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Innovative Farming Methods to Improve Indian Agriculture by Adopting the Best Practices from Israel

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ABSTRACT

The most important development challenge in India is to improve our agriculture sector. As we all know that majority of the workforce in India depends on agriculture and the growth production in agriculture cannot be equalized with the ever-increasing population in India. Hence the pattern and technologies adopted should be changed and this paper highlights the best practices that are being adopted by Israel. Israel is fast improving in agriculture and this country has become a world leader for adopting the best technologies to increase the production in agriculture. In fact, more than half of the land area in Israel is desert and their climatic condition and other resources do not favour farming. In spite of all these disadvantages Israel has become the major exporter and world leader in agriculture. This study aims to give an over view about the recent status of agriculture sector and the reasons for the slow growth of production in India, and also throw light on the best practices that is adopted by Israel in their agriculture sector and finally to adopt the important technologies that will be best suited for India to improve the production in the agriculture sector.

Key words**:** Israel, Innovative farming, Sustainable agriculture, Production and technologies

Agriculture sector is the backbone of our economy as it is an important source of livelihood for more than 70 percent of the people in rural areas. It contributes around 20.2 percent of the total Gross Value Added of India [1]. Similarly, the agriculture sector contributes a greater number of workers. The contribution of this sector in total Gross domestic product (GDP) in India is not quite satisfactory. At the time of independence, the contribution of agricultural sector was almost half of the total GDP. It was 45 percent in 1954-55, whereas it has seen a decline to 18 percent in recent years [2]. India also faced an unprecedented drought condition in 1966 that exacerbated the food crisis. The 1966 drought condition prompted the launching of a successful "Green Revolution" which in a period of ten years enabled India to transform itself from a starving nation to an exporter of food [3]. But the year 2002-03 again showed a decline in the production due to severe drought in the country. Green revolution brought in some positive changes in increase in agricultural production. This increase was seen for few years only. In 2021 which is more than five decades, after the introduction of green revolution there is no significant improvement in agriculture sector. So there has never been a consistent increase in this sector. There are number of reasons for the decline in agricultural production and the most important reason is that India lacks in using modern techniques in agriculture sector. Most of the farmers still follow the traditional method of cultivation. Manual and conventional methods such as physical crop inspection and manual removal of weeds and contaminants are not very effective approaches and do possess significant limitations in supporting the higher crop yield [4]. When compared to other countries, the use of agriculture equipment in India is about 40.45 percent. This is very less when we compare with other countries such as US (95 percent), Brazil (75 percent), and China (57 percent) [5]. Another important fact to be noted is that Indian farmers are not aware about the recent developments and research. There is a wide gap between the technologies developed in the research institutions and their applicability at the farmer's field [6]. Intensive farming practices in India adversely impacted environmental balance, and it is necessary that the country should go for sustainable farming practices that include employing efficient irrigation methods with digital technologies like groundwater regeneration, monitoring soil degradation, and adopting energy-efficient production methods. The study also mentioned about how small countries like Netherlands and Israel have augmented the production of high-value crops through enormous productivity breakthroughs and, even more importantly, by ensuring the optimal utilization of resources and maintaining the environmental balance [7].

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As aforesaid agriculture sector is the main source for more than 70 percent of rural population and at the same time half of the households in rural population show some sign of poverty [8]. This calls for tremendous development in agriculture sector if the priority of the government is welfare for its citizens. Israel, a desert land has improved a lot by using various kinds of techniques and innovative methods. Today Israel tops the world in agricultural production. The research bend of Israel has led to dramatic increase in the quantity and quality of agriculture production. The country has invested in research for seed and plant varieties that have high vigour and are resisted to insects and pest and has also innovated machinery and additional crop supplements. The holistic approach has led to tremendous increase in yield as well as quality and variety of the crop grown in the country [9]. When a country like Israel can reach to this top level, definitely India can also strive hard to improve the agricultural sector. However agricultural practices in India are still traditional and have many limitations as compared to the modern agricultural practices around the world. To improve its performance, government is taking several initiatives by collaborating bilaterally and multilaterally with those countries which have earned the global recognition of resolving the existing problems of Indian agriculture. In this aspect our study gives an over view about the recent status of agriculture sector and the reasons for the slow growth of production in India and to examine the best practices that is adopted by Israel in their agriculture sector.

