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TECHNOLOGY AND INNOVATION FOR A SUSTAINABLE FUTURE: A COMMODITY SCIENCE PERSPECTIVE

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EDITED BY ROBERTO MERLI

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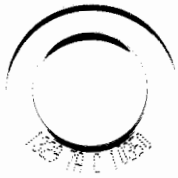

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ENVIRONMENTAL MANAGEMENT TOOLS AND EXPERIENCES IN THE AGRI-FOOD SECTOR: A FRAMEWORK OF PRODUCT-ORIENTED ENVIRONMENTAL MANAGEMENT SYSTEM (POEMS)

Roberta Salomone[1], Maria Teresa Clasadonte[2], Maria Proto[3], Andrea Raggi[4], Ioannis Arzoumanidis[4], Giuseppe Ioppolo[1], Agata Lo Giudice[2], Ornella Malandrino[3], Agata Matarazzo[2], Luigia Petti[4], Giuseppe Saija[1], Stefania Supino[3], Alessandra Zamagni[4]

[1] Department SEA - University of Messina (Italy)
Piazza S. Pugliatti 1, I 98122 Messina - +39 090 771548 - roberta.salomone@unime.it
[2] Department of "Impresa, Culture e Società" - University of Catania (Italy)
Corso Italia 55, I 95128 Catania (Italy) - +39 095 7537921 - clasadon@unict.it
[3] Department of "Studi e Ricerche Aziendali" - University of Salerno (Italy)
Via Ponte Don Melillo, I 84084 Fisciano (SA) - +39 089 963146 - mariap@unisa.it
[4] Department of Economics - University "G. d'Annunzio" of Pescara (Italy)
Viale Pindaro 42, I 65127 Pescara - +39 085 45083 225 - a.raggi@unich.it

Abstract

The Eco-Management for Food Project (EMAF Project - PRIN No.2008TXFBYT co-funded by the Italian Ministry of Education, University and Research) has the purpose to design and implement a Product-Oriented Environmental Management System (POEMS) framework that is specified for the agri-food industry. The POEMS framework has a modular structure resulting from the integration of complementary environmental management tools: the underlying basis is an *Integrated Quality and Environmental Management System*, while the product orientation is provided by a *Simplified Life Cycle Assessment* and a suitable *Environmental Product Label or Declaration* chosen following guidelines for the environmental product communication. These tools have been specifically structured in order to satisfy the particular needs of organizations operating in the agri-food sector and their strengths and weaknesses are being evaluated through their implementation in different pilot food companies.

This paper describes the core methodological structure of these environmental management tools, pointing out their main procedural aspects linked to the specific structural requirements of the agri-food companies and the early implementation experiences in the pilot food companies involved in the EMAF project which belongs to canned vegetables, wine, pasta, olive oil and coffee agri-food supply chains.

Keywords: POEMS, Integrated Management Systems, Streamlined LCA, Environmental Product Labels, Agri-Food Supply Chain.

Introduction: environmental management tools and experiences in the agri-food sector

In recent years, the management of the environmental variable in the agri-food sector has been continuously growing, mainly as a result of a few drivers raising companies' awareness, such as the following: i) the growing interest of the market in eco-sustainable agri-food products also connected to the awareness that the environmental impacts associated with the production and consumption of food

and agricultural products are relevant; for example, the Environmental Impact of Products – EIPRO study (Tukker et al. 2006, 12) conducted by the European Commission showed that among the products consumed in Europe, those which have the major environmental impacts, in a life cycle perspective, are foods and beverages, along with the private transport and the housing sector (buildings, furnishings, equipment, energy for residential use, etc.); ii) the need to increase the competitiveness of the food industry through the introduction of appropriate eco-innovations - in fact, even though the European food industry structure is particularly complex and articulated, with very different supply chains, one element that connects all the different agri-food firms is the significant presence of SMEs, variously placed along the entire production chain, that often compete in a globalized international market, heavily dominated by multinationals. For this reason, one of the target actions of the European Commission is to stimulate innovation (including eco-innovation) in SMEs, precisely in order to increase, in such a situation, the competitiveness of European enterprises. In addition to that, in traditional sectors, such as the agri-food industry, margins of innovation may be more limited, and working on issues of environmental sustainability, including for example the introduction of organizational innovations, may be of strategic relevance; iii) the need to face this growing environmental awareness pushes agri-food companies to adequately manage all environmental impacts related to the processes and products included in the whole agri-food chain; consequently these companies are called upon to govern the processes that extends beyond the limits of their own production sites, considering Life Cycle Thinking approaches.

