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Short communication

Risk efficiency of irrigation to cereals in northeast Germany with respect to nitrogen fertilizer

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ABSTRACT

The potential role of irrigation of cereals as a response to climate change is under debate. Especially under temperate continental conditions empirical evidence of crop yield response to irrigation in interaction with nitrogen fertilizer supply is rare. Besides mean yield effects, irrigation reduces yield variance, which may be an incentive for farmers to use irrigation. This paper investigates the risk-efficiency of irrigation in cereal production in a temperate continental climate, based on data from a long term field experiment on a sandy soil. Irrigation and no irrigation of winter rye (*Secale cereale*) and winter barley (*Hordeum vulgare*) were investigated in three different nitrogen (N) fertilizer levels. Crop yield response data (1995–2010) to irrigation and N fertilizer were used to calculate net returns, certainty equivalents (CE) for different levels of risk aversion and the conditional value at risk (CVaR) as a downside risk indicator in two price scenarios. The scenarios were calculated with a total cost and a partial budget approach. Irrigation was found to be profit-maximizing in all partial budget calculations, which sometimes required higher N input to be profit-maximizing. Irrigation and N fertilizer reduction were identified as risk mitigation strategies, even though their impact was limited. Irrigation reduced the downside risk only in the partial budget calculations. The analysis based on the CE did not show improved risk efficiency with irrigated management options. In contrast, reduced fertilizer input proved to be risk efficient at specific levels of risk aversion. The price expectations of winter rye and winter barley had a much higher impact on the ranking of the management options than risk aversion based on the crop yield variances. At low crop prices for all levels of risk aversion, irrigation of winter barley and winter rye was only economically justified if fixed costs for irrigation were not taken into account. At high crop prices, irrigation of winter barley was also justified based on the total cost calculation. However, this advantage was only given at a very low level of risk aversion. With increasing levels of risk aversion irrigation was not efficient based on the CE in the total cost accounting scenario. In conclusion, irrigation of cereals can contribute to downside risk mitigation and increased profits, if fixed costs for irrigation are covered. However, this conclusion holds only when irrigation is combined with an increased N intensity. If total costs need to be accounted for, irrigation in cereals is not an appropriate risk reduction strategy and a reduction of N input is more effective.

1. Introduction

As a response to climate change, irrigation of cereals in temperate regions of Europe is increasingly under debate (Olesen and Bindi, 2002; El Chami et al., 2015, Zhao et al., 2015). While under current conditions investments in irrigation systems are not likely to be profitable for cereals in temperate Europe, this could change with climate change or increased crop prices, which has been shown for English, Swiss and German conditions (El Chami et al., 2015; Münch et al., 2014; Finger and Schmid, 2008). Especially in northeastern Germany the future potential role of increased integration of irrigation in arable cropping systems has been highlighted (Münch et al., 2014). In this region, increasing pre-summer-droughts in combination with a low water holding capacity of predominant sandy soils often result in shortage of water available for plants, and lower yields (Schindler et al., 2007; Drastig et al., 2011).

Irrigation decisions should not be based solely on the expected profit, but should also consider uncertainties and farmers' attitudes to risk, since irrigation typically affects variance and skewness of profits and is often associated with an investment decision (Bosch et al., 1987; Finger, 2013). Lehmann et al. (2013) have presented a framework,

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Table 1
Soil physical and chemical properties of field research station of the Humboldt University of Berlin in Thyrow (according to Trost et al., 2014).

Soil attribute	Value
Soil pH	5.3–5.9
Field capacity (%)	16.1
Usable field capacity (%)	11.0
Wilting point (%)	4.5
Bulk density (cm^{-3})	1.67
Average Corg content	0.52
Sand (%)	83.10
Silt (%)	14.20
Clay (%)	2.70

which models the associated risks of fertilizer and irrigation decisions based on a bio-economic modelling approach with an integrated crop growth model and an economic decision model. Their study under Swiss conditions showed in all calculated climatic scenarios that for a moderately risk averse farmer irrigation of winter wheat did not result in a higher farmer's utility compared to not irrigated winter wheat. However, in contrast to winter wheat, irrigation was found to be the utility maximizing strategy for grain maize in several climatic scenarios.

