Chapter 4

Israeli Technology for Dry Land Farming and its Relevance to India
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Science and technology paves the way to progress and development. Technologies are at the heart of human civilization. The development of technologies over the centuries charters the path of learning and human growth. Technologies were developed to overcome the pressing problems and make life easier. However, the process of technology development was intensified with invention of machines. Same holds true for agriculture also. For technologies to be successful, there is a need for including people's participation in the development and use of technologies. Such technologies developed thereby would definitely be of tremendous use.

In earlier section much attention is paid on to different technological inputs in the case of Israel as well as India. Israel has many success stories in the development of dry land farming on the basis of many scientific and technological inputs and their management. India too has to her credit age-old success of dry land farming but the recent Green Revolution has opened many areas of success and failure. It needs a thorough probe and also makes a case for transfer of scientific ideas and understanding of a balanced management, specially from the Israel, which is very keen for friendly relation and eager to transfer some of the ideas and practices for the management of dry land farming. It could be both government to government as well as it could be people to people interaction. Farmers discovered, selected and domesticated all the major food crops and animals. Through their innovative activities many different farming systems emerged, adapting to the local conditions and available resources. Farmers have always been trying out practices that are innovative and are best suited to their needs. Rhodes (1988) believed that the technological change, which the farmers come out with, is not merely an accident but also has a strong farmer – based method for research, which, in many ways is similar to the scientific method.

At the governmental level, India and Israel have signed a number of agreements that provided a legal framework for trade and economic cooperation. A bilateral
agreement on cooperation in the field of agriculture was signed in December 1993 during the visit to India of Israel's Minister of Agriculture. A large number of experts from both sides have visited each other's institutions to exchange information and undertake specific projects for transfer of know-how and technology. The private sector in India has shown interest in accessing Israeli technologies in the agriculture sector. Approximately 170 collaboration agreements between Indian and Israeli companies have been signed in areas such as drip irrigation, greenhouse technology, floriculture and horticulture.

A number of Indian students have participated in training courses organized by the Government of Israel while others have pursued research by way of fellowships in the Hebrew University. Israel's Agricultural Research Organisation (Volcani Center) and the ICAR have signed a Work Plan for 5 years from 1997-2002 for agricultural research. A technical cooperation agreement signed during the visit of the President of Israel to India in December 1996 resulted in the setting up of a Demonstration Farm in New Delhi under Israel's assistance programme. Since 1996, the Israel International Agritech Exhibition, held every three years, has attracted a large number of visitors from India. In 1999, the approximately 800 Indian agriculturists, representatives of agro-industry companies and agricultural scientists attended the exhibition while a number of Indian companies displayed their products and technologies there.

What is technology?

Technology is the system of applied science by which a society solves its problems and provides its members with those goods and services needed or desired. The overall goal of any imposed, widespread change in technology should be to improve the quality of life of the individuals concerned, and to do this, increased productivity per person is required. If a bigger 'pie' is to be shared, each worker must produce a little bit more to make it bigger. Improved technology removes production constraints and makes it possible for the producers to accomplish more with available resources or inputs or to manage or operate a larger production unit or larger land area.
Thus technological change plays a critical role in agricultural development. But there is great diversity in the technology of agricultural production as seen in the many products, different inputs, changing land, climate and other geographical factors, scheduling problems, and marketing arrangements. New technology must play a part, but the technology used must be an appropriate technology.

**What is an appropriate Technology?**

'Intermediate technology' was defined a few years ago as a technology which is appropriate for a nation, its people, and its resources. The term, appropriate technology, is preferred today by most proponents of a new approach. Appropriate agricultural technology is appropriate for the producers, their society and the environment. The concept had its beginning in the developing countries where labor is plentiful and capital and other resources often scarce, but it is receiving increasing attention even in highly developed societies. 'Technology' includes the way of doing things as well as the tools, devices, and machines. The decisions of when to plant or cultivate a crop or how to manage a herd of cattle are just as much a part of agricultural technology as are the tools, implements, or equipment used in the fields. This aspect of appropriate technology has not been widely considered or discussed, most emphasis to date has been placed on the 'hardware' concepts. Some there by have the impression that the focus of appropriate technology is on machinery, tools, and processes.

