

1 **Supplementary material**

2 1 Supplementary information on field trial

3 The soil in this field trial was an acidic clay loam soil (44 % sand, 30 % silt, 26 % clay, all w/w) with a
4 pH of 6.0, 3.47 mg/kg nitrate N, 0.84 mg/kg ammonium N, and 16.2 kgN/ha available N in the top 30
5 cm, 42.0 mg/L available P, 130 mg/L available K and 88.5 mg/L available Mg. Organic matter loss on
6 ignition was 7.7 % w/w and the cation exchange capacity was 17.4 cmol(+)/kg (analyses performed
7 on soil sampled in March 2017 before applying fertilisers).

8 The herbicide solution contained 200 L water, 1 L Optica (Headland Agrochemicals Ltd., Flintshire,
9 UK), 21 g ALLY MAX SX (Du Pont UK Ltd., Herts, UK) and 0.45 L AXIAL (Syngenta UK Ltd, Cambridge,
10 UK), and 1 L of the adjuvant ADIGOR (Syngenta UK Ltd, Cambridge, UK), and was applied at a rate of
11 ca. 200 L/ha.

12 In order to take the differential amounts of husks and de-husked grains into account when consuming
13 whole grains (including husks), their respective weights were determined. In our samples, a typical
14 grain including the husk and bran, but not the awn, consisted of 9 ± 0.5 % husk and 91 ± 0.5 % grain
15 (including bran; values in weight percent, denoting average $\pm 1 \sigma$ including all plots).

16 2 Supplementary tables and figures

17 **Table S.1** *ICP-MS parameters*

Operating Conditions	
ICP-MS	Agilent 8800 ICP-QQQ-MS
ICP RF Power (W)	1550
Plasma gas	Ar
nebulizer gas flow (L min ⁻¹)	1.18
nebulizer type	MicroMist Nebulizer
sample uptake rate (mL min ⁻¹)	ca. 0.5 mL/min
sampler cone	nickel
skimmer cone	nickel
reaction/collision gas flows (mL min ⁻¹)	
He	3.9
H ₂	3.7
O ₂	0.3
integration time	0.1 or 0.2, depending on isotope
detection mode	dual
internal standard	¹⁰³ Rh and ⁸⁹ Y with various gases
<i>m/z</i> measured	
no additional gas	11 (B), 59 (Co), 66 (Zn), 86 (Sr), 95 & 98 (Mo), 111 (Cd), 206–208 (Pb)
with He	51 (V), 52 (Cr), 60 (Ni)
with H ₂	52 (Cr), 75 (As)
with O ₂	67 (V), 91 (As)

18

19

20 **Table S.2** *MP-AES parameters*

Operating Conditions	
MP-AES	Agilent 4200 MP-AES
Plasma gas	N ₂
nebulizer pressure	160 kPa
nebulizer type	pneumatic nebulizer with cyclonic spray chamber
sample introduction system	Autosampler Agilent Technologies SPS 3
wavelengths measured	213.857 nm (Zn), 371.993 nm (Fe), 285.213 nm (Mg), 324.754 nm (Cu), 396.847 nm (Ca), 403.076 (Mn), 407.771 nm (Sr), 769.897 nm (K)

21

22 **Table S.3** Recovery of certified reference materials in MP-AES analyses; values in brackets indicate
 23 expanded uncertainty about the mean to cover the measurand with approximately 95 % confidence

Reference Material		Zn	Fe	Mg	Cu	Ca	Mn	Sr	K
NIST1568a (rice flour)	certified (mg/kg) recovery	19.4 (0.5) 86%	7.4 (0.9) 171%	560 (20) 69%	2.4 (0.3) 82%	118 (6) 117%	20 (1.6) 86%		1280 (8) 91%
NIST1573a (tomato leaves)	certified (mg/kg) recovery	30.9 (0.7) 71%	368 (7) 80%		4.7 (0.14) 116%	50500 (900) 101%	246 (8) 101%	85 96%	27000 (500) 107%
NIST8415 (whole egg powder)	certified (mg/kg) recovery	67.5 (7.6) 97%	112 (16) 100%	305 (27) 99%	2.7 (0.35) 108%	2480 (190) 103%	1.78 (0.38) 105%	5.63 (0.46) 104%	3190 (190) 99%
NIST3232 (kelp powder)	certified (mg/kg) recovery	27.4 (1.1) 65%	672 (13) 59%	6130 (180) 87%	3.875 (0.087) 113%	12260 (680) 93%	24.6 (1.6) 80%		