MATERIALS AND METHODS

The data for this study is taken only through secondary sources. The information about agriculture and other relevant data are taken from reputed articles, books, Government reports, publications and various working papers. The information related to Israel's agriculture has been referred from the Israel's Ministry of Agriculture and various other reports of that count. The main idea of about this research paper is to bring out the best practices followed in Israel in their agriculture sector and the country has seen a drastic improvement. Hence the important aspects in Indian agriculture are been taken and it is compared with that of Israel's technology. Issues like availability of water, storage of crops and pest control in India usually face lot of problems. Hence these aspects are compared with that of Israel's techniques to see how the country has taken a stand on these issues and how India can follow these innovative practices.

RESULTS AND DISCUSSION

Recent status of Agriculture Sector in India

In India agriculture plays a major role and majority of them depend on agriculture. During the year 2015-16 agriculture contributed 16.2 percent to India's GDP as compared to 17.2 percent in 2013. The area under cultivation substantially declined for several crops in 2014-15 as against 2013-14. The Indian economy also witnessed an increase in agricultural imports as a percentage of agricultural GDP from 4.9 percent in 2009-10 to 5.8 percent in 2014-15 [10]. The share of primary sector in India's GDP has gone down from 56.5 percent in 1950-51 to15.7 percent in 2009-10 and it is to be noted that since 2012 the contribution to GDP from agriculture sector is around 17 percent till 2019. And in 2018 the contribution has decreased to 15.9 percent. In spite of projection done by NCAER (National Council of Applied Economic Research) the agriculture share in aggregate GDP has increased during the year 2019-2020. The current share of agriculture in GDP and it is clearly given in the (Fig 1). There has been a fluctuation in share of agriculture in GDP. The food grains production in India is also not showing any significant increase over the years.

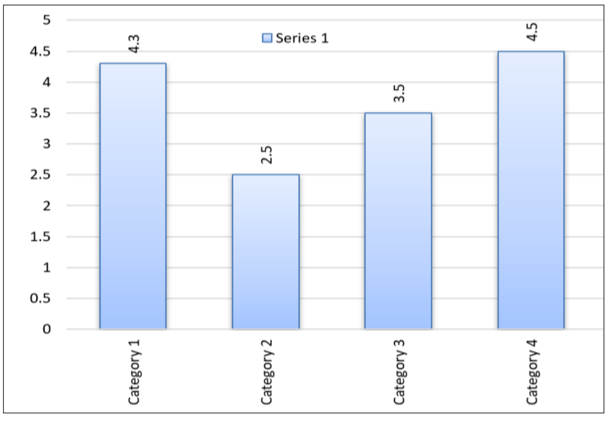

Fig 1 Share of agriculture in GDP in India

Source: CSO and Economics Survey

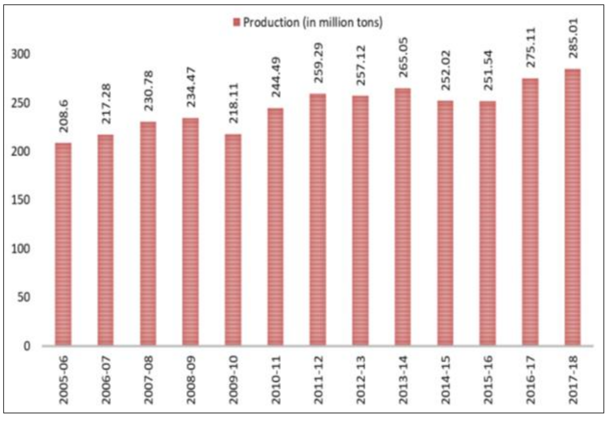

Fig 2 Food grains production in India

Source: Department of Agriculture, GOI

Data reflected in (Fig 2) indicates that the food grains production has increased in few years but does not show any drastic improvements. In contrast to other developed countries, in India it is a big challenge to achieve the anticipated growth in agriculture sector due to inadequate use of resources and unscientific approach to agriculture. According to third advance estimates for 2020-21 by Ministry of agriculture and farmer welfare, total food grain production in the country is estimated at record 305.44 million tonnes which is higher by 7.94 million tonnes than the production of food grain of 297.50 million tonnes achieved during 2019-20. But the demand for food grains would increase to 355 million tonnes by 2030. In order to strengthen the economy and also to meet the food demand to meet the ever increase of population, optimization of agriculture practice in agriculture is necessary [11]. It is estimated that adverse effects of climate change led to an annual loss of $9-10 billion in India [12]. Currently agricultural practices in India are facing many challenges such as climate change, conventional practices of agriculture, lack of effective implementation of policies and various economic and political scenarios. To solve all these issues, Indian agriculture should transform to modern agricultural revolution which will help the sector to meet the growing needs of rising population.