In this context, the management of the environmental variable in the agri-food sector is mainly carried out through the use of voluntary standards. In effects, agri-food firms, as enterprises of any other sector, have a series of tools at their disposition, based on international standards, which may be useful for the purposes of environmental management. The standards considered to be most significant for single or integrated use can be classified as "system standards" (such as ISO 14001 for the Environmental Management Systems) and "product standards" (such as ISO 14040 series for Life Cycle Assessment and ISO 14020 series for Environmental product labels and declaration). Indeed, system standards, in general, are the most widely used, as they can be adapted to the real situation of each business, especially regarding management of contractual and mandatory aspects, as well as continuous improvement processes; however, they have the significant disadvantage of being poorly perceived by final consumers. A more suitable approach to environmental quality management in the agricultural and agri-food sectors is probably one based on using direct means of ensuring the environmental performance of products; capable of guaranteeing and facilitating social acceptability, on the one hand, and, on the other hand, greater appeal in more environmentally aware markets, which are growing. Thus, the need for integration between system standards and product standards is increasing, gradually moving the emphasis from the system/process to the product/service. As a result of this, alongside management "tools" that are already widely used (ISO 14001 and EMAS), companies have started to appreciate other "tools" that are oriented more towards the management of environmental performances of products. These aspects can be considered as clear signs of the introduction of product management into Environmental Management Systems (EMSs), which have thus permitted the emergence of a new specifically product oriented environmental management tool: POEMS - Product-Oriented Environmental Management System (Salomone et al. 2011). Starting from these considerations, the research project Eco-Management for Food (PRIN No.2008TXFBYT), co-funded by MIUR (EMAF 2012), was designed in order to propose, test and, consequently, spread a model of POEMS, specifically tailored on companies operating in the Italian agribusiness sector, aimed at supporting these firms (mainly SMEs) in the introduction of organizational innovations that allow them to manage and continuously improve the sustainability and competitiveness of their products/processes. The POEMS

framework has a modular structure resulting from the integration of complementary environmental management tools: the underlying basis is an *Integrated Quality and Environmental Management System*, while the product orientation is provided by a *Simplified Life Cycle Assessment* and a suitable *Environmental Product Label or Declaration* chosen following guidelines for the environmental product communication. In the following a synthesis of the single environmental management tools of which the POEMS model is made up is presented, highlighting the main results connected with their innovative methodological structure and their early implementation experiences in pilot food companies.

1. Integrated environmental and quality Management System (IMS)

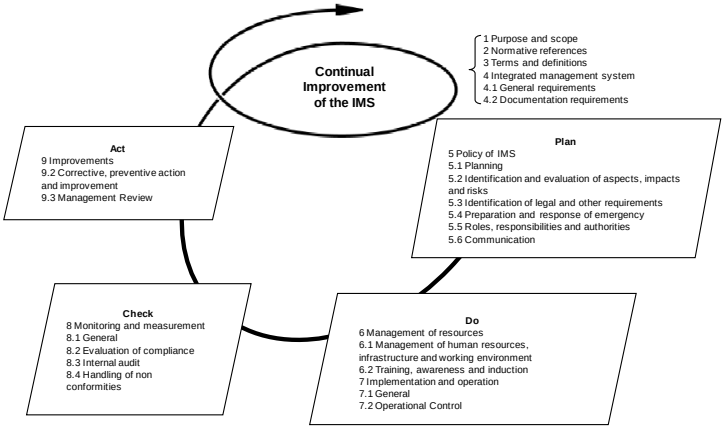
1.1. The core methodological structure of an IMS