24
25
26

27 **Table S.4** Recovery of certified reference materials in ICP-MS analyses; values in brackets indicate expanded uncertainty about the mean to cover
 28 the measurand with approximately 95 % confidence; ULQ = upper limit of quantification

Reference Material		B	V	Cr	Co	Ni	Zn	As	Sr	Mo	Cd	Pb
NIST1568a (rice flour)	certified (µg/kg) recovery		7 <LOD		18 <LOD		19400 (500) 80%	290 (30) 103%		1460 (80) 92%	22 (2) <LOD	
NIST1573a (tomato leaves)	certified (µg/kg) recovery	33300 (700) 103%	835 (10) 43%	1990 (60) 96%	570 (20) 115%	1590 (70) 270%	30900 (700) 93%	112 (4) 111%	85000 100%	460 111%	1520 (40) 94%	
NIST8415 (whole egg powder)	certified (µg/kg) recovery	410 (260) 206%	459 (81) 98%	370 (180) 238%	12 (5) <LOD		67500 (7600) >ULQ	10 <LOD	5630 (460) 112%	247 (23) 102%	5 <LOD	61 (39) 117%
NIST3232 (kelp powder)	certified (µg/kg) recovery			5920 (520) 46%	307 (11) 91%		27400 (1100) 81%	38300 (1300) 95%		244.1 (9.1) 121%	425.9 (8.4) 108%	1032 (12) 68%

29

30
31
32
33
34
35
36
37
38
39
40
41

Table S.5 Selected measured compositional data of seaweed-fertilised, NPK fertilised and unfertilised bere barley grains, husks and straw with respect to selected elements; values given as weighted averages of seven single measurements (one measurement each for four replicate plots, and triplicate measurements for one replicate plot) for each treatment type $\pm 1\sigma$; letters indicate the results of one-way ANOVA and Tukey post-hoc tests, whereby different letters indicate significant differences ($p < 0.05$) between treatments for each sample type (separately for grain, husk and straw); where no significant differences were found between treatments for the plant part, no letters are given; complete set of data reported in Table S.6

Sample type	Fertilisation treatment	Fe ($\mu\text{g/g}$)	Mg ($\mu\text{g/g}$)	Cu ($\mu\text{g/g}$)	Ca ($\mu\text{g/g}$)	K (%)	V (ng/g)	Cr ($\mu\text{g/g}$)	Co (ng/g)	Ni ($\mu\text{g/g}$)	Zn ($\mu\text{g/g}$)	Pb (ng/g)
grain	no fertiliser	41.8 \pm 2.4	1228 \pm 100	4.89 \pm 0.79	380 \pm 23	0.51 \pm 0.05 a	11.5 \pm 1.5	1.73 \pm 0.18	52.0 \pm 24.1	1.23 \pm 0.22	27.07 \pm 2.4	114 \pm 60
	25 t/ha seaweed	42.1 \pm 2.2	1245 \pm 108	4.91 \pm 0.98	366 \pm 52	0.51 \pm 0.01 bc	11.3 \pm 1.0	1.80 \pm 0.20	46.4 \pm 7.2	1.22 \pm 0.31	27.58 \pm 2.0	46 \pm 16
	50 t/ha seaweed	41.5 \pm 2.5	1289 \pm 52	4.48 \pm 0.52	388 \pm 76	0.46 \pm 0.01 c	10.8 \pm 1.2	1.73 \pm 0.07	62.8 \pm 41.8	1.12 \pm 0.08	27.15 \pm 2.8	62 \pm 27
	NPK fertiliser	42.9 \pm 7.0	1238 \pm 126	5.07 \pm 1.18	379 \pm 18	0.53 \pm 0.04ab	10.7 \pm 1.7	1.58 \pm 0.14	43.8 \pm 5.8	1.34 \pm 0.32	26.54 \pm 5.5	65 \pm 42
husk	no fertiliser	23.2 \pm 9.4	572 \pm 117	6.58 \pm 1.43	854 \pm 104	1.01 \pm 0.09	21.2 \pm 3.6	1.92 \pm 0.07	50.6 \pm 3.5	1.64 \pm 0.49	7.78 \pm 2.2	130 \pm 115
	25 t/ha seaweed	23.8 \pm 6.2	642 \pm 151	6.33 \pm 3.07	851 \pm 64	1.05 \pm 0.04	19.2 \pm 4.4	1.78 \pm 0.29	46.2 \pm 5.4	1.47 \pm 0.43	6.73 \pm 0.8	105 \pm 91
	50 t/ha seaweed	16.3 \pm 2.0	699 \pm 118	4.82 \pm 0.72	874 \pm 68	0.98 \pm 0.06	16.8 \pm 1.9	1.83 \pm 0.10	47.0 \pm 2.5	1.68 \pm 0.58	7.08 \pm 1.4	72 \pm 22
	NPK fertiliser	15.2 \pm 1.8	603 \pm 192	4.85 \pm 0.55	892 \pm 83	0.94 \pm 0.06	17.5 \pm 0.4	1.87 \pm 0.07	49.1 \pm 3.1	1.59 \pm 0.18	5.39 \pm 1.1	62 \pm 9
straw	unfertilised	60.2 \pm 19.8	423 \pm 43	5.19 \pm 2.17 ab	2454 \pm 257	1.45 \pm 0.14	79.2 \pm 15.9	3.99 \pm 1.48	119.0 \pm 44.2	3.11 \pm 0.82	7.09 \pm 1.2	231 \pm 100 ab
	25 t/ha seaweed	41.8 \pm 13.8	500 \pm 41	2.62 \pm 0.58 b	2079 \pm 108	1.29 \pm 0.13	53.4 \pm 11.8	2.63 \pm 0.97	83.9 \pm 31.4	1.97 \pm 0.70	6.41 \pm 1.7	161 \pm 34 b
	50 t/ha seaweed	54.5 \pm 16.1	499 \pm 74	8.09 \pm 4.61 a	2165 \pm 186	1.38 \pm 0.07	72.3 \pm 18.9	3.58 \pm 1.18	112.3 \pm 37.6	2.55 \pm 0.90	9.87 \pm 5.0	467 \pm 281 a
	NPK fertiliser	55.7 \pm 22.8	506 \pm 60	6.86 \pm 2.37 ab	2292 \pm 378	1.34 \pm 0.15	70.8 \pm 24.3	3.66 \pm 1.75	117.2 \pm 53.7	3.67 \pm 2.71	8.38 \pm 0.8	365 \pm 84 ab

