

START-UP  
NATION  
CENTRAL



# INDIA-ISRAEL: GROWING CHALLENGES AND AGRITECH SOLUTIONS





## INTRODUCTION: **AGRICULTURE IN INDIA**

India, the world's second most populated country, is an agricultural giant, ranked second in global farm output, having exported over \$26 billion worth of agricultural products in 2016. In addition to being the largest producer, consumer and exporter of spices and spice products, India is also the largest producer of millet, with an estimated output of 10.5 million tons in 2016, and is the world's third largest producer of wheat, producing 88 million more tons in 2016 than in 2015.

Agriculture plays a major role in India's economy and social fabric. The sector accounts for 17% of the country's GDP, with more than 58% of the country's rural households' dependent on agriculture as their principal means of livelihood. More than 263 million Indians, over half of all workers in the country, are employed in the sector. Rapid industrialization, global population growth and changing eating habits are resulting in increased demand world-wide for nutrient-rich food, such as fruits, vegetables and meat.

While India's global dominance in agriculture presents a vast opportunity, there are also many challenges. Because of more and more fragmented land holdings, aggressive use of chemicals, inefficient use of water or lack of it, obsolete farming technology, rising input costs, limited access to credit and insurance, supply-chain problems and outdated marketing, the majority of India's 140 million farmers are restricted to using traditional methods that limit crop yields and productivity, thus ultimately impairing farmers' welfare, prosperity, and security. The magnitude and nature of the challenges confronting India's agriculture sector provide an opportunity for growth and development.

At the same time, the complexities and unique characteristics of the Indian market must be taken into account in order to ensure success. Introducing innovation and technology is the only way to tackle the rising food insecurity in India.

# ISRAEL AND ITS INNOVATION ECOSYSTEM



In a region rife with challenges, Israelis have honed the art of problem solving. In the process, they have transformed their small desert nation into a powerhouse of innovation and an incomparable ecosystem of creativity and resourcefulness.

Israel's special mix of people and cultures has created a unique environment. It is a land of immigration, with populations arriving from all over the globe, bringing with them a wide variety of skills and

an abundance of academic knowledge. Israel boasts an open culture and a strong entrepreneurial drive mixed with a multi-disciplined approach. People shift from one sector of activity to another all the time; after building a career in cyber security, an individual might move and open an AgriTech start-up.

Since Israel's founding, much of the country's focus, allocation of resources and expertise have been devoted to agriculture. Because of its shortage of natural resources, Israel has developed innovative methods and technologies for "growing more with less" under difficult conditions, long before increasing agricultural productivity became one of the world's most acute issues. In the process, Israel gained deep insights

and know-how, which, together with its record of accomplishments in agriculture, positioned it as a leader in several areas of AgriTech. Israel's expertise in arid climate agriculture, efficient dairy farms, resilient seeds, drip irrigation, as well as novel plants, such as cherry tomatoes and collagen-producing tobacco plants, induced many leading multi-national agriculture corporations, including Monsanto, Bayer, BASF, Dupont and Syngenta, to collaborate with Israel's AgriTech sector, and sometimes to acquire an Israeli start-up or establish an R&D branch in Israel. Numerous Israeli Agritech firms are considered leaders in the global market, among them [Netafim](#) and [Naan](#), both drip irrigation companies, [Adama](#) with its line of crop

protection products, [ICL](#) for fertilizers, seed companies [Hazera](#) and [Zeraim Gedera](#), and [RMH Lachish Industries](#), [SCR](#) and [Afimilk](#), specializing in dairy-farm management. Precision agriculture is also particularly promising in Israel, as the country is recognized for its strong expertise in such technologies as sensors, big-data, computer-vision and drones. In addition, Israel's academic institutions, the Agriculture Research Organization (ARO), The Hebrew University, the Weizmann Institute of Science, the Technion, Ben-Gurion University and Tel-Aviv University, are well known for their outstanding knowledge and know-how in agriculture as well as in biotech and IT, areas which are becoming ever more meaningful for the agriculture and food industry.



## **START-UP NATION CENTRAL: CONNECTING INDIA TO ISRAEL'S INNOVATION ECOSYSTEM**

Start-Up Nation Central is an Israeli non-profit organization inspired by the best-selling book, Start-Up Nation. We build on our extensive knowledge of Israel's innovation ecosystem to help it grow and expand. Our activities include connecting businesses, NGOs and government leaders throughout the world with the people and technologies that can help them meet their most pressing challenges.

In the past year, Start-Up Nation Central has chosen the AgriTech sector for strategic focus, initiating projects to help Israeli start-ups in this area best realize their potential. We have specifically aimed at creating stronger connections between India and Israel in the AgriTech sector, leveraging Israeli innovation to help address some of India's critical issues and needs.

During March 2017, [Wikistrat](#) and Start-Up Nation Central ran an online, interactive simulation on agriculture in India. Over 40 experts on India's agriculture sector and Israeli Agri-technology examined and identified areas of agriculture where there are favorable opportunities for India and Israel to collaborate in efforts to improve India's food security and agriculture sector. We are excited to share with you some key insights that have emerged, organized by:

- Areas of agriculture in India ripe to benefit from Israeli innovation, and a few examples of Israeli start-ups involved in those areas.
- Key factors to be considered for successful implementation of AgriTech solutions in this amazing and challenging market.

