Irrig Sci (2007) 25:443–445
DOI 10.1007/s00271-006-0050-z

SHORT NOTE

Impact of research on water use for irrigation in Israel

Marcel Fuchs

Received: 22 August 2006 / Accepted: 18 October 2006 / Published online: 17 November 2006

Abstract The decrease of annual irrigation application rate observed since 1950 was reversed in 1988 as a result of a sudden increase of the amount of treated effluents used for irrigation. Intensification of research on irrigation with effluents and marginal water starting in 1994 resulted four years later in the renewal of the decrease of irrigation application rate.

Introduction

Evaluating the beneficial impact of scientific progress on society is an elusive matter that involves economical, sociological, ethical and philosophical considerations. In agriculture we measure the effect of research by increased productivity and quality, as well as wider food, fiber and other raw materials availability. Because agricultural production requires inputs, increased efficiency of input use is another measure of progress. On the basis of this premise, Stanhill (1992) showed that annual rate of water use for irrigation had steadily decreased from 885 mm in 1950 to 490 mm in 1987, a water saving of 45% (1 mm corresponds to ten cubic meter of water per hectare). Research leading to better equipment and sharper understanding of crop water requirements may have significantly lowered the amount of irrigation water per unit area applied in Israel, but there is no substantial evidence to support this presumption. The purpose of this study is to show that research on irrigation has a direct impact on the amount of water used for irrigation.

Communicated by E. Fereres.

Contribution No. 614/06 from the Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel.

M. Fuchs (✉)
Agricultural Research Organization,
Institute of Soil, Water and Environmental Sciences,
The Volcani Center, PO Box 6, Bet Dagan 50250, Israel
e-mail: fuchsml@agri.gov.il

Results

The study on irrigation rate started by Stanhill was continued through 2003, the last year for which data are currently available. The results in Fig. 1 show that the initial drop of annual irrigation rate is followed by an unexpected sharp rise starting in 1988 (Anonymous 2005b). The increase culminated in 1998 when it climbed to 690 mm. For the next five years the trend reversed and irrigation rates decreased at a rate of 28 mm per year (Anonymous 2005a).

What happened around 1988 and then 10 years later to cause the changes of the trends in irrigation rate? In 1988 there was an abrupt rise in the amount and proportion of effluents included in the water used for irrigation following opening of the effluent water carrier from the Dan regional waste water reclamation project (Fig. 2; Anonymous 2005b). The high solute concentration of the effluents, the chloride concentration of the water reclaimed in the Dan regional project is 290 mg per liter, prompted a higher irrigation application rate to increase leaching and prevent the accumulation of harmful chemicals in the soil. Soil and water scientists formulated theoretical hypotheses that appropriate treatment of soil, water and crop can lower the leaching requirements. Research on irrigation with effluent had already started in the later part of the eighties, but

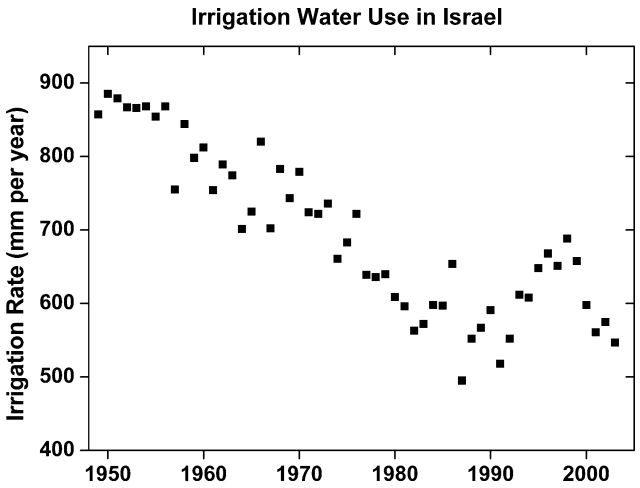

Fig. 1 Change of annual water application rate for irrigation in Israel

starting in 1994 it grew to culminate in 2001 as the major objective of soil, water and environmental sciences (Fig. 3)[1]. Considering that the average duration of a research project is three years, and that at least one year is needed to implement the results, the decrease of irrigation rate starting in 1998 is in direct concordance with the research effort. The economical benefits of decreased irrigation rate with effluents are supplemented by ecological benefits through lower discharge per unit area of potentially dangerous chemicals.