42
43

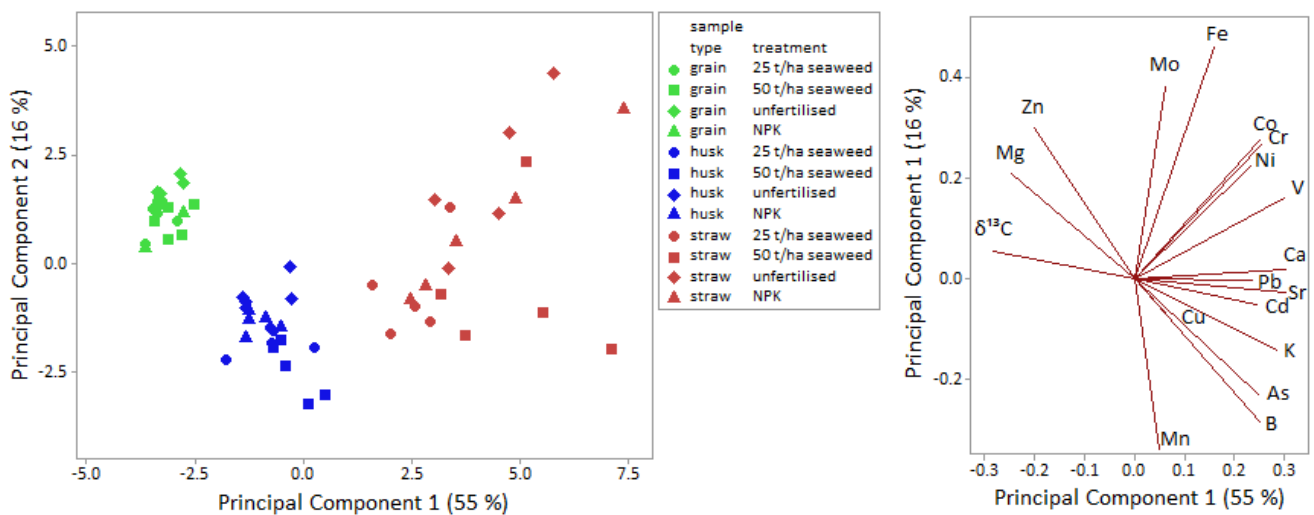
44 **Table S.6** Measured compositional data of seaweed-fertilised, NPK fertilised and unfertilised bere barley grains, husks and straw; each row
 45 indicates measurements from one plot, including averages where triplicate measurements were made; in case of husk measurements, the less
 46 reliable $\delta^{15}\text{N}$ measurements are in italics
 47