# SEVEN AREAS OF INDIAN AGRICULTURE RIPE TO BENEFIT FROM ISRAELI INNOVATION



## 1 HYBRID SEEDS

High quality seeds are the most basic and critical input for sustainable agriculture, and their quality determines the efficiency of all other inputs. It is estimated that the direct contribution of quality seeds to the total yield is about 15–20%, depending on the crop, and can reach 45% with efficient management of the other inputs.

India's hybrid seed market is growing rapidly. It is estimated that the \$4 billion market will grow 15% annually in the period of 2016-2020, with farmers' awareness of the benefits associated with hybrid seeds increasing. The industry has been adopting scientific methods in seed variety development and in quality seed production, mostly

for non-vegetable seeds, such as cotton and wheat. Corporations controlling a large proportion of the market, including Nuziveedu Seeds, Mahyco seeds, Monsanto, Rasi Seeds, Bayer India, Pioneer Seeds, Syngenta, Dupont and Kaveri Seeds, are engaged in R&D, and produce many hybrid varieties for all seasons for both field and horticultural crops. However, there are still many supply gaps. While drought-resistant seed varieties are available for crops like cotton, maize, tomatoes and okra, there are still crops facing shortages and requiring further advances in seed production, such as hot peppers, cauliflower, and early Nantes carrots. Seed varieties suitable for flat land and hill topography, as well as heat tolerant seeds for cereal, pulses and millet have yet to be developed. There is also a gap in the supply of seeds for high nutrient

foods, for which demand is increasing significantly, but which are currently not grown in India, such as oats, kiwi, strawberries, sweet peppers, pickling cucumbers and color capsicums.

Furthermore, there are still remote areas where both hybrid seeds and the high inputs needed for them, such as irrigation facilities, recommended fertilizer uses, appropriate nurseries, proper spacing, line sowing using seed drills, weedicides and pesticides, are not distributed or utilized, thus limiting the capacity of quality seeds to enhance crop yield. Availability of certain hybrids is sometimes restricted by the companies themselves. For example, Dupont Pioneer sells a hybrid variety of corn at a price of \$13 for 4 kilogram in India's southern states but does not sell the same variety in northern states like Bihar

and Maharashtra. As a result, farmers in these areas cannot try these hybrid and other low-cost seed varieties. Although these varieties have begun to be sold in more regions in India, this process is taking place at a rather slow pace for row and field crops. Supply shortages and imbalances in the regional distributions of certain seeds are obstacles in ensuring a steady supply of quality hybrid seeds throughout the country.

Israel is well known for its expertise in hybrid seeds, especially ones suitable for wide climatic conditions, including desert conditions, and which have an extended shelf life. Israeli start-ups and companies working in the area of breeding, developing and producing improved seed varieties include [Agreen Seeds](#), [OriGene Seeds](#), [Top Seeds](#), [NRGene](#) as well as [Hazera](#), [Kaiima](#) and [Evogene](#).



## 2 BIOPESTICIDES

There are also fundamental gaps between supply and demand in the field of biopesticides. Biopesticide demand is trending upward due to greater demand for organic farming, public health concerns related to aggressive use of highly toxic pesticides, such as endosulfan, and the rising need to comply with maximum residue limits for produce exports. India is one of the largest producers and consumers of chemical pesticides, using them on a wide range of food and cash crops due to their subsidized cost and ready availability. Across the world, the public is increasingly concerned about the health effects of these pesticides, thus boosting the demand for biological pesticides. Currently there are more

than 140 biopesticide production units in India, able to meet the demand of less than 1% of its farmed area. Moreover, many indigenous methods and products available in India are minimally effective against a myriad of diseases. The challenge is to find efficient and effective productivity-enhancing alternatives that can reduce India's chemical pesticide dependency.

Israeli biopesticide solutions with strong potential for use in India include [Stockton Group's Timorex Gold](#), [Bio Bee](#), [Botanocap](#), [BioFeed](#), [Agro Shelef](#) and ARO's Tamar Tech



### 3 COMPREHENSIVE IRRIGATION, FERTIGATION AND CHEMIGATION SOLUTIONS

The scarcity, distribution and management of water are all elements of a growing water problem in India. India has about 18% of the world's population, but only 4% of world's renewable usable water resources. An ever-expanding population is putting tremendous pressure on Indian water resources, without which food production is impossible. Heavy dependence on rainfall, climate change, lack of irrigation facilities, irrigation inefficiency and groundwater depletion present difficulties that increasingly plague most of India's cultivated areas. Despite the high subsidy for micro-irrigation in India, its rate of adoption has been slow, except in a few areas. This is the case both for farmers who invest in the technology and then claim the subsidy, and for companies that receive a government subsidy to install the technology. It is estimated that the micro-irrigation potential of the country is 40 million hectares, of which only 10% is currently micro-irrigated. Although

the irrigation technology industry is crowded with about 200 players, only a few offer comprehensive solutions that include irrigation, fertigation and chemigation, due to the technological complexity and cost of these products. New players seeking to enter this market need to offer attractive packages that include credit and insurance. They also must adapt their technology to local conditions, such as volatility in electricity costs, lack of access to the grid, etc. Marketing budgets should be devoted to supporting field tests, like the one conducted by Netafim, and encourage farmers to invest jointly with them in integrated irrigation systems.

