make the switch to IPM.

Farm Level Awareness of Environmental Benefits

When farmers were asked to rank from 1 to 5 their motivation to switch to IPM, 1 being totally irrelevant and 5 totally relevant, reasons having to do with market penetration came in at only number four, five, and under, ranking below farm health and environment concerns, and concern about pests resistance to pesticide:

Table 2: Farmers' response to factors impacting choice of IPM (average response per source on scale of 1 - irrelevant to 5 - most relevant)

Reduces my and others' exposure to dangerous substances	3.77
Reduces risk of losing the product (due to resistance of pests to pesticide)	3.70
Leads to improvement of safety and health conditions on the farm	3.50
Allows adjustments to health, safety, and environmental requirements	3.48
Permits meeting standards of international supermarket chains	3.35
Enables meeting foreign regulatory requirements	3.33
Reduces negative effects on the environment	3.25
Replacing old input with new input (chemical pesticides with other materials or means)	3.25
Allows greater flexibility on harvest days due to reduced sprayings	3.14
Enables improvement of quality of final product	3.03
Permits implementation of innovations (precise agriculture, etc.)	2.97
Permits entry into new market.	2.71
Increases yield	2.30
Permits offering new products or services	2.21
Enables reduction in personnel costs	1.85
Reception of a government grant	1.66
Information from environmental or health organizations on health effects of pesticides	1.62
Leads to reduction in use of energy, water, and/or other inputs	1.43
Obtains better insurance rate	1.22
Not enough personnel, especially trained personnel, for independent handling	1.15
Lack appropriate mechanization for independent handling	1.07

The finding was also reflected when analyzing the percentage of farmers who answered 3 and above to first 4 factors in the list (meaning that these factors were relevant in their decision to adopt IPM):

Table 3: Farmers' significant factors in farmers' choice to adopt IPM (percentage of farmers who marked 3 or more for each factor on a scale of 1-5)

Allowing adjustment to requirements	69%
Limiting exposure to dangerous substances,	79%
Reducing risk for loss of product due to resistance	74%
Improving safety and health conditions on the farm	71%

However, as these results were collected only after most of the farmers in the region have already adopted IPM as part of their certification process, it is impossible to determine whether their environmental approach toward IPM developed before or after they started the process. Pre-existing environmental concerns could contribute to adoption of IPM, or alternatively farmers could develop these attitudes as a result of having to switch to the new system.

Homogeneity of Production and Close Social Proximity

Since the regional economy in the Arava was so heavily dependent on pepper production, farmers were able to learn from one another, collaborate to reduce transaction costs, and enjoy the assistance of local knowledge institutions such as the regional R&D center, which helped develop and disseminate the new IPM practices.

In a personal interview, Ms. Rivka Offenbach, one of the researchers at the R&D center since its inception, said that the Arava region was uniquely positioned to adopt the IPM requirements as part of GlobalGAP thanks to its climactic conditions, but also because of the regional culture: "The farmers' culture is different. In the Arava (people) are organized with sharing knowledge and cleaning the area (from pests) so the collaboration succeeded."