In recent decades, agri-food organizations have become more aware of the importance of product and process quality and of the need for organizational and managerial innovation for constant improvement in global performance. Business and market remits are leading companies, operating in the agri-food sector, towards certified quality management in conformity with international standards, in terms of processes and products. Recent trends show a marked inclination towards a common vision of the different dimensions of quality organizations, assessed by third party audits and assured not only by compliance with Quality Management Systems - QMS (ISO 9001) but also by integrating other Management Systems (MSs), such as Environmental Management Systems - EMS (ISO 14001), Occupational Health and Safety Management Systems (OHSAS 18001) and Management of Social Accountability (SA 8000). Companies operating in the food industry have in addition, "tailored" Management Systems for food safety and traceability voluntary certifications (ISO 22000, ISO 22005) to harmonize and integrate mandatory and voluntary elements of food quality. Moreover, an increasing number of standards promote food products safety, the most widespread being the BRC (British Retail Consortium) and the IFS (International Food Standard). The use of the above mentioned standardized tools in the agri-food sector has determined the need to integrate the different approaches, highlighting similarities and synergies wherever possible and avoiding unnecessary duplication and fragmentation. Nevertheless, as is well known, there are no international standardized references for integrating the requirements of various management systems and procedures, even though in July 2008 ISO published an interesting handbook "The Integrated Use of Management System Standards" (ISO 2008). The Integration of Management Systems is a highly relevant management approach, capable of generating significant benefits, less bureaucracy and paperwork, combined audits, fewer costs and more efficient management and use of resources. At present, different models for the integration of standardized MSs have been developed both at theoretical, geographical, and empirical levels (Wilkinson et al. 1999, 95-104; Zeng et al. 2006, 1765-1766; Salomone 2008, 1802-1804; Jorgensen et al. 2006, 715-718).

Starting from these previous experiences, a model of Integrated Management System (IMS) specific for the agri-food sector was defined: compatibility, similar terminology, procedures and documentation, but above all, the common structure of MSs based on the Plan-Do-Check-Act (PDCA) cycle, represent the methodological pillars of the proposed integrated approach, structured on the correspondence among diverse national, international and sector standards (Fig. 1). The proposed IMS model is based on a process approach, aimed at uniforming targets, responsibilities and expected outcomes. In practice, the organization is no longer viewed as a set of activities (even integrated into a systemic view), but as a true system which implements its strategic-operational mission through interconnected elements (processes) and finalized to provide products/services that consistently meet requirements according to the needs of the multiple stakeholders. Therefore, independently of the organization and management of a firm,

numerous elements of integration can be identified. These include the development of an integrated policy and setting out strategic objectives, under which resources can be organized, responsibilities defined, documented and processed, and activities of analysis and evaluation of the efficiency of business management planned, intervention organized and, finally, monitored and evaluated to achieve the desired goals for a continuous improvement.

Figure 1 – Model of an Integrated Management System



1.2. Early IMS implementation experiences in a canned vegetables pilot company

The viable model for IMS proposed was applied to a pilot company, Petti SpA, producing canned vegetables. As a first step the applicative research was focused on reviewing, mapping and assessing the existing systems in the organization - QMS, EMS, BRC and IFS - and on analyzing processes, documentation, procedures and responsibilities in the various areas. This initial analysis revealed that all the systems implemented in the organization worked in a fragmented and independent manner, through many different documents and procedures, resulting in an overlap of resources and generating a lack of efficiency. The Manual of Petti's IMS was subsequently compiled in parallel with the proposed model of IMS, based on the correlation between the requirements of the standard considered and significant analogies in the conceptual and structural approach. The implementation of the framework for IMS enables the identification of the general requirements, shared by all standards and the specific requirements, that have to be addressed for a particular area or process. Consequently, the choice of integrated procedures for the pilot company led to their "rethinking", classifying them in: a) common or general integrated procedures envisaged for all the standards considered and applied on a horizontal scale to the organization's activities relevant to IMS; b) non integrated procedures specific only to some area or activities. The main barriers emerging during the initial implementation of the IMS model included: corporate management and employee resistance to change, difficulties in the adoption of a holistic view of the policy, objectives and targets, and finally a problematic approach towards the "rethinking" of paperwork and documentation. Despite such barriers, the company's commitment in applying IMS clearly emerged, in the awareness that it is a strategic key for achieving sustainable success.