Many of the more arduous tasks of arid lands agriculture in near-subsistence economies (societies) have been relegated to the women and children. Drawing and carrying water, harvesting, gleaning, and grinding grain are among their chores. Applications of appropriate, intermediate technology can ease their burdens. Known water resources improvement technologies can be adapted for the developing countries of arid lands. Storage losses in these countries are still large, yet storage technology, which can be adapted is available. Many 'micro-innovations' are necessary. Technology analysis will help identify such opportunities.
The key to improve the sustainability of dryland farming systems is soil productivity. It is measured in terms of outputs of or harvests in relation to the inputs of production factors for a specific kinds of soil under a physically defined system of management. The soil degradative processes like soil erosion, nutrient runoff, water logging, desertification, acidification, compaction, crusting, organic matter loss, solemnization, nutrient depletion by leaching and toxicant accumulation has negative effect on soil productivity. Soil conservation practices like conservation tillage, crop rotation, improved drainage, residual management, water conservation, terracing, contour farming, chemical fertilizers, organic fertilizers, improved nutrient cycling and improved system to match soil, climate and cultivator have positive effect on soil productivity. So, a truly sustainable farming system is one in which the beneficial effects of various conservation practices are equal to or exceed the adverse effects of degradative processes.

The important aspect of dryland technology is water budgeting; Run-off water is stored in catchment areas and utilized for irrigation. A better water conservation system combined with good crop management minimizes the risk as the water can be stored from the period of excess rainfall to be used in times of stress. Other measures of moisture conservation is by contour cultivation, adopting soil and water conservation measures; other proper crop management practices are the use of contours or graded bunds, strip-cropping, crop rotation, multiple cropping and the proper and best use of available water.

Farming Systems Research (FSR) evolved as a response to the need to identify opportunities for appropriate technology changes amongst poor farmers. FSR is an applied ‘Problem solving’ approach, conducted by multidisciplinary teams, with a degree of farmer participation, where the perspectives of technology change are assessed within a holistic framework.

The role of farmers in the process of technology evolution, adaptation and dissemination becomes increasingly important. There is a need to develop and replicate low cost technology in consultation with farmers. This calls for client-
Oriented On-Farm Research with in turn requires micro-level planning under difficult local farming situations to start from below and from fields with active and effective involvement of the farmer, extension personnel and scientist.

Success and failure of technologies can largely be explained in terms of good and poor management. Type of management of the technology transfer programmes, or rather the lack of it, should also be considered as an important determinant for success or failure of the technology. Participatory technology development therefore seeks to strengthen the existing experimental capacity of farmers and will sustain ongoing local management in the process of innovation. It involves activities where local producers and traders work together in the identification, generation, testing and application of new technologies and practices. Professionals engaged in agricultural technology development, therefore, will need a lot of creativity and endurance to identify and overcome the obstacles. This requires not only agronomic expertise but also sociological capabilities. There will be no specific guidelines for overcoming these obstacles; the diversity of the phenomena requires varying of solutions.

An ideal approach should include the skillful application of all modern management tools which support the different steps in the dynamic technology development cycle. This means that the surveys, need assessment studies, technology assessment, feasibility studies, monitoring programmes and evaluation studies. It is important to take the socio-economic and cultural environment into account and translate this environment into technology development strategies. The role of outsider in the process of technology transfer should be one of catalyst, and consultant. There is need to convene discussions and analysis by farm families in their experiments where advice may be sought from outside resource to supply ideas and technologies unknown in the rural community.

Transfer of technology is what keeps the wheels of agricultural development moving. The success of agricultural and rural development strategy, initiated, planned and developed by the policy maker, the planner and the scientist, hinges on the effectiveness of the extension machinery and personnel, whose task is to transfer the
technology from the lab to the land. Technology transfer has brought about a transformation in the lives of people in the countryside and the farmers and others who have adopted the new technology and methods of cultivation are happy to share their experiences with others. “Seeing is believing” and success is one place triggers a chain reaction, enthusing others to emulate it.

Technology transfer is the complex task which is multidisciplinary and multi-institutional in approach. It calls for close coordination in the functioning of agriculture departments, research organizations, educational institutions and extension agencies. Due to technology transfer India’s foodgrains production which stood at 50.9 million tonnes when the First Plan (1951-56) was launched, has now risen to more than 200 million tonnes – a four-fold increase. There has been a quantum jump in wheat production during this period from 6.5 million tonnes to over 70 million tones – more than ten times – while rice output has increased from 20.6 million tonnes to 86 million tonnes.¹

