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SUPPLEMENTARY MATERIALS

Table S1 – Main inventory data for maize cultivation in Farm 1

Section	Operation	Diesel (kg/ha)	Input other than diesel	Amount
(1) Soil tillage and seeding	Organic fertilisation	12.79	Cattle manure (0.4% of nitrogen content)	80 t/ha
	Ploughing	29.48		
	Harrowing	23.53		
	Seeding	7.53	Seeds	20 kg/ha
(2) Crop management	Weed control pre germination	4.35	Adengo (*Isoxaflutole, Thiencarbazone-methyl, Cyprosulfamide*)	0.4 l/ha
	Weed control post germination	4.35	Ghibli 240 OD (*Nicosulfuron*)	0.25 l/ha
			Joker (*Dicamba*)	1 l/ha
	Mineral fertilisation	3.87	Urea	250 kg/ha
			Fighter (*Deltametrina*)	0.5 l/ha
	Pesticide (II rep.)	4.35	Valiant flash (*Cymoxanil, Folpet, Fosetil*)	0.1 l/ha
(3) Harvesting and ensiling	Harvesting	54.70		
	Transport	-		
	Ensiling	-		

Table S2 – Main inventory data for maize cultivation in Farm 2

Section	Operation	Diesel (kg/ha)	Input other than diesel	Amount
(1) Soil tillage and seeding	Organic fertilisation	46.68	Slurry	90 t/ha
	Ploughing	24.08		
	Harrowing	20.17		
	Seeding	7.53	Seeds	20 kg/ha
(2) Crop management	Cocus Maize Impact	3.96	Calcium oxide Sulphur dioxide	0.1 kg/ha
	Weed control post germination	3.96	Adengo (*Isoxaflutole, Thiencarbazone methyl, Cyprosulfamide*)	0.40 l/ha
	Hoeing	9.07		
(3) Harvesting and ensiling	Harvesting	54.10		
	Transport	-		
	Ensiling	-		

Table S3 – Main inventory data for maize cultivation in Farm 3

Section	Operation	Diesel (kg/ha)	Input other than diesel	Amount
(1) Soil tillage and seeding	Organic fertilisation	33.21	Cattle slurry	60 t/ha
	Ploughing	25.55		
	Harrowing	22.95		
	Lay drip irrigation	3.46	Plastic pipes	8453 m
	Seeding	11.70	Seeds	19.69 kg/ha
(2) Crop management	Weed control pre germination	3.56	Adengo (*Isoxaflutole, Thiencarbazone-methyl, Cyprosulfamide*)	0,44 l/ha
	Mineral fertilisation	3.53	Zinc	0.6 t/ha
(3) Harvesting and ensiling	Harvesting	32.34		
	Transport	-		
	Ensiling	-		
	Remove drip irrigation	3.46		

Table S4 – Main inventory data for maize cultivation in Farm 4

Section	Operation	Diesel (kg/ha)	Input other than diesel	Amount
(1) Soil tillage and seeding	Organic fertilisation	43.08	Cattle slurry	75 t/ha
	Ploughing	30.41		
	Harrowing (II rep.)	26.90		
	Seeding	7.21	Seeds	16 kg/ha
(2) Crop management	Weed control post germination	3.17	Adengo (*Isoxaflutole, Thiencarbazone-methyl, Cyprosulfamide)*	0.44 l/ha
	Mineral fertilisation	3.53	Urea	320 kg/ha
	Pesticide	3.17	Coragen (*Chlorantraniliprole*)	125 mL/ha
			Audace (*Deltametrina*)	0.75 l/ha
(3) Harvesting and ensiling	Harvesting	60.38		
	Transport	-		
	Ensiling	-		

Table S5 – Results for Single point Environmental Footprint 3.1 (adapted) V1.00 / EF 3.1 normalization and weighting set