Besides the use of irrigation water, nitrogen (N) fertilizer also has an impact on mean profitability and profit variability of farming. Literature suggests that high N rates are risk increasing (Rajsic et al., 2009; Finger, 2012). So from a risk mitigation point of view, irrigation and N fertilizer reduction may both be a potential risk mitigation strategy, which should be traded off appropriately.

The economic analysis of irrigation, especially with respect to risk, is mostly based on modelling approaches, which generate yield response to irrigation for specified climate scenarios. Different biophysical models have been suggested, which can generate the necessary data sets (for example Münch et al., 2014; El Chami et al., 2015; Finger et al., 2010). Typically irrigation is modelled as a function of weather-, and plant-induced soil water status. However, modelled yield response to irrigation may deviate from empirical yield response to irrigation derived from field trials because of various restrictions that appear in practice. Such limitations are for instance limited information on soil water status or time restrictions. However, economic and risk analyses from empirical data are rare. Foudi and Erdlenbruch (2012) showed with an econometric approach based on European Farm Accountancy Data that French farmers with irrigation have higher mean profits with lower profit variability compared to those without irrigating. To our best knowledge no studies have compared risk mitigation by irrigation

Table 2
Annual amounts of irrigation water and the number of irrigation water applications.

Year	Winter rye: Annual irrigation water ($mm\ m^{-2}$)	Winter rye: Number of applications	Winter barley: Annual irrigation water ($mm\ m^{-2}$)	Winter barley: Number of applications
1995	No cultivation of winter rye		0	0
1996	0	0	47	2
1997	0	0	60	3
1998	0	0	60	3
1999	0	0	60	3
2000	20	1	100	5
2001	20	1	40	2
2002	21	1	43	2
2003	98	3	70	3
2004	30	2	30	2
2005	20	1	23	1
2006	77	3	142	5
2007	42	2	42	2
2008	134	7	127	6
2009	45	3	45	3
2010	14	1	No cultivation of winter barley	

accounting for interactions resulting from different N fertilizer rates based on empirical data.

We used data from a long term field experiment to model the implications of the variability of the expected net return, with respect to farmers' risk attitude. The study aims to contribute to the following questions: What is the potential impact of risk aversion on the utility of investments in irrigation of cereals on a poor soil, in a continental temperate climate? Is it economically justified to use existing irrigation equipment on poor soils in a temperate continental climate for cereal production? What are the implications of irrigation on the risk-efficiency of different N fertilizer applications?

2. Data and methods

2.1. Field experiment

Data on crop yield response to N fertilizer and irrigation were taken from a long-term field experiment located in Thyrow (52°15 N, 13°14 E) in the federal state of Brandenburg, Germany. The site is located 43 m above sea level with an annual average temperature of 8.9 °C and annual precipitation of 495 mm (Ellmer and Baumecker, 2008). According to the World Reference Base for Soil Resources 2006, the soil type is Cutanic Albic Luvisol (Abruptic Arenic) (Schweitzer and Hierath, 2010). The site is characterized by poor soil fertility because of limited water-holding capacity and cation exchange capacity. Sand is the primary particle size class in the topsoil. Further physical and chemical properties of the topsoil are listed in Table 1.

The long-term field trial with a rotation of five crops was established in 1969. Potato (*Solanum tuberosum* L.), winter barley (*Hordeum vulgare* L.), oil seed rape (*Brassica napus* L.), winter rye (*Secale cereale* L.), and cocksfoot (*Dactylis glomerata* L.) were grown in a five-year crop rotation until 2010, when some crops in the rotation changed. The rotation was replicated on five plots so that each crop of the rotation was planted in each year. The plots were split in irrigated and non-irrigated subplots with three N fertilizer intensities (0, 60, 120 kg N ha^{-1}), which were arranged with triple non-randomized replications within the subplots. The amounts of irrigation water were based on the water status of the soil, calculated with a soil hydrological model, taking into account water-holding capacity, plant growth stage and potential evapotranspiration (Table 2, further information in Trost et al., 2014).