Although Israel is a leader in drip and integrated irrigation systems, India's Jain Irrigation Systems Ltd. dominates the sector, with a 55% market share. Four Israeli irrigation firms, Netafim, NaanDan which is fully owned by Jain Irrigation, [Rivulis](#) and [Metzgerplas](#) are present in India in the drip and micro-emitter segment and they currently market peripheral equipment. These firms have already tested their marketing strategies. Other than that, Israeli start-ups like [I-dripper](#), [Tevatronic](#), [Amiad](#), [Inplant](#) and [Tal-Ya](#) can also be interesting and relevant.



## 4 FARM MACHINERY

The area of farm machinery in India suffers from a lack of products as well as from poorly-performing existing products. Most farmers use basic traditional equipment, which is not economical, especially for small and marginal farmers. This has a significant impact on farm productivity, farming costs and the ability to grow labor-intensive crops such as paddy, wheat, cotton, sugarcane and groundnut. Furthermore, the existing distribution networks for farm machinery offer only a limited supply of items, especially in the area of machinery and tools for small farmers, leading farmers to rely on ad-hoc distribution networks, local manufacturers for hand tools, and custom-hiring centers, or shared capacity centers for renting tractors. Timely and economical use of farm machinery, such as inter-cultivation tools,

proper land levelers and planting implements can greatly improve productivity and maximize yield and profits. Other equipment that could be introduced to help raise productivity and profitability include: blade harrows for tilling the soil where crops are to be planted and for chopping up unwanted weeds or crop remainders; broad bed furrows (BBF) and inter-row cultivators to cultivate in-between plants like chickpeas, ground nuts, etc., at 30 cm spacing; rolling cultivators for wide-spaced row-planted crops like hybrid red gram, maize, etc.; vacuum planters for precision planting; mechanical planters and more. The overall farm machinery market is expected to grow 8% annually in the period of 2015–2019, due to low interest rates and government subsidies, making this sector even more attractive.

While at present not many Israeli companies offer inexpensive farm machinery and tools, the large gaps between supply and demand in the realm of eco-friendly and effective farm implements, harvesters and crop residue management could create significant opportunities to penetrate this large untapped market. Israeli start-ups offering solutions for this space include [Etagar](#) and [Yung-Etagar](#), [Hishtil](#) and even [Virentes](#), with its grafting technology. Furthermore, as drones become a more popular method for automating agricultural tasks, Israel's expertise in this field can prove advantageous as well. A start-up like Skyx, with its autonomous agriculture spraying and asset monitoring, holds great promise for this area of the market.



## 5 ADVICE AND KNOWLEDGE SHARING

Small farmers' lack of knowledge, distance from distributors and need for extension services and other critical support for crop yield optimization emphasize the importance of information technology in helping farmers bridge the information gap that traps them in an economy of near-subsistence. At the same time, large and medium farmers need information technology in order to make productive use of the immense amount of data with which they are inundated from all directions, including their own cultivated fields. Despite having an abundance of computer engineers in city centers, in the countryside, India is deficient in its use

of smart-phones, internet and software. Overall, India ranks 138th in the ICT Development Index, after countries like Zimbabwe and Cuba. One farmer out of ten in India has internet access, and smartphone penetration, which is higher in urban areas, can fall as low as 20% elsewhere. However, the situation is changing. Smart-phone and broadband costs are falling rapidly and it may not be long before farmers become better connected and able to take advantage of new opportunities. [Cultivu](#), [Agriculture Knowledge on-line \(AKOL\)](#) and [AgriTask](#) are a few Israeli software offering solutions very relevant to this sector.



## 6 RESOURCE MANAGEMENT AND PRECISION AGRICULTURE

Proper application of fertilizers or herbicides, integrated pest management and accurate weather forecasts can all help increase crop yields. Using information communication technologies (ICT) and decision support system (DSS) sensors to control irrigation based on soil humidity and receive accurate weather forecasts, soil and plant health diagnostics and pest and disease recognition, as well as SMS based alerts prescribing preventive measures can greatly contribute to India's agriculture productivity. Finding ways to provide low-cost, easy-to-use precision technologies can greatly benefit the sector.

Israel has over 50 start-ups in this area, some of which can be very relevant for India. A few examples include [Sol Chip](#), with its solar energy sensor, [CropX](#), [Manna Irrigation](#), and [Saturas](#) for smart irrigation, [Taranis](#) and [ATP labs](#) for farm monitoring and management, and [Farmdog](#) and [FieldIn](#) for integrated pest management.