Treatment	Plot ID	Sample	Fe ($\mu\text{g/g}$)	Mg ($\mu\text{g/g}$)	Cu ($\mu\text{g/g}$)	Ca ($\mu\text{g/g}$)	Mn ($\mu\text{g/g}$)	K (%)	B ($\mu\text{g/g}$)	V (ng/g)	Cr ($\mu\text{g/g}$)	Co (ng/g)	Ni ($\mu\text{g/g}$)	Zn ($\mu\text{g/g}$)	As (ng/g)	Sr ($\mu\text{g/g}$)	Mo (ng/g)	Cd (ng/g)	Pb (ng/g)	$\delta^{13}\text{C}$ (‰)	C (%)	$\delta^{15}\text{N}$ (‰)	N (%)	C/N (molar)
no fertiliser	1L	husk	25.0	635	8.35	995	14.6	1.05	2.80	20.5	1.91	51.5	2.48	9.5	28.3	7.50	632	30.6	317.7	-28.5	44.7	<i>5.0</i>	<i>0.2</i>	262
no fertiliser	3R	husk	38.9	619	7.42	719	18.3	1.10	2.55	27.4	2.02	56.1	1.59	10.3	85.2	8.57	451	54.0	58.6	-28.1	44.6	<i>3.7</i>	<i>0.2</i>	238
no fertiliser	6L	husk	18.1	579	6.85	900	13.2	0.93	1.94	18.5	1.94	47.1	1.36	4.9	35.6	9.54	355	29.6	160.6	-27.7	45.0	3.3	1.3	68
no fertiliser	7L	husk	17.2	369	4.99	799	11.0	1.07	2.26	20.5	1.92	50.1	1.48	6.4	44.3	8.51	457	33.5	46.7	-26.8	45.0	3.7	1.6	33
no fertiliser	9R	husk	17.0	657	5.28	859	14.0	0.89	2.00	18.8	1.83	48.0	1.27	7.8	40.8	9.13	421	47.3	63.9	-28.4	44.0	<i>4.5</i>	<i>0.5</i>	112
25 t/ha seaweed	4R	husk	18.8	903	4.94	929	24.4	1.02	2.16	13.0	1.27	37.1	1.09	5.4	43.7	8.59	203	48.9	47.1	-27.7	44.7	<i>4.7</i>	<i>0.3</i>	204
25 t/ha seaweed	1R	husk	30.7	581	5.31	752	19.9	1.03	3.25	23.4	1.92	50.8	1.23	6.8	55.2	9.39	329	49.0	41.9	-28.1	44.3	3.6	0.3	163
25 t/ha seaweed	6R	husk	30.5	567	4.59	866	22.4	1.11	4.00	23.2	1.89	49.8	2.12	7.6	69.8	12.40	281	77.5	262.4	-27.4	44.2	4.0	1.0	106
25 t/ha seaweed	8L	husk	18.9	528	11.81	868	16.9	1.08	2.80	19.0	1.94	47.3	1.20	6.7	40.6	10.96	311	51.8	79.9	-27.8	44.7	<i>5.1</i>	<i>0.3</i>	158
25 t/ha seaweed	9L	husk	20.3	632	5.01	843	16.8	1.01	2.60	17.3	1.89	46.2	1.72	7.1	71.7	10.17	342	39.6	95.3	-28.2	44.7	<i>5.0</i>	<i>0.2</i>	249
50 t/ha seaweed	2L	husk	15.8	742	5.87	884	23.4	0.91	3.68	18.5	1.83	45.5	1.72	9.1	100.1	11.76	337	61.7	76.3	-27.8	44.5	<i>4.7</i>	<i>0.2</i>	216
50 t/ha seaweed	3L	husk	15.3	781	5.02	987	17.3	0.92	2.88	15.6	1.69	45.0	1.28	7.3	82.3	12.05	312	57.5	108.0	-28.5	43.6	3.3	1.0	51
50 t/ha seaweed	5R	husk	14.2	823	4.67	852	28.8	1.03	4.55	14.8	1.79	45.1	1.48	6.8	118.3	12.26	326	73.5	50.4	-28.4	44.4	<i>5.3</i>	<i>0.4</i>	131