2. Simplified Life Cycle Assessment (Simplified-LCA)

2.1. The core methodological structure of a Simplified LCA

In order for a suitable simplified LCA tool to be identified for the Italian agri-food industry, review papers on food LCA case-studies were surveyed, with the aim of identifying: a) the main LCA

methodological issues in the food sector and how they had been dealt with, b) whether there could be a tendency for some environmental impacts to be more affected than others, and c) whether there were any specific stages in products' life cycles that seem to be more impacting than the others (Arzoumanidis et al. 2011b). Having obtained the results of such a review, another one was conducted in order to identify simplified LCA tools: a) not sector-specific and b) specific for the food sector (Arzoumanidis et al. 2011a). The papers selected were analysed according to a set of criteria: 1) definitions of simplified LCA provided by the authors; 2) reasons to develop a simplified approach; 3) ISO compliance; 4) robustness; 5) approaches to simplification. Most of the papers reviewed confirmed that the need to simplify LCA is mainly related to the high resource-intensity (mostly time and cost) of a full LCA (this is an issue especially for SMEs) and to the fact that the data to conduct a full study may be lacking. These considerations have also been confirmed by a survey on LCA users' needs carried out within the CALCAS project (Rydberg et al. 2008). As far as the ISO compliance is concerned, this was explicitly stated only in a few cases, whilst for the rest it is not clear whether the compliance was taken for granted or simply it was not considered to be an important requirement. When it comes to robustness, in some cases the results of a simplified LCA were compared with those of a detailed LCA, showing a moderate or at least acceptable discrepancy. However, the limitations of some of the developed approaches were also pointed out; aspects that in some cases make the tools useful only as a first screening and not as a replacement or substitute for a full LCA. Finally, as regards approaches to simplification, a few main issues were identified: i) life cycle inventory (LCI), ii) life cycle impact assessment (LCIA), iii) data (availability), iv) user-friendly interfaces. The review resulted in various general simplified LCA approaches and food-specific ones (Arzoumanidis et al. 2011a). In order for the most suitable one to be identified a set of selection criteria were defined based both on the issues mostly discussed in the literature and on the experience of the authors, namely: a) ISO-compliance; b) broad focus (e.g., various impact categories considered); c) user-friendly interface; d) need of limited data or high adaptability to existing databases; e) relevance to life cycle steps identified in our review; g) ease of integration with EPD and POEMS. A short literature review followed in order to detect various decision making tools so as to prioritise the identified simplified tools on the basis of the above-mentioned selection criteria; such review resulted in the following: i) Delphi Method (Linstone and Turoff 1976); ii) Analytic Hierarchy Process (AHP) (Saaty 1990); iii) Multi-Criteria Decision Matrix (MCDM) (Voogd 1983); iv) Rough Sets Analysis (Greco et al. 2001). After having consulted additionally a number of experts of the decision-making domain, it was decided to move on with a combination of the MCDM-AHP methodologies. In order to implement a MCDM a set of weights for each criterion and a set of scores to be attributed for each tool have to be identified, as described in the next paragraph. A vector of weights for the criteria was obtained by averaging the weights given to each criterion by a number of experts of the domain, namely most of the researchers involved in the EMAF project. Later on, each one of the simplified tools will be assigned a score with regard to their performance for each criterion (a generic s_{ij} score being an indicator of how much the *i-th* tool meets the *j-th* criterion). To that aim a questionnaire was administered to the developers of the simplified tools in order for each of them to self-assess his/her tool's performance according to the various criteria and to answer a number of clarifying questions (e.g., related to the methodological aspects of the tool, margins for improvement, etc.). The scores collected will be complemented by those assigned by a number of experts reviewers of the tools and then the average score will be calculated for each tool. The average scores will then be multiplied by the average weights for each criterion in a way to then identify the highest score. The tool with the highest score (or more than one having scores very similar to each other) will be selected and will be tested in the framework of two small wine-making firms, as described in Section 2.2.

