Economic feasibility of salinization mitigation for sustainable agriculture

Innovative fresh water measures from an economic perspective in the Wadden region in the Netherlands

Tine te Winkel[1] Jouke Velstra[1] Stijn Reinhard[2]

1. Acacia Water 2. Wageningen Economic Research

Introduction

Arable farming is of great importance for the socio-economic environment in the Wadden region of the Netherlands. Groundwater is saline to brackish in the coastal zone so farmers nowadays depend on fresh rainwater lenses fed by precipitation and water supplied by water authorities. Salinization, climate change and soil subsidence will increase water demand and reduce fresh water availability (see fig. 1). For sustainable agrobusiness the need arises for farmers to become more self sufficient in fresh water. Therefore, solutions are developed and tested in a 6 year project *'Spaarwater'*. The economic and financial feasibility of the innovative measures are extensively studied to increase the likelihood of implementation and upscaling.

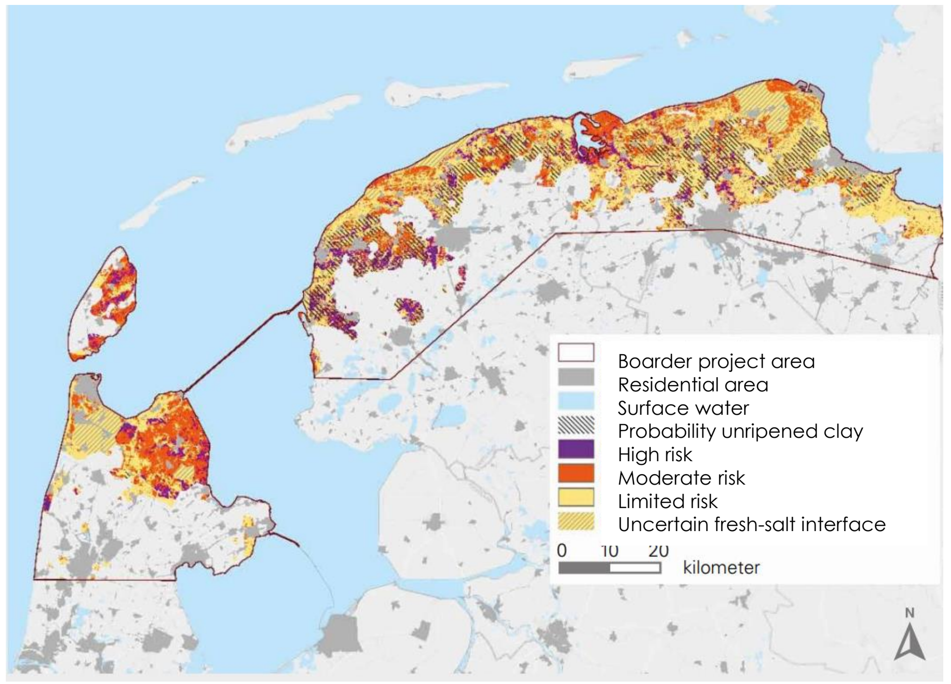

Figure 1. Salinization risk in the Wadden region in the Netherlands based on the thickness of the fresh water lenses [1].