Impact category	Unit	Farm 1 – Pivot	Farm 2 - Flood	Farm 3 - Drip	Farm 4 - Hose
Total	mPt	76.432	103.983	38.704	78.144
Acidification	mPt	14.317	4.871	2.374	9.460
Climate change	mPt	3.301	3.346	3.496	5.783
Ecotoxicity, freshwater	mPt	8.370	0.242	0.097	8.588
Particulate matter	mPt	13.362	4.360	2.051	8.658
Eutrophication, marine	mPt	4.978	6.795	9.776	15.444
Eutrophication, freshwater	mPt	2.169	1.495	0.627	2.316
Eutrophication, terrestrial	mPt	11.972	4.082	1.977	7.886
Human toxicity, cancer	mPt	0.025	0.018	0.017	0.046
Human toxicity, non-cancer	mPt	0.051	0.028	0.048	0.085
Ozone depletion	mPt	0.004	0.005	0.005	0.007
Photochemical ozone formation	mPt	0.367	0.552	0.433	0.816
Resource use, fossils	mPt	0.988	0.879	0.719	1.843
Res. use, minerals and metals	mPt	0.322	0.231	0.394	0.564
Water use	mPt	16.163	77.027	16.647	16.576

Table S6 – Sensitivity analysis results: Impact variations considering an average yield of 24.05 t/ha for all the farms. Greener patterns indicate a higher impact reduction compared to the absolute values reported in *Table 3*, while redder patterns indicate a higher impact increase.

Impact category	Farm 1 Pivot	Farm 2 Flood	Farm 3 Drip	Farm 4 Hose
Acidification	4.44%	-2.73%	15.10%	-16.81%
Climate change	4.36%	-2.67%	14.92%	-16.59%
Ecotoxicity, freshwater	4.45%	-2.67%	14.52%	-16.83%
Particulate matter	4.45%	-2.74%	15.13%	-16.82%
Eutrophication, marine	16.58%	-8.86%	45.73%	-31.64%
Eutrophication, freshwater	4.44%	-2.73%	15.11%	-16.79%
Eutrophication, terrestrial	4.45%	-2.73%	15.11%	-16.81%
Human toxicity – cancer	4.23%	-2.32%	14.26%	-15.98%
Human toxicity - non cancer	4.23%	-2.17%	14.56%	-15.82%
Ozone depletion	4.38%	-2.71%	15.02%	-16.68%
Photochemical ozone formation	4.22%	-2.59%	14.56%	-16.29%
Resource use – fossils	4.28%	-2.57%	14.45%	-16.40%
Resource use - minerals and metals	4.27%	-2.50%	14.74%	-16.27%
Water use	4.45%	-2.74%	15.18%	-16.84%

Table S7 – Sensitivity analysis results: Impact variations considering mass allocation between maize stalks and ear maize silage instead of economic allocation. Greener patterns indicate a higher impact reduction compared to the absolute values reported in *Table 3*, while redder patterns indicate a higher impact increase.

Impact category	Farm1 Pivot	Farm 2 Flood	Farm 3 Drip	Farm 4 Hose
Acidification	-19.10%	-27.45%	-14.62%	-16.55%
Climate change	-17.18%	-25.28%	-13.49%	-15.46%
Ecotoxicity, freshwater	-19.15%	-25.53%	-11.28%	-16.65%
Particulate matter	-19.14%	-27.56%	-14.76%	-16.60%
Eutrophication, marine	-37.75%	-48.01%	-15.51%	-21.89%
Eutrophication, freshwater	-18.98%	-27.38%	-14.47%	-16.49%
Eutrophication, terrestrial	-19.12%	-27.51%	-14.69%	-16.57%
Human toxicity – cancer	-14.35%	-19.18%	-8.95%	-13.80%
Human toxicity - non cancer	-15.70%	-19.61%	-11.97%	-14.48%
Ozone depletion	-17.09%	-26.03%	-13.81%	-15.62%
Photochemical ozone formation	-14.00%	-23.33%	-11.37%	-14.18%
Resource use – fossils	-15.16%	-21.80%	-10.42%	-14.39%
Resource use - minerals and metals	-15.43%	-20.98%	-12.58%	-14.50%
Water use	-16.17%	-26.90%	-12.82%	-13.95%

Table S8 – Sensitivity analysis results: Impact variations considering a ±10% variation of energy consumption for irrigation. Greener patterns indicate a higher impact reduction compared to the absolute values reported in *Table 3*, while redder patterns indicate a higher impact increase.

