An overview of

Agro-Informatics in Israel

Trends and developments

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Abstract

Agro informatics in Israel is well established, a major current contributor to agricultural production and a vital element in the emerging hi-tech profile of Israel's agriculture. The unique feature of this process is the intimate linkage between technology development, farmers as a source of innovation and innovation implementation. Its most important lesson for the future suggests that success in technological innovation and especially Agro informatics is overwhelmingly dependent on human elements.

Background

Agriculture's importance in Israel exceeds the agricultural sector's physical proportions. For example agriculture's share of employment is around 5% (including services) but it provides over 10% of Israel's exports (Economic Report on the Agricultural Sector, 1990, The Planning and Development Authority, Ministry of Agriculture). Since the establishment of the State of Israel in 1948, the increase in productivity in agriculture has, on the average, been 60% higher than the average increase of productivity in industry. In 1948 one farmer 'fed' 17 people. In 1990 (with a better diet) this number was 64, representing an average 3.2% increase in productivity per year (Fig. 1).

This dramatic improvement was achieved over a period during which the agricultural production pattern has changed from commodities for local consumption, to producing and exporting fruit, vegetables, flowers, processed- and higher value-added crops. During the transition, Israel attained and

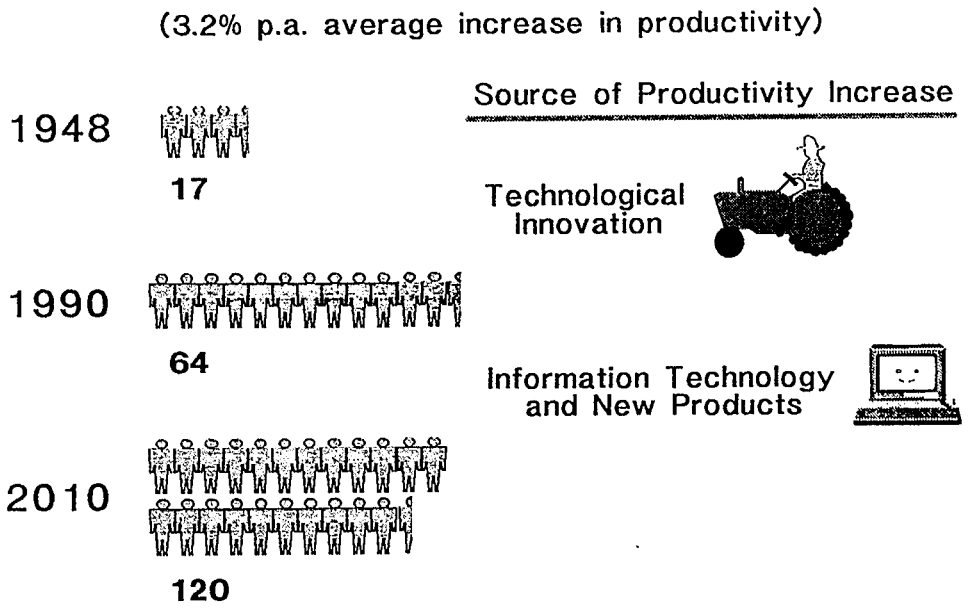

Figure 1
Persons fed by each producer in Israel

Table 1
Israel's existing and new agricultural-sector products

		for local consumption	for export	being developed
Food with an emphasis on higher quality, chemical free, exotic products, etc.	**Fresh, stored**	■	■	■
	Processed	■	■	■
Raw material	**Industrial**			
	prmimary	■		
	intermediate	■		
	By-products	■		
Agricultural inputs	**Primary** (seeds/clones)	■	■	■
	Secondary (roughage)	■		
Production Know-How	**Technical inputs**	■	■	■
	Technical Systems	■	■	■
	Information systems	■	■	■
Leisure Products	**Consumption** (flowers)	■		
	Occupational (pets)	■	■	■
	Environmenta l Activities (treking, farming, etc.)	■		■
Employment	**Primary**	■		
	Secondary (services)	■	■	■
	Tertiary (research, hi-tech development)	■	■	■
Management of Natural Resources		■		■
Education in a rural environment based on 'agriculture'	**High School and vocational level**	■	■	
	Higher-level technical and management training	■	■	■

maintained a balanced (import-export) agricultural account, with an ever-decreasing proportion of the population employed in primary agricultural production. The increase in productivity can be explained by successful adoption of technology and agricultural innovations. To a large extent these were the result of farmers' involvement in agricultural research (Gelb, Kislev, 1982).