Agriculture sector in Israel

Israel's agricultural growth is very impressive and the production multiplied 16-fold since independence. India mainly focuses on cultivation of wheat, rice and cereals whereas Israel concentrates in floriculture, vegetables, fisheries, horticulture etc. Israel has found so many effective ways that has completely changed the dry desert land to a green farm land. Israel with their innovative techniques has progressed a lot in their agricultural production. The production of the agricultural sector is $7.8 billion which represents approximately 3.3 percent of the national GDP with 18 percent of the agricultural production being exported. The hard work of the people has made a very good progress in exports as well. Israel agricultural sector contributes 2.5 percent to the country's GDP [13] and generated 1.7 percent of total employment in 2009 [14]. The number of initiatives taken by this country made them to feed the entire world.

Table 1 Land use in Israel in 2001

Land	Thousands of hectares	% of total lands
Total areas of Israel	2,24,000	100
Built areas	20,000	8.9
Non-agricultural open spaces	1,14,300	51
Natural reserves and forests	34,700	15.5
Arable lands	14,100	6.3
	41,000	18.3

Source: Ministry of Agriculture, Israel (2001)

From (Table 1), it is clear that during the year 2001 the percentage of total lands used is just 18.3 percent. The non-agricultural open spaces were around 51 percent. All this completely changed during the year 2015. The total areas under cultivation of agriculture sector have increased drastically. This is given in the (Table 2) which is given below:

Table 2 Use of agricultural land in Israel in 2015

Types of crop land	Thousands of hectares	% of total land
All crop land	382.2	100
Irrigate	192.3	58.6
Rain watered	136.9	41.4
Orchards	84.8	25.8
Citrus	25.3	7.7
Vegetables	55.1	16.8
Flowers and plants	5.2	1.6
Field crops	183	55.8
Cotton	29	8.8
Wheat	86	26.2

Source: Ministry of Agriculture, Israel, 2015

Data depicted in (Table 2) revealed that the use agricultural land in Israel during the year 2015. The data shows that the total percentage of land for irrigation is 58.6 per cent and for the field crops is 55.8 percent. The land that is being used for agricultural cultivation has increased and is been utilized in a more productive manner.

The efficiency and productivity in agriculture sector has improved a lot in Israel. From the early 1950's Agricultural productivity has raised 4.5-fold per unit area. From (Table 3) given below it is understood that the agricultural output in Israel has increased drastically.

Table 3 Agricultural output in Israel 2015

For domestic consumption	37.5%
Intermediate produce and miscellaneous	9.4%
For export	15.8%
For domestic industries	37.3%

Source: Ministry of Agriculture, Israel, 2015

In Israel for the domestic consumption 37.5 percent of the agricultural products are used and 15.8 percent is exported. For other intermediate produce 9.4 percent is being utilized.

Israel's best practices in agriculture

Israel is a land of desert and no cultivation can be done as most of the lands are infertile. The country faced a severe drought for seven years and the country faced several problems and very hard times due to scarcity of water, food and energy. In spite of all these problems, the country transformed in a better way by improving their technology and innovative approach in strengthening its agriculture sector. After which Israel's agricultural growth has been very impressive. The growth and production in agriculture increased many folds after independence. The various best practices followed by Israel to improve their Agriculture sector are as follows:

(a) *Drip irrigation*

The most innovative development the country followed is the utilization of water and for this drip irrigation is followed in Israel. Very little amount is pumped through the pipes that are used for irrigation purposes to the fields and this system is called as Fertigation. There is absolutely no wastage of water in this drip irrigation. The water is slowly released and it is being used very effectively. Only the required amount for the crops the water is used. This kind of micro irrigation has been very successful in Israel. The Israeli solution like micro irrigation system have gained wide spread popularity. An example for innovation is a kit developed for irrigation. It has helped 700 farming families in Sengual to harvest their crops in infertile land three times in one year instead of just once [15]. More than 75 percent of the fields followed drip irrigation. Due to this the productivity increased by more than 4 times per unit area. Not only this, water also increased by the same number per cubic meter. There are various types of irrigation that is being followed and the main idea about this irrigation technique is in what way the water is distributed equally or uniformly so that each plant has the right amount of water it requires [15].

