IT-policy for Agriculture, Nature Management and Fisheries

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Introduction

Ten years ago information technology became a main plank in the national Science and Technology policy in the Netherlands as well in other countries. In the Netherlands agriculture was one of the areas which got special focus. In my paper I will give a global overview of activities, results and the follow-up after this period. Furthermore, I will pay attention to the future IT-policy and international cooperation. Thereby I make use of the results of an EU-sponsored workshop, held in Wageningen 22-23 March 1994. The summary of the results of this workshop is the second part of my paper.

INformatics Stimulating Plan (INSP)

In 1984 the Ministry of Agriculture, Nature Management and Fisheries decided in close cooperation with the 3 farmers' organisations to participate in the national INformatics Stimulation Plan (INSP) together with the Ministry of Economic Affairs and the Ministry of Science and Education. The application of information technology is stimulated for the benefit of agriculture as such, as to improve the knowledge infrastructure: research, education and extension.

In the INSP-period (1985-1991) several initiatives of the farmers' organisations were subsidized by the government, which aimed to guarantee a coherent, innovative, user-friendly and profitable use of information technology (IT) from the farmers' viewpoint:

- projects of research, extension and farmers to develop management information and advice systems;
- pilot projects for videotex and electronic with respect to the communication between the farmers, industry and services (financial, quality control, extension, etc.);
- development of information models for the several branches of agricultural operation;
- establishing branch organisations to stimulate, coordinate and direct these activities.

These activities have contributed to a lot of new products and expertise, broad awareness of the importance of IT in the long term and a good infrastructure (standards, branche organisations, network). However, the use of PCs for farm management was still at a low level (5%).

For the entire INSP-period the government, farmers and agribusiness invested approximately Dfl. 75 million.

During the INSP-period attention was paid to the improvement of IT-facilities within research, education and extension. All research institutes and Wageningen Agricultural University were connected to the national R&D-data-communication-network (SURFnet). The computerfacilities and the development of software for internal use at the schools of vocational edcuation and extension services received an impulse.

Follow-up

After the INSP-period the IT-policy of the government changed. IT-activities are now integrated as much as possible in regular subsidies, R&D programs and activities of extension services, schools and the university. The government subsidizes the Agricultural Telematics Centre (ATC), which has taken over the activities of the branch organisations. ATC is responsible for the maintenance and further development of the information models and other standards. ATC is also a platform for coordination. It takes the lead in the development of a long-term IT-policy for agriculture. A status-report (IT in agriculture) and a policy plan for 1994-1997 have been

published recently. At the moment 10% of the farmers are using PCs for management and communication. Several network initiatives have been taken over by a private enterprise, which delivers network services to the agribusiness and farmers.

With respect to research and education the development and use of networks is still an important issue. The SURF-network has been improved in capacity (2 Mb). Further improvement is planned. In recent years several projects dealing with better accessibility and dissemination of scientific knowledge were subsidized. This means that there is attention for the methods/practice within research: modelling, good practices for software development and maintenance, as there is attention for pilot projects for "publication": databanks, CD-I, etc.

Future policy

At the moment the Ministry is in the process of developing the science and technology policy for 1995-1998. IT will be one of the main planks, but of an infrastructure nature. IT is more and more becoming more a useful "tool" for the Ministry itself (forecasting, monitoring, etc.) as well as for the several policy areas: agribusiness, nature management, recreation, etc. A relevant contribution of IT to the realisation of the priorities of the Ministry, may be expected: a competitive agribusiness, a vital rural area and an effective and efficient knowledge infrastructure. Enough reasons for an active government policy.

The IT-policy will focus on stimulating and guaranteeing a good use of IT. Starting points are the challenges in the general policy (crop protection, environment, rural development, etc.) and the possible contribution of IT. On the other hand, attention should be paid to further development of IT and communication facilities (Information and Communication Technology; IC&T) as such as to the measures to guarantee a good dissemination.

The EU-White-Paper deals with the chances and consequences of this widespread dissemination of IC&T: the transition to an information society and among otherthings the importance of the development of "electronic highways". This infrastructure will create new and enormous possibilities for information and knowledge management. Distant learning, knowledge-based-systems, databanks, better communication/cooperation between research groups, electronic publishing will become more and more important in the coming years.