50 t/ha seaweed	8R	husk	19.5	553	3.89	818	27.8	1.03	5.20	15.9	1.87	49.2	2.67	7.1	103.9	10.73	275	94.1	57.1	-27.7	43.4	5.8	0.9	55
50 t/ha seaweed	10L	husk	16.6	597	4.67	830	12.6	0.98	3.63	19.2	1.97	50.0	1.26	5.1	95.3	10.64	381	56.5	67.7	-27.6	43.5	<i>4.7</i>	<i>0.2</i>	208
NPK fertiliser	4L	husk	14.0	692	5.51	956	12.9	0.88	2.12	17.1	1.82	47.9	1.69	4.1	57.3	13.93	385	32.2	56.5	-27.7	44.3	<i>2.9</i>	<i>0.7</i>	78
NPK fertiliser	5L	husk	17.5	862	5.27	987	16.6	0.97	2.48	18.0	1.96	49.9	1.36	5.2	80.3	13.27	379	54.1	69.3	-28.9	43.1	<i>4.5</i>	<i>0.4</i>	114
NPK fertiliser	7R	husk	12.9	343	4.15	777	18.0	0.97	2.10	17.1	1.78	44.6	1.42	4.7	36.8	10.65	308	38.0	53.3	-27.8	43.7	2.8	1.4	37
NPK fertiliser	2R	husk	15.1	563	4.52	881	19.9	0.88	2.01	17.8	1.92	52.9	1.70	6.7	48.1	11.94	373	50.0	57.6	-27.4	44.4	<i>4.2</i>	<i>0.2</i>	294
NPK fertiliser	10R	husk	16.4	555	4.78	859	16.3	1.01	1.79	17.4	1.86	50.0	1.76	6.3	57.0	11.47	363	59.4	73.7	-28.1	44.2	3.2	1.3	41
no fertiliser	1L	grain	41.2	1122	5.92	389	11.5	0.60	1.27	13.8	1.60	49.0	1.33	26.0	10.3	3.45	763	34.0	210.6	-27.6	41.1	4.8	1.5	33
no fertiliser	3R	grain	44.2	1157	5.36	341	12.6	0.56	1.30	14.8	2.05	51.4	1.41	26.2	11.3	3.35	601	82.6	120.9	-26.9	40.4	4.8	1.4	33
no fertiliser	6L	grain	37.5	1139	4.51	448	11.9	0.49	1.03	10.6	1.71	40.3	1.55	24.7	12.3	3.13	504	45.0	109.3	-27.2	40.2	4.8	1.5	32
no fertiliser	7L	grain	41.6	1043	4.58	382	9.9	0.56	1.13	11.2	1.48	46.0	1.41	24.3	14.3	3.08	560	44.1	69.1	-27.0	40.8	4.9	1.4	35
no fertiliser	9R	grain	44.5	1291	6.06	395	14.9	0.61	1.25	10.5	1.46	47.5	1.11	31.3	18.4	3.64	592	46.5	60.6	-27.2	41.0	5.8	1.5	31
25 t/ha seaweed	4R	grain	45.2	1307	4.71	357	16.5	0.51	1.34	10.1	1.87	50.1	1.09	29.5	23.3	4.35	428	43.8	32.1	-27.0	40.2	5.3	1.5	32
25 t/ha seaweed	1R	grain	41.0	1225	4.21	399	16.7	0.51	1.34	12.7	2.07	46.7	1.65	25.0	35.1	3.68	412	42.4	36.7	-27.8	39.3	4.4	1.4	32
25 t/ha seaweed	6R	grain	39.9	1191	4.64	397	15.7	0.50	1.44	10.9	1.52	35.3	0.85	26.6	23.3	3.96	301	52.9	47.0	-26.6	39.4	5.2	1.4	33
25 t/ha seaweed	8L	grain	40.9	1111	4.39	373	14.0	0.49	1.29	12.0	1.74	54.6	1.15	27.0	22.8	4.17	425	55.5	41.9	-26.5	39.6	5.1	1.4	32
25 t/ha seaweed	9L	grain	43.6	1392	6.63	372	15.1	0.52	1.30	11.0	1.78	45.2	1.38	29.7	24.2	4.01	481	45.4	73.1	-27.4	40.1	5.7	1.5	31