(b) *Desalination*

Sea water in general is salted and cannot be used for agriculture but Israel used this sea water for agriculture. In Israel a reverse osmosis desalination process provides about one quarter of the countries water supply. The main idea behind this is that the sea water is pre-treated with the series of filtration membranes that removes the salt and other impurities. Table 4 states that the sea water desalination has increased drastically form 36 MCM (Million cubic meters) to 505 MCM. The water from desalination has been used for agriculture from desalination of sea water.

Table 4 Sea water desalination in Israel

Year	Quantity of water (in MCM)	Year	Quantity of water (in MCM)
2004	0	2009	160
2005	36	2010	280
2006	100	2011	305
2007	130	2012	405
2008	145	2013	505

Source: Water Authority, Israel, 2015

Due to water shortage the country started to use desalinated water. Israel's desalination capacity rapidly reached 560 million cubic meters with Sea water reverse Osmosis (SWRO) facilities. The cost is less and it is a very innovative method to solve the water crises. According to the targets set in the Water authority's master plan for water sector development, for the years 2025 and 2050, the construction of additional desalination facilitates is expected to increase desalinated supplies to approximately 40 percent and 60 percent of all national potable water demand respectively.

(c) *Treated sewage effluents*

More than 75 percent of recycled water is used in Israel. The sewage water is recycled and it is used for agriculture. Israel being a desert country receives very less rainfall. The recycling of sewage water has helped this country in many ways. Since 2000 the use of treated waste water is used for the country's irrigation purpose. Earlier it was 17 percent of recycled water that has been used but recently it increased to 50 percent of recycled waste water that is used for irrigation. The agriculture sector uses the largest water uses in Israel. Around 58 percent of the water is consumed for this sector alone. Most of the water is recycled (744 mcm) and around 460 mcm is fresh water. About 265 million gallons per year is utilized by agricultural settlements on their own farms. The percentage of available sewage actually utilized is higher in agricultural settlements than for the country as whole. The national plan for irrigation development in next ten years provides for the utilization of 40 billion gallons of sewage per year [17].

(d) *Recycling waste water*

In Israel, 75 percent of the countries waste water is recycled. Especially more than 80 percent of the water used in agriculture is taken from treated sewage. The sewage water in Israel is recycled locally and it is used after that it is used for agriculture also. The total renewable volume of water per capita stands at 276 cubic meters per year which is about half of the "shortage red line" of 500 cubic meter per capita per year, which defines a situation of water shortage [18]. Apart from all this, the country made it mandatory to install dual flush toilets. These kinds of toilets use very less water. In 1959 itself it centralized the control of water resources and because of this 80 percent of the water is recycled in the recent years. From 1985 to 2015, Israel succeeded in recycling more than 500 million cubic meters a year for agriculture irrigation. It is to be noted that about 90 percent of the waste water generated is recycled in Israel which is four times more than any other country and ranks as the number one global leader when it comes to water recycling [19]. Spain recycles about 20 percent of its waste water and this the second nation which stands for recycling the waste water and that is followed by US which recycles 1 percent of the waste water. The recycling waste water in Israel is big success and due to this it has a national water surplus and it exports water to adjacent nations also.

Table 5 Effluent quantity for irrigation

Country	% of National effluent used
Israel	86
Spain	17
Australia	10
Italy	8
Greece	5
Central Europe	1
USA	1

Source: Water Authority, Israel, 2015

The (Table 5) indicates that the percentage of use of recycled water is more in Israel. It states from the data that 86 percent of the water they recycle is used for agriculture whereas the percentage level is very less in other countries. The least being Europe and US where only one percent is used for irrigation.

(e) *Minimize leakage*

Another notable point is that they minimize the leakage of water. Leak detection is a big priority that has been followed in this country. Israel has been able to decrease the leakage to less than 10 percent. This leakage has been identified and they try to stop this by adopting innovative technologies that monitors the water grid.

(f) *National water carrier (NWC)*

In Israel 80 percent of the countries water is available in the northern regions while 65 percent of the land that are used for irrigation is available in the southern regions. The available water should be transferred from the north to the south. Hence this NWC was started that transported water to the tune of 1.7 million cubic metres a day. Due to this the farmland that comes under the irrigation increased drastically from 30000 ha in 1948 to 186000 ha in recent years [20].

(g) *Biological pest control*

Innovations in pest management have been carried out by employing methodologies involving microbiology and Phytopathology. These help to control post-harvest diseases. Bio-bee, an Israeli company, breeds insects and mites that are not harmful to the crops, providing competition for harmful pests and also produces bumblebees for pollinating crops and plants that enhances production [21]. In Israel the companies have developed number of pesticides and herbicides which are non-chemical. Instead of chemical fertilizers which are very harmful for the crops as well as the farmers who use it, the Israel scientists have invented biological pest control methods to safeguard their crops. The crops are protected by this biological pest control method.