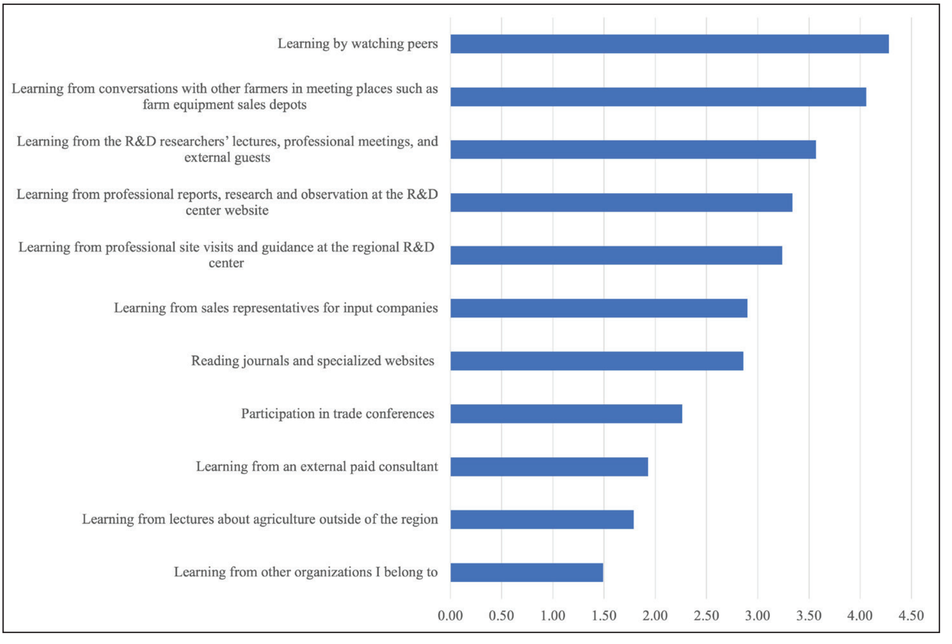
While not being a structured option in the question about motivation in the survey, some farmers interviewed for the survey mirrored this view. One respondent said, for example, "when I started off everyone was already doing IPM, I just trusted more experienced farmers". Another respondent argued there was peer pressure, and that when he saw everyone was doing it (IPM) he didn't want to stay behind or be any different. A third farmer testified that it was a word to mouth process: "people hear that it (IPM) works and is easy (to implement)".

This dynamic is, however, reflected in the survey data about the farmers' information sources. When farmers were asked how they learned about new agricultural practices or technologies (Figure 2), the highest-ranking source of information was other farmers in the region, followed by the learning from the regional R&D center researchers and their work.

Prior Experience with Alternative Practices

Pepper crop production in the Arava has been dramatically affected by events related to crop protection in Israel and abroad. In 2006, Spanish competitors of the Arava farmers in Almeria suffered a "residue crisis" whereby chemical residue was found in their produce, playing in favor of the Arava producers at the time. However, Arava farmers witnessed the possible impact chemical residue could have on income in outlier events, as well as the choice of farmers in Almeria to switch to IPM almost completely the year after the crisis (Van der Blom et al., 2009). A second 'focusing event' occurred in the Arava itself in 2010, when one of the key pests harming pepper, Thrips, developed a resistance to chemical control, significantly harming local pepper yields, catalyzing the move toward IPM. These two events represented crop protection "shocks", demonstrating to farmers and other actors in the region how chemical crop protection can affect farmers' income and ability to sell their produce to retailers.

Figure 2: Farmers' source of information on new agricultural practices and technologies (average response per source on scale of 1 - irrelevant to 5 - most relevant)



Availability of Affordable Services for Applying Alternative Practices

As mentioned above, implementing IPM is a central condition for receiving GlobalGAP certification, as IPM reduces chemical use and other interventions to a necessary minimum, protecting both human health and the farm's environment (Strazdina, 2018). However, the lack of effective knowledge dissemination could impede its adoption in the region (Waterfield and Zilberman, 2012), and consequently producers' ability to get certified by GlobalGAP. One way to overcome that gap is through servicizing the IPM business model, meaning rather than selling farmers products such as natural enemies to the pests, IPM companies offer plant protection services that include both the products and the guidance, instruction, and ongoing monitoring to apply them (Biobee, 2022).

The biologically based IPM model in the Arava region pepper crop became servicized over a gradual period in response to needs for the expertise the practice requires. The commercial IPM services in the Arava first relied on the development and availability of a comprehensive biologically based IPM solution for peppers, which was jointly developed with the growers. The service model complements the natural enemies product offered by the crop protection companies, and is considered by crop protection experts and growers to be almost as important as the product itself. The servicizing process improved both efficiency and effectiveness of biologically based IPM, and developed, via a gradual process, into a comprehensive servicized model adopted by the vast majority of the Arava pepper growers. Therefore, the Arava case study shows that while biologically based IPM was originally adopted as a commercial condition for being accepted as a supermarket supplier, other factors currently support its successful adoption.