In this study, a time period of 15 years (1995–2010) was used to collect data of crop yield response of winter rye and winter barley to irrigation in interaction with three different N fertilizer levels.[1] For the risk analysis crop yield data were trend-corrected applying a linear time trend model.

2.2. Economic analysis of the different management systems

The economic analysis in this paper is focused on the economics of irrigation with respect to N fertilizer application. A total cost accounting approach was selected to compare the net returns of the different management systems (Eq. (1)),

$$\pi = p_c \cdot y + DP - C_f - p_N \cdot N - C_{irrigation\ (fixed)} - C_{irrigation\ (variable)} \quad (1)$$

where π indicates the per hectare net return from growing a specific crop. p_c is the crop price, y is the crop yield, DP are the direct payments according to the Common Agricultural Policy of the EU, C_f are the total costs of farming, including land rents, but excluding N fertilizer and

[1] Since the experimental design was repeated in five blocks, representing the crop rotation, each plot was planted three times during the considered 15 years. Due to changes in the crop rotation in 1995 and 2010 winter rye and winter barley were not both planted at the same time. All considered crop yield data are provided in the appendix.

Table 3
Cost assumptions for sprinkler irrigation.

Cost item	Description	Costs	Source
$C_{irrigation\ (fixed)}$	Fixed costs for well, pumps, sprinkler irrigation systems and tubes	146 € ha^{-1}[a]	Fricke and Riedel (2011)
$C_{irrigation\ (variable)}$	Variable costs (energy, repair, labor) per m^3 water use	0.26 € m^{-3}	Fricke and Riedel (2011)
	Water costs per m^3 water use	0.10 € m^{-3}	Brandenburgisches Wassergesetz (BbGWG), 02.03.2012, § 40[b]

[a] Irrigated area: 100 ha, interest rate 7%, useful life: 25 years of well and tubes and 15 years for pumps and sprinkler.
[b] http://bravors.brandenburg.de/gesetze/bbgwg_2016.

irrigation costs. Where appropriate, for instance in the case of fungicides, different components of C_f are adapted to the yield expectation of different management systems under study. p_N is the price for N fertilizer, N is the amount of fertilizer use, $C_{irrigation\ (fixed)}$ are the fixed costs of irrigation (see Table 3), $C_{irrigation\ (variable)}$ are the variable costs of irrigation for energy, repair, labor, and water (Table 3).

The production cost assumptions for winter barley and winter rye were based on the cost calculations for the farming operations provided by Hanff and Lau (2016), for site conditions with low crop yield potential corresponding to the experimental field. N fertilizer costs were calculated based on the fertilizer rate given in the respective treatment.

Irrigation costs include fixed costs resulting from the investment in irrigation infrastructure, pumps and irrigation equipment and variable costs for energy, labor, and machine use were identified for a sprinkler irrigation system according to published cost assumptions made by Fricke and Riedel (2011) (see Table 3).

Crop prices are subject to substantial fluctuations, which strongly affect the economics of yield, and thus, impact investments. Therefore, to account for this effect, the analysis was performed for two price assumptions, reflecting the average of the 50% lowest crop prices (low price) and the 50% highest crop prices (high price) over a nine year period, from 2008 to 2015 (Landesanstalt für Landwirtschaft (LfL), 2016). The low and high price scenarios were 120,180 € Mg^{-1} barley and 120,170 € Mg^{-1} rye grains, respectively. Nitrogen fertilizer price was set at 0.9 € kg^{-1} N. For the calculation of net returns, land rents were based on the estimates (78 € ha^{-1}) given by Hanff and Lau (2016). Direct payments (283 € ha^{-1}) were based on the common agricultural policy in Europe.

