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Efficient Allocation of Water Resources among Competing Users: Economic, Environmental and Organizational Considerations

Jean-Philippe Terreaux, Mabel Tidball, J.M. Berland, J.A. Faby, G. Axelrad,
E. Feinerman

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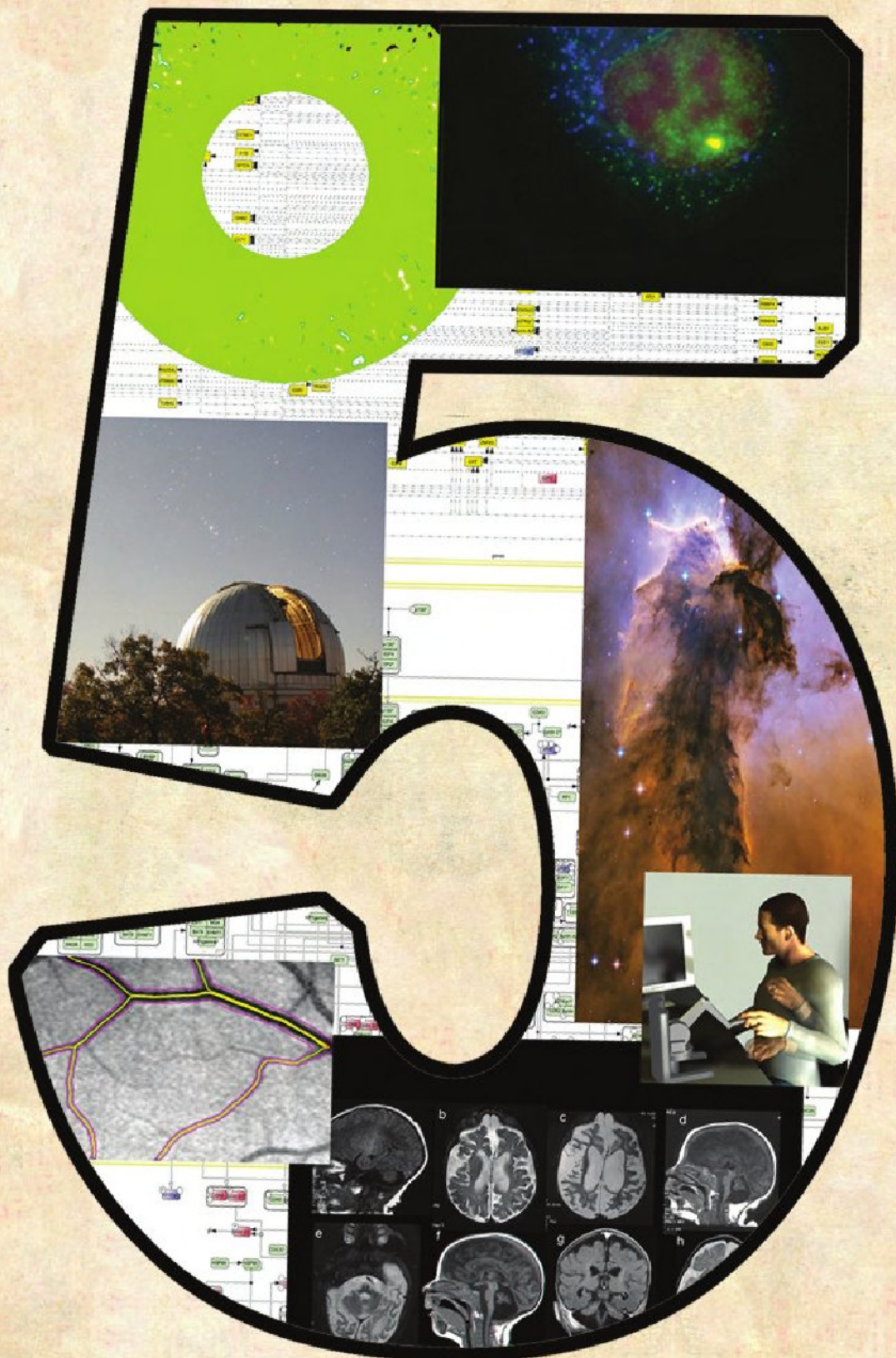
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YEARS OF THE FRENCH-ISRAELI HIGH COUNCIL FOR SCIENCE & TECHNOLOGY



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Directeur de la publication
Eric Seboun

Rédacteur en chef
David Steinboim

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Traductions en hébreu
Emmanuel Doubchak,
Dafna Lebowitz.