Israel is now, again, in the process of such a fundamental change in the pattern of agricultural production, with Agro Informatics at the cutting edge of technological innovation. If a conservative projection of the past average 3.2% annual increase of productivity, expected to be generated by Agro Informatics, can be achieved, the result will be one farmer 'feeding' 120 people by the year 2010 with an even better diet (Fig. 1).

Motivation for the pattern change reflects a very severe shortage of 'cheap' water, the urgent need to increase rural (agricultural) income to at least the national average, deteriorating terms of trade, a growing demand for higher, rural quality of life and environmental protection. Israel's growing population expects more. Constraints include fertilizer and chemical restrictions to avoid groundwater contamination, water rationing (with quotas in some cases reduced by more than 40% this year alone, ever higher cost of land and labor, and knowledge gaps. For the pattern-change to succeed and sustain the growth rate, there is a need for innovative and efficient production methods, higher valued-added, superior product quality and a whole new range of agricultural products. To maintain the agricultural balance (agricultural exports paying for agricultural imports - as an issue of national policy), a major proportion of these products must be attractive and competitive on world

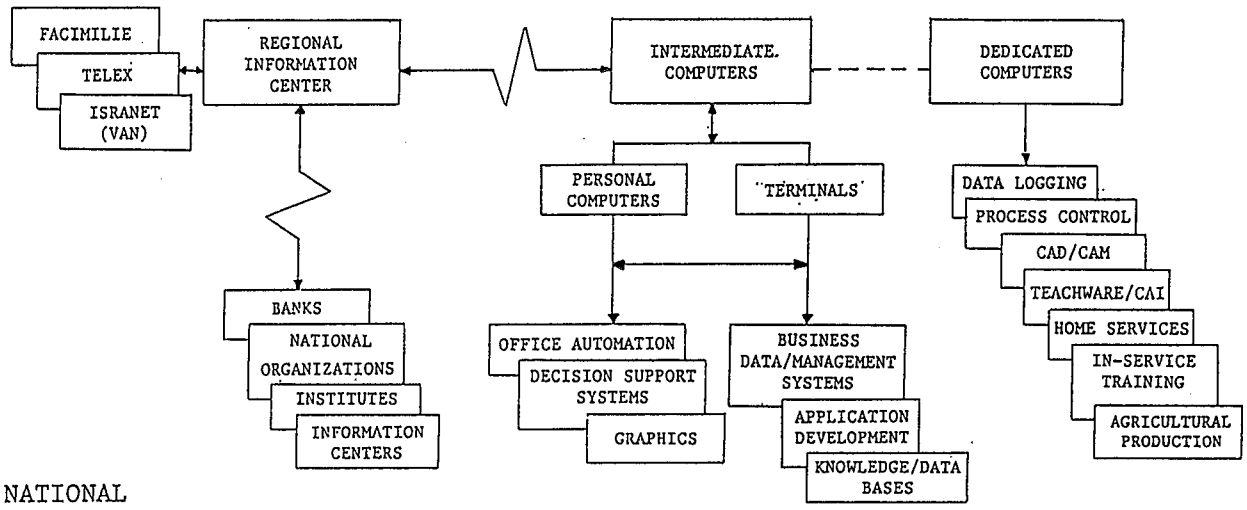

Figure 2
National and regional information environment

markets. Table 1 gives a rough breakdown of the current range of agricultural products in Israel, indicates if they are exportable, and identifies those which are in the process of development.