In addition to the two crop price scenarios, the economic analyses were also performed for two assumptions regarding irrigation costs. In the total cost scenario, fixed and variable costs of irrigation were considered in the net return calculation. In a further "partial budget" scenario, we calculate net returns without fixed costs arising from irrigation. This reflects the specific situation when unused irrigation equipment is available on the farm in early summer, at the time when cereals are irrigated (El Chami et al., 2015). In northeast Germany, this is a common case for farmers who mainly irrigate potatoes, which need the irrigation water later in the year.

2.3. Risk analysis

To analyze the impact of farmers' risk aversion on the selection of the risk-efficient irrigation N fertilizer combinations, a procedure proposed by Hardaker et al. (2004) was applied. Therefore, certainty equivalents (CE) were calculated for a range of absolute risk aversion coefficients (r_a) and a sample n observations according to Eq. (2), assuming an exponential utility function. In the equation, w indicates the wealth resulting from a specific irrigation — N fertilizer combination.

$$\mathrm{CE}(w, r_a) = \ln\left\{\left(\frac{1}{n}\sum_{i}^{n} \exp(-r_a w)\right)^{-1/r_a}\right\} \tag{2}$$

The CE is a theoretical money value exchanged with certainty that makes a decision maker indifferent between this exchange and a risky prospect, for example with agricultural production (Anderson et al., 1977). For a risk averse decision-maker, the CE is less than the expected average return of the risky alternative. The management option with the highest CE for a given level of risk aversion is regarded as the risk-efficient management option. The advantage of the chosen approach is that it uses all moments of the distributions of the data and always allows a ranking of analyzed management options and shows the impact of increasing risk aversion on that ranking.

The risk analysis was performed for a range of absolute risk aversion coefficients (r_a) ranging from 0 (risk neutral) to 0.01 (very risk averse), corresponding to the relative risk aversion coefficients (r_r) from 0 to 4, as suggested by Hardaker et al. (2004). This is in line with empirical findings of Maart-Noelck and Musshoff (2014) who have measured the risk attitude of German farmers and found that the majority of farmers can be classified as risk neutral to risk averse. The mean wealth in terms of net return outcomes of the analyzed high price scenarios is ranging between −67 € ha^{-1} and 526 € ha^{-1} with an average of 279 € ha^{-1} (see Table 6). Therefore, an r_r of 4 corresponds to a r_a of 0.014. This reflects a very high level of risk aversion, assuming no own capital, which would affect the utility of the management options.

As an additional risk indicator the conditional value-at-risk (CVaR) has been considered, which belongs to the group of downside risk measures (Monjardino et al., 2013). The empirical distribution of net returns based on the available 15 years of historical data was used to simulate m = 1000 random net returns based on the empirical cumulative probability function using the RiskCumul function implemented in @RISK (Palisade Corporation software, Ithaca NY USA) (see Gandorfer et al., 2011). This approach enables us to generate smoothed empirical distributions of net returns based on sparse data (see also Lien et al., 2006), which in turn, allows the calculation of the CVaR measure. CVaR (95) shows in our case the mean of the 5% lowest net returns.

3. Results and discussion

3.1. Crop response to different irrigation — N fertilizer combinations

The crop yields of winter rye and winter barley were sensitive to irrigation and N fertilizer, with more pronounced effects at higher fertilizer levels (Tables 4, 5). The variance of crop yields increased with higher N rates, which is consistent with the findings of other studies (Monjardino et al., 2013; Finger, 2013). As expected, irrigation resulted in lower crop yield variance, which is in accordance with the findings of Finger (2013). The variance of crop yields is much more strongly impacted by the level of N fertilizer than by irrigation. In addition to the impact on variance, irrigation and N management also influenced

Table 4
Moments of the winter rye crop yield distributions.

		Crop yield (winter rye)			
Irrigation	N rate (kg N ha^{-1})	Mean (Mg ha^{-1})	Variance (Mg $ha^{-1})^2$	Skewness (Mg $ha^{-1})^3$	Kurtosis (Mg $ha^{-1})^4$
No	0	2.11	2.63	0.50	−0.76
No	60	4.57	2.81	−0.74	0.21
No	120	5.20	7.61	−0.24	−0.84
Yes	0	1.92	0.99	0.83	0.70
Yes	60	4.54	2.11	−0.02	−0.15
Yes	120	5.84	4.36	−0.19	−0.39

Table 5
Moments of the winter barley crop yield distributions.