The SIPM market in Israel is a duopoly market. For many years a company called BioBee was the single provider of these services in the Arava and in Israel as a whole. The service model was developed by BioBee and later adopted by Yad Mordechai, another provider of SIPM that over the years grew in market share. Stakeholders reported that the competition between the SIPM suppliers, combined with the crisis in pepper production, contributed to the reduction in the price of SIPM package for farmers.

- *BioBee Biological Systems*: BioBee is based in kibbutz Sde Eliyahu and is considered to be one of the leading international companies in the field of biologically based Integrated Pest Management, Natural Pollination, and Medfly Control (Kloosterman, 2014). Its products are sold in over 50 countries, through subsidiaries, agents and distributors. One of BioBee's key products is the *Phytoseiulus persimilis*, a natural predator of *Tetranychus urticae* (red spider mite). According to the company, one of its main strengths is the extensive knowledge and experience of its field service personnel, who support the implementation process at their customers' sites, comprising the basis for the servicized model (BioBee, 2014).
- *Pollination Services Yad-Mordechai (1995):* Pollination Services Yad-Mordechai is based in kibbutz Yad-Mordechai and specializes in mass production of bumblebee colonies for pollination of various agricultural crops and the production of natural enemies for biological control of pests in greenhouse crops. This firm also supply advanced Pollination Solutions for agricultural crops.

The cost of the service packages has gone down as the market shifted from a single provider of SIPM into a duopoly market, although the change in price appears to be only partially acknowledged by different stakeholders, including growers. Growers still argue that the difference in cost between conventional chemical treatment and SIPM is significant and, thus, posed a disadvantage for adopting SIPM. In any case, experience from other regions shows that the SIPM solution should not be substantially more expensive than other practices, as higher prices could hinder wider adoption of the alternative to traditional chemical pesticide use (Van Lenteren, 2009). It is worth mentioning that the cost of the field guide comprises a third of the package cost. Thus, it might be beneficial to consider how this cost could be reduced for the companies and the growers by using innovative support schemes.

Policy Interaction with the NSMD Mechanisms

Public Funding and Support

While the retailers' standard mandates farmers to adopt IPM, finding locally appropriate solutions for each crop requires creating new knowledge that may not be readily available in the market. Furthermore, applying IPM solutions requires monitoring and adaptation over time. Thus, the government took an active role in supporting development of these IPM solutions and disseminating them in several ways: First, the regional R&D center worked hand in hand with BioBee to experiment and test their IPM solutions for peppers. According to Rivka Offenbach of the regional R&D Center:

> "We conducted experiments, met with the field inspectors, there was a perfect transfer of knowledge between the commercial company and the ministry of agriculture. All the knowledge passed on to the ministry's crop protection unit instructors. BioBee developed a new natural enemy, learnt how to grow it in their own station. But then they (BioBee) cooperated with the ministry so that the farmers received all the information on how to cultivate the natural enemies and which pesticides farmers could use so as not to harm them".

The government also provided subsidies to support some of the farmers' costs of switching to IPM, which according to one farmer interviewed amounted to 10-20 percent of the cost. Another farmer mentioned that Agrexco also offered funding at one point, but it wasn't a decisive factor in the transition. After IPM was mainstreamed in the region the government lifted its direct support to farmers, as the commercial companies established their customer base, though the ministry and regional R&D Center in the Arava continue to support farmers in the region in terms of crop protection. For example, the center and the ministry of Agriculture provide guidance on the list of pesticides allowed for use under IPM schemes (Israel Ministry of Agriculture and Rural Development, 2016) , analyze ongoing threats to the crops (Dubrinin, 2012), and provide recommendations on crop protection, referring farmers to the commercial companies' field inspectors when needed (Israel Ministry of Agriculture and Central and Northern Arava-Tamar R&D, 2021).