		Farm 1 Pivot		Farm 2 Flood		Farm 3 Drip		Farm 4 Hose	
		-10%	+10%	-10%	+10%	-10%	+10%	-10%	+10%
Impact category	Acidification	-0.04%	0.04%	-0.12%	0.53%	-0.04%	0.04%	-0.14%	0.16%
	Climate change	-0.89%	0.98%	-0.35%	3.92%	-0.06%	0.07%	-1.15%	1.27%
	Ecotoxicity, freshwater	-0.02%	0.02%	-0.22%	3.64%	-0.35%	0.38%	-0.05%	0.06%
	Particulate matter	-0.01%	0.01%	-0.07%	0.17%	-0.05%	0.05%	-0.05%	0.05%
	Eutrophication, marine	-0.06%	0.07%	-1.47%	3.22%	0.00%	0.00%	-0.05%	0.05%
	Eutrophication, freshwater	-0.02%	0.02%	-0.03%	0.07%	-0.18%	0.20%	-0.02%	0.02%
	Eutrophication, terrestrial	-0.04%	0.04%	-0.68%	0.52%	-0.01%	0.01%	-0.14%	0.15%
	Human toxicity – cancer	-0.70%	0.77%	-3.88%	4.14%	-1.96%	2.15%	-0.80%	0.88%
	Human toxicity – non cancer	-0.50%	0.55%	-2.66%	3.44%	-2.54%	2.80%	-0.59%	0.65%
	Ozone depletion	-0.75%	0.83%	-1.29%	2.14%	-0.11%	0.12%	-0.83%	0.92%
	Photochemical ozone form.	-2.32%	2.56%	-5.82%	7.33%	-0.11%	0.12%	-2.47%	2.71%
	Resource use, fossils	-1.78%	1.95%	-8.80%	9.05%	-0.17%	0.19%	-2.12%	2.33%
	Res. Use, minerals and metals	-0.10%	0.11%	-0.22%	0.35%	-2.40%	2.64%	-0.07%	0.08%
	Water use	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table S9 – Absolute environmental results using the ReCiPe 2016 Midpoint (H) V1.08 characterisation method.

		Unit	Farm 1 Pivot	Farm 2 Flood	Farm 3 Drip	Farm 4 Hose
Impact category	Global warming	kg CO_2 eq	124.99	127.04	133.76	218.45
	Stratospheric ozone depletion	g CFC11 eq	2.44	2.74	3.43	4.02
	Ozone formation, Human health	kg Nox eq	0.22	0.38	0.30	0.52
	Fine particulate matter form.	Kg PM2.5 eq	1.07	0.42	0.23	0.78
	Ozone form., Terrestrial ecosyst.	Kg Nox eq	0.23	0.39	0.31	0.54
	Terrestrial acidification	kg SO_2 eq	8.31	2.80	1.36	5.46
	Freshwater eutrophication	kg P eq	0.13	0.09	0.04	0.13
	Marine eutrophication	kg N eq	0.84	1.25	1.87	2.90
	Terrestrial ecotoxicity	kg 1,4-DCB	120.85	43.99	137.14	190.15
	Freshwater ecotoxicity	kg 1,4-DCB	1.33	0.64	2.37	2.19
	Marine ecotoxicity	kg 1,4-DCB	1.52	0.68	2.98	2.69
	Human carcinogenic toxicity	kg 1,4-DCB	1.88	0.96	1.35	3.57
	Human non-carcinogenic tox.	Kg 1,4-DCB	18.16	10.46	23.86	34.59
	Mineral resource scarcity	kg Cu eq	0.20	0.20	0.20	0.39
	Fossil resource scarcity	kg oil eq	17.73	15.55	12.60	33.01
	Water consumption	m^3	48.69	231.75	50.58	50.54

Table S10 – List of processes retrieved from the Ecoinvent® 3.9 database.