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Abonnements & Informations

Science & Technologie
AMBASSADE DE FRANCE EN ISRAËL
7 boulevard Rothschild
Tel Aviv 66881 - ISRAËL
Tél. : +972 (0)3 796 80 41
Fax : +972 (0)3 796 80 45

daguessh@ambfr-il.org
<http://fitscience.wordpress.com>

L'édito



La France est le 3^{ème} partenaire scientifique d'Israël, au coude à coude avec le Royaume-Uni et l'Italie, derrière les USA, en première position, et l'Allemagne en seconde position. Israël peut être un acteur important dans l'Union pour la Méditerranée (UPM), notamment dans les domaines de l'agronomie et de l'agriculture en zones arides, de l'eau, des énergies renouvelables ou de la recherche biomédicale.

Ce numéro de Daguessh-Science consacré aux 5 ans du Haut Conseil Franco-Israélien pour la Science et la Technologie (HCST) dresse le bilan de la coopération scientifique entre la France et Israël depuis la création du HCST en 2004. Plus de 120 projets de recherche en réseau (P2R) ont été financés entre 2004 et 2009 dans le cadre de 7 programmes : agronomie, astrophysique, bioinformatique, génétique humaine, imagerie biologique et biomédicale, mathématiques et neurosciences et robotique. Vingt projets, les plus emblématiques de ces programmes, sont présentés dans les pages qui suivent. Ils confirment la qualité de ces collaborations.

L'excellence scientifique de la France et d'Israël est internationalement reconnue. La France, comme état membre de l'Union Européenne (UE), et Israël, comme état associé, participent aux programmes cadres de l'UE. Leurs taux de réussite les placent dans le peloton de tête des pays de l'UE. Le renforcement de la coopération scientifique bilatérale, initié par le HCST, pourrait se poursuivre avec la création d'une fondation binationale pour la science. Dotée d'un comité scientifique et de moyens financiers renforcés, sa vocation serait de soutenir des projets de recherche binationaux ambitieux qui trouveraient, ensuite, leur épanouissement dans le cadre de l'UE ou de l'UPM.

Professeur Eric Seboun
Attaché pour la Science et la Technologie

רפת הינה שותפתה השלישית של ישראל בתחום המדע, וזאת כמעט בשווה עם בריטניה ואיטליה, ומאחורי ארצות הברית, המככבת במקום הראשון וגרמניה במקום השני. ישראל תוכל להוות גורם חשוב במסגרת איחוד מדינות הים התיכון, בייחוד בתחומי האגרונמיה והחקלאות באזורים צחיחים, בתחומי המים, האנרגיות המתחדשות או המחקר הביורפואי.

גיליון זה של דגש-סיינס, שהוא מוקדש לחמש שנות קיומה של המועצה העליונה הצרפתית ישראלית למדע ולטכנולוגיה, מציג את הסיכום של שיתוף הפעולה המדעי בין צרפת לישראל מימי הקמת המועצה העליונה בשנת 2004. יותר מ-120 פרויקטים ברשת (P2R) מומנו בין 2004 ו-2009 במסגרת שבע תוכניות: חקלאות, אסטרופיסיקה, ביו-מחשוב, גנטיקה אנושית, דימות ביולוגי וביורפואי, מתמטיקה ומדעי המוח ורובוטיקה. בדפים הבאים יוצגו לפניכם עשרים פרויקטים, שהם המיזמים הייצוגיים ביותר לתוכניות אלו, ומעידים על איכות שיתופי הפעולה האמורים.

רמתן המדעית המצויינת של צרפת ושל ישראל מוכרות בכל העולם. צרפת, בתור מדינה החברה באיחוד האירופי וישראל, בתור מדינה שותפה, משתתפות בתוכניות המסגרת של האיחוד האירופי. אחוזי ההצלחה מציבים אותן בקבוצה המובילה בין מדינות האיחוד האירופי. חיזוק שיתוף הפעולה המדעי הדו-צדדי, בו החלה המועצה העליונה עשוי להוביל להקמתה של קרן דו-לאומית למדע. בזכות מועצה מדעית ואמצעים פיננסיים מוגברים, יעלה בידה לתמוך במיזמי מחקר דו-לאומיים שאפתניים העשויים בהמשך לבוא לידי בטוי במסגרת האיחוד האירופי או איחוד מדינות הים התיכון.