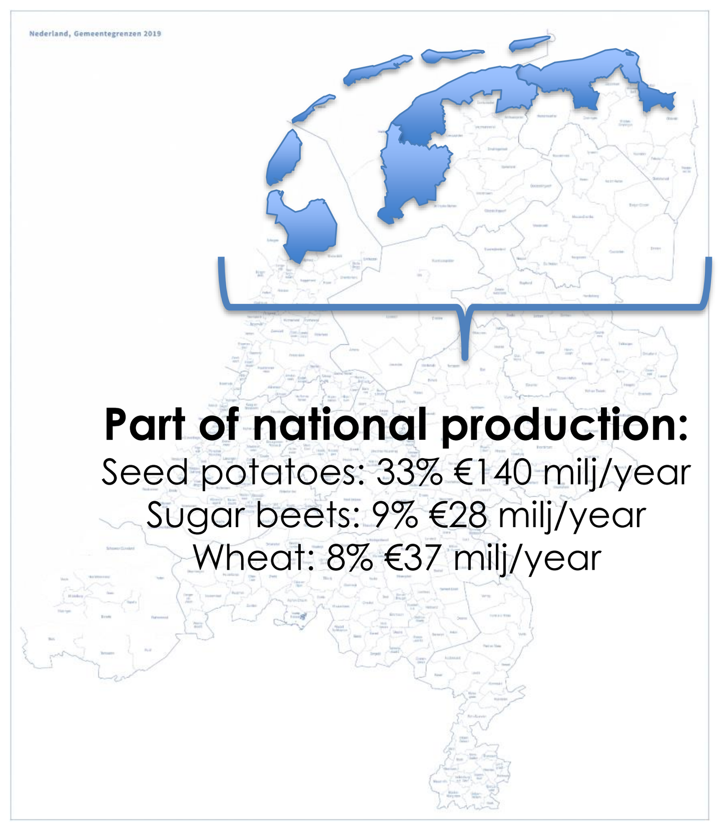

Figure 2. Share of the agricultural sector in the Wadden region in National production [2].

The research question presented in this poster is:

"What is the farmers' business case for Agricultural Managed Aquifer Recharge in the Wadden region?"

Agricultural Managed Aquifer Recharge and Recovery

From 2013-2019 Acacia Water and partners carried out applied research to develop and investigate the feasibility of several innovative measures to improve water resources and increase fresh water availability. A self-supporting fresh water storage and recovery system was designed and tested at two locations, consisting of a fresh tile-drain effluent collector unit (rainwater harvesting) feeding into a Managed Aquifer Recharge and Recovery system in a brackish aquifer in winter, which in turn is used as irrigation water during the growing season in the summer.

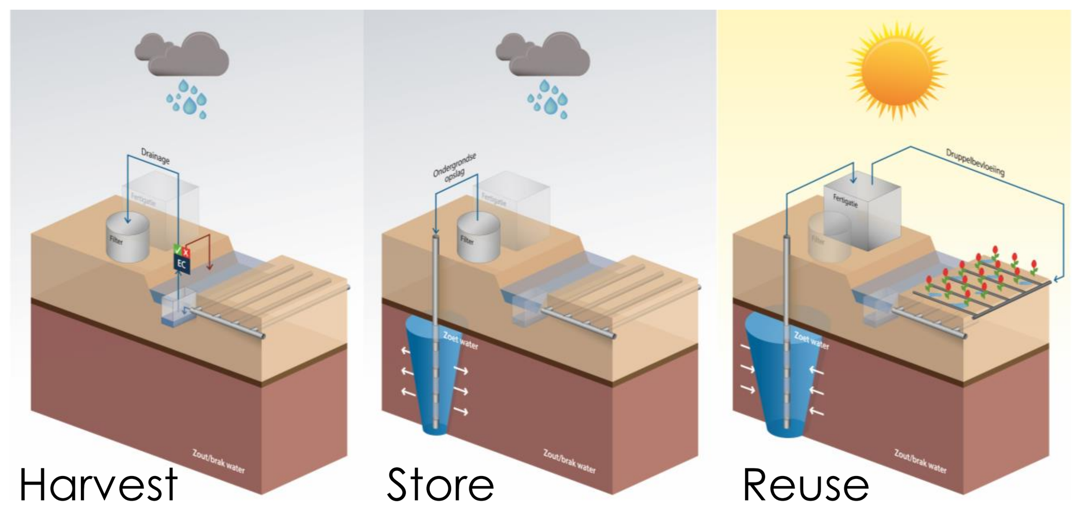

Figure 3. Agricultural Managed Aquifer Recharge and Recovery [1]

Costs

Total costs are made up by investment costs, financing costs and yearly recurring operation and maintenance costs. We were able to reduce cost price to € 800,000 and current innovations and cost reductions will result in a system of € 500,000 for a complete system which covers a 100ha farm (see figure 5). Which translates to an average cost price of €300,-/ha/year.