Ecoinvent Process	Used for modelling of	Modification
Agricultural machinery, tillage {GLO}| market for agricultural machinery, tillage | Cut-off, U	Field operations performed with implement that work and/or in contact with the soil (e.g., ploughing, harrowing and seeding).	The mass of the different equipment was calculated for each operation considering their mass (kg), annual use (h/year) and lifespan (year).
Agricultural machinery, unspecified {GLO}| market for agricultural machinery, unspecified | Cut-off, U	Field operations performed with non-soil contact implement (e.g., fertilisation, pest control, weeding, irrigation, harvesting and transport).	
Tractor, 4-wheel, agricultural {GLO}| market for tractor, 4-wheel, agricultural | Cut-off, U	All the field operations carried out with a tractor	
Diesel {Europe without Switzerland}| market for diesel | Cut-off, U	Fuel consumption during field operations	n/a
Maize seed, at farm {GLO}| market for maize seed, at farm| Cut-off, U	Maize seed used for seeding	n/a
Manure, solid, cattle {GLO}| market for manure, solid cattle| Cut-off, U	Fertiliser consumption of in organic cultivation	n/a
Transport, tractor and trailer, agricultural {CH}| market for transport, tractor and trailer, agricultural| Cut-off, U	Transportation of the product obtained on the farm for ensiling and organic fertiliser (digestate, manure or slurry)	n/a
Pesticide, unspecified {GLO}| market for pesticide, unspecified| Cut-off, U	Active ingredients such as: Isoxaflutolete (Herbicide), Thiencarbazone (Herbicide), Cyprosulfamide (Herbicide)	n/a
[sulfonyl]urea-compound {GLO}| market for [sulfonyl]urea-compound| Cut-off, U	Active ingredient Nicosulfuron (Herbicide)	n/a
Pyrethroid-compound {GLO}| market for pyrethroid-compound| Cut-off, U	Active ingredient Deltametrina (Insecticide)	n/a
Benzoic-compound {GLO}| market for benzoic-compound|Cut-off, U	Active ingredient Dicamba (Herbicide)	n/a
[thio]carbamate-compound {GLO}| market for [thio]carbamate-compound| Cut-off, U	Active ingredient Cymoxanil (Fungicide)	n/a
Folpet {GLO}| market for folpet| Cut-off, U	Active ingredient Folpet (Fungicide)	n/a
Fosetyl-Al {GLO}| market for fosetyl-Al| Cut-off, U	Active ingredient Fosetyl (Fungicide)	n/a
Acetamide-anilide-compound, unspecified {GLO}| market for acetamide-anilide-compound, unspecified| Cut-off, U	Active ingredient Chlorantraniliprole (Insecticide)	n/a
Electricity, medium voltage {IT}|market for electricity, medium voltage| Cut-off, U	Pivot handling	n/a
Urea {RER}|market for urea| Cut-off, U	Mineral fertiliser consumption	n/a

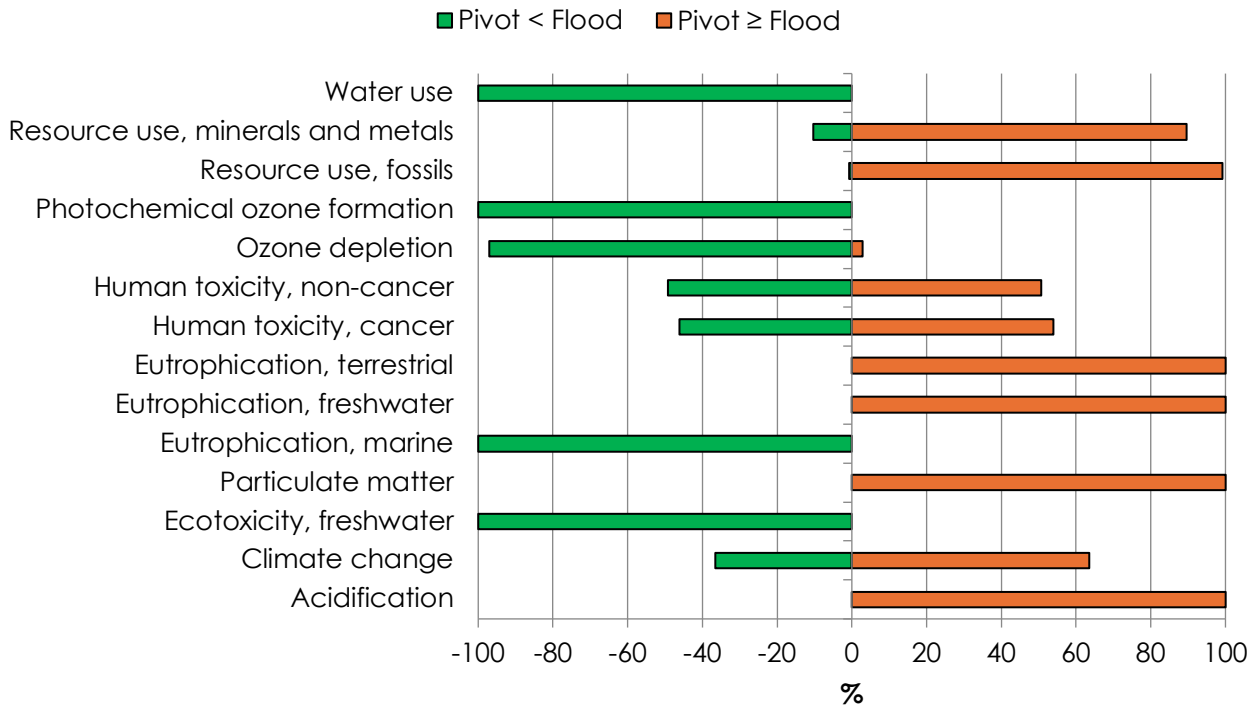

Figure S1 – Results for the uncertainty analysis: Comparison between Farm 1 with Pivot and Farm 2 with Flood using the Montecarlo technique (1000 iterations and a confidence interval of 95%).