Policies to Limit Chemical Use in Export Destinations

While NSMD mechanisms often go beyond local regulatory demands, the regulatory environment in the farmers' export destinations greatly affects standard design. Local constituents' demands, translated to both market power and local regulation, eventually shape the new practices farmers must adopt abroad to get certified. This was evident in the Arava's transition to IPM as part of the GlobalGAP certification.

In 2009 the EU enacted directive 2009/128/EC, which established a framework for community action to achieve the sustainable use of pesticides (European Parliament, 2009a). The directive acknowledged that applying the general principles of IPM and crop and sector specific guidelines would result in better use of pesticides and other pest control measures. Thus, it concluded that IPM reduces the risk to human health and the environment and, hence, member states should promote it and establish necessary conditions and measures for its implementation. The directive further noted that based on Regulation (EC) No. 1107/2009 and of the directive itself, implementing the principles of IPM is obligatory for all member states, though states reserve the right to decide how to implement them.

The directive states that each member state should describe in a national action plan how it plans to implement these principles, giving priority to non-chemical methods of plant protection and pest and crop management. These plans must include quantitative objectives, measures and timetables, as well as indicators to monitor the use of substances of particular concern and its gradual diminishment.

Member states were required to ensure that professional users have at their disposal "information and tools for pest monitoring and decision making, as well as advisory services on integrated pest management." States must also put in place appropriate incentives to encourage professional users to implement the guidelines for IPM. The directive also encouraged exchange of information and best practices, through its expert group on the thematic strategy, on sustainable use of pesticides. Finally, annex III of the directive specifies the general principles of IPM.

Prioritizing the use of non-chemical methods is emphasized in the directive: "To ensure a high level of protection of human and animal health and the environment, plant protection products should be used properly, in accordance with their authorization, having regard to the principles of integrated pest management and giving priority to non-chemical and natural alternatives wherever possible. The Council should include in the statutory management requirement referred to in Annex III to Council Regulation (EC) No 1782/2003 of 29 September 2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers (European Parliament, 2009a), the principles of integrated pest management, including good plant protection practice and non-chemical methods of plant protection and pest and crop management." (Preamble {35}).

This evolving regulation of pesticides also reflected general societal concern in the EU. According to the ENDURE project, the key concerns regarding crop protection in EU countries are related to health and the environment. Civil society is mostly concerned with the following three topics: 1. the exposure of the public to pesticides in general and more specifically by vulnerable groups, 2. residues of pesticides and, 3. GM foods. In addition, concerns related to water contamination are also gathering attention, coupled with awareness-rising campaigns. The project's 'Foresight report' concluded that a more significant part of the European population, even if at times it is characterized by a limited understanding of actual agricultural practices, is requesting to use pesticides at levels "as low as reasonably achievable", to implement Good Agricultural Practices, and to fully integrate crop protection into farming systems (ENDURE, 2009).

Importantly, European regulations mainstreamed IPM in the Arava's export markets even beyond the GlobalGAP's requirements (which were designed before the directive had been adopted). European regulation also primed the IPM as a necessary policy solution among farmers in the Arava, building support not only in their own adoption of the practice but as a policy issue in Israel itself, as some farmers mentioned:

> "Regulation abroad was an important factor in transitioning to IPM", "Pest control is determined by the extremes – the countries with the harshest requirements".
>
> "Only in 20 years we might reach the standards used in Europe. In Israel you can sell poison…", "There are no sanctions in Israel if you use illegal chemicals even if you get caught. The Arava maintains a high level of quality because it's meant for export. That's where the awareness came from, but (after adopting IPM) farmers started caring and became aware".
>
> "Farmers in the north of Israel meet almost no regulation, there's no inspection on chemical prevalence in produce meant for the local market."

In conclusion, European policy played an important part in mainstreaming IPM, reflecting consumer demand for setting standards that limit pesticide use, and sending farmers abroad the message that IPM is an inescapable norm they must adopt and adjust to.