2.2. Early LCA implementation experiences in a wine pilot company

In order for the selected simplified tool(s) to be tested, two small-sized wine-making firms located in the Abruzzo region, Italy, were identified: a) Dora Sarchese (Ortona, Chieti province), and b) Palazzo Centofanti (Giuliano Teatino, Chieti province). As a first step, full LCAs concerning a few wines produced by the above pilot firms have been started. Carrying out both full and simplified LCAs on the same products will allow us to compare the results and to actually test the robustness of the simplified tool, e.g., by identifying more relevant aspects (e.g., impact categories) that might not be correctly (or only partially) taken into consideration. The reason for starting with the full LCAs is mainly related to time constraints and the need to optimise the time scheduling of the various project activities. However, it was obvious that postponing the simplified LCA testing to a full LCA completion might generate some bias in the testing itself, as regards, e.g, the correct appraisal of the time resources required. The wines selected for the LCAs were the following: for the first firm Montepulciano (type: novello); for the second one four different wines: Montepulciano (red), Pinot Grigio (white), Pecorino (white) and Cerasuolo (rosé). As regards the functional unit, for every study this was defined as a 750 mL bottle of the relevant wine, including primary packaging (glass bottle, cork, shrinking cap, and label) and secondary packaging (cardboard box, film and wooden pallet). The system boundaries include all steps from the agricultural phase to the final disposal of packaging (Fig. 2). Although the life cycle of wine can generally be defined by a series of phases such as: grape production, stemming and crushing, fermentation, clarification, ageing, packaging, storage and distribution, consumer phase, and end-of-life phase, it has to be highlighted that different types of wine may actually follow different processing paths after the agricultural phase (e.g., for white wine a soft pressing may take place before fermentation). For the sake of exemplifying, a detailed flow-chart for the winemaking process of Palazzo Centofanti's white wine is shown in Figure 3.

Figure 2. Life cycle of wine

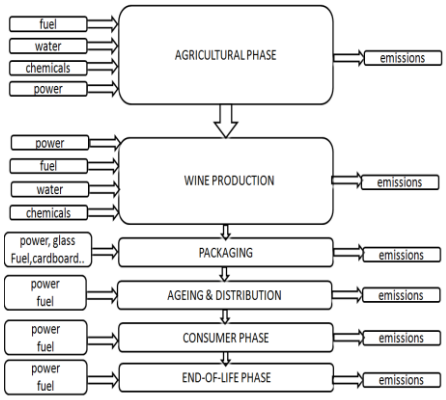
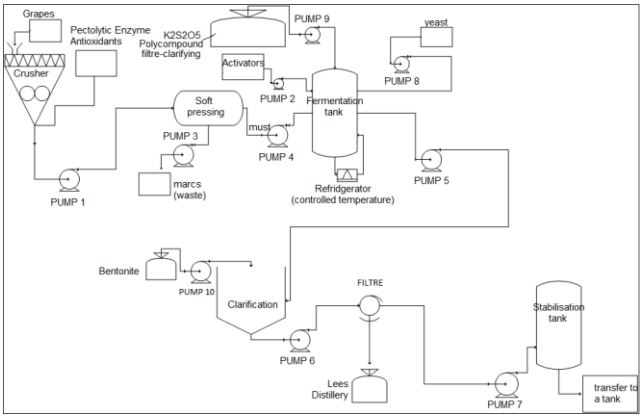


Figure 3. A detailed flow-chart of the production of Pinot Grigio (Palazzo Centofanti)



The collection of inventory data has been mostly taking place in the two involved pilot firms, as well as by contacting related supply-chain companies (e.g. cooperative winery). The time reference was a whole crop year. Some of the primary data which have been collected on-site include: fertilisers, pesticides, power consumption, water consumption, maintenance, etc.

In parallel, the system modelling and implementation of the full LCA have commenced using *SimaPro* as software and the *Ecoinvent* database as the main source for secondary data.