Irrigation	N rate (kg N ha^{-1})	Crop yield (winter barley) Mean (Mg ha^{-1})	Variance (Mg ha^{-1})^2	Skewness (Mg ha^{-1})^3	Kurtosis (Mg ha^{-1})^4
No	0	1.81	3.68	−0.10	1.40
No	60	3.95	11.99	−0.25	−0.42
No	120	4.31	21.31	0.11	−0.93
Yes	0	1.72	2.80	−0.65	0.00
Yes	60	4.41	9.23	−0.65	−0.52
Yes	120	5.38	18.11	−0.64	−0.92

higher moments of the crop yield distributions (Tables 4 and 5), which may also affect the decision of a risk averse decision maker. Finger (2013) found for maize in Switzerland decreasing skewness of profit distribution with increasing fertilizer levels and increasing skewness with the implementation of irrigation. The results of this study show this pattern only in the moments of the crop yield distributions of winter rye and no consistent pattern in the data of the crop yields of winter barley. However, the kurtosis varied substantially, which may have an impact on the risk-efficient management option for a farmer with a specified level of risk aversion.

3.2. Economic return of irrigation with respect to different N fertilizer intensities

The profitability of irrigation of winter rye and winter barley with respect to N fertilizer application strongly depends on the crop prices and assumptions regarding the cost allocation (Table 6). With higher crop prices, yield effects due to irrigation justify the investment in irrigation of barley with the highest N fertilizer rate (120 kg N ha^{-1}). For winter rye, the irrigation efforts are only justified if irrigation equipment is available, and fixed costs are covered by irrigation of other crops. At low crop prices, the advantage of the irrigated system is less pronounced, and irrigation is justified for both crops only if irrigation equipment is available (partial budget scenario).

3.3. Risk-efficient irrigation and fertilizer application strategies

The CE, based on the distributions of the expected crop yields for winter rye and barley, are shown in Fig. 1. The CE for a risk neutral decision maker is given at the absolute risk aversion coefficient (r_a) of 0. With increasing risk aversion (r_a), the CE typically declines.

The graphs do not show a strong effect of risk aversion on the ranking of the management options. Cost and price assumptions have a greater impact on the relative efficiency of the management options than the level of risk aversion. This observation complies with findings of Finger et al. (2010), who found that the economic benefits of adopting irrigation in Swiss maize production is constrained by the crop price.

In general the CE of management options with less N declined with increasing levels of risk aversion at a lower rate than the CE of management options which received more N and indicates a risk mitigation effect of reduced N input. This results for example in a higher risk efficiency of the moderately fertilized management options (60 kg ha^{-1}) in the total cost scenarios of rye (Fig. 1a, c) and moderately fertilized irrigated management options of the partial budget scenarios of barley (Fig. 1f, h). This result is in line with the findings of Finger (2012) and Rajsic et al. (2009), which identified nitrogen as a risk increasing input.

In the partial budget scenario for all price scenarios and all considered levels of risk aversion, management options with irrigation were risk-efficient. While for rye the highest fertilizer rate is the most efficient fertilizer level for all levels of risk aversion, for barley with higher risk aversion the moderate fertilizer level is efficient over the highest N level for $r_a > 0.005$ or $r_a > 0.008$ for the low and high price scenario, respectively. In the total cost scenarios irrigation is not risk efficient, even though in absence of risk aversion at high crop prices barley with irrigation is efficient over barley without irrigation. However, the increased yields with irrigation do not compensate the risks associated with the investment in irrigation.

