

# **Management of Publicly Funded Agricultural Research**

(An Israeli ICT case study)

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## **Abstract**

Information and Communication Technologies (ICT) can make a major contribution to the management of publicly funded research in agriculture by improving the effectiveness of research activities, their results, their dissemination and eventual implementation. The Israeli ICT adoption case study outlines a combination of competitive, cost effective public R&D funding with public maintenance of scientific infrastructure. It details management specifics; human resource considerations; integration of funding sources and stakeholders; collaboration efficiencies and more. ICT adoption involved management changes, R&D constraint alleviation and maximizing research productivity.

Keywords: Public funding of research, Information and Communication Technologies, Agriculture, Technological innovation adoption.

## **1. Background**

“Support of Research Activity directed towards improvement of most forms of agricultural technology has long been recognized as a responsibility of the Public Sector, even in the most private-market oriented economies” Boyce and Evenson (1975). Ruttan, 1982 details agricultural research policy, the research review process and the role of the research administrator. This role includes knowledge acquiring and funding effective research via monitoring within an overall research utility function. The Chief Scientist of the Ministry of Agriculture in Israel is such a Research Administrator. Perspectives guiding the Research administrator are outlined by Boyce and Evenson, (1975) “implicitly presuming that research and extension are productive activities that contribute to the efficiency with which scarce resources are converted to agricultural products”. Grilliches (1958) quantitatively estimated the contribution of such research to farm productivity. Evenson and Kislev (1975) survey in detail and quantify this productivity in the context of investment in agricultural research and extension. Alston et al (1995) specifically indicate that “...in a time of tight government budgets research administrators are faced with the need to provide strong evidence that costs are justified by benefits”. Eyal (1996) quantified this benefit suggesting a positive return ratio of 1:2.5 for public funding of agricultural research. Earlier Kislev (1986) suggests a similar ratio. The contribution and impact of innovative Information and Communication Technologies (ICT) to R&D management is reviewed within these generalizations via the Israeli case study and the role of the Chief Scientist in the Israeli Ministry of Agriculture.

A general overview of agricultural research is presented by Pardey and Beintema (2001) accessible at [www.ifpri.org/pubs/fpr/fpr31.pdf](http://www.ifpri.org/pubs/fpr/fpr31.pdf). An additional history and review of agricultural research in general and in developing countries can be found in the FAO manual: “Management of agricultural research” [www.fao.org/sd/RTdirect/RTre0025.htm](http://www.fao.org/sd/RTdirect/RTre0025.htm); [www.fao.org/sd/RTdirect/RTan0004.htm](http://www.fao.org/sd/RTdirect/RTan0004.htm) and in the CIGAR Science Council review

accessible at [www.asti.cgiar.org/pdf/SfADSection05.pdf](http://www.asti.cgiar.org/pdf/SfADSection05.pdf). For an expanded review of agricultural research in Israel see Loebenstein and Putievsky (2007).

Public sector funding of advanced agricultural research and ICT supported research management is focused in this case study on “developed countries”. By definition these countries, in this context are characterized by capital intensive agriculture, utilizing modern technology, cutting edge science supported methodologies and minimal labor input. In order to achieve efficiency of public research in agriculture and attain its resulting productivity goals R&D management methodology employs uniquely complex interactions. This insight is universal. The interactions are dictated by extremely varied agricultural products and stakeholders. They range from environment maintenance to genetically modified crops, diverse research disciplines, various and heterogeneous stakeholders representing multiple and possibly conflicting interests and/or priorities with concerns and benefits spread over varying periods of time, regions and markets.

Traditional management methodology to manage R&D in agriculture was and is supported by use of basic Information and Communication Technologies (ICT) - skillfully adapted and employed to do “traditional” clerical chores. Innovative research management methodology supported by ICT involves coordinating interactive knowledge accessing, cross referencing and integration of ever expanding and varied data sets, real time client feedback of research results and product implementation, maintaining geographically-neutral collaboration, synchronizing long term goals with resource allocation priorities and much more. In some cases R&D management methodology and practice are even dictated by ICT specifics. Exploiting innovative ICT supported management practices can considerably improve the efficiency of research, research results, and their dissemination and eventually result implementation. This efficiency can be expressed via an increase in general agricultural productivity, product quality and technological progress - Levanon et al (2005). Additional economic benefits can be derived from commercialized, publicly funded/generated Intellectual Property Rights, agricultural products, increased production output, marketing and management methodology and more. In turn improved agricultural productivity contributes to rural viability and public welfare in general which justifies public funding of agricultural research beyond the direct benefit to agricultural producers. The importance of such public investment in ICT for agriculture was recognized at a recent conference of the European Federation of Information Technology in Agriculture (EFITA) Gelb, Parker (2005). The importance of incorporating ICT into the publicly funded research management procedures is universally recognized to the extent that specific programs are outlined for that purpose. An illuminating example is a program initiated by the Research Office for Research Information Management at the University of Sydney – detailed at [www.usyd.edu.au/ict/PMO/es/Projects/rm/index.shtml](http://www.usyd.edu.au/ict/PMO/es/Projects/rm/index.shtml). The purpose of the ICT initiative (Research Management Systems Project) was to promote the following:

- Improve accessing information, information management, reporting, analysis and enable assessment of quality and impact;
- Increase research income resulting from improved awareness of opportunities and income management;
- Reduce risk of data inaccuracy and improve data integrity;

- Ensure compatibility with future trends in Research Information Management, database, web and workflow technologies;
- Reduce costs by reducing manual processes, paperwork and system maintenance;
- Support end-to-end research management.

The specific project objectives were to:

- Redefine the business processes to adhere as far as possible to best practices including electronic workflow, e-records management, paper management;
- Conduct a gap analysis of the business requirements across the potential vendors and products;
- Rationalize the recommendation for the best-fit vendor and product;
- Implement the Research Management System without negative impact to business operations;
- Reduce data redundancy and manual data handling;
- Improve data security, confidentiality and privacy standards;
- Improve control and management of research financials;
- Improve technical platform to support open architecture and web based options;
- Reduce the number of disparate and adhoc systems across the University.

Agricultural R&D in the “developed countries” of the world is to a large extent a public strategic concern due to Agricultural R&D market inefficiencies and the reflection on the general public – economic and social. This is the result of the fact that the total of private benefits of all firms is smaller than the overall public benefits Alston, et al (1999). Consequently the investment in Agricultural R&D will be sub optimal without public sector funding. This market allocation inefficiency of funding for research has several causes. They include:

- The products of Agricultural R&D are usually within the public domain. Examples include an overall reduction of pesticide applications or long range planning criteria for using natural resources such as water and land, and many more. It is very difficult to patent the results of applied agricultural research and basic life sciences studies – a fact which deters private sector investments;
- Technological innovation in agriculture deteriorates agricultural terms of trade – namely lowering the farmer income from products and increasing the cost of inputs. It is the public that gains from this situation - better produce at lower prices and not the farming sector. In general since the public benefit is larger than the sum of benefits for the agricultural producers it stands to reason that it is within the public concern to sustain these trends;
- The agricultural producers are usually small and they cannot afford agricultural R&D. In this sense Agricultural R&D is in essence different from Industrial R&D carried out by firms that are the direct beneficiaries of the results.

This description does not ignore the fact that agribusinesses (Large scale farming and the Agricultural Inputs Industry) and concerns can be large. In fact to the extent that some of them have registered patents, “public” shareholders, multi-national scope, etc. In many cases they are innovative and ICT intensive. They however are not “public welfare” oriented and they do not invest generally in public domain research. They do fund

research in areas with potential Intellectual Property rights such as seeds, chemicals, fertilizers, etc. This is reflected in their share of the total funding of agricultural research but not to the extent that diminishes public funding dominance. A recent survey estimated their share in Israel at around 15% of the total agricultural R&D (Appendix A.)

The public sector funding of agricultural research has frequently resulted in the establishment of Governmental Research Institutes dedicated to agricultural research and complementing academic research institutes. The academic teaching entities (universities) do not have a binding commitment to agricultural research or to agricultural productivity. Basic agricultural research in various areas done in University Faculties of Agriculture may not even be relevant in the short term to current agricultural production. Examples include such "basic" agricultural research areas including theoretical genetics, bio-informatics, cell biology, molecular physics along with their "applicative" aspects such as improving plant varieties with spliced in genes, gene specific pesticides, etc.