Treatment	Plot ID	Sample	Fe ($\mu\text{g/g}$)	Mg ($\mu\text{g/g}$)	Cu ($\mu\text{g/g}$)	Ca ($\mu\text{g/g}$)	Mn ($\mu\text{g/g}$)	K (%)	B ($\mu\text{g/g}$)	V (ng/g)	Cr ($\mu\text{g/g}$)	Co (ng/g)	Ni ($\mu\text{g/g}$)	Zn ($\mu\text{g/g}$)	As (ng/g)	Sr ($\mu\text{g/g}$)	Mo (ng/g)	Cd (ng/g)	Pb (ng/g)	$\delta^{13}\text{C}$ (‰)	C (%)	$\delta^{15}\text{N}$ (‰)	N (%)	C/N (molar)
50 t/ha seaweed	2L	grain	38.4	1361	5.11	311	14.8	0.47	1.49	9.9	1.63	43.8	1.16	28.3	36.9	3.92	437	57.0	40.0	-27.0	39.1	5.3	1.3	35
50 t/ha seaweed	3L	grain	40.3	1275	3.99	366	15.6	0.47	1.24	11.2	1.71	137.4	1.12	23.4	30.8	3.93	365	56.2	62.3	-27.7	39.6	5.7	1.5	31
50 t/ha seaweed	5R	grain	41.1	1322	4.87	370	16.8	0.46	1.54	9.5	1.74	41.3	0.99	28.2	49.0	4.32	413	71.1	106.4	-27.9	41.2	5.4	1.9	25
50 t/ha seaweed	8R	grain	44.9	1243	4.48	381	20.3	0.46	1.90	11.1	1.71	43.5	1.11	30.6	35.6	4.80	355	82.9	57.8	-26.6	40.2	5.6	2.1	22
50 t/ha seaweed	10L	grain	42.9	1242	3.94	515	14.7	0.45	1.46	12.5	1.84	47.8	1.21	25.3	26.1	3.87	496	62.4	43.0	-27.1	39.8	6.1	1.3	35
NPK fertiliser	4L	grain	38.0	1424	5.96	387	13.3	0.58	1.11	10.1	1.55	45.0	1.79	26.7	18.7	4.51	530	40.4	46.6	-27.5	39.0	4.8	1.3	36
NPK fertiliser	5L	grain	41.5	1238	6.30	338	14.9	0.56	1.17	10.9	1.58	43.3	1.46	35.8	16.0	4.12	492	51.8	103.0	-27.4	40.4	3.9	1.4	33
NPK fertiliser	7R	grain	38.3	1098	3.37	411	14.3	0.48	0.94	8.3	1.36	35.8	0.98	21.9	50.0	3.71	320	31.6	36.7	-26.6	39.7	4.8	1.2	38
NPK fertiliser	2R	grain	55.1	1153	5.29	289	15.2	0.53	1.13	11.3	1.71	52.0	1.11	23.6	65.0	3.89	478	44.0	115.2	-26.8	39.9	3.6	1.4	33
NPK fertiliser	10R	grain	41.4	1277	4.45	406	15.2	0.49	0.99	12.9	1.70	43.1	1.37	24.6	21.1	3.95	505	65.4	22.8	-27.4	39.8	4.5	1.6	28
no fertiliser	1L	straw	81.3	372	8.31	2550	8.8	1.49	2.73	91.3	5.15	165.0	4.14	8.2	83.6	28.22	1153	72.9	389.6	-29.5	42.5	4.5	0.4	138
no fertiliser	3R	straw	55.8	414	5.84	2275	12.9	1.47	2.82	78.8	3.28	109.2	3.00	7.6	117.3	35.20	763	90.2	244.1	-29.7	42.2	4.1	0.4	136
no fertiliser	6L	straw	49.0	489	2.55	2506	8.4	1.22	2.59	65.2	4.46	91.8	2.66	5.1	76.7	25.89	593	61.8	134.0	-29.7	43.0	4.4	0.3	151
no fertiliser	7L	straw	79.2	409	3.91	2139	6.6	1.50	3.28	98.7	5.32	163.7	3.68	7.6	79.3	24.93	538	72.7	160.1	-29.2	42.7	4.5	0.3	154