Results for winter rye in the not irrigated system show that with increasing risk aversion, the system with moderate N supply becomes superior over the elevated N supply management option, which has the same CE as the moderate N supply for a risk neutral farmer, when irrigation costs are fully accounted for (Fig. 1a). The irrigation management options are most efficient only in the scenario without fixed costs for irrigation. This holds for the high and low price scenario.

The findings based on the CE calculations are consistent with the applied downside risk measure. In the partial budget scenario the irrigated management options with the highest CVaR (95) values were the management options with the highest N rate for rye and the options with the moderate N rates for barley (Table 7). Thus irrigation proved to be downside risk mitigating in the partial budget scenario. In the total cost scenario the CVaR (95) of the not irrigated management option was always lower than or the same as the irrigated option, which indicates no risk reducing effect of irrigation, if total costs need to be accounted for. In contrast in years with low crop yields the capital costs of the investment cannot be covered and result in a lower CVaR as without irrigation.

Table 6
Net return of different N/irrigation options for winter rye and winter barley under high and low crop price assumptions (with total cost and partial budget scenario).

Management		Winter rye		Winter barley	
		Low price scenario	High price scenario	Low price scenario	High price scenario
Irrigation	N rate kg ha^{-1}	Expected value – € ha^{-1}			
Not irrigated	0	70	175	−25	83
	60	203	433	95	333
	120	195	456	68	326
Irrigated total cost scenario	0	−81	15	−171	−67
	60	63	290	−8	257
	120	107	399	17	341
Irrigated partial budget scenario	0	46	142	−44	60
	60	190	417	119	384
	120	234	526	144	468

3.4. Implications for the use of irrigation in cereals with climate change

While our findings are based on crop yield response data from 1995 to 2010, with climate change crop yield response could be more pronounced, which may justify irrigation of cereals in the future based on total costs as has been stated by Münch et al. (2014) for winter wheat in northeast Germany. Also, our analysis is based on winter rye and winter barley, which are cereals with rather low economic value. In contrast, winter wheat, especially with high quality can achieve higher gross margins, which may justify irrigation of wheat rather than other cereals. Furthermore, an improved irrigation scheme may cause higher yield response, which could result in a better economic performance of the irrigated management option. An additional consideration is that the data used from the field experiment are bound to constraints of the experimental design, which possibly does not exploit the full yield