A useful review of the Institutionalization process in general is presented in the FAO National Agricultural Research System Manual: [www.fao.org/sd/sdrr/rom\\_en.asp](http://www.fao.org/sd/sdrr/rom_en.asp). At [www.fao.org/sd/researchinstitutions/index.asp?lang=en](http://www.fao.org/sd/researchinstitutions/index.asp?lang=en) a listing of such Institutes can be found. It is important to note however that neither governmental nor academic research entities necessarily formulate national research priorities or monitor them and all the publicly funded agricultural research. In Israel the governmental Agricultural Research Organization (ARO), is recognized as one of the successful government agricultural research institutes with close collaboration with Universities. Both undertake publicly funded research on behalf of the Government. As outlined below it is however the Chief Scientist that decides the research priorities based on Government policies and supervises compliance to them. For a detailed review of the ARO see Loebenstein and Putievsky (2007).

For a review of Israel's agricultural sector and research organizations see [www.moag.gov.il/documents/760agri.pdf](http://www.moag.gov.il/documents/760agri.pdf), Levanon et al (2005) and Appendix A. The reviews illustrate the fact that Israel has a diversified and complex agricultural profile which provides Israel with a comparative advantage in agricultural products, the market place and in promoting agricultural related technological innovations. To be specific Israel's geographical and climate diversity result in Israel becoming a producer of a wide variety of products and a testing ground for innovative technology, innovations and novel/niche products for export. To sustain this advantage it is essential to maintain wide and comprehensive research capabilities able to address unique problems in the various areas of production and marketing with minimal lead times till implementation of research results. This dictate is similar to that confronting other countries. In most, but not all of them there are large agricultural sectors and consumer bases to support necessary agricultural research. The viability of the agricultural sector is consequently less dependant on exporting their products.

Israeli farmers and their representative organizations participate in funding the publicly funded agricultural research. Their funding participation is facilitated via fees levied by statutory marketing boards on marketed produce and regional funding by grower associations. Their priority choices are expressed in joint committees which allocate the "Public" funds according to overall needs and agreed criteria. The current composition of

the committees is a three way partnership – farmers, extension and researchers – each in turn being a source of innovation, stakeholder and end user.

This framework is quite similar to the funding allocation practice in the US and Western Europe. Gelb Kislev (1982) evaluated the impact of farmers within this framework by detailing a series of committee allocations and the farmer’s point of view:

*“Agricultural research is mostly a public undertaking. In Israel, as in many other countries, farmers participate in the finance of research through taxes imposed by farm organizations on the marketed products. Farmer contribution ranges from 8% of research outlay in tomatoes to 79% in cotton. Strength of organization and ease of collection were the major factors affecting this share. In general, as inflation eroded the real value of government's finance, the farmers increased their share.*

*Representatives of farmers' organization participate in the bodies that approve grants to proposed research projects. It was found that the higher the share of farmers' finance the larger the part of short-term research directed at immediate outcomes and the smaller the part of long-term, more basic research. The tendency of the farmers to prefer short-term, applicable research may reflect both their familiarity with practical problems and a comparatively high degree of risk aversion. It is not clear how farmers' participation in the direction of research, which is based on their financial contribution, affects the efficiency of resource allocation to the agricultural science”.*

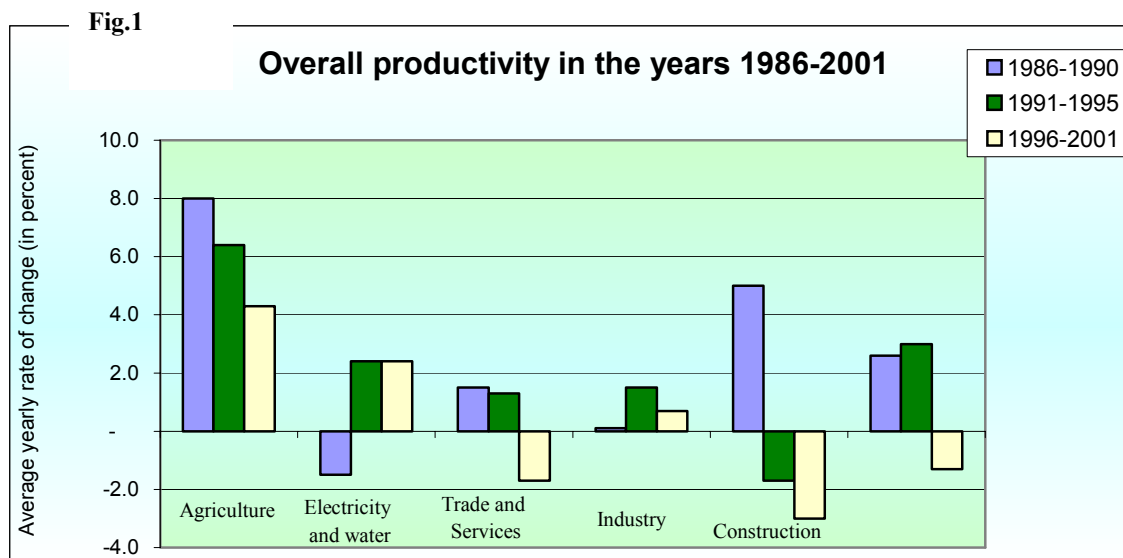
Economic evaluation of public funding of agricultural research in general indicates a high rate of return Evenson and Kislev (1975). A detailed review of Israeli funding for agricultural research with overall benefit resulting from it and its breakdown is presented in Levanon et al (2005). Overall benefit was calculated using a Cobb-Douglas production function with labor and capital weighted .60 and .40 respectively.