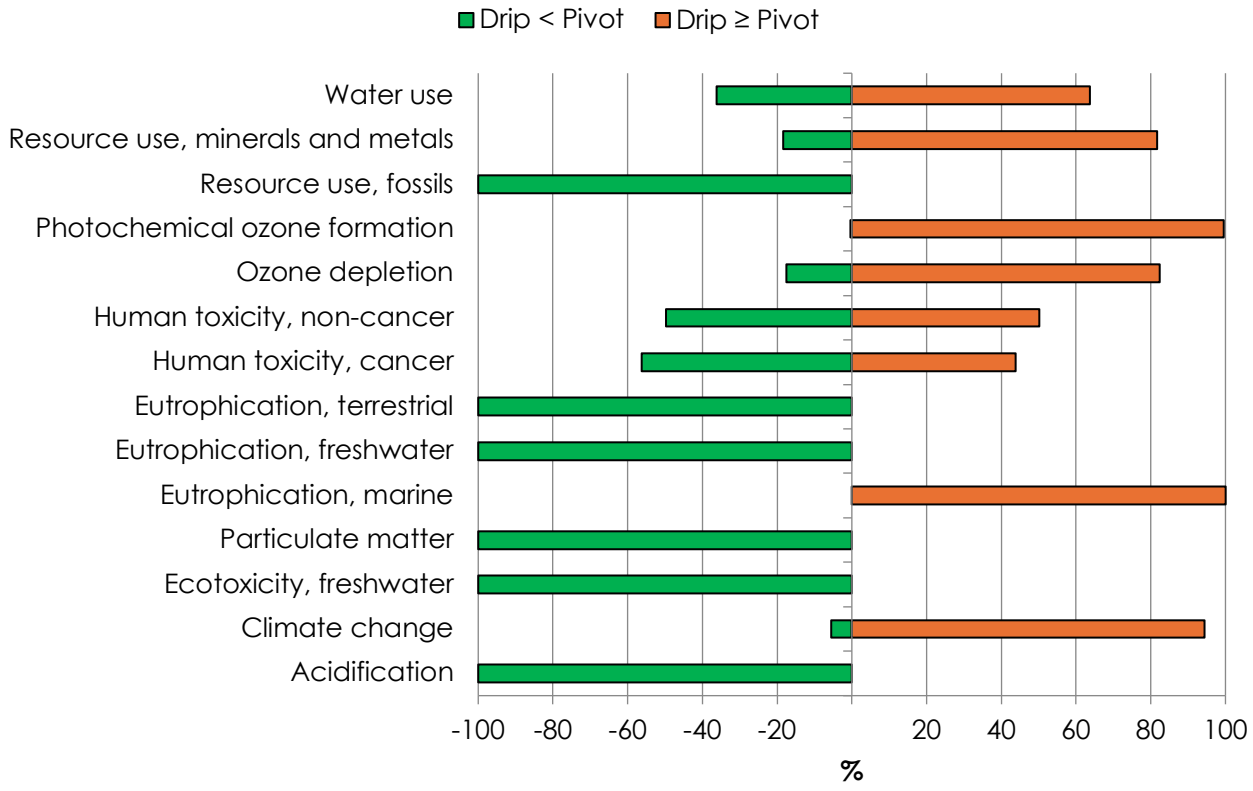

Figure S2 – Results for the uncertainty analysis about the comparison between Farm 1 with Pivot and Farm 3 with Drip using the Montecarlo technique (1000 iterations and a confidence interval of 95%).