(h) *Grain cocoon*

In Israel the harvest products are kept safe and fresh through this Grain cocoons. This is a huge bag that covers the agricultural products and it keeps both water and air out. The products are kept very safely even in extreme heat and humidity. There is absolutely no damage that is caused to the crops that are harvested.

(i) *Post harvesting protection*

Post harvesting protection is very essential and the country does it efficiently. Environmentally friendly technologies are used to protect the crops and to preserve its quality. About 15000 tons of food grains are protected by using portable plastic structures which uses low pressure vacuum technology [22]. It is a long-term storage technology that is being used. The crops are also protected from environmental hazards like rain, flood or fire. Photo selective nets are used to protect the crops.

(j) *Agricultural knowledge on-line*

This on-line software helps the farmers to get more knowledge about the various new varieties and prices in the market and so on. Unique software gives ample information to the farmers and also advises the farmers to know all information regarding their soil. They will know what kind of soil they have and what kind of crops is best suited for their soil. They can get information about when to irrigate, when to harvest, and plant and they are also informed about the drought situation and how to cope up with the situation.

(k) *Tal-Ya water technologies*

Tal Ya water technologies developed the reusable plastic trays to collect dew from the air. This is a tray which is kept in the plant and the water that is collected in the tray goes straight to the roots of the plants. Tal-ya water technologies thus reducing water demand by 50 percent [23].

(l) *Effective use of fertilizer*

Fertilizers are a very important input in agriculture sector. The quantity of fertilizers should be used correctly. It should not be used less nor used more. Israel has come out with their local technology such as fertigation that supplies only required quantify of nutrient to plants. The crops are protected based on principles of integrated crop Management (ICM) spraying of the crops is done only when necessary, preferring environment – friendly chemicals.

(m) *Green houses*

Green houses have been adopted by Israel. It is used in arid regions. To overcome the restrictions imposed in the quality of the soil there are about 3000 hectares of greenhouses cultivation that enable the farmers to overcome the restrictions. Green houses are used to protect high value-added crops such as flowers and fruits from the fluctuations in the climatic conditions. The plastic that is used to cover the green houses is made of polyethylene with 3 or 5 layers and this kind of new technology protects the plants from dust and other climatic conditions.

Table 6 Export/import-fresh and processed agricultural produce (US $ million)

	2013		2014	
	Export	Import	Export	Import
Fresh	1495.2	1688.1	1392.4	2022.4
Processed	1037.8	1987.3	1051.9	2376.4
Total	2533	3675.4	2444.3	4398.8

Source: Ministry of Agriculture, Israel, 2016

(n) *Productivity and efficiency*

From the early 1950's agricultural productivity has risen. It has increased to 4.5-fold per unit area. There has been continuous introduction of new crops and verities. The production is of highest international standard and export oriented agricultural.

Only about 17 percent to 30 percent of Israel's land is cultivable. Nevertheless, Israel grows 93 percent of its own food. Agricultural exports are about 2.2 percent Israel's export trade. The export of agricultural inputs and technologies are given in (Table 7).

Table 7 Export of Agricultural Input and Technologies

Fertilizers	50.20%
Chemicals	11.30%
Irrigation	18.60%
Machinery	5.80%
Seeds	4.30%
Others	8%

Source: Ministry of Agriculture, Israel, 2016

Table 8 Agricultural Input in Israel, 2015

Inputs	Percentage used
Fertilizer	3.7%
Biological Pesticides	4.0%
Packing material and hired transport	3.3%
Seeds and Seedlings	8.4%
Water	9.5%
Depreciation	11.9%
Fuel lubricants and electricity	11.0%
Fodder	32.6%
Other inputs	15.6%
Total N/S	19748.6 million

Source: Ministry of Agricultural and Rural Development Statistical data 2014, Nina Lehmann, Arie Regev

Table 8 depicts the agricultural inputs in Israel. From the table it is clear that the inputs used are the fertilizer, pesticides, water etc. The inputs used differ over the years. The percentage of water used is less when compared with other countries. Even the pesticides used are biological and not the chemical fertilizers.