Table 1. Overall benefit resulting from research

Crop	Innovative Technology	Change %			Overall benefit
		Output	Labor	Capital	
Loquat	Early ripening	64.7	0.0	20.0	56.7
Avocado	More trees per area unit	77.0	45.2	61.1	25.4
Flowers	Sea transportation	14.6	0.0	0.0	14.6
Greenhouses	Roof cleaning	21.0	-14.3	29.6	17.8
Mushrooms	Agro technique	44.0	-5.0	16.1	40.6
Dairy	Economy of scale techniques	20.5	-20.0	5.3	30.9
Ornamental fish	Feeding management	32.3	12.0	4.0	23.5
Peanuts	Improved harvesting	30.4	-10.0	16.7	29.7

**Source:** <[www.science.moag.gov.il/frame-truma.html](http://www.science.moag.gov.il/frame-truma.html)>, Levanon et al (2005).

The review indicates that average annual increases in agricultural productivity ranged from 8% between 1986 till 1990, 6.4% from 1991 till 1995 and 4.7% between 1996 and 2001 see Fig. 1. These rates were higher than those of other sectors of the economy. This rate of change in productivity is due to rapid technological progress originating from research and development in agriculture. The Source of this data is the Bank of Israel, Research Department 1996, 2001 and Levanon et al (2005).



Agricultural research in Israel contributed to the viability and development of the rural sector and public welfare. The public as beneficiaries were provided with high quality and affordable agricultural produce and other public goods derived from agriculture. These included environmental preservation, adopting agricultural practice to livelihood in areas of national priorities – arid lands, frontiers and unique geography, an agricultural framework for high school education and rural viability. Agricultural innovations provided a basis for international scientific and economic collaboration, development of an agricultural input industry with profitable exports and additional employment. A brief summary of the R&D and funding structure is outlined in Appendix A.

## 2. The Role of the Chief Scientist

The role of the Israeli Chief Scientist in the management of publicly funded agricultural research was defined by a governmental decision. It designates the Chief Scientist as the scientific advisor to the Ministry of Agriculture, its Minister and its Director General. The Chief Scientist is responsible to define the agricultural research priorities as guided by the Ministry's goals. These reflect national priorities. In detail "The government attaches special importance to the role of Chief Scientist in all of the Government Ministries that have a Chief Scientist. The Chief Scientist has to be a senior scientist recognized and accepted by the scientific community, active as a researcher in areas relevant to the ministry's activities with authority and judgment abilities in areas of his competence. The Chief Scientist will have the ability to coordinate between the scientific community, other R&D entities, farmers and other sectors."

As soon as the Ministry of Agriculture outlines the annual priorities the Chief Scientist is expected to identify the knowledge gaps that need to be addressed in order to achieve the Ministry goals. Bridging these gaps is translated by the Chief Scientist into the research goals to be achieved by the research funded by the Ministry. There are alternatives as well which the Chief Scientist is expected to identify. The Chief Scientist accordingly allocates the Ministry originating research funds (budgets) in a manner that will enable to

attain the Ministry designated goals. A long term overall research outline is defined and updated yearly. It is important to note that funding agricultural research is not limited to the public domain - around 15% of agricultural research is not publicly funded. The Chief Scientist's overview of all research priorities uniquely contributes to overall synchronization. Whereas the public funding procedures provides guidelines for public research priorities competitive bidding for allocation of public funds ensures effective allocation of resources – funds and research prowess. The Chief Scientist provides an impartial authority to guarantee this smooth interaction. The details of the system and ICT's contribution follow.

