UNIVERSITÄT HOHENHEIM

INSTITUT FÜR AGRARTECHNIK

Agrartechnik in den Tropen und Subtropen

First supervisor: Prof. Dr. Joachim Müller

Second supervisor: Prof. Dr. Folkard Asch

International Master of

Agricultural Sciences in the Tropics and Subtropics

cand. M.Sc. Katrin Schulze

Master Thesis

Agronomic and Economic Aspects of Water Saving Irrigation Methods in Mango Production in Northern Thailand

This work was financially supported by the Foundation fiat panis

30 September 2010

Conceptual Demarcation

The situation of rapid population growth is a challenge for global agriculture to grow more food with declining allocation of water and land. In Northern Thailand water is an increasing scarce resource for agricultural production during dry season. Mango is a very important fruit for the local market and for the export. Irrigation is needed as mango flower and develop their fruits during dry season.

This research evaluates water saving irrigation methods – here partial root zone drying (PRD) - under field conditions in Northern Thailand in consideration of the increasing water scarcity. PRD is one of a deficit irrigation method where spatially targeted water and deficit is applied to alternating sides of the root zone. Therefore, a reduced water level can be applied in relation to the full crop-water requirements (evapotranspiration).

The aim of this master thesis is to contribute to the understanding of the linkage between the maximization of productivity per water unit under different irrigation regimes and discusses the profitability of water saving irrigation methods for farmers as crop water productivity is not the objective of the farmer per se. It is also important to take into account the profitability and other issues related to the sustainability of the irrigation methods applied.

The study is based on field survey mango fields on sandy loam soils situated in a foothill at Phrao, in Northern Thailand. Modern micro sprinkler irrigation systems have been installed on farmers' orchards. Four different treatments are applied: full irrigation (FI) as calculated based on the climatic water balance, partial root zone drying (PRD) and farmer's conventional irrigation, which is split into 'traditional irrigation' (CIt) with the farmer using his own equipment and 'modern irrigation' (CIm) with the farmer using micro-irrigation technology.

Major trends in yield output, fruit weight distribution, quality of mango, and crop water productivity under these different irrigation regimes will be discussed. Therefore, an irrigation schedule based on climatic data will be setup and the monitoring of water application will take place. On-tree fruit development will be monitored by measuring fruit length, maximum thickness, and maximum width. Based on this measurement the fruit mass development will be estimated.

Furthermore, at harvest total yield and fruit weight distribution will be determined under consideration of fruit load per tree. After harvest and during ripening phase of the mango fruits several physical and chemical analyses will be conducted to determine the influence of PRD on fruit quality.

Regarding yield output and water application, the crop water productivity will be evaluated under the aspects of increasing water scarcity during dry season. As the crop water productivity is not the objective of the farmer per se, economical water use efficiency – based on profit before tax - will also be evaluated. Therefore, interviews with each farmer will be carried out for collection of further information on cost and returns. Research results, information from farmers and other experts, and observations yield in an agronomic and economic analysis. A profitability analysis of the four irrigation management regimes will be calculated and a comparative analysis of the investment will be conducted thus including evaluation of the net present values and the payback-periods of each irrigation treatment. Different scenarios will be carried out with varying prices for mango, electricity, and water to simulate the profitability of PRD under changing conditions and will be compared to other irrigation treatments. This will allow an investigation of management alternatives. Based on the results of this study, a summary and conclusion will give an overview of the feasibility of PRD strategy either under agronomic and economic aspects.

8 CONCLUSION

2010 was an exceptionally dry year in Northern Thailand. It can be assumed that in future water is an increasingly scarce resource during dry season where mango growers irrigate their mango trees. Therefore, major trends in, i.e. yield output, fruit weight distribution, quality of mango, and crop water productivity under different irrigation regimes have been discussed and the methodology used to calculate the cost and returns has been demonstrated. Although the operating costs and returns were estimated, the evaluation are based on own observations and results, information from farmers and experts and on literature research.

DI methods, by reducing irrigation water use, can aid in coping with situations where water supply is limited (Satienperakul et al., 2006; Satienperakul et al., 2008). Based on the results of this study, it can be stated that PRD regime can optimize crop water productivity and economical water use efficiency. PRD can be used as a measure to reduce the water amount for irrigation. From the data in this study it can be concluded that PRD is a good alternative to traditional irrigation management as the quality of mango is not affected even though a decrease in yield of one of the experimental fields was observed. This decrease could be offset by a better fruit weight distribution. Still with less profitability, these small reductions could then be offset by using less fertilizer. Further investigations with greater sample sizes are required to validate these findings. Furthermore, the long term effects of PRD are not known and the sustainability over a long time period has to be observed under long-term studies.

Drought-induced depressions of mango yields are likely to occur more often, making smallholder farmers, who specialize on mango production, particularly vulnerable. Therefore, farmer could benefit from using PRD with its potential for saving water. As water is not priced in Thailand, potential benefits from water savings can only be quantified in form of saved energy for pumping. Therefore, different scenarios were run through with varying prices for mango, electricity, and water to simulate the profitability of PRD compared to the other irrigation methods. This allowed an investigation of management alternatives. When water becomes priced, PRD is even more attractive compared to the other irrigation treatments.

Thailand's challenge, thus, will be to supply mango for an expanding market under these adverse conditions, while ensuring environmental and economic sustainability of mango production through appropriate agricultural and rural development policy. Water pricing is an important way of improving water allocation and encouraging users to conserve scarce water resources.