Filling Gaps in Data and Policy Capacity in the Producing Countries

While public policy was essential for farmers' ability to adopt IPM as part of the new NSMD regime, the efforts to certify farmers for GlobalGAP also complemented existing policies and filled gaps in Israel's regulation of chemical pesticides. The NSMD mechanism answered the need for additional data collection, monitoring capacity, health and safety regulations, and eventually scaling up of IPM practices beyond the Arava region and its producers.

While Israel has put in place an extensive set of laws and regulations to control the use of pesticide, a survey conducted by Israel's Central Bureau of Statistics in 2010 found that in that year the ratio of the quantity (tons) of active ingredients in pesticides, per 100 hectare of agricultural land in Israel (plantations, vegetables, and field crops), was 3.19 (Israel Central Bureau of Statistics, 2012). This figure was the highest among the OECD countries at the time. For example, in Austria it was 0.28 tons and in the United Kingdom it was 0.36 tons. The Israeli ratio was almost double the ratio of the next country down the list, Portugal, which was 1.68 tons of active ingredient per 100 hectares. When adjusted for active ingredient per quantity of produce (instead of area), Israel still scored very high.

A report published by The State Comptroller's in 2012 focused on the regulation for the use of pesticides and fertilizers and the management of agricultural waste. Several issues raised in the report revealed potential complementarities between government policy and NSMD procedures (The State Comptroller and Ombudsman of Israel, 2012). First, the lack of regular data on pesticide quantities was identified in the audit as a key challenge in the regulation of pesticides in Israel. While centralized monitoring and surveying processes are often hard to achieve, using data collected through the NSMD mechanism could add to the country's estimation of pesticide use, at least among certified farmers.

Second, the report identified a lack of enforcement authority and capacity. The three inspectors of the Nature and Parks Authority who inspect pesticide storage rely on farmer cooperation in order to perform their duties. Moreover, although it is within its mandate to inspect pesticide application, adherence to labeling instructions etc., the Ministry of Agriculture does not engage in inspection beyond that of the produce. GlobalGAP adds significant resources to the inspection process and exerts greater pressure on farmers to cooperate.

Third, health and safety regulations require those producing pesticides and those spraying pesticides from the air to pass health checks. However, farmers spraying from the ground are not required to pass such health checks. The audit report agreed that this is a gap in the health and safety regulation and warns against the lack of training on the safe use of pesticides. In contrast, certification from GlobalGAP requires farmers to offer all employees who are in contact with pesticides the opportunity to go through voluntary health checks.

Fourth, the report noted IPM's contribution to the reduction of pesticide use where the practice is applied. The available data at the time of the report regarding implementation of IPM in 2009 only accounted for 10,000 hectare and the plan was to increase with another 20,000 in 2012. As this was a small fraction of 214,000 hectare allocated for crops in the country, the report considered the quantity to be insignificant in the overall management of pesticides in the entire country and suggested that the regulators focus on the reduction of pesticide use. Interestingly, stakeholders interviewed argued that following the success of IPM adoption in the Arava, in 2011 the Ministry set a goal for shifting all pepper and strawberry production in Israel to IPM within three years. While often the California effect is discussed in terms of changing market dynamics, with producers who are lagging behind being forced to match the pace of early adopters of environmental (and other) practices due to changing market demands and norms, in this case the NSMD mechanism has pushed government policy to change market practices directly.

CONCLUSION

Non-state market driven (NSMD) mechanisms have become a central driver in transnational agri-food chains. In this paper we explored different factors that impacted farmers in the Arava region in the south of Israel to adopt GlobalGAP, the predominant certification scheme for agricultural producers exporting to the European market. Based on a survey of more than 100 farmers in the region, as well as interviews with different stakeholders and reports from regional and national sources, we aimed to deepen our understanding of NSMD mechanism adoption by local producers in countries where environmental regulation and norms may be lagging. Rather than focusing downstream on factors contributing to the legitimacy of the NSMD governance or how it evolved, we looked upstream to the farmers, the region, and the country in which the farmers operate. This allowed us to shed new insights on how local factors such as regional characteristics, availability of markets for alternative solutions, and the supporting role of public policy, all contribute to the ability and motivation of farmers to adopt new sustainable practices and enroll in the certification scheme.