### **3. Detailing Information and Communication Technologies' contribution**

ICT are today a major tool in managing public research – they are detailed below in context of the various stages of managing research. They are integrated in all stages of research implementation and the reporting of research results to a wide range of users and beneficiaries. ICT supported teams led by the Chief Scientist facilitate the research program in the following general stages:

- Finalizing the research priorities and preparing the Call for research proposals;
- Collecting the proposals from scientists, regional research entities, regional councils, various organizations and individuals:
- Monitoring the proposals and preparing them for evaluation;
- Consolidating proposal evaluations for allocation decision;
- Budgeting funds based on priorities and Benefit/Cost ratios;
- Preparing the contracting of the approved proposals with necessary guidelines;
- Allocating funds and financing the approved proposals;
- Follow up of ongoing research to ensure compliance with its approved program;
- Evaluation of research results and preparation of further professional recommendations including possible updating and/or continuation research proposals;

In detail the process involves the following sequence:

3.1 Formulation of research goals according to identified knowledge gaps – with participation of scientists, extension, farmers, economists, marketing professionals and others. These are cross checked against available results from various sources;

3.2 A call for participation – requests for submission of research proposals by “all involved in agricultural research in Israel” including researchers from ARO, Universities, regional research entities, regional councils and others. At present the calls are available electronically;

3.3 Processing of applications and proposals (several hundred a year) and their inclusion in the relevant information data base;

3.4 Evaluation of the proposals by a two stage process:

First stage – assessment of the potential contribution to Israeli agriculture

Second stage – assessment of the scientific merit and success probability including ex - ante economic analysis.

The evaluation process involves hundreds of professionals: farmers, extension, researchers, economists, planners, market professionals and others. The process

eventually prioritizes research proposals eligible for public funding. ICT provides the Chief Scientist with tools to independently follow all the above stages of the evaluation process and in turn optimize the review recommendations in terms of expected agricultural productivity increase potential. It should be noted that the Chief Scientist's funding is mainly directed toward "applicative research" with "basic research" done mainly via the academic entities. Funding for basic research is allocated based mainly on scientific excellence. Funding for applicative research involves a multitude of considerations. These include economic viability, innovativeness, contribution to the public welfare, employment and sector enhancement, market comparative advantages, effective (scarce) natural resource utilization, and more. ICT supported evaluation is indispensable in incorporating and integrating these considerations

3.5 Managing implementation of the approved research proposals in the various venues which includes:

- final approval of the chosen proposals and funding them;
- follow up during the research duration including decision making, changes and termination mid study if and when necessary. The procedure involves professional monitoring of the written scientific and fiscal annual reports for each approved proposal till its completion – in addition to ongoing verbal updating and frontal review by professional panels and periodic scientific inspections at the research sites;
- follow up of the dissemination of the research results to all relevant "clients" and their implementation.

This ongoing process is closely monitored with innovative ICT. Allocation is decided competitively – a process facilitated by ICT. The unique contribution of ICT in this case over the traditional pencil and paper reporting is focused on real time follow up, ongoing iteration of economic alternatives and their consideration.

3.6 Managing the reporting of interim and final research results – verbally and formally by dissemination of the results to end users – farmers via the extension service, extension, researchers, others and publication. This process and its transparency is a major beneficiary of ICT facilities.

In all these stages ICT plays a critical role by enabling the system to involve large numbers of individuals in their various diverse capacities and exposing them to large data bases. In turn ICT facilitates dissemination of the research results to the various potential beneficiaries. In this case they include agricultural producers, extension, follow up research, agricultural services and international collaborators. This collaboration has become a mainstay of international collaboration as well – mainly sharing initiatives, information, joint research activities and their results.

King and Scholar (1997) commented on the efficiency and benefits of the Israeli procedures. They combine competitive evaluation and acceptance of research proposals with and without institutional funding of the national scientific infrastructure. They lauded the achievements of the multiple public and private funding sources: "Israel provides an excellent example of cost effective research", and "Israel shows quite dramatically that a system can intertwine an intramural research with competitive grant

project funding to maximize research productivity and provide direction towards predetermined national objectives." ICT were dominant in enabling effective decision-making based on public priorities, monitoring their implementation and disseminating the results.