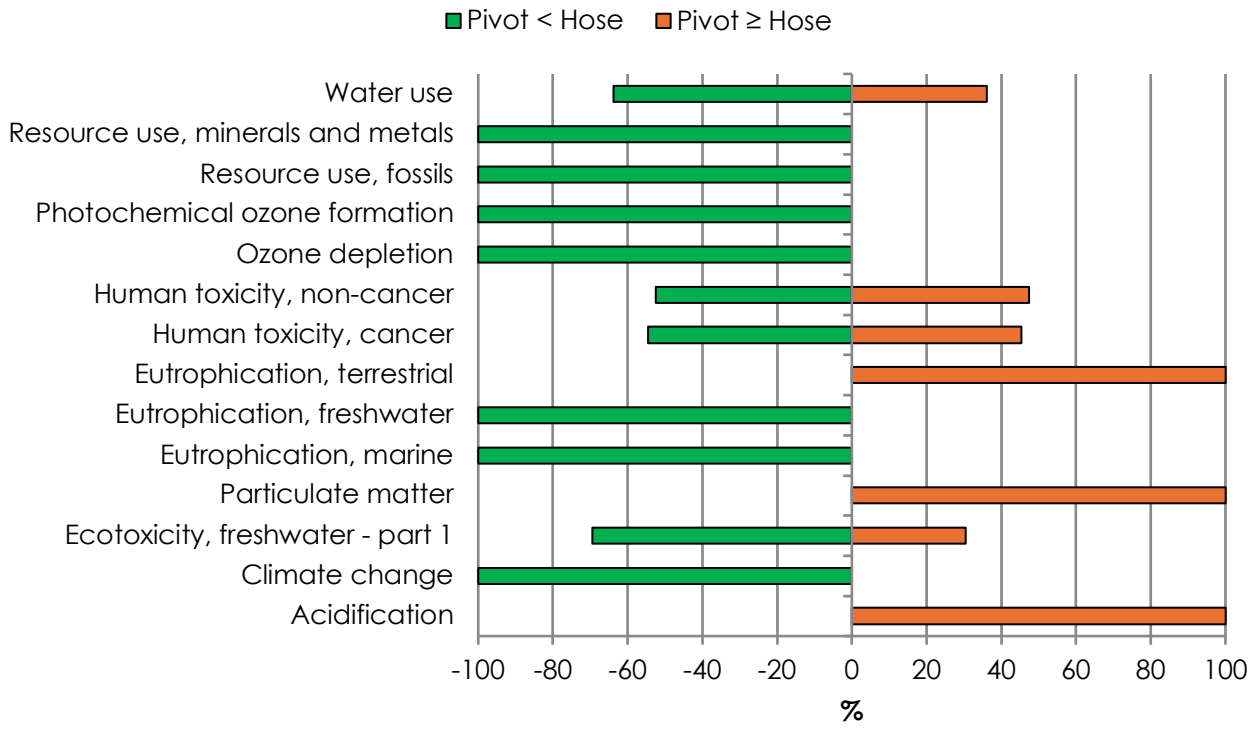

Figure S3 – Results for the uncertainty analysis about the comparison between Farm 1 with Pivot and Farm 4 with Hose using the Montecarlo technique (1000 iterations and a confidence interval of 95%).