The technology transfer is particularly slow in drylands, that is, areas dependent on rains, which constitute 70 percent of the cultivated area in India but contribute 42 percent to the national food basket. Among the constraints in technology transfer, the major one is finance. No doubt, states are doing their best despite the resource constraints. To cite a few examples, Maharashtra has gone in for integrated extension delivery by merging development functions of agricultural and allied department at district and below levels. Rajasthan is encouraging NGOs and Para-extension workers while Kerala has established Krishi Bhawans at Panchayat levels promoting group farming approach. Punjab and Andhra Pradesh are demonstrating private sector involvement in transfer and use of technology. At the farmer’s level a major constraint in technology transfer is that the majority of them are small and marginal

farmers\textsuperscript{2}, not financially sound to adopt new technologies. Mechanization is viewed as a package of technology to:

(i) ensure timely field operations to increase productivity, reduce crop losses and improve quality of agro-produce.

(ii) increase land and other inputs productivity more effectively; and

(iii) increase labour productivity using labour saving and drudgery reducing devices besides, being cost effective and eco-friendly.

Farmers, particularly, small and marginal, still practice subsistence farming. Since dry areas often witness wide fluctuations in production year after year, increasing and stabilizing agricultural production is of crucial importance. One-third of the dryland areas are badly degraded, and cannot be put under cultivation. They receive rainfall of less than 500 mm. Another one-third of the dryland areas receive heavy rainfall exceeding 1,500 mm and have, therefore, serious water management problem. These areas also include the black cotton soil, which have their own problems. The remaining 40 percent of the estimated 100 million hectares of dryland areas have shallow depth and have been affected by massive soil erosion. The production potential of these areas is obviously quite limited.

4.1 Agricultural Technology and the Small Farmer

In order to make the agricultural technology available to small and marginal farmers, three major changes have to be brought about in the field of agriculture, viz. institutional, technological and infrastructural\textsuperscript{3}, with the assumption that these shall improve farm productivity.

\textsuperscript{2} The Small Farmers Development Agency (SEDA) defines a small and marginal farmers according to the size of the land-holding that a farmer owns and cultivates. According to K.T. Chandy, “Marginal farmers are those who have less than one hectare of land and those having 1-2 hectare are small farmers”. Chandy, K.T. ‘Agricultural Technology for Small Farmers’, Social Action, Vol. 43, 1993, New Delhi, P.320.

\textsuperscript{3} Chandy, K.T.; 1993, Agricultural technology for small Farmers, Social Action, Vol. 43, July-Sept., new Delhi, p.318.
(i) **Institutional Changes**

Institutional change refers to those measures which are related to agrarian relations and the size of a viable operational unit. It refers to the institution of ownership of land, especially cultivated land. The institutional change desired is one in which a standard family (of five) can have an economic holding, by which it is meant possession of enough land by a cultivator, to produce sufficient to support himself and his family in reasonable comfort and to meet the usual economic needs such as food and non-food expenses, and special expenses like sickness, marriage, death and birth ceremonies and other emergencies.⁴

This would require institutional changes in the form of land reforms at two levels. The **first** is fragmentation of large holdings to bring them down to the size of a viable unit. Studies like (Sen, 1995)⁵ have indicated that for a genuine green revolution to take place in India, the farm size should be of about 10 acres. Agricultural economists like, (Minhas, 1976)⁶, and others think that around 20 acres is the ideal size. In either case, the consensus is that for the best productivity, farms should be of a limited size.

The **second** land reform required is the consolidation of holdings. The size of the farm should be such that the cultivator is able to have a decent living from his farm. Hence the farm size should be structured permanently to turn it into a permanent asset which can generate a regular income for the owner cultivator and his family, to have a decent living. The size of this holding will vary from place to place depending on the climate, topography, soil condition and whether there is assured irrigation or not. Such farm sizes should be frozen and should never be fragmented under any circumstance. This implies

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that the law of inheritance is amended and only one descendant will inherit the
land if individual ownership is institutionalized.

(ii) **Impact of Agricultural Technology**
The question is how would small farmers get machinery for farm operations?
They do not have money to buy it nor can they maintain them. Agricultural
machinery is beyond their reach. The solution would be to make technology
available to small and marginal farmers without themselves owning the
machinery. This can be done by NGOs as well as by governmental agencies
but they too require institutional changes. All the farm technological inputs
like seed or seedlings, fertilizers, irrigation, pest and disease control, weed
control etc. should be run by these organizations. The capital investment such
as land levelling and development, establishing irrigation and drainage
systems, soil and water conservation structures, farm buildings and other
permanent immovable structures should be the responsibility of the
organization. The farmer should only be the regular maintenance person and
cultivator. Similarly, output management such as grading, storing, processing,
transporting, marketing etc. should be the responsibility of some other people.