no fertiliser	9R	straw	35.4	431	5.32	2801	12.9	1.59	3.34	62.2	1.76	65.3	2.06	6.9	97.0	30.95	830	83.4	229.2	-29.5	43.4	4.6	0.3	145
25 t/ha seaweed	4R	straw	40.5	558	3.36	2000	23.8	1.46	3.77	53.2	1.95	67.7	2.41	9.1	86.0	27.45	429	114.9	209.9	-29.8	42.4	4.7	0.3	144
25 t/ha seaweed	1R	straw	35.7	503	3.10	2270	18.1	1.40	3.76	50.0	2.43	82.8	1.89	6.7	73.9	28.12	407	102.4	182.8	-28.9	43.5	5.1	0.3	164
25 t/ha seaweed	6R	straw	33.1	512	1.98	2045	19.6	1.22	3.50	43.7	2.35	62.8	1.28	6.3	74.2	27.91	305	118.3	142.9	-29.2	43.4	5.0	0.4	144
25 t/ha seaweed	8L	straw	66.0	476	2.23	2031	11.2	1.13	3.56	73.6	4.33	138.4	2.91	4.9	71.2	26.12	313	99.0	136.8	-28.5	39.6	5.1	0.3	138
25 t/ha seaweed	9L	straw	33.8	449	2.45	2051	7.6	1.25	3.24	46.7	2.08	67.7	1.34	5.0	85.6	24.00	477	72.8	133.6	-28.9	43.8	5.2	0.4	141
50 t/ha seaweed	2L	straw	39.1	518	6.20	2093	17.0	1.46	4.87	66.1	1.98	66.9	1.42	8.5	103.7	28.70	432	137.9	350.4	-29.7	41.9	5.1	0.3	151
50 t/ha seaweed	3L	straw	39.6	506	5.36	2143	14.5	1.34	3.84	45.0	3.38	84.3	2.04	8.2	83.0	27.25	368	123.5	308.0	-29.2	42.0	5.3	0.4	133
50 t/ha seaweed	5R	straw	57.4	607	15.82	2446	38.6	1.37	6.39	83.1	3.42	117.3	2.71	18.6	130.2	33.28	430	171.6	939.7	-29.9	41.7	5.4	0.4	115
50 t/ha seaweed	8R	straw	58.4	451	8.67	2204	33.1	1.29	4.19	71.8	3.86	131.6	2.73	8.3	85.0	30.97	284	181.4	497.0	-29.8	44.1	5.9	0.4	146
50 t/ha seaweed	10L	straw	77.9	412	4.38	1938	10.1	1.45	3.95	95.4	5.28	161.4	3.84	5.8	89.1	24.12	506	124.5	237.7	-28.4	41.6	5.6	0.3	144
NPK fertiliser	4L	straw	34.1	470	6.86	2030	9.6	1.51	3.21	54.8	2.02	72.7	1.76	7.3	71.8	30.18	510	85.4	374.9	-29.7	42.2	4.3	0.3	156
NPK fertiliser	5L	straw	56.6	574	8.71	2180	10.5	1.49	3.54	67.6	2.85	96.3	2.06	8.8	87.2	27.69	555	85.4	285.1	-29.5	41.3	5.1	0.4	129
NPK fertiliser	7R	straw	32.2	433	9.69	1895	12.1	1.28	2.82	43.0	2.52	70.7	2.72	9.3	64.9	23.14	290	100.5	503.7	-28.8	41.4	4.7	0.4	136
NPK fertiliser	2R	straw	71.4	561	4.72	2544	19.5	1.18	3.49	83.4	4.73	154.0	3.42	7.8	80.4	31.87	417	98.7	314.6	-29.4	42.5	3.8	0.3	151
NPK fertiliser	10R	straw	84.3	494	4.31	2810	19.2	1.26	3.51	105.0	6.21	192.2	8.38	8.7	86.9	32.55	462	126.1	348.0	-29.6	42.8	4.2	0.3	146