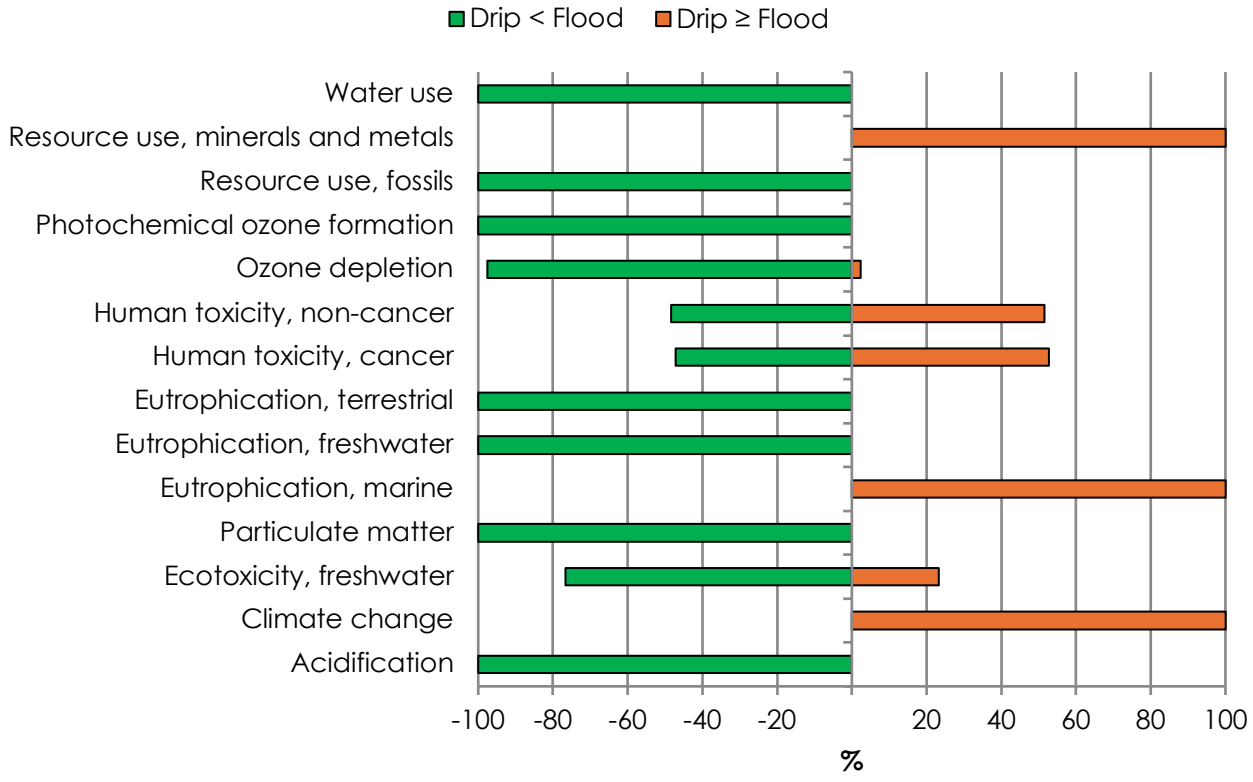

Figure S4 – Results for the uncertainty analysis about the comparison between Farm 2 with Flood and Farm 3 with Drip using the Montecarlo technique (1000 iterations and a confidence interval of 95%).