(iii) **Infrastructural Changes**
Change in the infrastructural facilities is a pre-condition for the judicious use
of farm technology, improvement in farm output as well as for the socio-
economic and political development of the people. By infrastructural facilities
one means the roads, transport, communications, facilities for credit,
marketing, storage services for efficient management of inputs and outputs
and efficient irrigation development. In other words, the management of
inputs, production, function and management of outputs have to be organized
(by keeping irrigation development in mind). These infrastructural changes
can be executed in the following pattern to make farm technology available to
the small farmers:
1. **Implement Land Reforms**
   
a. Consolidation of Fragmented and Scattered small Holdings.

b. Merging Marginal Land with Smaller Holdings.

2. **Cooperative Farming**
   
a. Cooperative Tenant Farming
   
b. Cooperative Collective Farming
   
c. Cooperative Better Farming
   
d. Cooperative Joint Farming

3. Government services

4. Non-Governmental Organisation (NGO)

4.2 Principal Problems of Agriculture in Arid Regions

A. **Water**

Water is absolutely necessary for all plant and animal life. Plants have evolved that are capable of living and reproducing in semi-arid, arid, and even desert regions. However, as aridity increases, fewer and fewer species are adapted, and the potential biomass is reduced. Plants are adapted to aridity by several mechanisms. There are plants with a short life cycle that can germinate, grow and produce during a very short period of available moisture.

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7 In this system a society is registered consisting of a number of farmers. The whole land is divided into equal or unequal small plots. These smaller holdings then are leased to individual members of the society. The society provides facilities of credit, seed, manure and implements, and undertakes marketing of the produce. Every member pays a fixed rent for his holding but the produce of his holding is his own and is entirely at his disposal.

8 In this system the members pool all their land, animals, other natural resources and equipment together into a common ownership. The cooperative is managed by an elected council. Farm technology can be employed to increase production under this system. Each member will be paid the wages and a share in the surplus produce of the farm. A collective farm is usually a large scale farm which is highly mechanized. But by and large cooperative services and production have proved to be more successful than collective ownership.

9 In this system all the farmers join together and perform all operations together and mechanically wherever it is possible and needed. But all retain their individual ownership of the land. In this system all the small holdings too will get the facilities of farm technology.

10 The members pool all the land together while retaining its individual ownership. But for all practical purposes the system operates like collective farming. There will be homogeneity in the corps cultivated. All the heavy and difficult operations are carried out together, but the produce from each one's land is appreciated by the owner himself.
There are plants with deep or extensive root systems which have the ability to gather water over a wide area. There are plants which store up water in their tissues and release it very slowly. There are plants that are protected from water loss by wax or other impediments. There are plants with very small or narrow leaves, thus reducing water loss. There are plants in which the tissues themselves can withstand much desiccation without dying. Crop plants in arid regions may have any or a combination of such mechanisms.

Water that falls in arid regions may be of little use for crop plants because the amount is too small to penetrate the soil sufficiently, or it may run through a porous soil too quickly, or it may run off too quickly. Furthermore, weedy species may be so adept at utilizing scarce water that they rob the water from crops. On the other hand, some soils store water so efficiently that it is possible to grow crops over an extensive period of drought.

Water from rivers, lakes and wells in arid regions may have problems of quality, especially the presence of excess minerals. The use of irrigation water might lead to the accumulation of salts in the soil resulting in alkalinity or salinity, which might then limit crop production. The removal of salt from the soil is very difficult.

In all arid regions a major challenge is to manage water appropriately. The purpose of such management is to obtain water, to conserve it, to use it efficiently, and to avoid damage to the soil. Israel, with its underground water-carrier systems, provides a good example of stringent, scientific management and budgeting on a national scale for scarce water generated within or adjacent to the arid and semi-arid zone. Two-thirds of all the water used, for all purposes, is pumped from aquifers that, in addition to acting as sources of water, are also used for water storage, as conduits, for regulation of base flow.
by pumping from confined aquifers, and, because of their granular structure, as natural filters.11