(o) *Research and development (R&D)*

In Israel in spite of severe water shortage and dry lands there is growth in the agriculture sector. The reason behind the country's success is the continuous efforts taken by the government in Research and Development. This is followed in Israel for many years and also the productions are improved by innovative methods that are adopted. The advancements in R&D in Israel try to increase the production to the maximum level. The expenditure made in R&D for agriculture sector since 2004 account for about 17 percent of the budgetary allocation in this sector. The Ministry of Agriculture Research body accounts for nearly 75 percent of nationwide agriculture research in the country. The important driving force behind Israel's internationally acclaimed the agriculture achievement in R&D [24].

(p) *Israel's success in vegetables production*

In Israel the right hybrid varieties are used for the vegetables. The fertilizers are used in the right quantity and the best irrigation method is followed for the growth of vegetables. The vegetables account for 17 percent of Israel's total agriculture production. Being a desert, this country has seen a marvellous growth in vegetables. In recent year's tomatoes and melon have shown a significant growth with saline water irrigation. These products are marketed under the brand name as "Desert Sweet".

(q) *Israel's success in field crops*

In field crops there are about 2, 20,000 hectares that are devoted and about 80,000hectares are cultivated for the cultivation of wheat. Drip irrigation is followed for the cotton cultivation and the water used is the waste water that is recycled. The cultivation of crop is completely mechanized and the farmers who are growing cotton produces $100000 worth of cotton annually [25].

Adopting Israel's technology in Indian agriculture

A very important lesson that India can learn from Israel is the Water Technology. In India the major problem is wastage of water. Every field is filled with water which is more than required. Water is wasted when it is in abundant and then when there is a scarcity, farmers face lot of problems. The following table shows the availability of water in India in future.

Table 9 Per capita water availability in India

Year	Population (in millions)	Per Capita water availability (m^3/year)
1951	361	5177
1955	395	4732
1991	846	2209
2001	1027	1820
2025	1394	1341
2050	1640	1140

Source: Ministry of Agriculture, Govt of India, 2009

Data depicted in (Table 9) revealed that the per capita availability of water and the data shows that the water availability is decreasing over the years from 5177 m3 to 1820 m3 and the future estimation shows an alarming rate of water availability in India [26]. So, in order to overcome this problem, the water technology method that is adopted by Israel can be followed in India. The drip irrigation has been a real success in Israel which turned a desert land to a cultivable land. This drip irrigation method where water is used most economically can be best suited to India where water shortage is faced in almost all the parts of the country. Modern irrigation interventions can help farmers of small holdings and farms to save water by 30 percent. Moreover, investment in advanced technologies like drip irrigation can save water up to 60 percent as compared to traditional irrigation systems [27]. In India the total water used for irrigation in traditional farming methods is more but in spite of using more quantity of water only 20-30 percent reach the crops and the rest of the water is completely wasted. Moreover, underground water tables are reducing by 10 metres annually [28]. In Israel due to advanced technologies like sprinklers and drip irrigation the water used is very less.

Secondly the use of biological pest controls method to the crops. Israel farmers do not use pesticides rather they use the biological methods to safeguard their crops. Whereas in India the use of pesticides and chemicals are more and that destroys the nutrient level of the crops. The amounts of pesticides used are enormous and also the use of chemical pesticides. The more and more of these chemical pesticides causes lot of problems to the farmers and also the crop loses its nutrition level. The table 10 depicts the consumption level of pesticides in India.

Table 10 Pesticide consumption in Indian agriculture

Year	Consumption of pesticide (000, tonnes)	Year	Consumption of pesticide (000, tonnes)
2005-06	39.77	2009-10	41.82
2006-07	41.51	2010-11	55.54
2007-08	43.63	2011-12	52.98
2008-09	43.86	2012-13	45.39

Source: http//www.pesticide -industry

Thirdly, storage of crops can also be adopted from Israel. In India the major problem is the agricultural products are not kept safely. The wastage caused to the crops is more. Traditional storage conditions lead to crop wastages. It has been estimated that crop wastage due to inefficient storage is 7 percent of annual grain production per year in India. It has been reported that in India almost every year, the country losses about 21 million tonnes of wheat due to lack of storage facility. This amount is equivalent to the total production of wheat in Australia. The loss of food grains is almost three times as high as the new budget for the agriculture sector, which has seen an increase of 44percent from Rs. 24,909 crore ($ 4 billion) in 2015-16 to Rs. 35984 crores ($5billion) in 2016-17 [29]. Almost 40 percent of the total food production in the country is damaged. In India our farmers do not use any kind of technology rather they still sprinkle the fertilizers using their hands which is very harmful to them plus when the fertilizers are used more, it will be very harmful to the social and leads to other environmental effects like leading to water pollution etc.