פרופסור אריק סבון
הנספח למדע וטכנולוגיה

Efficient Allocation of Water Resources among Competing Users: Economic, Environmental and Organizational Considerations

Prof. Jean-Philippe Terreaux - PI (CEMAGREF*), Dr. Mabel Tidball (INRA*), Dr. Jean-Marc Berland, Dr. Jean-Antoine Faby (Office International de l'Eau - OIEau), France - * CEMAGREF and INRA are members of ALLENI

Dr. Gilad Axelrad - PI (D.G.A. Projects Ltd.), Prof. Eli Feinerman (The Hebrew University of Jerusalem), Israel

It is now well recognized that an efficient management of scarce water resources is crucial for guaranteeing the sustainability of agriculture in Israel and often in France. As competition with other sectors (urban, industrial and environmental) increases, Israeli farmers find themselves relying more and more on the utilisation of recycled and saline water. In France, an increase of irrigated areas in the last two decades has led in case of drought to severe degradation of the environment and to inefficient administrative banning on water uses. Thus new policies and approaches need to be designed to improve water management strategies.

Our principal objective was for both countries to evaluate the consequences of new alternatives for the allocation of this scarce resource, in order to guarantee economically efficient water sharing subject to several environmental constraints. Through this cooperation, we shared both theoretical tools (mathematical programming, mechanism design, game theory) and knowledge of the practical difficulties in water sharing in tense conditions.

Of course we based our work on the relevant state of the art literature, especially the literature that deals with water pricing practices under uncertain conditions and asymmetric information. We developed and implemented agro-economics models which describe the economic, environmental and organizational aspects involved in sharing different types of water (i.e., fresh, recycled, etc.) by the agricultural sector (with different types of irrigated cultures and crop mixes), the environmental sector, and the urban and industrial sectors, at the regional or water-basin levels. The models evaluate and compare several schemes of cost and profit allocations among the economic entities

involved: (i) direct negotiation by utilizing a mechanism design model; (ii) allocation via an agreed upon objective/neutral middleman who uses different approaches from game theory, and (iii) allocation via an adequate pricing system.

In addition to our cooperation on the definition of problems and model formulation, we had to adapt our models to the local conditions. For the Israeli part, we determined the optimal crop mix and the optimal allocation of the limited (fresh and recycled) water and land resources among all potential water users. The selected area (the Sharon region in central Israel) includes four economic entities: a city (the wastewater producer), two groups of farmers and a river authority. The model suggests that all economic entities will gain from cooperation in the water arena: the farmers will increase their irrigated areas and benefits, and the river authority will increase its stream flow and environmental benefits. Since wastewater is "bad" for the city and "good" for its consumers, the city's utility will increase from a paid transfer of recycled water to the latter.

In France, we studied an original pricing scheme aiming at the improvement of the ecological state in the river, by guaranteeing a minimum water flow and an increase in farmer's profit so that they would accept to adopt such a pricing system, while a constraint was the budget equilibrium of the water user association. Our results are very encouraging, since we see that locally there is real demand for such theoretical and analytical results in order to accompany the ad hoc tentative essays of one water user association. Practically too, we show that the economic efficiency of the agricultural water may be considerably enhanced, while the environmental conditions may be improved, with a pricing system that field studies showed acceptable.

We discussed the difficulties involved in implementing our models in our respective countries while taking into consideration the current experiences and possible solutions currently applied in both. This cooperation allowed a participation in other research projects (we thank French Agence Nationale de la Recherche 'Agriculture and Sustainable Development' Appeau project, and the European Union Noviwam project). In addition, the research has yielded two papers published in peer-reviewed journals. Moreover, discussions on the use of wastewater in Israel showed there is some interesting work to do on sludge management and disposal in both countries. Future collaboration would be very promising and would give us an opportunity to investigate in depth the links between the 'pricing' and the 'planning' approaches, and to develop a pricing mechanism for wastewater in Israel, working on the implementation in the European Union Water Framework Directive in France.