Despite the continuous rise in the proportion of effluents used for irrigation (Fig. 2), the annual irrigation rate has continued to decrease at an accelerated pace. This trend undoubtedly reflects the outcome of the sustained scientific action focused on irrigation with effluents.

The correlative arguments derived from the data presented in this study do not provide absolute proof that the decrease of irrigation amount per unit area is a result of research. Increasing the price of water is a strong incentive for parsimonious use. From 1998 to 2003, the period when irrigation per unit area decreased again, the price of water for agriculture, adjusted to the prices index of input, increased on the average by 4.6% per year (standard error = 0.92%) (Anonymous 2006). From 1990 to 1998, when water use per unit area grew, the input index adjusted price of water increased at an average rate of 3.5% per year (standard error = 1.02%). The difference of water pricing during the two periods is not significant and cannot explain trend reversal of the irrigation rate.

[1] Michal Gurevich, Administrative Director of the ARO Research Authority, provided the listing of all public funded agricultural research projects carried out by research institutes, extensions, universities, and regional research and development, from which the data shown in the figure were computed.

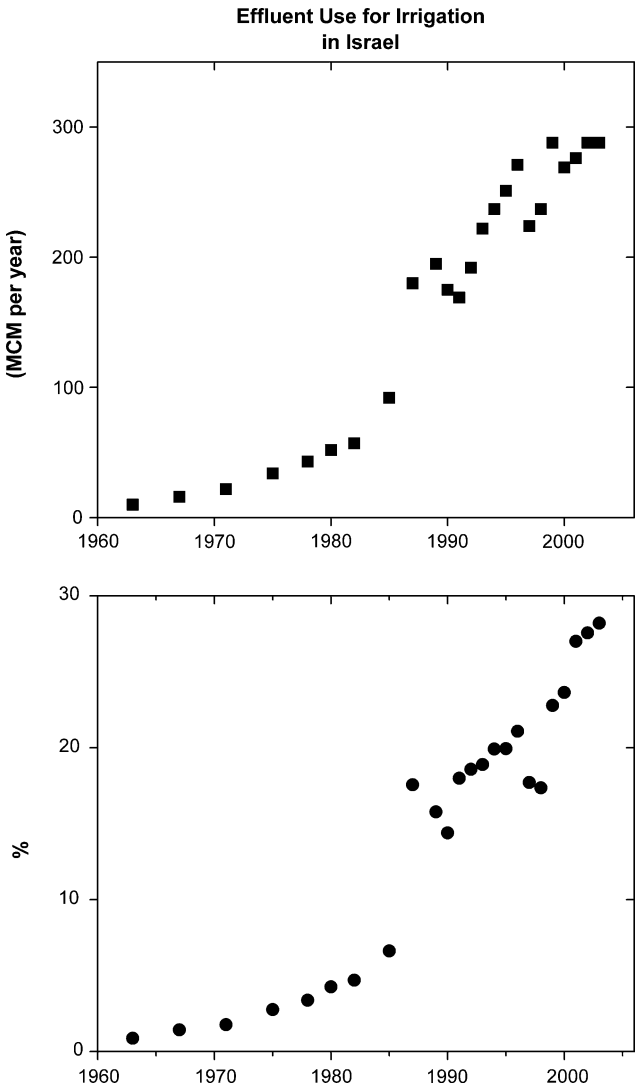

Fig. 2 Effluent use for irrigation, in million cubic meters (MCM) per year

Specific composition of irrigated crops can also cause changes of irrigation requirements. From 1988 to 1998 orchard area decreased from 890 to 840 square kilometers, mostly because of citrus plantations decline. Since 1998 total orchard area is on the rise despite accelerated decrease of citrus. Field crops have declined steadily since 1988 in favor of vegetable crops (including potatoes and melons) that grew from 400 km^2 in 1988 to 540 in 1998. Vegetable crop area has continued to increase reaching 650 km^2 in 2004 (Anonymous 2006). None of these changes bear a relation to the irrigation use trends in Fig. 1.