## 7 POST-HARVEST AND INTEGRATED VALUE CHAINS

Post-harvest losses involve food loss across the entire food supply chain, from harvest to consumer. These losses have major economic consequences, such as lost opportunity costs and lower price realizations, result in harm to natural resources, including waste of water, land, and energy used in the production of agricultural goods, and deplete available vitamins and minerals. Conservative estimates from the Indian Ministry of Food Processing Industries estimate post-harvest losses of agricultural produce at \$13 billion, almost three times the government of India's 2016-17 budget for the agricultural sector.

Many factors contribute to post-harvest food loss: spillage; consumption by pests, mites, rodents and birds; fungus; use of insecticides or pesticides; changes in physical properties due to high temperatures;

and exposure to rain and water. One of the biggest concerns for farmers is the lack of warehouse and storage infrastructure, which often leaves the produce vulnerable to damage. Insufficient drying or over-drying of grains cause spoilage and increased grain breakage during threshing. The lack of appropriate storage drives many farmers to sell their produce immediately after the harvest when the supply is at its peak, thus resulting in low prices. Other key issues are logistics, transportation and the lack of an efficient and comprehensive method for tracking the produce as it traverses the supply chain. As warehouses are commonly located at railway stations near major urban centers, the transport of produce to warehouses takes time and requires driving on unpaved roads. Harvesting usually takes place in the heat, and after harvesting, the produce is not moved to cold storage at any stage of the supply chain. By the time the produce reaches the nearest market yard the night of the harvest or the following day, it loses its freshness. If the process takes even more time, the produce spoils. Excessive handling in the market yard leads to further damage.

Some of the key technologies for post-harvest management include: washing and drying machines; sorters and graders; sanitary and phytosanitary practices such as hot water treatment; storage bags; packaging, especially corrugated fiber board (CFB), modified atmosphere packaging (MAP), ethylene removing packaging and edible films and coating, the latter commonly used to improve the appearance and conservation of fruits and vegetables; mobile cool chambers (MCC) for short-distance transportation; and end-to-end real-time cold chain management (CCM). These technologies often are inaccessible or too expensive for small and marginal farmers. In addition, they require skilled manpower often lacking among such growers.

Israeli technology ventures tackling some of these issues include: [Amaizz](#) and [Pimi Agro](#), offering storage solutions preventing spoilage and the sprouting of diseases; [BT9](#), providing real-time cold chain management; [Aclartech](#), which monitors and analyzes fruit quality and ripeness; [Yarok](#), providing improved food safety testing; and [Stepac](#) and [R.O.P.](#), which offer examples of some of Israel's modified atmosphere and humidity packaging technologies.

# FIVE KEY FACTORS TO CONSIDER ABOUT AGRICULTURE IN INDIA:

## INDIA MAJOR CROPS AND ISSUES PER REGION



- JK JAMMU & KASHMIR**
  - Major Crops: Apples, saffron, cherries, peaches, pears
  - Major Issues: Unsuitable agro-climate and preference for horticulture; dependence on mono-cropping
- HP HIMACHAL PRADESH**
  - Major Crops: Apples, seed potatoes, ginger, vegetables, mushrooms, chicory seeds, olives, figs
  - Major Issues: Agro-climate conditions suitable for cash crops; poor inputs, supply chain/distribution systems
- PB PUNJAB**
  - Major Crops: Wheat, barley, basmati rice, maize, oilseeds, millets, fruits, cotton
  - Major Issues: Region was one of the largest beneficiaries of the Green Revolution's initial period, but now faces stagnancy due to mono-cropping, heavy use of fertilizers and pesticides, groundwater and surface water degradation, and single agricultural marketing chain through wholesale markets
  - Other: Most irrigated Indian state

- MH MAHARASHTRA**
- KA KARNATAKA**
- AP ANDHRA PRADESH**
- TN TAMIL NADU**
- KL KERALA**

- UK UTTARAKHAND**
  - Major Crops: Basmati rice, wheat, soybeans, groundnuts, pulses, oilseeds
  - Major Issues: Slow agricultural development due to hilly terrain, poor inputs, supply chain/distribution systems
- HR HARYANA**
  - Major Crops: Rice, jowar (sorghum), bajra (pearl millet), maize, wheat, barley, gram, mustard, cotton
  - Major Issues: Region was one of the largest beneficiaries of the Green Revolution's initial period, but now faces stagnancy due to poor irrigation efficiency, watershed management, disease pest/management, soil degradation, soil salinity, high pesticide and fertilizer use, lack of hybrid/quality seeds, lack of penetration of farm machinery and inadequate infrastructure for post-harvest management
  - Other: Second most irrigated Indian state

- RJ RAJASTHAN**
  - Major Crops: Oilseeds, wheat, barley
  - Major Issues: Unsuitable agro-climate, lack of quality drought-resistant seeds, poor irrigation coverage, groundwater depletion
  - Other: India's largest state by area, but has only one percent of water resources of country, ranked by NITI Aayog as third in the country on agricultural market reforms
- UP UTTAR PRADESH**
  - Major Crops: Barley, wheat, rice, gram, pulses, sugar cane, maize, oilseeds, vegetables
  - Major Issues: Lack of proper post-harvest management infrastructure, poorly developed marketing facilities, irregular power supply, falling size of land holdings, shortage of skilled labor, simple farm machinery, pervasive drudgery, lack of quality hybrid seeds
  - Other: One of the largest agricultural states, largest producer of food grains and second largest producer of vegetables