B. Heat and Wind

The major effects of heat and wind are to increase the rate of evaporation, and thus to increase the effects of aridity. Wind may also cause mechanical damage to crops. Both are combated by changing the micro-climate. The effects of winds can be reduced by windbreaks (lines of trees perpendicular to the direction of prevailing winds). Some useful tall species are tamarisk, casuarina, and eucalyptus. A windbreak can consist of trees and other plants of varying height. As a general rule, a windbreak is effective over an area 2.5 times the height of the tree. One must remember, however, that a windbreak may also rob crops of light, water and nutrients. Thus, the advantages of a windbreak must be weighed against the disadvantages in any particular environment. Windbreaks can also be constructed of non-living materials, which are likely to be expensive. Heat is received principally from the sun and can be reduced by shading. But, shading also reduces the yields of plants. A light shade such as that below a coconut planting or a protective screen or lathwork can be useful in reducing heat and retaining moisture, with only a minimum loss of yield.

C. Soils

Soils of the arid tropics are highly variable, as they are in any climate. Nevertheless, it is possible to make some generalizations about such soils. Because of the low rainfall and consequently reduced plant growth, organic material is produced slowly. Yet, again because of low rainfall, it may be broken down slowly as well. The amount of organic material in the soil, and thus the potential fertility, is likely to be high in semi-arid zones, low in deserts. Because of low rainfall in desert soils, minerals derived from breakdown of rocks are not leached from the soil. In some cases where the

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soil is periodically flooded or irrigated the soil might be saline as well. Such soils support few crops. Soils of the semi-arid and arid zones might support few plants on the surface, but a good part of the biomass might be in the soil itself as roots. Shrubby desert plants often have very hard woody roots that may be physical barrier to agriculture.

**D. Disease and Pest Problems**

Arid regions have their fair share of disease and pest problems. However, these may often be quite different from those of wetter regions. Nematodes are often a severe problem in sandy soils. No general rules are useful, and indeed, agriculture anticipates diseases and pests, and their parasites as well.

**4.3 Lessons from Israel for India**

Israel has already proved herself to be amongst the most efficient countries in the world in terms of obtaining maximum economic output from minimum water input. However, the problem of continued population growth, together with the increase in standards of living, will put even greater strains on the water supply network in the future. How long Israel can go on supplying these expanding needs from its present water resource base without some demand areas beginning to suffer considerably is a matter of conjecture. A feature of the last two decades has been the growth in demand of domestic supply as population numbers have increased. At the same time, *per capita* use has gone up as standards of living have risen. Agricultural use still remains the dominant one, though its relative importance has been falling steadily.

**4.4 Agricultural Techniques for drylands**

Many of the techniques for agriculture in arid lands are not very different from those in other climatic zones. The unique problems of drylands are almost entirely related to water or its effects over long or short times. Therefore, the discussion here revolves around two questions: “How to capture existing water?” and “How to use water wisely?”
A. How to capture existing water

Much of the water that falls on drylands is lost by runoff, deep penetration into sands, or by evaporation. Runoff can be captured for later use in natural or nature-like ways, or in man-made structures. These include the following:

(i) Furrows, and diking of furrows, ditches, and pits following contours to slow the runoff of water and permit deeper penetration.

(ii) Similar structures reinforced by bench terraces, vegetative strips, or trees for alley cropping.

(iii) Crescent-shaped basins arranged to gather water for one or more trees.

(iv) Reservoirs of water, such as natural or constructed shallow basins along roads which capture runoff, earth structures that lead water into aquifers, rock or clay-lined underground basins.

(v) Other man-made structures, includes cisterns (household or community sized clay, stone, or concrete tanks), check dams (small structures that impede water movement in a stream), and conventional dams.

B. How to enhance and conserve water quantity and quality.

In many dry regions water can be obtained from wells. The depth of the well necessary to obtain water may vary a few to hundreds of feet. Water in wells is either fossil (stored over impermeable layers for thousands of years), or from water that has entered the soil from rain, and is therefore stored rainwater. Both sources of water are limited and can be exhausted. New water is also obtained by condensation from the air, either onto metal screens or plastic (the principle of the solar still) or onto foliage. Ingenious systems can be developed to capture this condensation. The source of water depends on nighttime temperatures that lower to the point of condensation.

Water that is conserved is just as valuable as water that is obtained, and conservation is one of the best strategies for arid zones. There are many techniques:
(i) **At the level of the home:** Reduce water use in the home. Capture gray water (from kitchen and bath) for later use in the garden. Use overflow from septic tanks to irrigate trees.

