Dr.-Vater: Prof. Dr. C.-H. Hanf
MSc BADER, ESAM:

MATHEMATICAL PROGRAMMING MODELS FOR OPTIMISING IRRIGATION WATERT MANAGEMENT IN EGYPT

The availability of reliable water supplies from Lake Nasser is governed by an existing water sharing agreement, under which 55.5 billion cubic meters of water are allocated to Egypt. Due to the increasing demand for water caused by rapidly growing population and fixed water supplies, greater emphasis is now being placed on the need to improve the efficiency in use of the available water resources for crop production.

Linear Programming (LP) was used to make decisions about irrigation water management options in conjunction with optimal cropping patterns to ensure optimal use of water. The suggested optimal model was then used to measure the impact of different water policies. The solution of the LP model was obtained using GAMS modelling programme. The LP model was essentially static, allocating irrigation water in a single year among different crops in the first stage of the mathematical analysis at governorates level and in the second stage at the global level. The crop allocation model, which maximised gross margins for a growing season, was constrained by land, water and organisation constraints (a minimum and maximum area under each crop of the last 5 years). The calculations were based on statistical data from the official statistical institutions in Egypt, where the technical coefficients were determined as the average of real values for the three years (1999-2001).

The results showed that there is a potential to increase net income from crop production through efficient allocation of irrigation water. The optimal cropping patterns would result in an increase in income by 3.01 % and 3.82 % over the actual farm income at the governorates and global levels, respectively. They can also help increase food self-sufficiency ratios.

The results also showed the future impact of different water policies resulting from the use of comparative-static planning models. The results of the various scenarios, which can be implemented in Egypt, are as follows: Under increasing water supply conditions through improving water distribution efficiency, the total gross margins increased by 1.71 % and 1.50 % more than the optimal base values at the governorates and global levels, respectively. Under drought conditions, farm income decreased by 5.30 % and 5.05 % indicating losses below the basic solution at the governorates and global levels, respectively. Under water charging scenario (Partial Cost Recovery), farm income decreased representing increased production costs. There was no impact on resources use under this scenario.

Results of the modelling show the optimal cropping patterns and the potential to reallocate water resources in an optimal way. This may provide valuable policy information, which may

serve as a guideline in pre-season indicative planning for cropping patterns and irrigation water use in the Egyptian agriculture.