Farm internal traceability and ecolabelling to improve environment safety: the case of greenhouse vegetables

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Abstract

It is well known that, for some years now, Europe Union contemplate a system aimed at giving an environmental impact label to different no-food products, the so-called European Ecolabelling. It allows the consumers to easily identify "green" products and the producers to inform the consumers that their products are environment-friendly. More recently, at national states level, there is a growing interest toward a similar system also for the food chain. Internal traceability, that is the linking up of all inputs to outputs is, as far, a voluntary act. With the objective of getting the ecolabel of a farm produce (together with collecting data for a better management of the farm production processes) the implementation of an internal traceability system at farm level in the case of greenhouse vegetables cultivation has been considered.

The traceability system is very simple at the moment: every greenhouse has been equipped with a sheet-card where each work and material input is reported. These data are then periodically collected, transferred and elaborated by a common "electronic-sheet" application. The collected data allow evaluating an impact indicator to the products and to the different inputs of the process. The analyzed vegetables are radish and basil, this last one grown either in summer or in winter. As environmental impact parameters we have used both energy cost and greenhouse effect like CO_2 emissions equivalent.

The obtained results for radish and basil indicate that regardless the cultivation technique, package and heating and lighting represent great part of environmental impact, as energy cost and CO_2 emissions eq. Radish cultivated in greenhouse in summer, and packaged for supermarket has an energy cost of 10,6 MJ/kg, more than 55% due to package. For summer cultivation of basil, more than 90% of total energy cost, and CO_2 emissions is due to package, with total energy cost of 48 MJ/kg. For winter cultivation of basil, heating and lighting represent more than 86% of total energy cost, packaging included, (368 MJ/kg), and more than 96% of total CO_2 emissions eq. (22,7 kg/kg).

Keywords: impact, energy-cost, greenhouse effect.

Introduction

Traceability requirements stated by the General Food Law Regulation 178/2002 and come into force the 1 January 2005 do not, however, require 'internal traceability', that is the linking up of all inputs to outputs. The adoption of an internal traceability system is thus a voluntary act. Section 2 of the mentioned law specifies that vegetable produce before harvesting is not considered food. So, the farm is partially excluded from traceability obligations.

In the fresh fruit and vegetable sector, a distinction is done between loose and packed produce. Packed food is subjected to stronger constraints due to labelling requirements (INDICOD-ECR, 2004). The label is in fact, the tool with which end-consumers are informed about the packed food.

It is well known that, from some year, Europe Union contemplate a system aimed at giving an environmental impact label to different no-food products, the so-called European Ecolabelling (European Union Eco-label, 2007). It allows the consumers to easily identify "green" products and the producers to inform the consumers that their products are environment- friendly. More recently, at national states level there is a growing interest toward a similar system also for the food chain. Emphasis is given on associating to the different foodstuff en environmental impact indicator, like CO_2 emissions.

Starting from the assumption that the objective of getting the ecolabel of a farm produce (together with collecting data for a better management of the farm production processes) seems enough strong to justify the cost of introducing an internal traceability system at farm level, the Authors report the results of a first application of such a system in the case of greenhouse vegetables cultivation.

Materials and methods

The analyzed vegetables are radish and basil, this last one grown either in summer or in winter. The farm of experimentation is located nearby Firenze and vegetable cultivation is mainly in greenhouse for a total of 85 units and a surface extension of 54000 m^2. About 90% of the production consist of "rucola", basil and radish in equal percentage.

Table 1. Energy and CO_2 emission coefficients

		Energy	N2O	CH4	CO2	GWP CO2 eq
	unit quantity	MJ	mg	g	g	g
Diesel fuel	kg	51,5	8,0	4,35	3500	3519
Nitrogen	kg	75,4	10012	8,09	1269	3003
Phosphorus	kg	8,8	39,9	3,80	2995	3017
Potassium	kg	10,5	8,6	0,69	542,8	547,0
Fungicide	kg	217,0	140,0	27,50	9500	9634
Insecticides	kg	420,5	328,0	52,50	23020	23286
Plastics	kg	94,0	15,5	13,45	1677	1733
Seeds	kg	50,0	4,2	1,01	525,8	530,6
Tractors	kg*h	0,014	0,010	0,0016	0,83	0,8
Equipments	kg*h	0,034	0,024	0,0037	1,99	2,0
Human Labor	h	7,33	0	0	0	0

The traceability system is very simple at the moment: every greenhouse has been equipped with a sheet-card where each work and material input is reported. These data are then periodically collected and transferred in a computer were, by a common "electronic-sheet" application, are then elaborated. That solution has been preferred by the farmers in alternative to more complex informative systems based on the use of specific and dedicated hardware and software. As impact parameters we have used both energy cost and greenhouse effect. The approach followed is that of Life Cycle Assessment, that is to consider "*the entire* *life-cycle of product, process or activity, encompassing extracting and processing raw materials, manufacturing, transportation and distribution, use, re-use, maintenance, recycling, and final disposal...."* (SETAC, 1993). With the aim of harmonising the different approaches used in applying LCA (Life Cycle impact Assessment) to agriculture, in 1995 the European Commission promoted a concerted action (AIR3-CT94-2028) the final report of which (Audsley, 1997) has be taken as reference in the present application. Specific coefficients used to assess the "Energy resources depletion" (here said Energy costs) and "Global Warming Potential" (green house effects) of every input are reported in Table 1. In the table are also indicated the specific value of gas emissions responsible for green house effect, namely CO_2, N_20, CH_4. Their impact effect in term of Global Warming Potential (GWP) are here evaluated on a time scale of 500 years and expressed in g (grams) equivalents of CO_2. The values of CO_2 equivalents for N_2O and CH_4 are obtained by multiplying their values by a factor of 170 and 4, respectively.