3. Guidelines for environmental labels and declaration

3.1. The core methodological structure of the guidelines

The analysis of the state of the art of environmental labelling activities in the agri-food sector revealed that, even if the environmental impacts of food production are complex, accumulated throughout an articulated supply chain (from primary production to processing, packing, distribution, retail, consumption and waste management) and with numerous potential environmental effects that can have a range of direct and indirect impacts, positive or negative, there is a low number of food eco-labels. This is probably due to a number of factors, including: the diversity of food products and production systems; the complexity of determining environmental impacts, issues involved in communicating environmental information to consumers via product labels, including issues of trust, preferences and motivations, and the lack of evidence showing that labels can help deliver environmental benefits. The majority of existing food eco-labels are based on the promotion of best-practice and do not quantify emissions or impacts, primarily for reasons of practice and cost. Therefore, they do not claim that any direct, product-specific, environmental benefits have been achieved. One driver that has recently received attention is the use of product labels, whereby the environmental "credentials" of a product are communicated to the consumer, either on a single issue (e.g., its carbon footprint) or on multiple issues (using omni-labelling). However, the science and practice of using labels to drive changes in consumer and industry behaviour is complex. There are many issues to resolve, including their scientific credibility and robustness, and how consumers understand and use them in practice. The literature review (Tzilivakis et al. 2012, 8-25) showed that the amount of work that is ongoing regarding environmental labelling is very considerable and its interest is growing worldwide. The amount of scientific papers focussing on eco-labelling for food products is also growing but it is relatively small compared to other industry sectors, and especially with respect to outcome-based labels and communicating multiple environmental issues on products. In this context there is a need to create guidelines that take into account the specific nature of products, the characteristics of the chain of production, territorial peculiarities, types of market, etc., and that can supply businesses in the sector with a carefully thought out and solidly motivated direction on how to choose the environmental labelling most appropriate for their agricultural and food products. The purpose of this guidelines is to provide a basis for identifying opportunities to improve existing (or designing new) labelling initiatives from the perspective of implementation and effectiveness. The main characteristics of the guidelines can be synthesized as follows: a) consistency with the provisions of series ISO 14020 and ISO 14063 standards; b) general character, that is to say all organizations can apply them, regardless of size, sector, location; c) structure based on iterative procedural steps, so as to support companies' decision-making processes in the choice of the labelling most suitable for the requirements and characteristics of their products; d) perfect suites for the firms needs; e) ease of grounding in a product-oriented environmental management system (POEMS) (Salomone et al. 2011). The iterative approach of the proposed guidelines arises from processing the answers obtained from a questionnaire distributed to companies settled in eastern Sicily of different sizes and of different production chains (wine, milk dairy-products, poultry, fruit and vegetables, confectionery and pasta) in order to identify the most significant environmental impacts generated during the whole production cycle of each sector and the problems found by the companies on the adoption of environmental labelling systems. The data of the questionnaire have been analyzed by the Rough Set approaches based on indiscernibility, a mathematical tool for the analysis of a vague description of objects, called actions in decision problems (Pawlak et al. 1994, 443-450; Pawlak 1991, 35-45). The adjective vague, referring to the quality of information, means inconsistency or ambiguity

which follows from information granulation (Greco et al. 2001, 1-47). The guidelines can be drawn as a clear decision making support in adopting the most appropriate system of voluntary environmental labelling. Reporting back may also let to identify the effective development of environmental performance, understand and answer stakeholders' needs and improve the management system, adopting the most effective innovations in environmental labelling. Moreover, in order to facilitate the self-evaluation of the firms on the real implementation of these guidelines, appropriate check lists in tabular forms have been presented with some questions linked to required requisites and linked both to the real environmental impacts and potential ones arising from the activities done along each phase.

3.2. Early guidelines implementation experiences in a pasta pilot company

In order to verify the robustness of the above mentioned guidelines, they were implemented in a small-sized Sicilian pasta firm placed in Floridia (SR). Through the use of check lists and the self-evaluation done by the environmental management, the guidelines implementation allowed the firm to identify the most suitable label among all the environmental labels found in literature: considering the existence of the Product Category Rules (PCR) for the assessment of the life-cycle environmental performance of "Pasta, cooked, stuffed or otherwise prepared; couscous" (Environdec 2012), the Environmental Product Declaration (EPD) label resulted as the most appropriate one because it matches the pilot firm needs of clear communication of its impacts based on credibility and transparency, and tailors for different target audiences. This analysis could represent a starting point to obtain an ecological label as the EPD which, in the food-processing sector, could answer to the needs of a right communication about the products environmental quality (Lo Giudice et al. 2011, 65-79).

The guidelines implementation experience in the pilot company is actually pursuing the identification of the impact categories that can be used within the above mentioned labelling scheme over the life cycle of food production. In particular, a preliminary analysis has been conducted considering the phases of: the durum wheat farm production; the semolina industrial production; the pasta industrial production; the domestic consumption. First results highlighted that the most impacting phase is the agricultural one, in particular for the use of fertilizers, with the related outputs as the airborne emissions (for examples NH_3, N_2O, NO_2) and the waterborne ones (for examples NO_3^- and PO_4^{3-}).

