

animals-2104482 Supplementary Materials

Table S1. Life Cycle Inventory (CI) inputs and outputs.

Life Cycle Phases	Inputs	Outputs
Hive placement (winter)	Beehives	Beehives with honeybees
	Wooden frame	
	Beehive paint	
	Supplemental feeding	
	Beeswax	
	Medication	
	Electricity	
	Beekeeping equipment	
Hive placement (summer)	Transportation	Beehives filled with honey Co-products: honeycombs
	Beehives	
	Wooden frame	
	Beehive paint	
	Supplemental feeding	
	Beeswax	
	Medication	
	Beekeeping equipment	
Honey extraction	Transportation	Honey Co-products: beeswax, propolis, royal jelly
	Uniform	
	Gloves	
	Lab coats	
	Electricity	
	Water	
	Machines	
	Filters	

2020								2021					
Inputs	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6
Transport for hive placement (winter)	km/hive	109.0	22.0	12.0	0	0	0	110.0	5.2	16.0	0	0	0
Transport for hive placement (summer)	km/hive	41.0	23.0	14.0	0	0	0	12.0	5.2	14.0	0	0	0
Medication	gr/hive	66.0	66.0	51.0	2.4	53.0	28.7	356.1	53.2	1002.6	1.1	81.8	28.3
Supplemental feeding	kg/hive	15.0	13.0	0.7	1.2	2.0	1.5	15.0	17.0	4.0	10	3	1.5
Electricity (Maintain the frames)	kWh/hive	3.54	3.52	4.03	1.67	3.55	3.54	0.94	0.24	3.06	0.1	0.9	1.1
Beekeeping equipment	kg/hive	1.2	1.2	0.4	0.1	0.4	0.1	0.7	1.6	0.9	0.6	0.8	0.1
Wood (Wooden frame)	m³/hive	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Beehive Paint	kg/hive	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Outputs	Amount	Unit											
Hive	One	Item											

2020								2021					
Inputs	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6
Water	l/honey	30.0	29.0	61.0	4.4	22.4	17.4	14.5	25.0	66.0	6.4	14.6	0.3
Electricity (<i>Honey extraction</i>)	kWh/honey	0.7	0.5	0.6	0.3	0.5	0.4	0.4	0.8	1.2	0.7	0.5	0.6
Beekeeping Clothing (<i>Uniform, gloves, lab coat</i>)	gr/honey	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Honey Extraction equipment (<i>Machines</i>)	kg/honey	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.5	0.4	0.2	0.6	1.1
Outputs	Amount	Unit											
Honey	One	kilogram											

Table S4. Collecting meteorological data.

	Temperature	Temperature	Precipitation	Precipitation	Days with Rain	Days with Rain
	<i>Mean</i>	<i>Mean</i>	<i>Millimeters</i>	<i>Millimeters</i>	<i>Number</i>	<i>Number</i>
	2020	2021	2020	2021	2020	2021
44°25' N 10°12' E						
Jan	10.1	4.3	63.8	261.0	8	13
Feb	12.2	7.9	65.2	134.4	8	11
Mar	12.1	8.6	133.8	26.6	9	5
Apr	17.7	10.2	49.0	129.2	2	10
May	21.7	13.2	85.0	160.8	7	15
Jun	23.1	20.4	183.2	26.8	8	4
Jul	27.5	22.3	23.2	40.6	3	5
Aug	27.6	22.1	151.0	90.2	6	8
Sep	23.8	19.7	58.2	275.6	8	6
Oct	16.0	13.4	241.2	93.8	13	6
Nov	14.1	9.7	43.4	154.0	8	12
Dec	8.7	6.3	424.6	139.4	21	12
	17.9	13.2	1521.6	1532.4	101	107
44°40' N 10°27' E						
Jan	4.4	1.7	13.0	207.6	5	14
Feb	7.5	5.0	14.8	82.4	4	9
Mar	5.6	6.0	155.8	6.6	15	3
Apr	10.4	8.0	65.6	110.4	5	12
May	14.8	13.2	98.2	77.8	10	10
Jun	17.5	20.0	96.6	56.6	13	3
Jul	20.7	21.7	52.4	17.8	6	6
Aug	21.5	21.0	177.4	42.0	7	4
Sep	16.6	17.3	69.0	168.2	10	5
Oct	10.5	10.2	172.4	57.2	17	9
Nov	7.3	6.5	32.0	181.8	5	19
Dec	3.2	3.7	378.6	79.4	21	14
	11.7	11.2	1325.8	1087.8	118	108
43°78' N 11°32' E						
Jan	7.9	6.4	51.8	144.2	5	15
Feb	10.1	9.7	32.0	79.2	5	7
Mar	10.4	10.5	57.6	4.0	5	1
Apr	14.4	12.3	36.6	83.2	4	7
May	18.9	16.7	61.6	57.0	7	11
Jun	21.4	23.6	41.8	12.4	8	3
Jul	25.2	25.6	24.6	14.6	2	1
Aug	26.3	25.7	26.8	17.6	3	3
Sep	22.1	21.8	38.0	68.8	8	6
Oct	14.6	15.6	169.4	33.4	10	3
Nov	12.3	12.3	25.4	111.4	5	14
Dec	8.2	7.7	160.0	167.2	17	4
	16.0	15.7	725.6	793.0	79	75
44°66' N 11°33' E						
Jan	3.0	2.0	21.6	32.8	16	17