A close inspection of the products in Table 1 will reveal the dominant requirements for sophisticated knowledge-based systems and IT. The current Agro Informatics environment and development trends are the subject of this overview.

National and regional information environment

Fig. 2 (Gelb, 1987) illustrates the current and projected Agro Informatics environment in the agricultural sector in Israel. The hard- and software are well advanced on their development trajectories and their state-of-the-art reflects current performance demands at each level of the systems. A comparative advantage of these systems can be identified in successful adaptation of (world) market-available hardware components to agricultural production systems. Some specialized chips and hardware-mainframe, mini and personal computers and equipment are, in fact, engineered and produced in Israel. The hardware is supported by substantial software production and adaptation capability. This capability is located at the various levels in the knowledge-generating hierarchy in the agricultural sector, as is demonstrated in Fig. 3: at farmer, regional and national level, in research and specialized service facilities (Gelb, 1987).

Both Fig. 2 and Fig. 3 illustrate the current elements of existing networking. The volume and efficiency of telecommunications are rapidly increasing to the extent that computer networking is not expected to be an effective constraint in any sense. The trend is well recognized, as are the services made available by networking: information and knowledge accessing, transmission of information, various levels of computer and human communication, remote control and data collection, integration of information (production) systems, etc. The technical specifications of both hard- and software comply with international standards, facilitating interchangeability and export of Israel systems and products (Table 1).

Agro informatics implementation and development

Changes in Agro Informatics are not only technical but conceptual. Previously 'computers were seen as a technical solution to administrative problems' (Geuze, 1990). Today, in Israel as elsewhere, expected changes in the agricultural production pattern depend on implementation and development of such above-mentioned information intensive systems. The degree of implementation capability at farm level varies.

Innovative farmers are ahead on the learning curve - to the extent that they themselves sometimes develop, and even export, computer supported production systems. Herd management systems which include computerized milk-parlor and feed distribution equipment are an example (Rosen, 1990). Computerized systems for total environment control in broiler and greenhouse production are another example. A third example - water control systems, both indoors and outdoors, commands special current priority. The urgent need for efficient control of water quality, irrigation precision, fertigation and water allocation is being met with computer-supported systems. They plan,