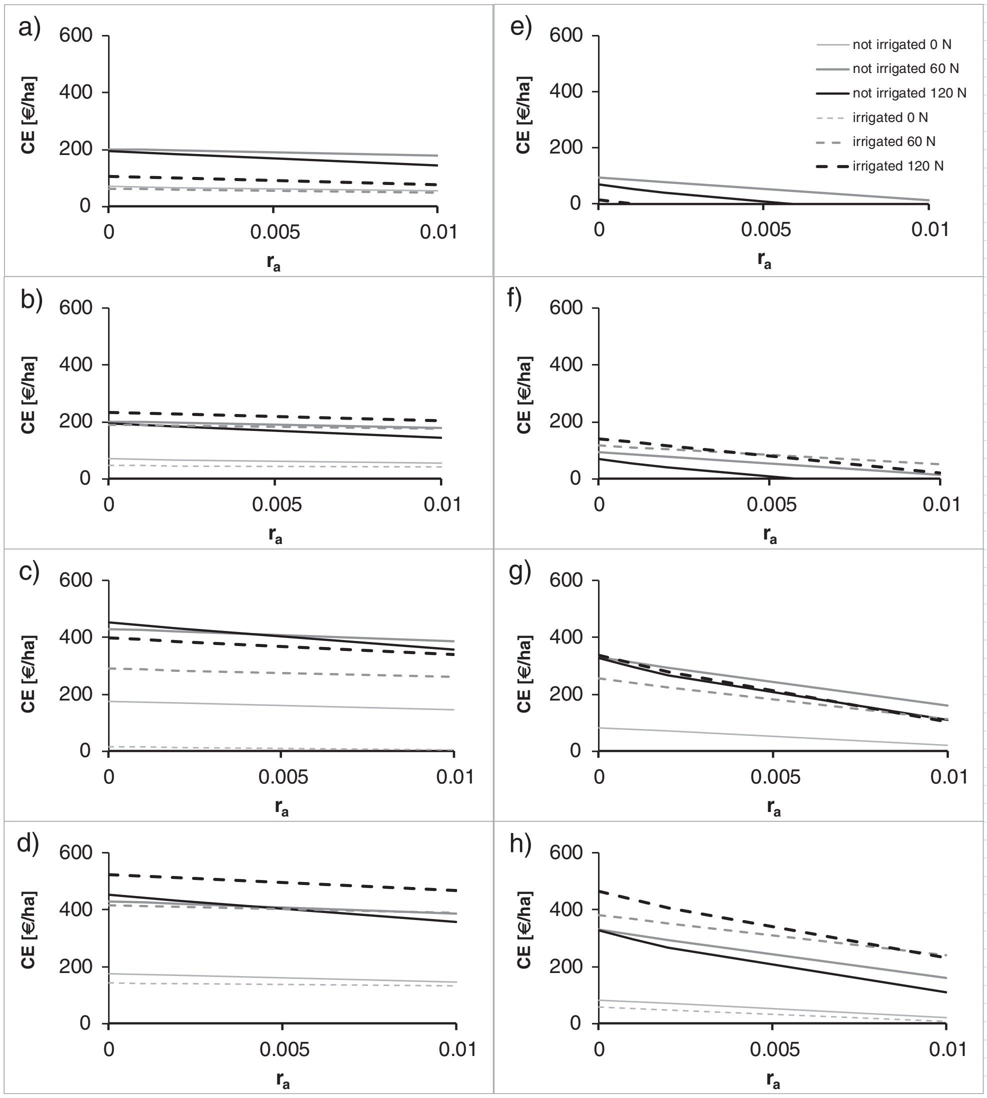

Fig. 1. Certainty equivalent (CE) of fertilizer irrigation combinations for winter rye and winter barley for absolute risk aversion coefficients from 0 (no risk aversion) to 0.01 (very risk averse) (left (a–d): winter rye, right (e–f)): winter barley, from top to down: (a, e): low crop price, total costs; (b, f): low crop price, no fixed costs; (c, g): high crop price, total costs; (d, h): high crop price no fixed costs).

Table 7
Conditional value at risk (CVaR(95)) of different N/irrigation options for winter rye and winter barley under high and low crop price assumptions (with total cost and partial budget scenario).

Management		Winter rye		Winter barley	
		Low price Scenario	High price scenario	Low price scenario	High price scenario
Irrigation	N rate kg ha^{-1}	CVaR(95) − € ha^{-1}			
Not irrigated	0	−11	61	−161	−120
	60	77	253	−134	−11
	120	22	210	−185	−53
Irrigated total cost scenario	0	−131	−56	−298	−257
	60	−28	161	−211	−47
	120	−27	210	−248	−57
Irrigated partial budget scenario	0	−4	71	−171	−130
	60	99	288	−84	80
	120	100	337	−121	70

potential under irrigation. Thus our results may underestimate the economic potential of irrigation in cereals.

4. Conclusions

Irrigation of cereals in northeast Germany can be profitable with a lower downside risk if irrigation infrastructure and equipment is available and cause no opportunity cost due to alternative irrigation options. This is the case for farmers who irrigate, for example, potato, which needs to be irrigated later during summer. However, this conclusion holds only when irrigation is combined with an increased N intensity.

If total costs of irrigation have to be accounted for, irrigation of cereals does not show lower downside risk and does not prove to be risk-efficient based on the CE for different levels of risk aversion. Under consideration of risk, the moderate N fertilizer option turned out to be the most efficient for irrigated barley. In general, from a risk mitigation point of view, a reduction of N fertilizer levels had a stronger impact than irrigation. From an environmental point of view, it is important to highlight the situations where the decision to irrigate will likely lead to higher N rates as shown in this study. Therefore, we recommend that the environmental impacts of irrigation as an often proposed strategy for climate change adaptation be carefully analyzed.