Feb	6.8	6.4	1.2	16.0	6	9
Mar	8.5	7.5	18.8	9.0	11	5
Apr	12.8	10.6	23.2	46.6	3	1
May	18.2	16.2	15.2	45.0	8	3
Jun	20.8	23.0	70.4	27.4	10	4
Jul	23.8	25.0	62.8	51.8	9	6
Aug	24.8	24.6	128.4	62.8	10	6
Sep	20.2	20.5	66.8	24.8	13	6
Oct	13.3	13.2	65.2	11.2	17	6
Nov	8.6	9.1	24.2	88.0	14	20
Dec	5.0	2.4	151.6	25.2	21	16
	13.8	13.4	649.4	440.6	138	99
44°81' N 10°80' E						
Jan	3.4	1.7	20.4	50.2	17	17
Feb	7.6	6.3	1.2	23.8	5	9
Mar	8.9	7.8	38.2	1.0	8	5
Apr	14.0	11.0	22.6	59.4	5	14
May	19.8	16.6	25.0	56.2	9	8
Jun	21.7	23.3	27.8	48.4	8	4
Jul	24.4	24.6	66.2	15.8	6	6
Aug	25.2	23.7	77.2	29.6	7	6
Sep	21.3	19.7	66.0	42.2	10	6
Oct	13.3	12.3	90.8	28.0	13	6
Nov	8.8	8.6	20.0	108.2	11	19
Dec	4.5	1.9	167.6	65.0	11	15
	14.4	13.1	623.0	527.8	110	115
44°50' N 10°45' E						
Jan	2.7	1.7	24.4	50.2	18	17
Feb	7.1	6.3	1.0	23.8	7	8
Mar	8.4	7.8	32.4	1.0	12	3
Apr	12.9	11.0	39.4	59.4	6	8
May	18.4	16.6	22.6	56.2	6	8
Jun	20.9	23.3	80.8	48.4	9	2
Jul	23.9	24.6	86.4	15.8	9	6
Aug	24.6	23.7	141.2	29.6	6	5
Sep	19.7	19.7	36.2	42.2	9	8
Oct	12.8	12.3	87.6	28.0	10	6
Nov	8.3	8.6	21.2	108.2	18	23
Dec	4.6	1.9	196.2	65.0	14	21
	13.7	13.1	769.4	527.8	124	115

Table S5. Contributions to Carbon Footprint (% of total impact) of honey production and yield in the two years of survey.

	2020						2021					
	Hive Management (Spring-Summer Season)		Hive Management (Winter Season)		Honey Extraction		Hive Management (Spring-Summer Season)		Hive Management (Winter Season)		Honey Extraction	
	Kg CO ₂ e/kg of Honey	% Total Impact	Kg CO ₂ e/kg of Honey	% Total Impact	Kg CO ₂ e/kg of Honey	% Total Impact	Kg CO ₂ e/kg of Honey	% Total Impact	Kg CO ₂ e/kg of Honey	% Total Impact	Kg CO ₂ e/kg of Honey	% Total Impact
Farm 1	1.19	55%	0.59	27%	0.39	18%	1.72	41%	2.23	53%	0.24	6%
Farm 2	0.87	48%	0.56	32%	0.35	20%	1.22	42%	1.22	42%	0.47	16%
Farm 3	0.68	43%	0.44	28%	0.45	28%	0.9	42%	0.46	21%	0.81	37%
Farm 4	0.026	6%	0.14	33%	0.25	61%	0.25	26%	0.26	26%	0.46	48%
Farm 5	0.007	2%	0.17	37%	0.28	61%	0.03	4%	0.36	47%	0.38	49%
Farm 6	0.006	2%	0.12	34%	0.24	64%	0.004	2%	0.1	19%	0.41	79%