#### **4. Research management changes resulting from ICT Adoption**

The following lists the changes and/or improvements enabled by ICT Adoption:

4.1 On line and real time addressing of large audiences efficiently via the Chief Scientist's Portal and individual e-mail contacts. Both in turn facilitate online accessing of relevant information and individual contacts as and when required;

4.2 Computerized handling of the research proposals enable improved and efficient decision making. The proposals can be efficiently categorized according to decision making criteria. These include crop/subject differentiation, spatial orientation, innovation category, scientific discipline, required research duration till implementation, scientific and agricultural innovativeness, economic contribution, and more. In this case avoidance of duplication, repetition and details of international study results availability are a prime benefit in efficient funding, human capital allocation and their management.

4.3 Innovative dissemination technologies shorten end user result accessing lead times; enable provision of more detailed and varied information, feedback and interpersonal interactions. These in turn provide the Chief Scientist with an enhanced ability to monitor and manage research in process and interact with the researchers.

4.4 An unsuccessful research project is not necessarily a failure. The knowledge gleaned from the research might be useful in its own right and as a significant input to other research. The most prevalent case is avoiding repetition of mistakes. In terms of efficiently managing public funds ICT supported "organizational memory" effectively ensures avoiding allocation of "soft money" (funding of research programs) just for supporting "hard money" (existing scientific infrastructure and personnel). Making "unsuccessful results from the past" common knowledge saves a lot of time and resources. The existing ICT supported overview contributes to this aspect.

4.5 Allocation of human capital is a delicate issue. ICT enables the Chief Scientist to anticipate human capital deficiencies, among others, in the various stages of various studies and input the necessary support. The ICT supported proposal-evaluation may indicate the need of a multidisciplinary approach to the extent of being a critical success factor – again enabling the Chief Scientist to initiate remedial measures.

4.6 ICT potentially flattens various hierarchies – among them information accessing. The various evaluation procedures described above employs hundreds of scientists and other agricultural professionals. These ICT supported procedures provide access to all information available and relevant to proposal evaluation and monitoring. This has yet to be perfected, as detailed below, with facilities for providing access to all involved and concerned.

## **5. Existing ICT supported tools and ICT being developed**

It is impossible to imagine managing the Israeli public research funding system without the extensive and advanced ICT described above. They include

5.1 An Internet site which enables interactive communication with a large and varied users. The site provides proposal and report forms with instructions how to use them, general background material describing Israeli agricultural State of the Art which includes “crop pages” with specific data and economical evaluation for many of Israel’s important crops. In addition the site provides calls for research proposals, addresses of researchers, institutions, Agricultural organizations, sources of information and lists of relevant contacts.

5.2 A Decision Support System (DSS) for managing and supervising research implementation. In addition to continual data input the DSS itself is constantly upgraded as needed insuring compatibility with the specifics of the various research projects. This facilitates the ongoing management decision processes, management of the allocated funds and supervision of subject matter content of the research in progress.

5.3 A Knowledge Base Management System (KBS) which enables decision makers ongoing access to information while evaluating research proposals, monitoring the implementation and assessing the benefits from the research results.

5.4 An advanced review and documentation center.

5.5 From a management point of view various operative ICT have yet to be incorporated. One example is a paperless environment with electronic forms. This framework will serve the whole decision making process before proposal selection and later while monitoring the approved projects. The main constraints in realizing this plan are various legal aspects involving commitments by the researchers, their respective institutes/organizations and authorities. Solving these will enable realizing this planned enhanced system efficiency.

5.6 An elaborate formal economic evaluation framework – which includes multiple interactive economic evaluations and comparison of research alternatives and results.

## **6. ICT and interaction with research beneficiaries**

It is hard to exaggerate the importance of ICT in enabling interaction with the End users, beneficiaries, the public at large and international collaborators. As outlined above farmer participation in deciding and funding the research priorities enables a “bottom up” contribution to a traditional “top down” public funding allocation framework. Participants include the research personnel (which in some cases can be the farmers or other beneficiaries), the Institutes funding or contracting the studies, those involved in the funding allocation process, endusers and the public at large. ICT facilitates real time access to information in addition to:

6.1 the rate of knowledge and innovation transmission – with the Chief Scientist’s site and e-mail leading the way;

6.2 ICT enabled public accessibility to available information – with identified demands from publicly funded research that were larger and more varied than formerly assumed. Experience indicates that previously unassociated individuals joined the Chief Scientist’s clientele following publications on the Chief Scientist’s site.

6.3 Real time response to comments, questions and suggestions from the public in general in addition to specifically involved research participants. This enables their incorporation in Chief Scientist priority decisions and inclusion in ongoing interim benefits.