51

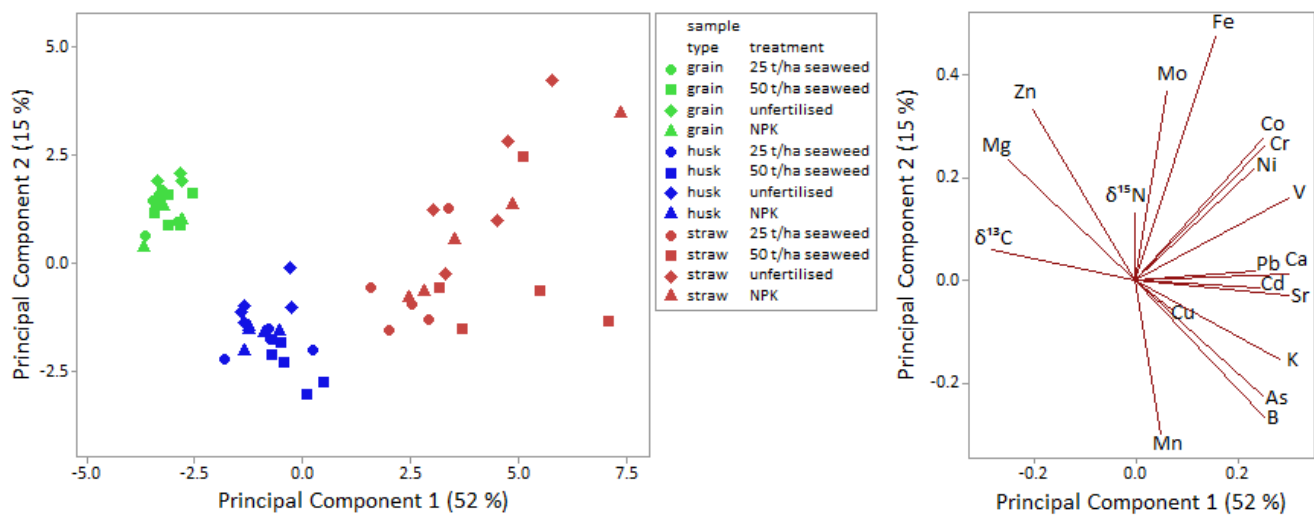
a)



52

53

b)



54

55 **Fig. S.1** Score plots (left) and loading plots (right) of two principal component analyses of all measured
 56 element concentrations and isotope ratios (without $\delta^{15}N$ in a), and including the unreliable $\delta^{15}N$
 57 values in b)) in grain, straw and husk samples, indicating the changes induced by the different
 58 fertilisation treatments; these results indicate that for the elements and isotope ratios measured in
 59 this study, differences between the different parts of the plant tend to be larger than the
 60 compositional differences induced by fertilisation

61 **Table S.7** Measured compositional data of the composted seaweed and NPK fertilisers; results are
 62 mean values $\pm 1\sigma$ of triplicate analyses; the bioavailability of these elements likely varies significantly;
 63 *Bateman and Kelly, 2007; **manufacturer information for Yaramila maincrop 14-14-21 NPK
 64 fertiliser

65

units	seaweed fertiliser	NPK fertiliser
Fe $\mu\text{g/g}$	610 \pm 20	817 \pm 12
Mg $\mu\text{g/g}$	7429 \pm 407	1413 \pm 233
Cu $\mu\text{g/g}$	5.2 \pm 0.3	15.4 \pm 0.6
Ca $\mu\text{g/g}$	22935 \pm 2737	36262 \pm 1699
Mn $\mu\text{g/g}$	34.3 \pm 1.4	68.4 \pm 0.9
K $\mu\text{g/g}$	23368 \pm 1108	160161 \pm 8397
B $\mu\text{g/g}$	289.8 \pm 16.5	9.08 \pm 0.15
V $\mu\text{g/g}$	13.3 \pm 0.9	> 50
Cr $\mu\text{g/g}$	4.48 \pm 0.44	30.7 \pm 0.9
Co $\mu\text{g/g}$	0.75 \pm 0.02	0.42 \pm 0.01
Ni $\mu\text{g/g}$	8.07 \pm 0.38	4.37 \pm 0.12
Zn $\mu\text{g/g}$	79.1 \pm 0.9	35.0 \pm 0.8
As $\mu\text{g/g}$	50.3 \pm 0.6	5.21 \pm 0.19
Sr $\mu\text{g/g}$	1437 \pm 32	6899 \pm 62
Mo $\mu\text{g/g}$	5.34 \pm 0.25	0.40 \pm 0.01
Cd $\mu\text{g/g}$	1.59 \pm 0.02	2.34 \pm 0.03
Pb $\mu\text{g/g}$	1.14 \pm 0.11	1.61 \pm 0.07
$\delta^{13}\text{C}$ ‰	-19.5 \pm 0.2	
C %	32.2 \pm 0.5	
$\delta^{15}\text{N}$ ‰	6.67 \pm 0.31	likely -1 to 0*
N %	3.70 \pm 0.10	14**
C/N (molar)	10.2 \pm 0.3	

66