Success story in India by adopting Israel's agriculture technology

India has marked success in first phase of Green Revolution by achieving self-sufficiency and food security. And now India is in its second phase of most celebrated concept called 'Green revolution' and its first goal is transition towards sustainable agriculture by reducing the use of pesticides, chemical fertilizers and implementing agricultural production practices. This also takes into consideration the protection of natural resources and the environment by effective utilization of scarce resources. The second goal is diversifying the food basket [30].

Based on Israel's expertise in Agriculture, India has signed the agreement for agriculture cooperation in 2006. India has chosen Israel as G2G level strategic partner in the field of Agriculture. Based on the agreement first action plan stage (2008-10) was signed and number of areas were identified on which collaborative initiative are implemented in the states of Haryana, Maharashtra and Rajasthan. This was implemented by Mission for Integrated Development of Horticulture (MIDH) and MASHAV-Israel Agency for International Development Cooperation under the Ministry of Foreign Affairs. This has evolved into Indo-Israeli Agriculture Project (IIAP) and the main goals are increasing crop diversity, increasing productivity and resource use efficiency. To achieve these goals under IIAP, the implementing agency has established Centres of Excellence (CoE) which provides a platform for a rapid transfer of technology to the farmers with the aim of increasing productivity, improving quality of product and maximizing their income. The chart 3 shows the current status of Centre of Excellence under India -Israel Cooperation.