(ii) **On the farm or garden:** Reduce evaporation with windbreaks and light shade. Plant in the best soil, and lead runoff water to it. Plant in furrows, pits, or swales. Establish plants in a nursery in pots, when feasible, for later transplanting. Keep the soil rich in organic material. Use drought resistant crops or varieties, when possible. Maximize use of trees that produce food in arid regions. Plant during appropriate seasons. Use mulch, but not in excess. Irrigate efficiently (usually the most efficient system in drip irrigation). Keep weeds down. Eliminate crop plants as soon as they finish producing.

### C. Other Techniques:

(i) **Hillside farming:** The special aspect of hillside farming that merits attention here is that water rapidly runs off and often causes erosion. Thus, hillsides can be arid even in an otherwise wetter climate. The techniques required for successful hillside farming are those that capture, minimize runoff and erosion, and help build soil fertility. Some techniques are very simple, such as plowing along the contour and leaving vegetative strips between planting. Some are more complex and expensive, and may require engineering, such as building bench terraces, correcting gullies, and building ponds and dams. The most elegant techniques and probably the most satisfactory are associated with the use of multiple purpose legumes in systems of alley cropping. Trees along the contours are used to gradually develop terraces and meanwhile enrich soil by capturing nitrogen and bringing up deeply buried nutrients, making them available in foliage, used as fertilizer. In addition, such trees may furnish firewood, feed, or occasionally food. The crops for hillsides should be those with very deep roots or that can take advantage of short times of availability of water.
Use of trees: Trees will often be the most useful crop plants in arid regions, for with deep roots they can make maximum use of water. Trees will need special protection when they are planted, including irrigation in time of need. A good tree crop ought to fill many purposes.

Residual moisture: In some soils in arid regions with short rainy seasons, crops are planted near the end of the rainy season and even after rains have ceased in order to take advantage of moisture stored in the soil. Tepary beans are produced using this principle. Melons are often used as such crops in Central America and Israel.

Alternate years: A common practice in arid regions is to plant only every other year. During the year when the ground is left fallow, weeds, which use up the water in the soil, are controlled. This type of planting is suitable only for soils with a large capacity to store water. This will be evident when the crops or weeds on a soil remain green for a long period after rains have ceased.

Feeding of animals: Crop residues, both harvested and those left in the fields, may be used as feed during dry seasons. Animals such as cattle, goats, sheep, hogs, chickens, and ducks clean up the field and can help eliminate weed seeds, and, of course, they also leave their manure.

4.5 Crop plants for tropical dry regions

Crop plants for dry regions are those that survive and produce inspite of aridity (See Appendix 3, table 1). However, in almost all of these crops, seeds must be germinated or cuttings must be rooted under conditions of almost normal water availability. Therefore, when one speaks of tolerance of dry conditions one is talking mostly about the drought tolerance of the growing or mature plant. In the following tables, plants that are useful in dry or arid regions are considered. These plants vary in ability to tolerate aridity and in yields under arid conditions. Choosing the right crops for arid regions might involve
considerable experimentation in a particular region, and, infact, the development of suitable production systems might require years. This should come as no surprise. Native systems, as crude as they may appear, usually represent the accumulated wisdom of centuries of experimentation. If this is so, how can one hope to make an improvement? The answer is often in the introduction of species or varieties unknown in the arid regions. In other cases it is the introduction of technologies developed in other regions.

Israel is involved in the development and production of new seed varieties, which are resistant to disease and are able to meet farmer’s requirements. Market demands influence seed research and development. For instance, the hybrid onion with the highest level of dry layers in the world, making it particularly suitable for countries with fewer daylight hours. Another example is the melon-sized watermelon which fits easily into the refrigerator. Highly resistant varieties of seeds are being developed that minimize the need for pesticides and fertilizers, allowing them to grow naturally. A variety of tomato renowned for its long shelf-life has been developed, which is a hybrid of two varieties. Another new variety is the seedless watermelon.

4.6 Principal Animals for dry regions and their characteristics

In dry regions of the tropics where agriculture is always difficult, animals are frequently more capable of utilizing the often-abundant plants that are available, and many times can be fed with crop residues. While some feed crops are given in (See Appendix 3 table 2), the most important feeds in many regions will be those which grow by themselves, naturally are untended. Sometimes improvement of this natural fodder by fertilizing, watering, or selected weeding may be the best solution to increasing the yield of animal feed. In addition, appropriate case of animals is necessary, and even poor herdsmen are often very skilled in raising animals. Animals on the farm can be used for a wide variety of purposes. In addition to excellent food in the
form of eggs, milk and meat, animals serve as beasts of burden, and can be trained to handle difficult jobs on the farm. The dung is a useful resource for crop production but is also used in plastering walls and floors, and when dry, as fuel. Animal wool, hair, or fur can be used in bedding and clothing. Categorically, it could be focused as follows:

(a) Cattle: In many arid regions the production of cattle might be the best way to make use of land. Cattle feed principally on grasses, but also benefit from legumes. They are much less apt to graze or browse on shrubs than goats. They are very adept at finding something useful to eat on grasslands, even during the dry season. Cattle may be used for milk, for meat, for farm labour, and for their hides and other by-products. There are many breeds of cattle, often used for a single purpose, or at times serving for two or more main purposes, and some of these will be much more adapted to a given situation than others. Choosing the appropriate breed or strain or cattle will always be important.

The carrying capacity of land, the number of cattle (or, other animals that can be raised on it), will vary widely, and can determine the success or failure of a given venture. Cattle may graze in open range or fenced pastures, but in either case, rotation is necessary in order to, not destroy the future potential of the grazing area. Improvement of the grazing area can be achieved by the introduction of new grasses or legumes, by fertilization, occasionally by fire (a risky process), by killing poisonous plants, and by eliminating brush and some trees. Some breeds will gain more on a given pasture than others.

Since cattle raising is a capital-intensive effort (even the cattle represent considerable capital), a great deal of investigation and local knowledge is desirable before embarking as such an enterprise. On the other hand, raising the family cow is possible almost everywhere and can be the foundation of success on the small farm.
(b) Goats: Goats may be produced for about the same purpose as cattle, and their smaller size makes them suitable for many situations. They are often grazed on open range in arid regions. They are browsers (nibble at a variety of plants), and sometimes are better adapted to production of useful meat than cattle, especially in heavy shrubland. While goats may be raised for milk, the really fine milk varieties are not well adapted in the tropics.

(c) Sheep: In addition to the wool-bearing sheep of the temperature zone, there exists hair sheep which are much better adapted to the tropics. In addition to their value in producing meat, such sheep are often used to control weeds in orchards, and thus constitute a profit-producing biological control.

(d) Burros: The small donkey of the drylands of the world is supremely adapted to living off the browse and meager feed often available, and for its size is surprisingly strong and a magnificent beast of burden. The burro can easily be adapted to useful roles on the farm, including basic transportation and pulling carts.

(e) Camels: This species is best adapted to very dry areas where agriculture is very limited.

The choice of animals for the farm in the arid tropics, and the techniques used to raise such animals are very important, and vary considerably from one region to another.

**Feed Crops for animals**

After adaptation, no element in the production of animals is more important than feed. Farmers may be quite conscious of acceptable treatments in care and breeding of their animals. They may not be aware of the progress that could be made by improvement of feeds, even though such advice may be
available through local agricultural experiment stations, extension services, or the department of agriculture. A first step in improving animal production should be to learn how farmers are feeding animals, and the second step is to learn what feeding practices are recommended. A third possible step, much more difficult, is to learn the feeding practices in areas of similar soils and climates.

A major problem in the production of animals is what to feed them during the dry season. An efficient production system includes solving this problem in advance. Some of the potential solutions include: dry season irrigation of pastures; restricted grazing of pastures during wet seasons so that feed will remain for the dry season; harvest and storage of wet feed as silage; harvest and storage of dry feed as hay, or as seed, in the case of grain crops; cultivation of feed crops adapted to arid zones; and migration to more productive areas. One of the most useful possibilities for increasing dry season feed is the use of crop residues. The value of such residues as feed varies, and sometimes other substances are added to enhance palatability or nutritive value. In a well-managed agricultural enterprise of any kind, it will be useful to look for such potential uses of residues. Another solution to the problem of dry season feed shortage is to reduce the size of the herd as the dry season approaches. The frequent practice of letting animals go hungry cannot be recommended as good husbandry.

4.7 Latest from Israel

Degania Sprayers

Degania sprayers has been manufacturing sprayers since 1956. Degania is the largest producer of sprayers in Israel, and is one of the largest leading companies in the world in its field (air assisted boom). Degania sprayers was the first company to invent and develop a revolutionary type of sprayer, using air-assistance for spraying. This spraying method has won recognition as the most innovative spraying methods developed in years, and tests have shown
that it saves up to 30% to 50% of spraying chemicals. This type of sprayer is mounted onto conventional tractors and comes in various boom lengths.