- GJ GUJARAT**
  - Major Crops: Cotton, groundnut, vegetables, sesame seeds
  - Major Issues: Poor investments and agricultural marketing, deteriorating soil health
  - Other: Potential for contract farming and process agri-product exports; ranked by NITI Aayog as second in the country on agricultural market reforms
- MP MADHYA PRADESH**
  - Major Crops: Rice, wheat, jowar (sorghum), maize, gram, cotton, sugar cane, linseed, soybean
  - Major Issues: Lack of credit sources, lack of post-harvest management facilities, significant land fragmentation (average farmer has 2.6 hectares of farmland)
  - Other: Potential for contract farming; highest area under certified organic farming
- CG CHHATTISGARH**
  - Major Crops: Rice, wheat, maize, oilseeds, groundnut, pulses
  - Major Issues: Lack of irrigation, inadequate input and product supply chain, lack of agricultural research
  - Other: Dubbed "rice bowl" of central India; potential for enhancing horticultural produce

- WB WEST BENGAL**
  - Major Crops: Rice, potatoes (and other vegetables), jute, sugar cane, tea, chili peppers
  - Major Issues: Soil degradation, soil salinity, poor fertilizer application, lack of quality seeds, inadequate cold storage facilities for fruits and vegetables, predominance of mono-cropping, large number of small and marginal lands
  - Other: Highest rice-producing Indian state
- OD ODISHA**
  - Major Crops: Jute, pulses, oilseeds, millets
  - Major Issues: Water shortage, losses due to natural calamities, unstable supply of quality seeds, fertilizer and irrigation, low credit and insurance facilities, lack of agriculture equipment and machinery, lack of research and extension services
- P MAHARASHTRA**
  - Major Crops: Rice, jowar (sorghum), bajra (pearl millet), wheat, pulses, cotton, sugar cane, several oil seeds (including sunflower, groundnut and soybean), turmeric, mangoes, pomegranates, oranges, onions
  - Major Issues: Lack of irrigation, water stress, heavy dependence on rainfall, water-intensive cropping patterns, power/electricity crisis, lack of reliable credit sources
- TS TELANGANA**
  - Major Crops: Rice, cotton, sugar cane, mangoes
  - Major Issues: Erratic rainfall distribution, lack of investment in micro-irrigation systems, lack of drought-resistant and hybrid seeds, poor water use efficiency, high prevalence of fragmented land holdings
  - Other: Potential for enhancing horticultural produce

- KA KARNATAKA**
  - Major Crops: Ragi, sunflower seeds, jowar (sorghum), coffee, cardamom, rice, areca nuts, sugar cane
  - Major Issues: Lack of farm mechanization and irrigation, water stress, land degradation, lack of investment in value-addition/food processing/agri-infrastructure, regional disparity in agricultural development
  - Other: Lowest growth rate of agriculture gross state domestic product
- AP ANDHRA PRADESH**
  - Major Crops: Rice, millet, cotton
  - Major Issues: Absence of adequate storage, poor soil health management, heavy pesticide use, lack of agricultural and allied university and knowledge centers, natural calamities (mainly cyclones)
  - Other: Scope for food processing industry, extensive network of nurseries
- TN TAMIL NADU**
  - Major Crops: Millet, rice, pulses, maize, gram, coffee, cardamom, bananas, turmeric, tapioca, mangoes
  - Major Issues: Water stress, drought-prone agro-climate water-intensive cropping patterns, groundwater depletion, poor soil micronutrient management, power/electricity shortage, informal credit sources, lack of insurance
  - Other: High demand for precision farming techniques, extensive network of nurseries
- KL KERALA**
  - Major Crops: Peppers, cashews, coconuts, coffee, rubber, tea
  - Major Issues: Labor shortage, high degree of land fragmentation due to land reforms
  - Other: Major spice exporter

- BR BIHAR**
  - Major Crops: Barley, jute, oilseeds, maize, sugar cane, rice, cauliflower, litchi
  - Major Issues: Slow adoption of modern technologies, excessive marginal land holdings, lack of irrigation, lack of skilled labor, poor post-harvest management infrastructure, inadequate marketing and processing facilities
  - Other: Dubbed as the destination for second Green Revolution in India, ensuring high productivity
- NE NORTHEAST**
  - Major Crops (in Assam): Tea, jute, rice, fruits, pulses
  - Major Issues (in the northeast): Lack of extension services, lack of input and product supply chains/distribution channels, inadequate post-harvest management infrastructure
  - Other: Sikkim is India's first fully organic state

- JH JHARKHAND**
  - Major Crops: Maize, rice, wheat, chickpeas
  - Major Issues: Poor pest/disease management, inadequate farm mechanization, lack of agro-advisory network, poor soil micronutrient management



## 1 INDIA IS A VAST, DIVERSE SUBCONTINENT

India is a huge country consisting of many semi-independent states. Just as in Europe, where France is different from Italy and Spain is different from Poland, states in India vary widely: Punjab is different from West Bengal, and Maharashtra is not Goa. States differ in food, language, economic development, and their approaches to foreign investments, as well as in soil, climate and the crops that are grown. The following map indicates the relative strengths of various states. According to our analysis, the leading candidates for conducting Ari-Tech business in India include the states of: Gujrat, Maharastra, Chattisgarh, Andhra Pradesh, Odisha, Karnataka and Punjab. The information contained in the following graphic highlights the diversity of the different states.