Table 2. Energy cost and GWP effect due to the different inputs for a kg of product.

		RADISH SUMMER		BASIL SUMMER		BASIL WINTER	
		Energy cost MJ/kg	GWP CO2 eq g/kg	Energy cost MJ/kg	GWP CO2 eq g/kg	Energy cost MJ/kg	GWP CO2 eq g/kg
	Diesel fuel tractor	0,97	66,0	0,25	16,8	0,25	16,8
	Diesel fuel cogenerator					318,8	21783
	Direct inputs	0,97		0,25		319,0	
	Machinery	0,13	20,9	0,03	5,71	0,03	5,71
	Cogenerator					0,80	83,1
	Fertilizers	0,99	53,2	0,28	14,8	0,28	14,8
	Pesticides	0,01	3,49	0,02	4,55	0,02	4,55
	Seed	0,08	1,46	0,02	0,31	0,02	0,31
	Irrigation pipes	1,88	36,1	0,52	10,1	0,52	10,1
	Labor	0,69		1,79		1,79	
	Indirect inputs	3,78		2,66		3,46	
	Total	4,75	181,1	2,91	52,3	322,5	21918
	Package (300 g of radish)	5,86	108,0				
	Package (60 g of basil)			29,3	540,1	29,3	540,1
	Package (30 g of basil)			45,1	831,8	45,1	831,8
TOTAL	Packaged product	10,6	289,1	32,2 48,0	592,4 884,1	351,8 367,6	22458 22749

The descriptive and computational LCA model used in the present application is a simplified version of that reported in reference (Spugnoli et al. 2005) where the similarity in expressing the total impact of CO_2 end Energy efficiency is also underlined. The aptitude of the energy analysis parameters in representing the environment impact is exemplified in reference (Spugnoli et al. 1993). A fundamental step in LCA impact analysis of a process is the allocation of environmental effects to each production phase referring them to the functional unit. This is done by considering and registering the quantities of the input flows used in all the different phases of the process, which is typical of the internal traceability activity.

Results

The results of the process analysis, performed on the farm examined, are reported in table 2. The data refer to unit of product (kg). For radish in summer, as regard cultivation phase, the data show higher energy costs for tractors fuel (20,3%), as direct inputs, and for fertilizers (20,9%) and irrigation pipes (39,6%) as indirect inputs. GWP is due especially to fuel (36%) fertilizers (29%) and irrigation pipes (20%).

Package has a very high impact in terms of energy costs (55%) and GPW (37%).

For basil in summer labor has the highest impact in terms of energy cost relatively to the cultivation phase (62%), while for GWP, fuel represent 32% and fertilizers 28%. Package has for basil a very high impact, due to the very small quantity of product for each package (30-60 g), so for one kg of basil, package weight 91-94% both in terms of energy cost than in GWP.

The cultivation of basil in winter needs to maintain temperature not below 18-20 °C, and an artificial lightening equivalent to that of summer: to recreate that conditions the energy cost is terribly high and represent more than 99%, that is 319 MJ/kg of basil. The same stand for GWP, with almost 22 kg of CO_2 equivalent for kg of basil.

Table 3. Impact weight of the production phases.

	RADISH SUMMER				BASIL SUMMER				BASIL WINTER			
	Energy cost		GWP CO2 eq		Energy cost		GWP CO2 eq		Energy cost		GWP CO2 eq	
	MJ/kg	%	g/kg	%	MJ/kg	%	g/kg	%	MJ/kg	%	g/kg	%
Cultivation	4,75	44,8	181,1	62,6	2,91	6,06	52,3	5,91	2,91	0,79	52,3	0,2
Heating and Lightining	0	0	0	0	0	0	0	0	319,6	86,9	21866	96,1
Packaging	5,86	55,2	108,0	37,4	45,1	93,9	831,8	94,1	45,1	12,3	831,8	3,7
Total	10,6	100	289,1	100	48,0	100	884,1	100	367,6	100	22750	100

Conclusion

Traceability, apart its proper original purpose, could become a start point for a widespread of ecolabelling. Infact, internal traceability - as far as economic, energy or LCA analysis - requires the allocation of the process inputs in the different production phases, so that the quantity of every input needed for a unit of output could be established. Than, the computation of the energy requirement or CO_2 emissions is only a question of coefficients knowledge. For monetary costs of course, you have only to know the prices.

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