## **7. Constraints in adopting ICT**

Four categories of problems became urgent issues in effectively adopting ICT for management of publicly funded research. They have yet to be routinely integrated in research funding management methodology.

The first was a major problem in collaboration with unstructured frameworks such as regional or random contributions from farmer organizations. The problems were a result of the incompatibility of various organizational cultures and structures. Integrating scrutinized public funding procedures with farmer requests unhindered by formal and structured decision making frameworks occasionally made the whole research funding process cumbersome, ineffective and counterproductive. ICT went a long way to smooth out such problems by facilitating collaboration – sometimes under intense short term problem solving necessities.

The second was ICT illiteracy – within the various aspects of digital divides. They are not limited to “have – have not” and how to use a “computer/internet/computer supported device” considerations. They include how to use ICT when accessible, how to integrate ICT in the production chain, how to avoid information overload, “computer made” mistakes, farmer “age” constraints, unnecessary “market push” hardware/software updates, and more.

The third was the inflexibility of government formalities imposed on Ministry funding and activities. A national Information Society (IS) initiative adapting government procedures to ICT supported programs is now in place. In the long run these constraints should be insignificant.

The fourth was adherence to international procedures, regulations and collaboration agreements – all facilitated to a great extent by adoption of ICT supported procedures.

## **8. The Management Model**

As outlined above the following benefits are the result of the ICT component of the Israeli case study management-model and details:

- The overall ICT supported centralized public funding management enables consolidation of team efforts under the Chief Scientist’s umbrella;
- The Chief Scientist ICT facilities enable a follow up of the allocation match up of scarce human capital with Ministry priorities and subsequently identification of future human capital needs;

- The various ICT supported aspects of this model enable a global approach to need priorities, resources and goal attainment;
- The ICT supported management model enables integrating research efforts, research result dissemination, end user feedback with overall public welfare;
- The Chief Scientist monitored research structure hierarchy is “flattened” by ICT resulting in more efficient research results implementation;
- ICT enables the Chief Scientist to maintain an impartial mediating function between research beneficiaries as a source of research funding and public interest funding;
- The Chief Scientist overview can identify ICT subject matter research needs and priorities – an issue with major potential cost overruns and missed opportunities;
- The Chief Scientist model is a focal point for identifying ICT spillover opportunities.

### **9. ICT supported contacts with scientists abroad**

Within Israel all the above is Hebrew specific with the Chief Scientist’s site being accessible in Hebrew worldwide. This in turn however is a constraint for international cooperation and collaboration. This impediment is characteristic of all independent national governmental research in Israel and other non English reporting countries. Use of mainly English is however standard for bi-national, multi-national and internationally funded research programs included in the Israeli agricultural research programs. With this in mind ICT can make a major contribution to making the Chief Scientist’s site at least bi-lingual. This can go a long way to enhance international collaboration with Israel’s agricultural research. In addition “Automatic” translations are getting better by the day.

### **Summary**

The contribution of ICT to the management of publicly funded agricultural research can be summarized in the following points:

- Accurate monitoring of fund allocation to specific studies, progress and use of funds for each study and reporting of the research results;
- Efficient fund allocation re Ministry goals and priorities via a monitored competitive comparison of proposals;
- Shorter lead times for implementing research results;
- Improved evaluation of study proposals vis a vis earlier studies in Israel and international research to avoid duplication and ensure study relevance;
- Real time follow up of study progress with improved transparency;
- Efficient collation of study proposals and their evaluation for economic viability, compatibility with Ministry priorities, scientific relevance, public sector interest and available funds;
- Improved human interaction between regional, national and international study participants;
- End user access to information re study proposals, funding allocation and study progress

- In service communication efficiency – researchers, extension, farmers and agricultural sector service providers;
- Improved collaboration and research integration with regional based research and ongoing field trials;
- Improved collaboration between the various sources of “public funds” – government, farmers, consumer groups, etc;
- Interaction with the various partners of the rural sector.

ICT supported issues yet to be improved include the following:

- Unified funding reporting and monitoring criteria;
- Faster and more efficient communication and software facilities;
- In service computer literacy competence;
- National ICT standardization;
- Improved internal study follow up and result implementation procedures;
- Improved real time research follow up transparency – mainly for end users – with a provision for suitable cautionary advice.