## 2 PARTNERS ARE CRITICAL

India's supply chain is fragmented and complex. The distribution of agricultural inputs is accomplished through an archaic multi-level distribution network in which the producers sell to the farmers through distributors and retailers. The large geographic distances between farmers and distributors, the lack of transparency regarding distributors' pricing and lack of information about distributors' available inventory prevent farmers from sourcing directly from distributors, leaving them to rely on their local retailers. The retailer is often not only the farmers' agronomist, but also the main source for credit or the main buyer of the farmers' produce, exacerbating the dependency of farmers on their retailers.

It is advisable for those interested in distributing their products in India to form partnerships with established players with nationwide distribution networks. Leading Indian agrochemical companies with widespread distribution networks and strong recognition among farmers include: United Phosphorus, Rallis India, Gharda Chemicals, Indofil Industries, Excel Crop Care, Dhanuka Agritech, PI Industries, Nagarjuna Agrichem, Punjab Chemicals & Crop Protection, and Insecticides India.

The following chart portrays the Indian supply chain, with a few examples for key players in each of the different areas.



SEEDS

**Function:** Research, production and sale of hybrid and open-pollinated seeds

**Size and Growth:** \$4 billion market, 15 percent CAGR 2016–20

**Major Players:** Nuzveedu Seeds, Mahyco, Monsanto, Rasi Seeds, Bayer India, Pioneer Seeds and Syngenta

**Market:** Competitive, with opportunities in small-crop, topography-agnostic, high-demand crop, drought- and flood-resistant, warm-tolerant seeds

**Business Model:** Market-driven with or without subsidies

Crowdsourced Business Models and Marketing Strategies → Input Mix → Hybrid Seeds



PESTICIDES

**Function:** Research, produce and sell chemical, plant or microbial pesticides

**Size and Growth:** \$3.5 billion market, 15 percent CAGR 2014–2018

**Major Players:** UPL, Bayer Crop Science, Syngenta, Rallis India and BASF

**Market:** Competitive, especially in traditional, underpenetrated plant/microbial sector, opportunities in broad-spectrum, cross-crop or local plant-based biopesticides

**Business Model:** Market-driven with or without subsidies

Crowdsourced Business Models and Marketing Strategies → Input Mix → Biopesticides



FERTILIZERS

**Function:** Research, produce and sell chemical and natural fertilizers

**Size and Growth:** \$28 billion market, 5 percent CAGR 2016–2022

**Major Players:** Chemical Co., Coromandel Intl., Deepak Fertilizers, Gujarat State Fertilizers, Indian Farmers Fertilizer Cooperative, Nagarjuna Fertilizers and Chemical National Fertilizer

**Market:** Competitive market in traditional fertilizers, underpenetrated market in vermicompost/natural fertilizers, opportunities in small-scale vermicompost

**Business Model:** Market-driven with or without subsidies, one-time and recurring revenues for vermicompost

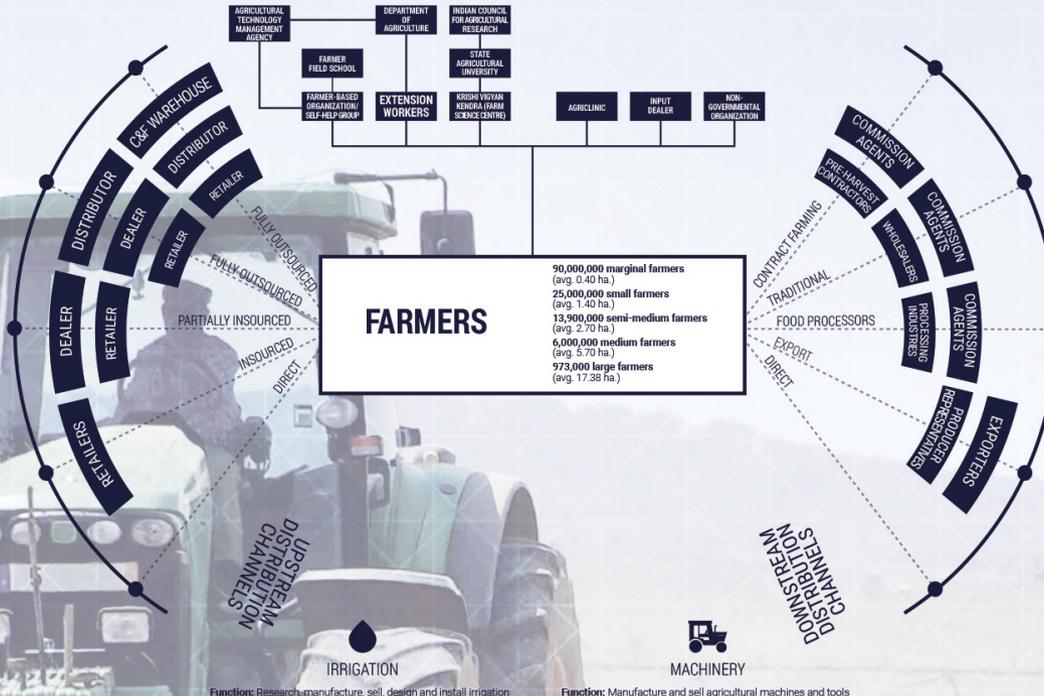
Crowdsourced Business Models and Marketing Strategies → Input Mix

EXTENSION SERVICES

Network of 90,000 experts that provide education on agriculture, marketing, health, and business to farmers.