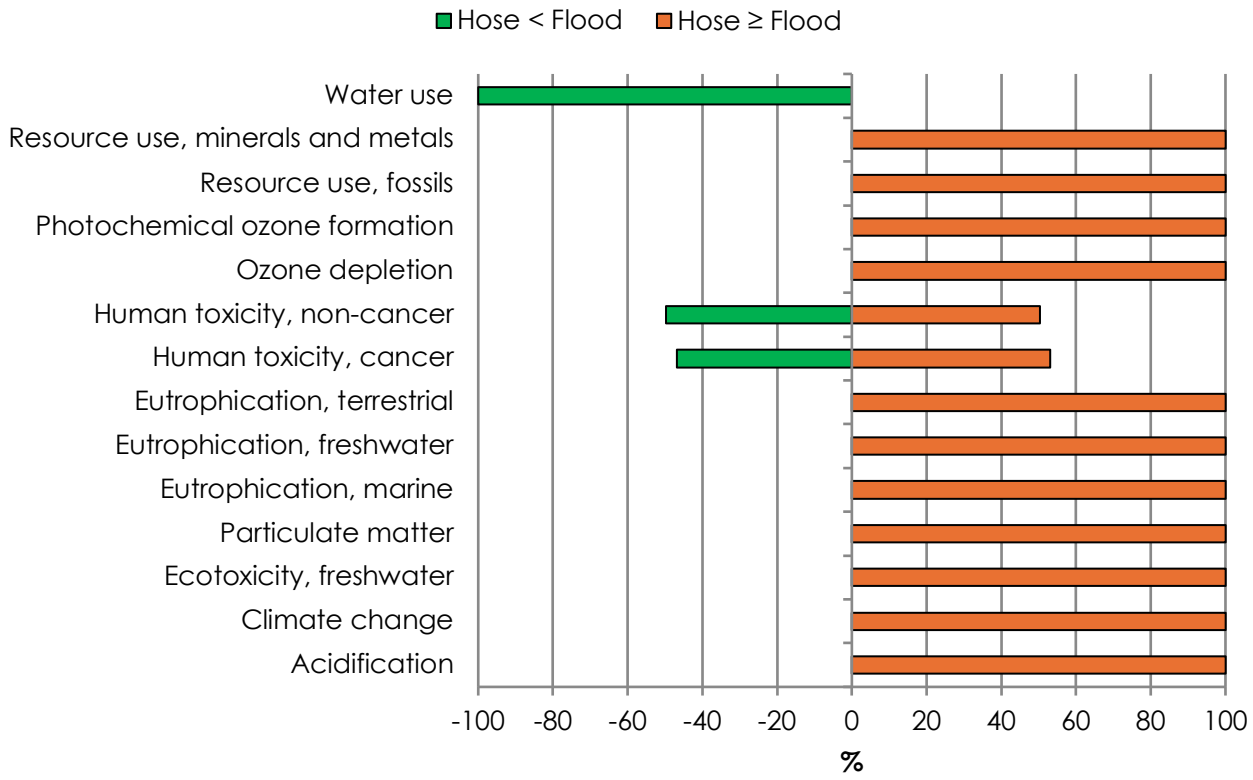

Figure S5 – Results for the uncertainty analysis about the comparison between Farm 2 with Flood and Farm 4 with Hose using the Montecarlo technique (1000 iterations and a confidence interval of 95%).

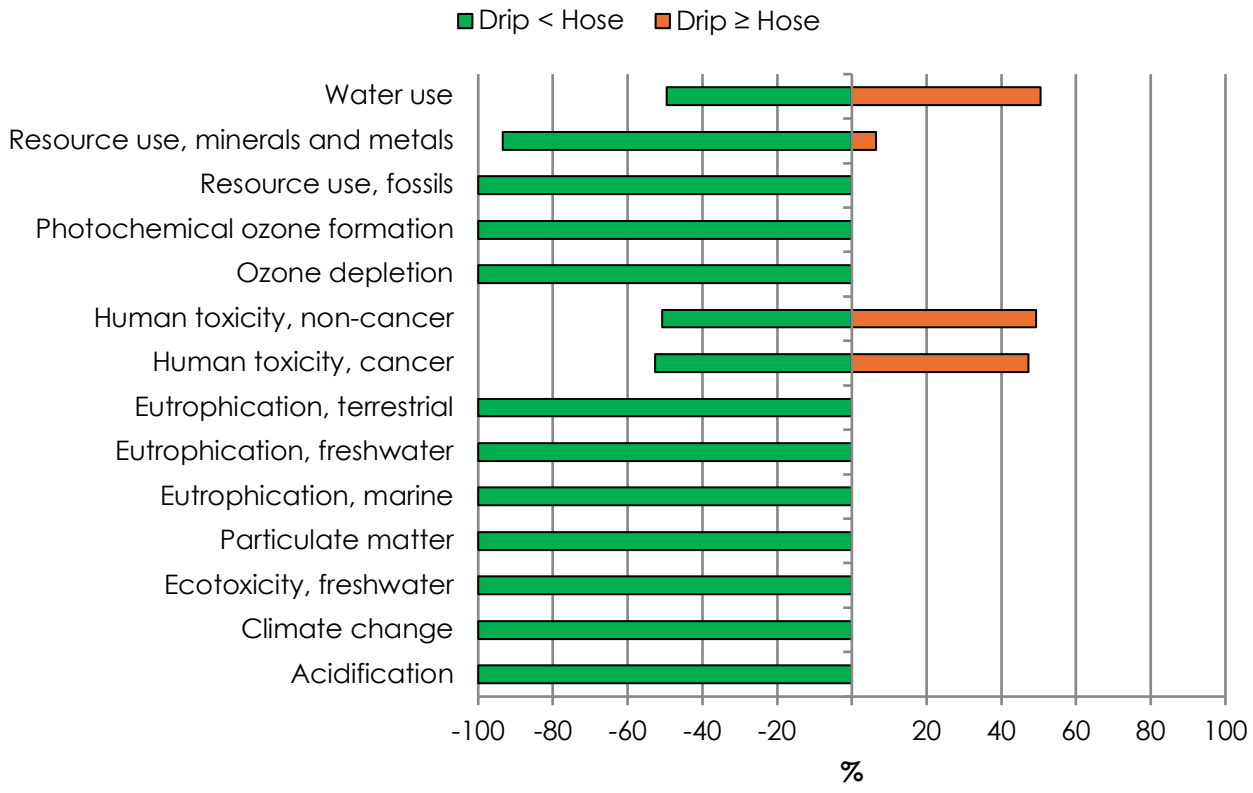

Figure S6 – Results of the uncertainty analysis about the comparison between Farm 4 with Hose and Farm 3 with Drip using the Montecarlo technique (1000 iterations and a confidence interval of 95%).