By combining a regional perspective with farm level surveys and interviews, this paper enriches the literature on NSMD in exporting countries. It shows the necessary conditions for farmers to be willing and able to join the NSMD, and the specific regional attributes that facilitate NSMD diffusion within the target region and later elsewhere in the country.

We found that specifications by European supermarkets and retailers have proven to be a key driver for the shift in pepper growers' pest control practices in the Arava from conventional chemical treatments to biologically based IPM. We asked how farmers' ability and willingness to join the certification scheme built on three factors in particular: regional characteristics, availability of affordable alternatives, and public policy.

The Arava region had several characteristics that enabled and accelerated the shift from chemicals-based crop management to a biologically based Integrated Pest Management approach. First, farmers' near total dependency on export left them no choice other than to adopt GlobalGAP rules and the IPM practices the certification entailed if they wanted to maintain their ability to export to European and British markets, and to a growing degree the American market as well. While farmers also exported to other destinations such as Russia where demands were less stringent, the dominance of the European market was such that foregoing export to European supermarkets was not a viable option economically. However, while access to markets ranked high in the survey, improving farm health and environmental performance received an even higher rank. We cannot infer that the expectation for better environmental and health outcomes led to farmers adopting IPM, in fact it is reasonable to assume that awareness to IPM's benefits followed farmers' acceptance of the NSMD mechanism. However, this does indicate that environmental and health benefits of the NSMD mechanism are important not only to consumers but also to producers, whether before or after joining the scheme.

Two additional regional factors were found conducive to farmers adopting the NSMD mechanism: the region's economic homogeneity and social proximity, and prior experience with proposed alternative practices. The fact that most farmers in the Arava grew the same crop, pepper, allowed the region to invest resources in tailoring and disseminating IPM solutions for the entire region. Farmers learned from one another and from the regional R& D center the benefits and realities of IPM, and soon it became a regional norm that farmers accepted and taught newcomers to the region. In terms of prior experience – the Arava farmers saw firsthand the adverse effects of chemical pesticides on yields on two occasions in the years building up to certification, first when their competitors had large amounts of produce discarded due to chemical residue found in the peppers, and second in their own produce when a local pest developed immunity to local pesticides.

However, farmers in the Arava would not have been able to make the necessary shift to IPM in fulfillment of their obligations to GlobalGap if they didn't have a viable alternative, in this case the companies developing IPM solutions. The collaboration between regional and national policy makers and an Israeli company specializing in IPM solutions yielded a solutions package for farmers that included natural enemies to pests, as well as the ongoing monitoring and knowledge on how to apply them in order to meet GlobalGAP demands and ensure crop quality and safety. An initial subsidy to farmers was aimed at financially facilitating the shift to these new services, but over time prices changed through market competition in the form of another company offering similar IPM solutions to farmers.

This dynamic sheds light on the intricate embeddedness of policy in the process of joining an NSMD mechanism, in this case GlobalGAP: the very design of the program is rooted in local norms and regulations that shape exporting farmers' perception of what is 'progress' in health and environmental standards. The conditions of the NSMD mechanism are met through different kinds of policy support for farmers – through direct financial support, joint research and education activities, and finally the NSMD itself supports diffusion of these environmental practices by complementing specific gaps in local policy such as data collection, enforcement mechanisms, and even setting long term goals. Policy makers' experience with the new practices mediated through the NSMD mechanism also helped them better understand how they could apply similar schemes in other regions and crops. Thus, the NSMD mechanism supported policy and knowledge diffusion beyond the scope of participating farmers.

The factors and mechanisms identified in this paper deepen our understanding of how NSMD mechanisms are able to shift practices among producers at a regional scale, and the role that supermarkets play in changing policy and perceptions even beyond the scope of the value chains they dominate. Future research could further reveal how similar policies and practices may develop in other sectors and locales in the exporting country following an NSMD program implementation and compare NSMD governance adoption in different regional settings to empirically examine differences in diffusion at a regional scale.

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