Concluding remarks

The tight link between change of trend in annual irrigation that occurred starting (Fig. 1) in 1998 and the

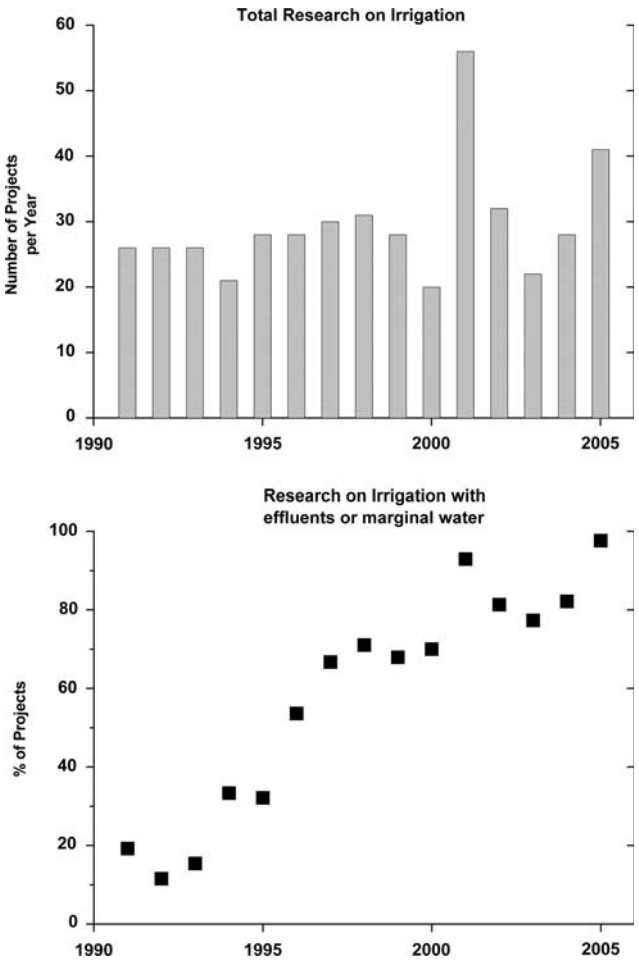

Fig. 3 Research on irrigation and irrigation with effluents

number of research projects (Fig. 3) provide strong circumstantial evidence that advances in science did have a significant positive impact on agriculture and environment. Considering the average annual cost of a research project is 250,000 NIS and the average number of project from 1991 to 2005 was 30 per year, the annual research expenditure was 7.5 million NIS per year (1 NIS = 0.23 US $ = 0.18 €). The 28 mm per year decrease in annual irrigation rate represents a national annual saving of water amounting to 56 million cubic meters. The cost of one cubic meter of water reclaimed in the Dan regional project is 1.25 NIS per cubic meter so that the immediate annual direct financial saving is 70 millions NIS, a 10-fold return on the 7.5 million NIS cost for research.

References

Anonymous (2005a) Economical Report on Agriculture 2004. Rural Planning and Development Authority, Ministry of Agriculture and Rural Development

Anonymous (2005b) Statistical Abstract of Israel 2005. No. 56, National Bureau of Statistics, State of Israel

Anonymous (2006) Statistical Abstract of Israel 2006. No. 57, Central Bureau of Statistics, State of Israel

Stanhill G (1992) Irrigation in Israel: past achievements, present challenges and future possibilities. In: Shalhevet J, Chiang-ming L, Yuexian X (eds) Water use efficiency in agriculture. Proceedings of the binational China-Israel workshop. Priel Publishers, Rehovot, pp 63–77