Majority funded by the national government and state departments. Increasing presence of the private sector.

**Main issues:** fragmented system, limited capacity, government-driven (as opposed to farmer-driven), little focus on empowering farmers, lack of technology and accountability.



**Function:** Research, manufacture, sell, design and install irrigation systems and peripheral equipment

**Size and Growth:** \$1 billion market, 17 percent global CAGR 2016–2020

**Major Players:** Jain Irrigation (55 percent market share), Israeli firms include Netafim, Oshanben (fully owned Jain Irrigation), BIVULIS and Metzertplas

**Market:** Competitive market (200 players), with few providing comprehensive solutions for irrigation, chemigation and fertigation that suit the Indian market

**Business Model:** Market-driven with or without subsidies, one-time and recurring revenues; variations include traditional, cooperative and HP model

Crowdsourced Business Models and Marketing Strategies → Input Mix → Comprehensive Irrigation, Fertigation and Chemigation Solution

**Function:** Manufacture and sell agricultural machines and tools

**Size and Growth:** \$5 billion market, 8 percent global CAGR 2015–2019

**Major Players:** Deere and Company, Mahindra and Mahindra, Sonalika, TAFE, VST

**Market:** Capital-intensive industry in an underpenetrated market; opportunities in farm implements and female-friendly tools

**Business Model:** Market-driven with or without subsidies; one-time and maintenance revenues

Crowdsourced Business Models and Marketing Strategies → Resource Management

PUBLIC SUBSIDIES

In addition to regulation, central, state and local apparatuses (PS) are involved with the upstream, production and downstream parts of the food chain. The PS distributes seeds, approves pesticides and fertilizers and provides subsidies on inputs such as seeds, pesticides, fertilizers, irrigation and machinery. Through the state-owned banks, the PS extends subsidized loans and provides crop insurance. PS extension services influence farmers' strategic and operational decisions, including purchase. In the downstream, a web of PS-regulated markets allows downstream players to access food products. The PS provides incentives to downstream players in the form of subsidies, credit, favorable foreign subsidiary policies and rebates on customs duties. It also intervenes to stabilize produce prices.

Many subsidy schemes exist in India. The majority are funded and implemented by the central government in coordination with the states, although some state-level power and water subsidies exist. They are occasionally established, are revised and are sometimes repealed. Some are very product-specific, issue specific or temporal (e.g., drought subsidies).

Types of subsidies include: fertilizer, power, agricultural equipment, irrigation, seed, export, credit and agriculture infrastructure.

Examples of subsidies include: Rashtriya Krishi Vikas Yojana (100 percent), Bringing Green Revolution to Eastern India (50 percent of the cost, 100 percent for the community assets), Agricultural Marketing Infrastructure (25–33 percent), National Horticulture Mission (rural primary market is 40 percent general, 55 percent hilly and tribal; terminal market complex is 25–33 percent, wholesale markets are 25 percent general, 33 percent hilly and tribal; PHM component is 35 to 55 percent).



MARKETS

Agricultural commodities are traded through 27,500 regulated markets (6,500 are wholesale and 21,000 rural primary). Average area covered by each market is 450 sq km with wide variance among states (119 sq km in Punjab, 11,200 sq km in Meghalaya).

The market's inefficient and multi-layered structure (see distribution channels below) increases retail produce prices and food losses – and significantly compresses farmers' margins.

Reform of the market system is underway.



FOOD PROCESSORS

**Function:** Produce procurement, storage and processing

**Size and Growth:** \$250 billion market, 17 percent global CAGR 2016–2020

**Market:** Fragmented market with around 37,000 players; significant opportunity for foreign firms due to capital subsidies, tax rebates, depreciation benefits, reduced custom and excise duties for processed food machinery, 100 percent foreign equity stake

**Business Model:** Market-driven with or without subsidies

Crowdsourced Business Models and Marketing Strategies → Input Mix → Biopesticides