International cooperation in the area of science and technology is of growing importance. This should also include IC&T. In a recent IT-workshop in Wageningen, sponsored by the EU, there was a wide consensus between the representatives of the several EU-countries on the role of IC&T and the need for international cooperation. The IC&T-policy of the (inter)national government will be to facilitate and selectively stimulate new developments.

The summary of the results of the workshop was published June 1994 by Udink ten Cate et al. and is presented in the next section of this paper. A complete report on the workshop is being prepared and will be published soon.

Commission of the European Communities

Workshop on ICT

Information and Communication Technology in Agriculture

Summary with conclusions and recommendations

The CEC expert workshop was held in Wageningen 22-23 March 1994. A complete report on the workshop is being elaborated and will be published soon.

October 1994

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MANAGEMENT SUMMARY

The challenges to present-day European Agriculture are many and serious and may be summarized in a need for comprehensive changes to maintain sustainable agriculture in a broad sense. Five main challenges can be identified (box 1).

Box 1: Main Challanenges for Agriculture
- integration of agriculture and the environment;
- overproduction concerning certain products;
- reduction of production costs;
- product diversification and product quality to meet consumers' preferences;
- land use and rural development.

Meeting these challenges requires improved planning, managing, monitoring, control and analysis of production in existing technologies and farming systems as well as the development of new technologies and farming systems. For Information and Communication Technology (ICT) it was concluded that:
- ICT is a key enabling factor for meeting the five challenges above in practice, this being valid at the farm management level as well as at the level of the agro-industry;
- ICT is a critical success factor for conducting research relevant for these developments;
- ICT is essential for new developments in changing the logistics of the physical product chain, the value added aspects of the product chain and the knowledge chain in agriculture and the agro-industry.

Relevant Informatics areas for ICT application in agriculture can be found in box 2 *(full explanation section 7)*.

Box 2: Informatics in Agriculture
- image processing/pattern recognition;
- decision support systems/knowledge based systems;
- control;
- robotics and tracking;
- databases and information systems;
- logistics and chain management;
- software development, standards and simulation;
- geographical information systems.

It was further concluded that:
- application of ICT facilitates more timely and accurate applications of inputs, leading to a reduction of production costs and of environmental side-effects and facilitating precision farming;
- new technological thrusts in fields such as data acquisition, (bio)sensors, image processing and knowledge-based models for decision support as well as in simulation methodologies will be of great benefit to the agricultural sector;
- information overflow is a danger, which must be addressed, and that agricultural research plays a major role for suitable filtering, interpretation and presentation of data;
- ICT is an essential tool for agricultural research in analyzing, developing and implementing farm management systems suited for rapid adaptation to new challenges;
- some of the bottlenecks in the involvement of ICT in agriculture are: education; the need for standardization and coordination; and various organizational structures in research and development in the sector.

The CEC general research priorities concerning targeting, concertation and harmonization are recognized along with the specific priorities for the agricultural sector.

In order to meet the five challenges listed in box 1 and thereby fulfil the CEC priorities, it is recommended that the Specific Programme for Agriculture in the Fourth Framework Programme:
- gives high priorities to research and development of information and communication technology in agriculture;
- establishes links to the specific programme for information and technology with the agricultural sector as a very important application area for ICT.

Specific recommendations concerning target areas for research and development complete the report (see box 3).

Box 3: Recommended target areas for research (full explanation section 9).

- (bio) sensors in precision farming;
- process reproducibility at farm level;
- total quality management by tracking;
- and tracing over chains;
- software for post-harvest processing;
- automatic selecting and grading;
- chain management of food products;
- technologies for knowledge transfer.

Specific items were identified for international cooperation (box 4).

Box 4. Recommendations for international cooperation (full explanation section 9).

- standardization and discovery of the user-needs
- legal requirements, monitoring and EDP auditing
- product quality and certification standards
- improving quality and logistics chain
- "book of good ICT practices"
- standardization for trans-border statistical analysis

1. OBJECTIVES

The objectives of the workshop were to:

- identify future challenges to agriculture and agricultural research (including agro-industries and the environment);
- review trends in ICT relevant for agriculture;
- suggest recommendations for research priorities of the CEC specific research programme.

