Environmental and economic assessment of protected horticulture in four European scenarios

Marta Torrellas, Assumpció Antón and Juan Ignacio Montero (marta.torrellas@irta.cat)
IRTA Carretera de Cabrils, km 2. 08340 Cabrils, Barcelona.Spain

Áron Bálint (balint.aron@morakert.hu)
Mórakert Zöldség-gyümölcs Termelői Értékesítő Szövetkezet. 6782 Mórahalom, Röszkei út 49

Marc Ruijs, Nieves García, Cecilia Stanghellini (Marc.Ruijs@wur.nl)
Wageningen UR Greenhouse Horticulture. PO box 644, 6700 AP Wageningen
Building 107, Droevendaalsesteeg 1, 6708 PB Wageningen. The Netherlands

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Abstract: EUphoros is a research project financed by the Seventh Framework Programme of the European Community. The aim of this four-year project is to develop sustainable protected horticultural and ornamental crops with a reduction of external inputs. The issues to focus on are reduction of fossil energies, carbon footprint of equipment, water use, fertilizers emissions, plant protective chemicals application and full recycling of substrate. High productivity and resource use efficiency are also priorities to fulfill. Research institutes and companies from the main European countries specializing in greenhouse crop production participate in this project: the Netherlands, Spain, Italy, the United Kingdom, Hungary, Switzerland and Latvia.

One of the EUphoros workpackages deals with the environmental and economic sustainability of the greenhouse production system. An initial analysis of resource requirements will help to identify the main burdens of the current situation in European greenhouse operations and to establish a reference situation for comparisons with potential improvements developed in the course of this project. Four scenarios were defined for the study: a) tomato crop in a multi-tunnel greenhouse in Spain; b) tomato crop in a Venlo greenhouse in Hungary; c) tomato crop in a Venlo greenhouse in the Netherlands; and d) rose crop in a Venlo greenhouse in the Netherlands. The environmental analysis was conducted using the Life Cycle Assessment methodology (LCA). For the economic assessment, a partial cost-benefit analysis will focus on the new developed tools. The main results obtained in the analysis of the reference situation were:

- Fossil energies consumption for greenhouse heating could be reduced by alternatives such as cogeneration systems, use of geothermal water, new developments in cover materials, management of energy storage systems and availability of renewable energy resources.
- The contribution of structure materials could be decreased by the use of recycled materials, progress in the greenhouse design and expansion of life span of the greenhouse.
- Substrate entailed an important environmental impact. Efforts should be done in recycling and manufacturing processes; and reducing the volume of substrate per plant as well.
- Fertilizers incurred a large environmental contribution because of emissions in manufacture and application. Recommendations focus on Spain and Hungary in order to reduce doses, adjust balance fertilizers-water and implementation of a close watering system.
- Waste management should advance in recycling and reusing, especially for green biomass.
- The best economic perspectives to reduce resource use seem to be for energy saving options in scenario b, c and d and for fertilizer reducing options in scenario a and b. Low pesticide costs and high risk of loss of yield hinder the economic possibilities of pesticide reduction.
- The performance of environmental and economic assessments on the product systems have shown the importance of including these aspects in sustainability studies in order to reflect the relevance between environmental improvements and their economic consequences.