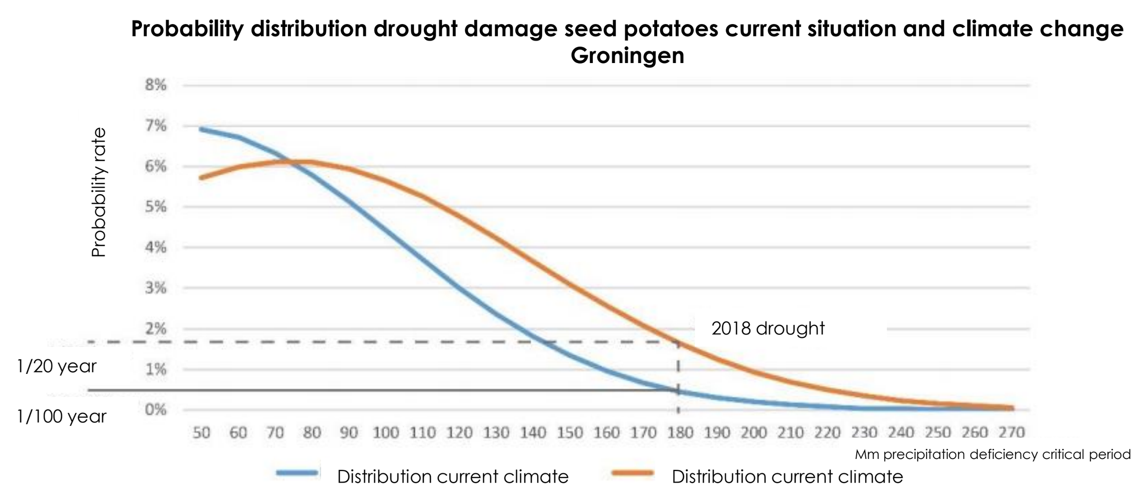

Figure 4. Probability distribution drought damage seed potatoes, Groningen [1].

Benefits

The direct benefits are presented in terms of crop yield. Avoided drought and salinization damage are monetized and translated into yearly yields/ha. A new methodology for seed potato is presented in this study as no region-specific data on drought damage was available. Acacia Water and Wageningen Economic Research developed a regional model based on historical yields, meteo-data and farm-inputs. The model predicts the additional benefits of water availability per year and therefore the direct benefits of Agricultural Managed Aquifer Recharge. Extra yield predictions are supported by integration of the return time of specific mm drought. Doing this gave insight in regional differences in return time, extra yield and under influence of climate change. In Groningen, 89 mm and 162 mm occur once every 4 and 35 years with a drought damage of € 825 and € 3930. In future Noord-Holland can expect a 90 mm drought every year, 162 every 5 year and Groningen respectively every 2 and 10 years (see figure 4 and 6).

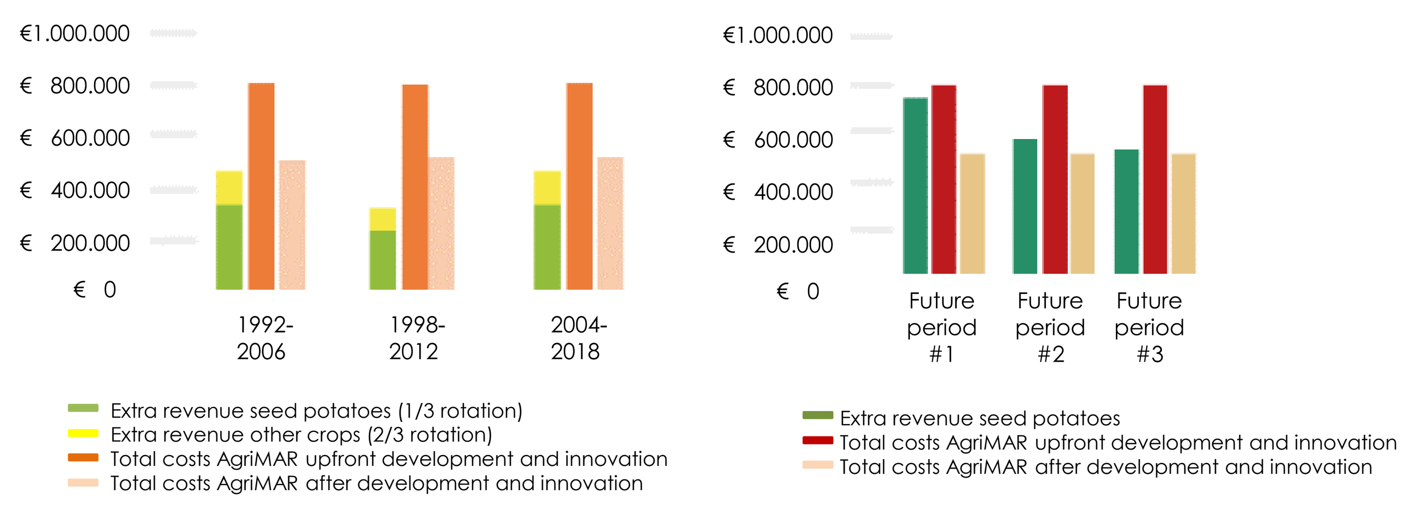

Figure 5. Benefit cost results for seed potatoes based on two types of price setting, upfront and after development and innovation [1].