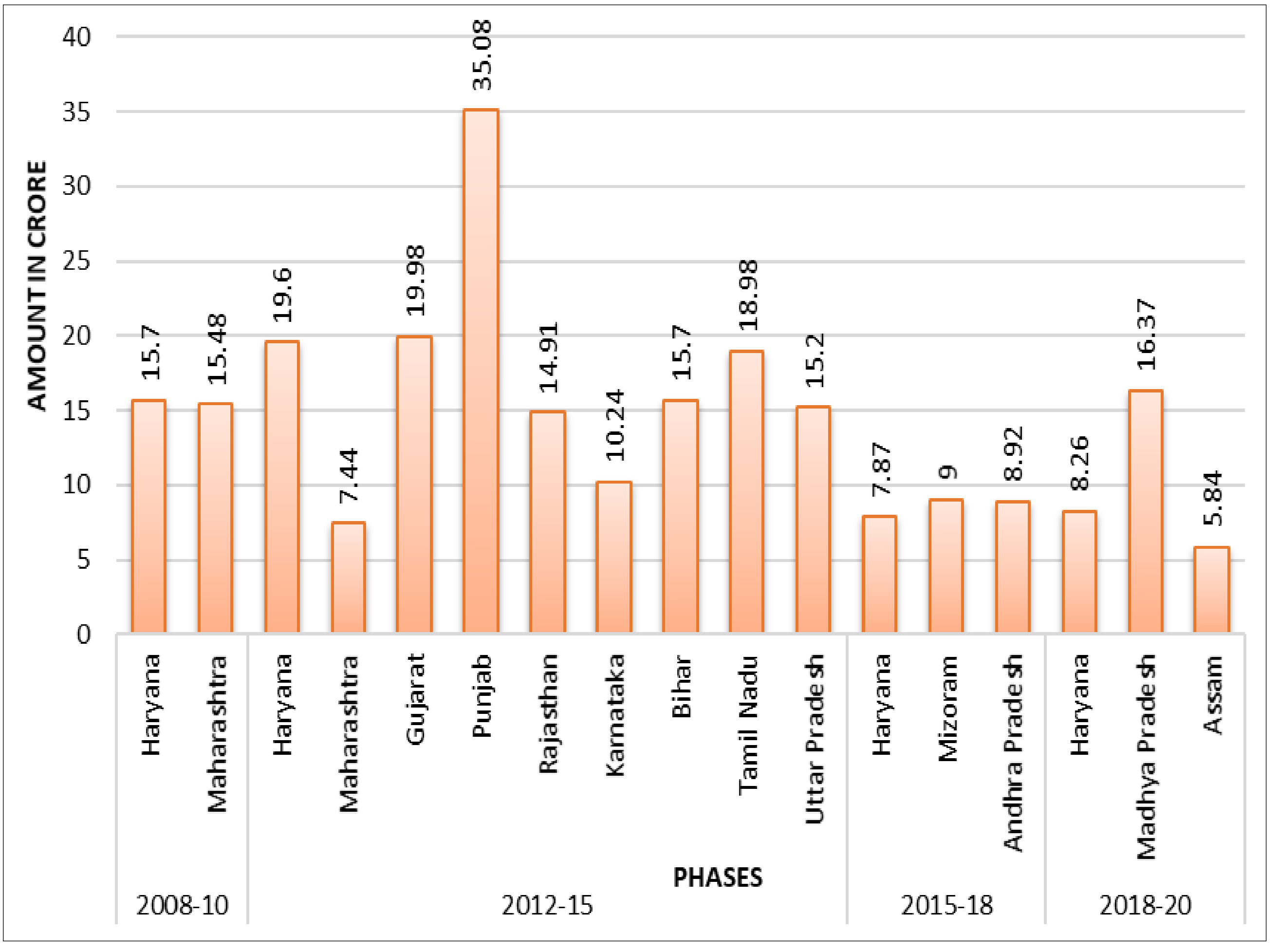

Fig 3 Status of centre of excellence under India -Israel cooperation
Source: Ministry of Agriculture and Farmers Welfare, Press Information Bureau, 2021

The first Indo – Israel cooperation agreement leads to the success of Gharaunda centre of excellence. Israel's technology has been implemented here and it is called as Plug Seedlings technology. It means that young plants are grown in small individual cells and then it will be transplanted to the containers or a field. The seedlings include hybrid seeds of tomatoes, cherry tomatoes, egg plants, capsicum and lot more. In three years, a remarkable change has been noticed by adopting this innovative method. There has been a fivefold increase in the cultivation.

Table 11 Increase in vegetable cultivation in Gharaunda

Crop	Open Field (kg/ acre)	Protected cultivation (kg/acre)
Tomato	16000	96000
Cherry tomato	Cannot be cultivated in open field	72000
Cucumber	3500	45000
Capsicum	12000	72000

Source: MASHAV, Israel's agency for international development and cooperation

From the (Table 11) is clearly understood that the innovative technology that is being used has increased the production growth of tomato, cucumber etc. Tomato increased from 16000 to 96000 and the cherry tomato that cannot be cultivated has shown a remarkable growth up to 72000. There are an increase the other two vegetables namely cucumber and capsicum. This has also increased in considerable numbers. Not only the production of these vegetables and some crops has increased but the water usage has decreased. Another notable point is that a noticeable decrease is seen in the use of pesticides and fertilizers [31].

Table 12 Decrease in use of pesticides and fertilizers in Gharaunda

Crop	Open Field (RP/acre)	Protected cultivation (RP/acre)
Use of pesticides	45000	10000
Use of fertilizers	25000	12000

Source: MASHAV, Israel's agency for International development and cooperation

The (Table 12) indicates that the use of pesticides and fertilizers have decreased to a considerable amount, by following Israel's methods. And also, with the adoption of Israel's technology, the harvest period of various vegetables and fruits has improved in better way. As part of the growing partnership in agriculture between Israel and India, the two governments have signed a three-year work program agreement for development in Agriculture cooperation, by implementing a new project called India-Israel Villages of

Excellence. This is a new concept aimed at creating a model ecosystem in agriculture across eight states, alongside 13 Centers of Excellence within 75 villages. This programs main aim is to increase the net income and better livelihood of the individual farmers, transforming traditional farms into modern intensive farms [32-33].

CONCLUSION

Agriculture in India is tradition whereas in Israel it is science. Indian farmers still follow the methods that were used by their forefathers and hence their production has not shown any improvement. In our country the availability of land is more, but the crop yielded from the land is very less and it is decreasing year after year. The percentage share of agriculture in GDP growth also is not in a satisfactory position over the years. Israel on the other hand adopted innovative techniques to improve their agriculture sector. Agriculture is 95 percent science and it has worked well with Israel with their innovation. Along with advancement of science and technology they have improved their desert land to a most fertile land. When science can work in Israel, it can also work well in India. Another important fact to be noted is that the population growth in India and rapid urbanization create huge challenges to Indian government. Therefore, sustainable way of using scarce natural resources is need of the hour. Latest slogan states "*Innovate or Perish".* The future belongs to those countries who can successfully compete in the race of technological advancement and innovative ideas. Old ideas are becoming obsolete and giving way to the new ones. The dry lands once are witnessing lot of changes and modernization and innovations take place. It's time for Indian government to reform the agriculture sector by changing domestic policy framework by transforming the method of cultivation from tradition to innovative farming ideas.

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