Appendix A

Year	Irrigation	Crop yield (Mg ha^{-1})		
		N fertilizer	Winter rye	Winter barley
1995	No	0	n/a	2.81
1996	No	0	3.5	2.3
1997	No	0	2.4	1.59
1998	No	0	2.25	2.68
1999	No	0	2.11	2.07
2000	No	0	3.32	1.85
2001	No	0	2.07	3.26
2002	No	0	1.47	1.27
2003	No	0	1.54	0.36
2004	No	0	2.01	2.14
2005	No	0	2.6	1.63
2006	No	0	2.03	0.92
2007	No	0	1.2	1.45
2008	No	0	1.49	1.32
2009	No	0	1.84	1.49
2010	No	0	1.86	n/a
1995	No	60	n/a	5.34
1996	No	60	5	4.22
1997	No	60	4.38	2.86
1998	No	60	4.52	5.11
1999	No	60	4.43	4.44
2000	No	60	5.24	3.23
2001	No	60	4.91	5.79
2002	No	60	4.14	2.89
2003	No	60	3.38	1.73
2004	No	60	5.06	5.25
2005	No	60	4.46	3.9
2006	No	60	4.29	3.03
2007	No	60	4.67	4.54
2008	No	60	3.82	3.54
2009	No	60	5.12	3.32
2010	No	60	5.15	n/a
1995	No	120	n/a	5.73
1996	No	120	4.99	3.52
1997	No	120	4.65	2.46
1998	No	120	4.51	5.52
1999	No	120	5.02	5.41
2000	No	120	5.75	3.46
2001	No	120	6.13	6.84
2002	No	120	5.61	2.52
2003	No	120	3.94	2.1
2004	No	120	6.4	6.42
2005	No	120	5.34	4.58
2006	No	120	4.21	3.27
2007	No	120	4.89	4.84
2008	No	120	3.85	4.02
2009	No	120	6.69	3.95
2010	No	120	6.01	n/a
1995	Yes	0	n/a	2.64
1996	Yes	0	2.87	1.95
1997	Yes	0	2.24	1.77
1998	Yes	0	2.06	2.49
1999	Yes	0	1.91	1.85
2000	Yes	0	2.83	1.99
2001	Yes	0	1.84	2.43
2002	Yes	0	1.49	0.98
2003	Yes	0	1.73	0.45
2004	Yes	0	1.86	1.86
2005	Yes	0	1.8	2.1
2006	Yes	0	1.82	0.98
2007	Yes	0	1.36	1.07
2008	Yes	0	1.59	2
2009	Yes	0	1.64	1.31
2010	Yes	0	1.75	n/a
1995	Yes	60	n/a	5.18
1996	Yes	60	5.16	4.78
1997	Yes	60	4.21	3.22
1998	Yes	60	4.14	4.92
1999	Yes	60	4.22	4.63
2000	Yes	60	5.31	5.42
2001	Yes	60	4.62	5.91
2002	Yes	60	4.03	2.61
2003	Yes	60	3.64	2.93
2004	Yes	60	4.88	5.02
2005	Yes	60	4.46	4.54
2006	Yes	60	4.66	3.43
2007	Yes	60	4.8	5.05
2008	Yes	60	4.21	4.69
2009	Yes	60	4.95	3.83
2010	Yes	60	4.82	n/a
1995	Yes	120	n/a	6.24
1996	Yes	120	5.4	5.18
1997	Yes	120	4.45	3.37
1998	Yes	120	4.49	5.92
1999	Yes	120	5.08	5.71
2000	Yes	120	6.2	6.18
2001	Yes	120	6.42	6.96
2002	Yes	120	5.62	3.06
2003	Yes	120	5.91	3.43
2004	Yes	120	7.09	7.2
2005	Yes	120	6.18	5.57
2006	Yes	120	6.04	3.73
2007	Yes	120	5	6.39
2008	Yes	120	6.61	6.3
2009	Yes	120	7.04	5.4
2010	Yes	120	6.06	n/a

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