**Segments:**

**Procurement and Storage**

**Function:** Warehouses, cold storage and silos

**Major Players:** Food Corporation of India, NCMISL, Arshiya International

**Processing**

**Function:** Grading, sorting, milling and packing

**Major Players:** ITO Ltd, Cargill, Adani Enterprises, Olam International



### 3 WHO ARE THE INDIAN FARMERS?

India has one of the most fragmented land ownership systems in the world, with smallholder and marginal farmers dominating the market. Only 1% of India's farmland is in larger holdings of 10 or more hectares. Farm size is a major issue, as small farmers cannot afford to invest in machinery, seeds or fertilizers. Because these small farmers' access to official credit and insurance is limited, they mostly rely on their own savings or on the informal sector for funding. Expensive technologies, such as drip irrigation, penetrate the market only when they are heavily subsidized. Furthermore, the small farmers' ability to adopt and deal with precision tools is often quite limited. The lack of efficient agronomic knowledge-dissemination tools, training and capacity-building all hinder farmers' ability to adopt and implement technology. Improving the connectivity of small holder farmers to agricultural advisory networks

is essential for addressing India's productivity gap. Succeeding in the Indian agricultural sector requires:

- reducing cost to affordable limits;
- establishing relations with cooperative models of ownership - community agricultural projects in which thousands of farmers share equipment;
- ensuring that products are compatible with existing equipment, such as tractors of 35-50 HP, which are common among small farmers;
- providing solutions that are simple and quickly set up, with a simple user interface, minimum requirements for support and maintenance and minimal dependence on special communication infrastructures and in-field hardware, like sensors;
- providing comprehensive and flexible solutions that address a range of problems.

Although often overlooked, women are an important part of India's agricultural labor force. As men migrate to big cities for higher wages and employment, more and more of farming households at the bottom of the pyramid are headed by women. The female proportion of the agricultural labor force in India is just over 30%. Despite their pivotal role in the agricultural sector, especially in seeding and weeding, these women suffer from poor access to various resources, tools and services. They use traditional tools and equipment, resulting in very low productivity. The prevalence of gender stereotypes, social restrictions and traditional role expectations hamper women's access to technical knowledge and improved technologies. Only 1% of women attend farm-training programs. Providing women access to simple technologies, tools and equipment like a power weeder can improve resource efficiency and agricultural productivity.



## 4 LOCAL PRODUCTION AND ACQUIRING EMPIRICAL EVIDENCE

In India the importance of the first adaptors cannot be overestimated. Proven efficacy and demonstrable results are key to succeeding in India. Most Indian farmers choose what seeds and inputs to purchase based on their performance history and the advice of fellow farmers. Generally speaking, early adaptors willing to invest in the newest technologies and implement them in their farms will be large farmers or corporations with investment capabilities. Therefore, proof of concept at larger farms is a useful if not essential step that will subsequently influence others to invest in these innovations.

Furthermore, Prime Minister Modi's "Make in India" policy is not only a slogan; it is accompanied by high

customs duties and does bode well for manufacturers exporting goods to India and hoping for favorable treatment. Thus, concentrating on exporting goods to India is not a viable long-term option. Foreign companies understand that without a real presence in the local market, including local manufacturing, competition will be harsh. The government of India is pushing everyone to understand that its first priority is to attract high-end manufacturing capabilities. This is especially relevant for Israeli companies, as the Free Trade Agreement between Israel and India has yet to be concluded and it is not clear when duties will be reduced. Setting up a joint venture in India will not only increase the chances for business success

in every commercial aspect, but will also offer a wide range of advantages, including the ability to react to the price sensitivity of the market. Joint ventures with Indian partners can also expand exporting capabilities to additional countries in South Asia, the Persian Gulf and Africa that have better access to India than to Israel.

Collaboration with a knowledgeable local partner, from the design phase, not only can advance local production, but can also help tailor solutions for India's farmers. Joint development of agriculture-technologies will also ease the challenges faced when importing to India: regulation, pricing, usability of the product, etc.



## 5 MARKETING STRATEGIES

In India, marketing strategies rely mostly on traditional channels, such as farmers' markets, print advertising, and local retailers. Farmers' limited access to information provides short-term opportunities for favorable product pricing, but also forces firms to rely on a broad group of public and private entities to convey their message. As most Indian farmers choose what seeds and inputs to purchase based on their performance history and the advice of fellow farmers, most seed companies and retailers convince the farmers to purchase new seeds through field performance demonstrations, which are normally carried out during the previous season. Additional activities undertaken include showcasing products, followed by advertisements and promotional activities before the sales season at trade counters and village

meetings. Information on products and their benefits are shared via print and other media, such as television advertisements, mobile ads, etc., to attract the farmers. Word-of-mouth promotion of positive experiences of progressive and influential farmers is usually very effective. Finally, trade or distribution partners have their own networks of farmers and can influence farmers to promote products of their choice based on the seed's performance, company history of product performances or the business or trade benefits, based on the margins the farmers receive and the confidence the farmers have about companies' product availability, quality and ease of financial transactions.

Regarding marketing strategies, it is important to distinguish between high-end, sophisticated

solutions, demand for which is constrained by farmers' limited ability to pay and which is highly dependent on subsidies; and low-end solutions, which have wider potential market demand, but are also more exposed to local competition. Other common issues that have been identified are the need for trustworthy local distribution partners, product adaptation and local production, as already discussed above.

There are several central government organizations that are involved in agricultural marketing in India, such as the Commission of Agricultural Costs and Prices, the Food Corporation of India (FCI), and the Cotton Corporation of India. There are also specialized marketing organizations for rubber, jute, tea, coffee, spices and vegetables.