To this end, the workshop "ICT trends in agriculture" assembled 38 specialists representing both the research and agro-industry communities of the various EU countries. These specialists contributed to a number of scoring and technology assessment sessions. Brainstorm sessions concluded the workshop.

2. CHALLENGES TO AGRICULTURE

Challenges to European agriculture, agro-industry and the associated agricultural research were discussed using the following, five key sentences for grouping the many present, serious challenges:

- integration of agriculture and the environment;
- overproduction concerning certain products;
- reduction of production costs;
- product diversification and product quality to meet consumers preferences;
- land use and rural development.

Meeting these challenges requires improved:

- planning;
- managing;
- monitoring;
- control;
- analysis

of production in existing technologies and systems. Also the development is required of:

- new technologies and
- new farming systems.

These needs apply to: primary production at the farm; agro-industry; knowledge transfer in agriculture; land use and environment.

Likewise, there is a need for close coordination and linking of ICT research, agricultural research, advisory service, primary production with industry and policy making.

3. INFORMATICS

The term "informatics" was introduced to denote the theory and methodology needed for information handling within the complete data-chain. For agriculture this chain is defined by:

- registration and data-acquisition;
- storage of data and information;
- retrieval of data from external databases;
- processing, filtering and presentation of data;
- semi-automatic and automatic planning, regulation and control of physical and management processes, production lines and physical distribution;
- communication, dissemination and decision making.

4. COMPARITATIVE "STATE OF THE ART" REVIEW

A review was undertaken on the state of the art with respect to ICT in agriculture. This review was based on questionnaires filled in by one representative from each EU-country and a presentation at the Workshop. A similar review was performed in connection with a workshop in 1987.

The present review shows that:

- there are considerable differences between the EU-countries but certainly not too much for a successful collaboration and exchange (as exemplified by the EU-concerted action ENITA : European Network for Information Technology in Agriculture);
- the underlying basis (infrastructure) has been improved considerably since 1987, which opens possibilities for future development and wider use;
- many new tools and applications are available and have not yet found their full potential in agriculture;

- ICT is considered especially important with respect to issues like quality control and cost reduction in primary agricultural production.

5. ICT STRATEGIC THRUSTS ANALYSIS

Information and communication technology in general is technology driven, whereas applications of ICT in agriculture are driven by the challenges of agriculture and associated research.

Keeping this in mind, the workshop participants analyzed the potentials for agriculture of 22 listed strategic thrusts in ICT. The potentials were analyzed for three chain types relevant in agriculture and their associated actors (table 1).

Table 1. Chain types and associated actors in agriculture.

Chain type	**Actors**
product	*chain supplier*
	farmers
	industry
	distribution
	consumers
knowledge chain	*research and development*
	education
	extension
land use and environment	*policy and monitoring*
	planning and design
	management
	users (society)

The 22 strategic ICT thrusts were grouped in the following four groups (table 2):

Table 2. ICT thrusts

User computing	*massive storage,*
	human factoring,
	knowledge software and AI
Professional computing	*software development,*
	super computers
	intelligent documents
Networks	*EDI,*
	intelligent networks,
	optical fibres
Control and robotics	*automatic identification,*
	control systems
	image processing,
	intelligent sensors
	robotics

A ranking of significance was given to each of the 22 x 12 combinations by the participants in the workshop. The exercise showed in broad terms:

- the largest direct influence of ICT thrusts with respect to applications is expected in the "knowledge chain" with the "product chain" in second place;
- of the ICT thrusts most influence is expected from the "user computing group" followed by the "professional computing group";
- the "control and robotics" group has a significant relation with the "product chain";
- of the specific ICT thrusts within the four groups "human factoring", "knowledge software" and "software development" were found to be very important methodological thrusts.