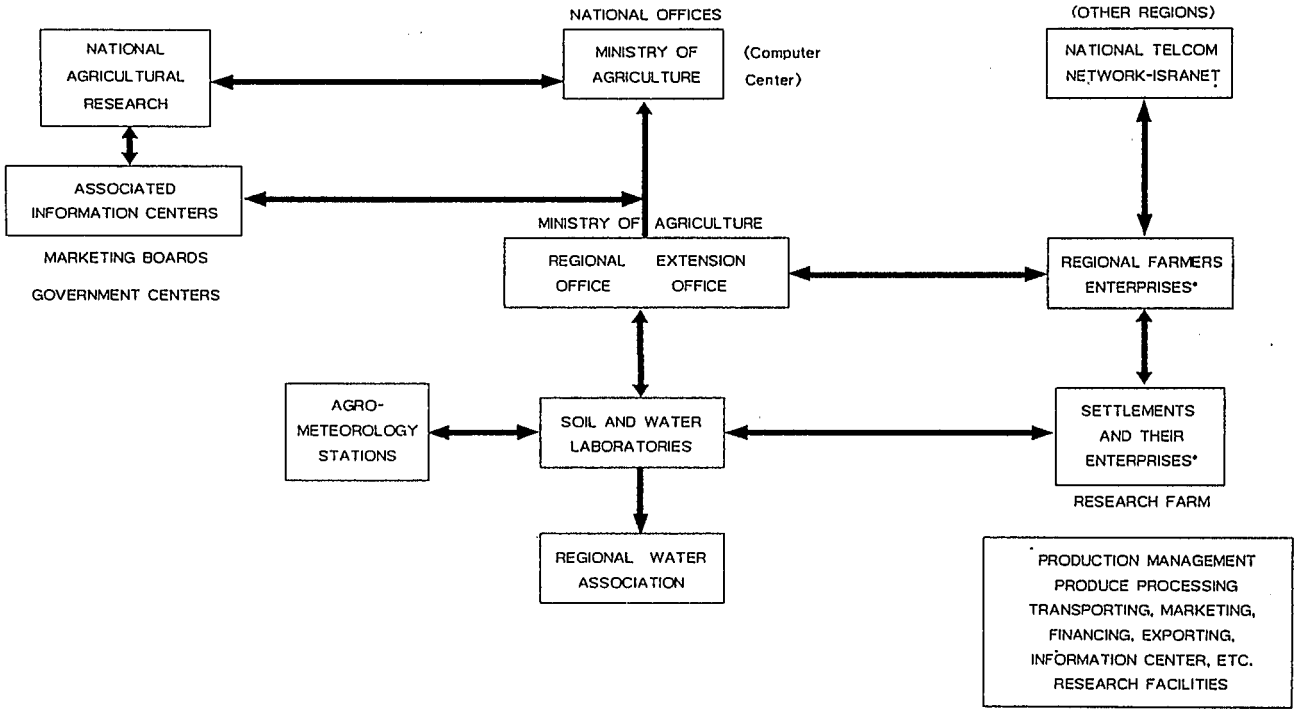

Figure 3
Regional Agricultural Production Information Infrastructure

operate, monitor and evaluate irrigation, water use and more. The systems are constantly being upgraded, integrated and consequently fit the definition of a 'new' (see Table 1) agricultural sector product. A unique feature of this trend is intimate farmer involvement as a source of innovation and development.

The Figures 2 and 3 illustrate the integration of these systems on the agribusiness level; individual farmers can have their products processed via a regional facility (sorted, packed, processed, etc.) with the information-processing involved being vertically integrated. Participants today include mainly, but not exclusively, the larger farms (kibbutz farms). The current trend is to tighten information integration, streamline data collection and knowledge management (to integrate, for example, production on and from the farm to the retailer's shelf). There are at present 10 such systems in Israel operating on a regional basis, with many others operating at lower levels, such as small regional cooperatives, production facilities or services.

On an aggregated national level there are various national systems such as a National Dairy Herd Book, an Artificial Dairy Insemination service and system operators such as Marketing Boards, Agricultural-input Services, Agricultural Extension and National (with Regional) Agricultural Research Institutes. These and others provide relevant information, information management facilities and link-ups between national and international sources of information. They are also involved in the upgrading of these systems and development of utilization methodology. Farmer participation is the major motivating factor in this process.

Knowledge generation and information management capability trends

Implementation of Agro Informatics in Israel is accompanied by research in agricultural production. To be effective in the long run, know-how must be supported by know-why. Production models, knowledge-bases and simulation capabilities are but some of the tools in the modern farmers' toolbox now under development. Farmer proficiency a prerequisite for using them. This calls for information-literate producers, an educational system capable of producing them, knowledge management and 'getting computers to do what we want them to do rather than (our) being confined to what they can do' (The Economist, 1990). The trends and demand for all of these are well defined, but difficult to realize. Expert Systems, Knowledge Based DSS, Plant Models, etc. as solutions had - and have - a strong appeal. In Israel they are in their initial stages of development and implementation. They command a disproportionate share of development resources, since they seem irresistable, attractive and a logical solution to computer support-capability for production purposes. Currently their contribution can be identified in better management of information, maturing farm management software, more rational production methodology and evaluation. Specific examples are: potato and evergreen fruit production models, diary cow evaluation, fruit tree (citrus) performance, avocado stock-variability monitoring, indoor facility environment control, broiler production- optimization schedules and water system management. Two information dissemination systems for farmers are in the process of implementation (with more than a thousand subscribers); hopefully to be operational and widespread when the above knowledge systems become available (knowledge systems are the limiting factor, not technology). The rural education system