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## **Appendix A. Outline of Agricultural Research and Development (R&D) in Israel**

Agricultural R&D in Israel is essentially publicly funded. The Ministry of Agriculture and Rural Development (MOARD) through the Chief Scientist's office plays a major role in allocating these funds based on priorities synchronized with Ministry guided national goals. The Chief Scientist's Bureau is situated within the Ministry, headed by the Chief Scientist who reports directly to the Minister. Its role is to annually determine define the national research goals and specific objectives according to the Ministry's policy. The Agricultural Research Organization (ARO) is the main research body in Israel - being the recipient of about 60% of all public R&D funds. It is an extension of the Ministry which to a large extent funds and operates the nation-wide Agricultural Extension Service (SHAHAM) as well. The main role of the Extension Service is to disseminate research results, initiate transfer of knowledge and adoption of technological innovations. SHAHAM is actively involved in applied research – field trials, feedback to the formal research programs, identification of knowledge gaps and feedback from farmers to the Ministry. Shaham experts participate in the development and implementation stages of Agricultural R&D at national and regional levels.

The public funding of Agricultural R&D can be divided into two categories:

- a. Infrastructure costs including ARO and SHAHAM salaries.
- b. Research project budgets

Allocation of the publicly funded agricultural research budgets in Israel is basically competitive, and open to the entire scientific community and the public.

The main publicly competitive funding sources available today are:

1. The Chief Scientist's Fund
2. Bi- and Multi-National Funds (US, EU, the Netherlands, etc.)
3. Funds allocated by the various national and regional farmers associations and the agricultural production and marketing boards.

The following are the main bodies carrying out agricultural research in Israel:

- a. The ARO (The Agricultural Research Organization alias The Volcani Center) which is a semi-autonomous extension of MOARD. Its mission is to carry out research in all fields of the agricultural production chain (FtoF – Farm to Fork) and animal husbandry (excluding veterinary and animal health research). The ARO is also responsible for the scientific management of all regional agricultural R&D (see below). The ARO is managed by a director with permanent, government employed, staff.
- b. The Kimron Veterinary Institute which is a semi-autonomous extension of MOARD. This institute is responsible for all public veterinary and animal health research and collaboration with the national Veterinary Services.
- c. Universities and other formal research institutes which include among others the Faculty of Agriculture of the Hebrew University of Jerusalem which carries out the main share of research carried out by the academic agricultural research institutions. Other

important ones are the Technion's Faculty of Agricultural engineering, Ben Gurion University's Institutes of Applied Research, the Blaustein Desert Research Institute, Tel Aviv University, and the Weitzman Institute of Science.

d. Regional R&D facilities which are mainly joint initiatives integrating farmer needs and activities through their regional councils with experts from MOARD (ARO and SHAHAM), the Jewish Agency, the Jewish National Fund (JNF) and commercial interests. Their significant role is to evaluate and implement formal research results, adapt them to the multitude of Israel's geographical conditions and promote viable agriculture in often disadvantaged peripheral regions of Israel, jump start and encourage local initiatives to alleviate knowledge gaps and shorten development timetables and integrate peripheral areas of national priority into the mainstream of current agro-technology and various markets.

e. Local, regional and national farmers' organizations contribute to the national funding mechanism in addition to their participation in the formal MOARD framework. Their R&D activities are undertaken mostly by the above institutes and the regional facilities. An in-depth review of their impact is outlined in Gelb, Kisleb 1982. In many cases their efforts are geared to solve short term problems.

f. Private and commercial R&D. These include farmer initiated field trials, "model (demonstration) farms", trial and "observation" plots and other variations of "trial and error" and innovation dissemination instruments.

Privately funded agricultural R&D is relative small compared in volume to other developed countries. On average it usually does not surpass funding more than 15% of all agricultural R&D. This has been changing due to increased exports of agricultural equipment and inputs with Intellectual Property rights protection. These include for example seeds, fertilizers, chemicals for plant and animal protection, irrigation equipment, ICT based software and hardware, plastics and more. Israel's comparative advantage as an "agricultural field testing laboratory" results in revenue justifying increased R&D investments in these areas. Investments sources include international companies and venture capital funds.

The Chief Scientist employs all the above individuals, their respective research infrastructures and services in various flexible combinations. Each and all are eligible for competitive funding applications.

The Chief Scientist's products are mainly public domain goods. They include among others:

- More efficient use of existing technologies, production methods and their marketing;
- Cheaper agricultural products and services;
- Cheaper agricultural inputs;
- New agricultural products and services;
- New agricultural production technologies;
- Methods for more efficient use of scarce natural resources;
- An improved agricultural research infrastructure