6. CEC PRIORITIES

CEC priorities relating to the Fourth Framework programme were discussed. The core priorities concerning targeting, concertation and harmonization were reflected with respect to the CEC priorities specific to the agricultural sector. This comprises:

- integrated production and processing chains;
- scaling-up and processing technologies;
- generic science and advance technologies for nutritious foods;
- agriculture, forestry and rural development.

It was concluded that informatics in agricultural production and in agricultural research is:

- a key enabling factor for meeting the five EU challenges in practice, this being valid at the farm management level as well as on the level of the agro-industry;
- a critical success factor for conducting research relevant for these developments;
- essential for new developments in changing the logistic product chain, the value added product chain and the knowledge chain in agriculture and the agro-industry.

7. THE ROLE OF INFORMATICS

ICT has been perceived in terms of informatics concerning applications within the field of agriculture. The following application area's of ICT have been identified as important in agriculture:

- image processing and pattern recognition;
- decision support systems and knowledge based systems;
- control;
- robotics and tracking;
- databases and information systems;
- logistics and chain management;
- software development, standards and simulation;
- geographical information systems.

The application area's "ICT-networks and high performance computing" and "human factors informatics" were considered to be of less importance.

8. MEETING THE FIVE CHALLENGES

ICT was recognized as a Critical Success Factor within each of the five challenges, with the following application area's being the most important:

- *Agriculture and the environment*
  Specific importance was given to the area's of Decision Support Systems and Knowledge Based Systems, Data Bases and Information Systems, And geographical Information Systems.
- *Overproduction concerning certain products*
  Importance was given to Decision Support Systems and Knowledge based Systems, and Data bases and Information Systems.
- *Reduction of production costs*
  Specific importance was given to decision Support Systems and Knowledge Based Systems, Control, Robotics and Tracking, Data bases and Information Systems, and Software development, Standards and Simulation.
- *Product diversification and product quality*
  Importance was given to Decision Support Systems and Knowledge Based Systems, and specific importance was given to Logistics, Chain Management and Quality Management Systems all along the production chain.
- *Land use and rural development*
  Specific importance was given to Geographical Information Systems and Image Processing and Pattern Recognition.

9. CRITICAL SUCCESS FACTORS WITHIN DOMAINS AND SPECIFIC EXAMPLES

The following four domains in the agricultural sector were discussed:

- farmers and suppliers;
- agribusiness;
- knowledge chain;
- land use and environment.

Important points relating to the application of informatics in the sector as a whole were identified:

- informatics can promote a "systems approach" in agricultural research, including interdisciplinary research;
- establishing an open knowledge chain including ICT research, agricultural research, advisory service and agricultural production will promote the adaption of new production methods and uptake of ICT in the sector;
- informatics and the production chain concept of ICT is a prerequisite for quality management systems in agriculture.

Specific recommendations concerning target areas for research and development are given in the report. Examples are:

- (bio)sensors play an crucial role in precision farming, which is aimed at using less inputs at the farm level thereby maintaining a certain output;
- process reproducibility at the farm level can be improved by appropriate sensors, control and decision making ICT systems;
- improved control and management at the farm level and in agro-industry is essential for total quality management - which itself requires product tracking and tracing over chains using ICT technology;
- post-harvest processing at the farm requires specific management and transaction software;
- selecting and grading calls for improved image processing and on-line decision making;
- chain management of food products in general requires ICT systems both at the inter-organizational level (transaction and distribution) and at the physical product flow level (product history and certification), and aggregated information is e.g. used for improved marketing;
- education, knowledge transfer and advisory services can be improved using knowledge based software, multimedia and databases: these technologies must be aimed at support and not at replacement.

Specific items were identified for international cooperation:

- standardization, discovery of user needs, user support for cost reduction at the level of farms and suppliers;
- legal requirements and decision support or expert systems for the environment and farming systems using monitoring and EDP-auditing (e.g. mineral bookkeeping);
- consumer/market oriented definition of quality standards and product certification in logistic chain management using product (history) identification technology and data storage;
- improving the quality and logistics chain by defining appropriate information and physical product flows;
- there should be a "book of good ICT practices" as far as software systems development is concerned both for scientific research and industrial development;
- for land use and the environment standardization of data types and of data exchange is considered to be vital -also with respect to trans-border statistical analysis.