Cost & benefit analysis

In this study a 1/3 rotation for seed potatoes and 2/3 sugar beets, onions and carrots is taken into account. It is the farmers' decision if he distributes the water to the 1/3th seed potatoes or he irrigates all crops. Ultimately, the benefits depend on the farmers' approach. The average lifetime of AgriMAR systems is 15 years. In the analyses arbitrary periods (timeseries 1988-2018) of 15 year benefits based on mm avoided drought are conducted. This results in a total of expected yields per investment period. The benefit-cost comparisons for Groningen are shown in figure 5. The analysis is carried out under current and expected climate change conditions, in the latter the benefits will be substantially higher.

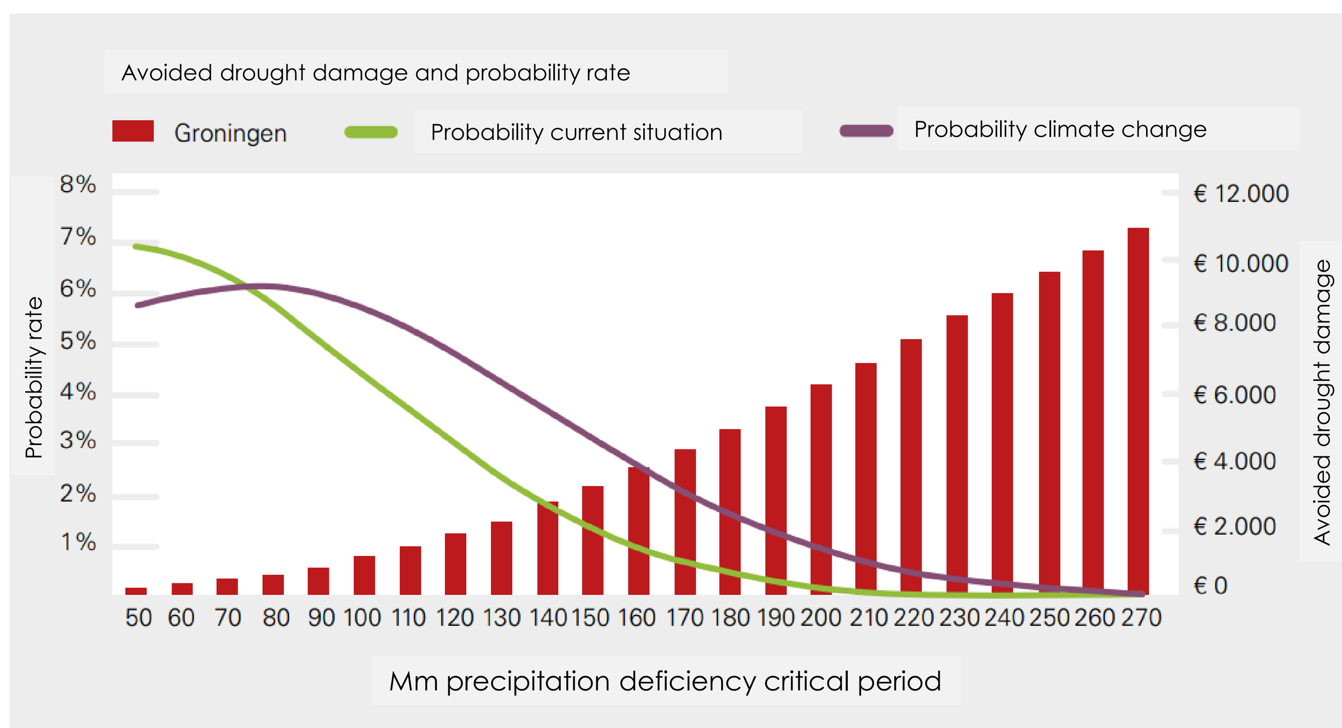

Figure 6. Probability and avoided drought damage per mm precipitation deficiency in the critical period [1]

Figure 7. Extra yield in 2018. Left: yield without use of Spaarwater, right yield with use of Spaarwater – difference is between €4.500,- and € 4.950,- [1].

ACACIA WATER

References: [1] Acacia Water; Spaarwater: Cost-effective and sustainable agricultural water use and water management in the salinizing Wadden Sea region. Hoofdrapport 2016-2018, Acacia Water, Gouda, The Netherlands. [2] CBS Statline, www.statline.cbs.nl