**Naan Irrigation Systems**

Naan Irrigation Systems offers Israel’s largest selection of sprinklers, drip, micro and mobile mechanized irrigation products and systems. Naan products and complete irrigation systems are currently in operation in 80 countries on 6 continents. Naan produces over 50 specialized sprinkler models ranging from small capacity energy-saving sprayers to huge waterguns. The Naan-Tif and Naan-paz continuous seamless dripline with regular or pressure compensated integrated drippers are available in a variety of sizes and discharges. Naan Irrigation Systems offers a comprehensive consulting and design engineering service for the drawing up, supply, installation and turn-key irrigation systems. Naan, with 60 years of experience, is able to meet all the requirements of modern irrigation in agriculture, orchards, nurseries, sports fields, parks and gardening.

**Plastro Gvat**

Plastro Gvat was established in the year 1966 by Kibbutz Gvat. In the beginning, the factory manufactured only plastic pipes and basic irrigation products. Using their agricultural knowledge, field experience and advanced technology, and basing their R & D on the real needs of the farmers in Israel and all over the world, have made 'plastro' a leader in the field of irrigation. Plastro’s products are designed with an emphasis on saving water and energy and on simplifying the work of the farmer. Plastro’s products are manufactured from highest quality materials with computerized manufacturing methods, according to the strict standards of ISO 9002.

The problems in agriculture are many, special water requirements for each crop, many types of soils and water quality and variations in climatic conditions are only a few. Plastro produces a large selection of state-of-the art irrigation products and modern irrigation systems, enabling them to offer their
clients all over the world correct solutions to all their agro-technical requirements.

Plastro's unique products include: drippers, sprinklers and sprayers with various flow rates and wetting patterns that can be pressure-regulated or flow-regulated, online drippers, integral driplines and specialized fittings. As a full service company, Plastro also provides its customers with services related to its products: agro-technical consultation, design and planning of all types of irrigation systems, assistance in installation and help in training local personnel to operate and maintain modern irrigation systems.

As a result of serious market research to learn the needs of the various sectors, Plastro has developed new lines of products for infrastructure ("Kanaflex" large diameter drainage pipes) and communications ('Kav-on' cable conduit).

Other recent developments
(a) Saucer-shaped yellow zucchini, destined for world markets and for home gardening.
(b) The black watermelon, aimed at world market.
(c) Following the transition to originally-grown, chemical-tree products Israel has developed naturally colored cotton, so that in addition to white cotton brown and green cotton can now be grown.

Agridev (Agricultural Development Company (International) Ltd.)

Agridev is a government-owned company, under the auspices of the Ministry of Agriculture, whose function it is to transfer agricultural technology and know-how. Agridev operates on a commercial basis, providing professional and technical services to both public and private sectors of client countries. Agridev's services cover the following: feasibility studies, planning, implementation, technical supervision and management, professional consultancy and advice, etc. in performing its operations. Agridev applies the
latest technology developed by the advanced Israeli agricultural and agro-industrial sector, and also the vast experience acquired in other countries. All these above mentioned technologies can improve the existing technologies available in India. The above mentioned drippers and nozzles can be fitted to sprinklers and drip irrigation systems to improve upon them. These are more sophisticated and computer controlled. Then water in these systems would be utilized more judiciously. The transfer of these technologies can come true with the help of agridev, the nodal agency responsible for the transfer of technology from Israel to rest of the world.

4.8 Conclusion

In an information age, the role of appropriate information package and its dissemination is of crucial significance. It is not enough to generate information but also to ensure that the required information is delivered to the end-users at the earliest and with the least dissemination loss. The cornerstone of India's agricultural revolution is due to availability of improved varieties of cereals, oilseeds, pulses & other crops, breeds of livestock including poultry and fisheries, horticultural plant materials and improved management practices for increased productivity, sustainability and stability of various crop and livestock enterprises. This has triggered the search by the farmers for availability of quality seeds, planting materials and other inputs, easy accessibility to diagnostic services for soil fertility and plant protection.

Technological changes are taking place more rapidly now then at any other moment in the history of mankind. The latest slogan is "Innovate or Perish". The future belongs to those countries who can successfully compete in this race for technological innovation. Old technologies are becoming obsolete and giving way to the new ones for improving efficiency and reliability. The dry land farming which of late has acquired considerable importance, has witnessed a sea-change, and modernization is taking over. Its time for Indians to develop their drylands to accommodate and feed the growing population, by learning lessons from Israel.