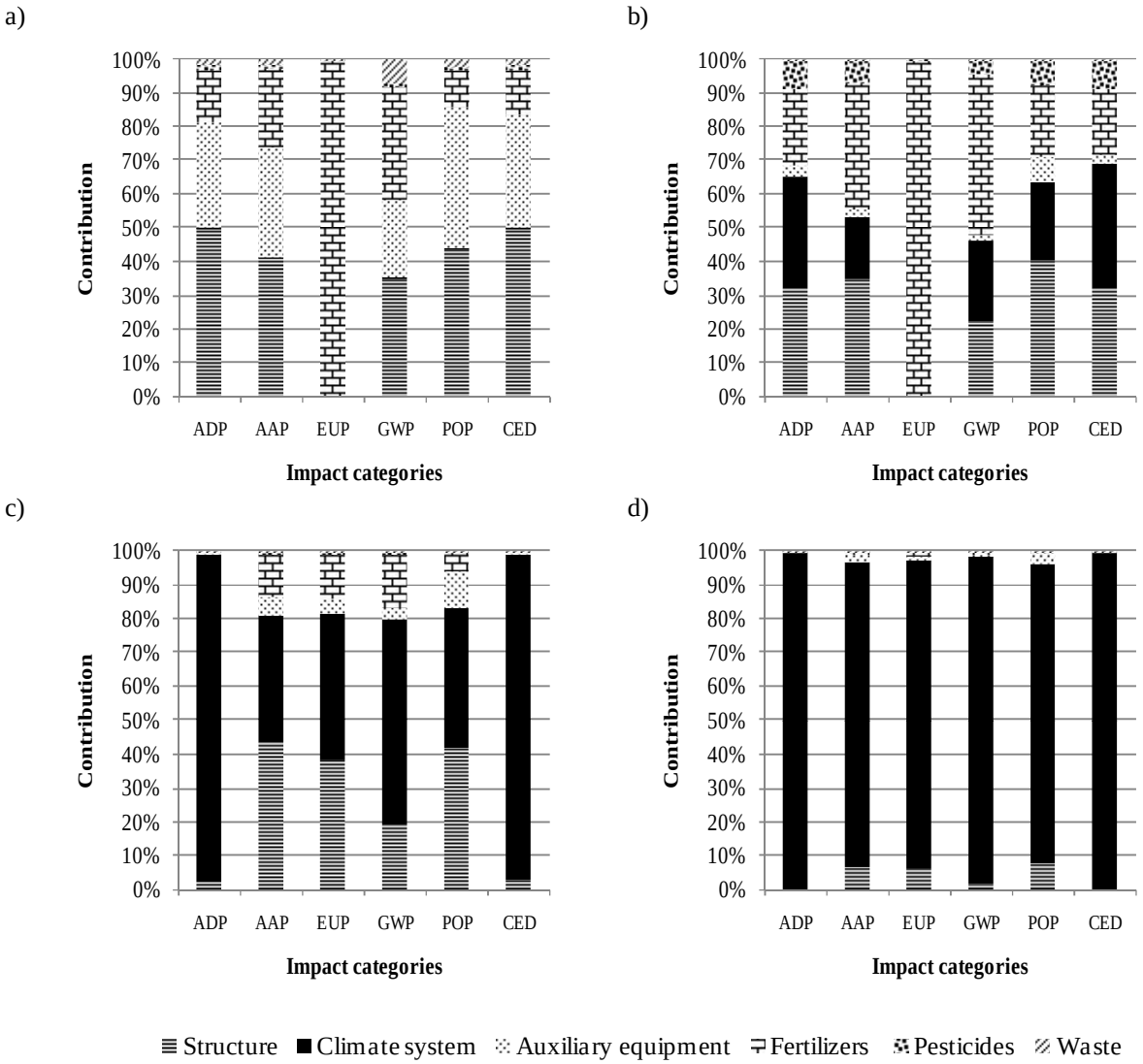

Fig. 1. Stages contribution to impact categories for: a) tomato crop in a multi-tunnel greenhouse in Spain; b) tomato crop in a Venlo greenhouse in Hungary; c) tomato crop in a Venlo greenhouse in the Netherlands without cogeneration; and d) rose crop in a Venlo greenhouse in the Netherlands with cogeneration. Impact categories ADP, Abiotic Depletion Potential; AAP, Air Acidification Potential; EUP, Eutrophication Potential; GWP, Global Warming Potential; CED, Cumulative Energy Demand.

Cost component	**Scenario 1: Tomato in multi tunnel (Spain)**	**Scenario 2: Tomato in Venlo greenhouse (Hungary)**	**Scenario 3: Tomato in Venlo greenhouse (the Netherlands)**	**Scenario 4: Rose in Venlo greenhouse (the Netherlands)**
Equipment	33	28	23	22
Labor	27	17	26	22
Plant material	6	9	3	3
Energy	2	11	31	36
Fertilizers	7	19	2	1
Crop protection	4	3	1	3

Table 3.2: Summary of the relevant cost components of the reference greenhouse systems in Spain, Hungary and the Netherlands (in %).