4. Product-Oriented Environmental Management Systems (POEMS)

4.1. The core methodological structure of POEMS

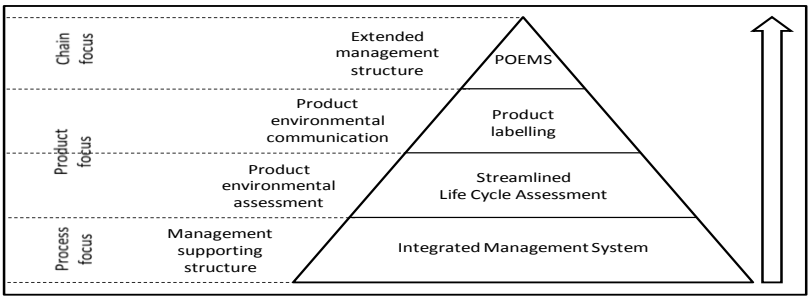
In order to define a suitable POEMS model for the Italian agri-food industry, a literature review of previous methodological or applicative studies of POEMS was conducted, with the aim of identifying: a) the most suitable definition of POEMS for the agri-food sector, b) the main structural elements of a POEMS, and c) the critical points related to the introduction and maintenance of POEMS in SMEs.

The analysis of the literature has firstly allowed us to highlight that one of the most widely used definitions of POEMS is the one provided by Rocha and Brezet: *"an environmental management system with a special focus on the continuous improvement of a product's eco-efficiency (ecological and economic) along the life cycle, through the systematic integration of eco-design in the company's strategies and practices"* (Rocha and Brezet 1999, 32). But, another definition of POEMS, which is more appropriate for the agri-food sector as it is not unequivocally tied to eco-design and is, thus, also applicable to companies that do not deal with product design, is the one coined by de Bakker: *"a systematic approach to organizing a firm in such a way that improving the environmental performance of its products across their product life cycles becomes an integrated part of operations and strategy"*

(de Bakker et al. 2002, 456). Furthermore, currently, there are no prescriptive standards for POEMS and the only elements that can offer methodological references as a starting point for their wider use are the Spanish UNE 150.301 standard and the ISO 14006 (both relating to the insertion of Eco-design in environmental management systems). The literature review also highlighted that the application of POEMS have dealt mainly with manufacturing industries (resin-makers, wood suppliers, metal products for ships, trucks manufacturing, etc.) and the integration of Eco-design in the EMS, in some cases also by associating an EPD. None of the previous pilot projects, however, concern the agri-food sector, where the only partial experiment reported is the one relating to the wine-making industry (Ardente et al. 2006, 350-364). Finally, the critical points related to the introduction and maintenance of POEMS in SMEs were identified, such as: complexity of assessment tools; data availability and consistency; limited cooperation within the chain. Starting from the main finding of the literature review, the most appropriate methodological solutions for the Italian agri-food industry were identified and translated in POEMS model requirements: *i)* fundamental structure composed of a management system conforming to ISO 14001 or to the EMAS Regulation, integrated with ISO 9001 and other possible management systems typical of the agri-food sector; *ii)* methodology based on the Deming Cycle, fully exploiting the iterative character of the cycle in order to pursue continuous improvement of both the methodological structure and environmental and product performance; *iii)* product orientation ensured by the integration of a simplified Life Cycle Assessment methodology suitable for organizations in the agri-food production chain, which can be used to evaluate different cultivation methods, production technologies and alternative materials; *iv)* ability to transform the environmental measures taken into commercial advantages in the best possible way for the organization, thanks to the use of guidelines that can support organizations in their choice of the most suitable form of environmental message, closely linked to the product; *v)* simplification of certain operational aspects and reduction of "bureaucracy"; *vi)* general character, making it applicable to any type of activity in the agri-food sector, whatever the organization's size, nature and position in the agri-food supply chain; *vii)* modular structure, as it is composed of a collection of management tools that can be applied, individually or as an integration of two or more elements, on the basis of organizations' specific requirements and of the objectives they aim to reach.

The modular structure of the proposed model is illustrated in Figure 4.

Figure 4. The modular structure of the POEMS framework



Source: (Salomone et al. 2011)

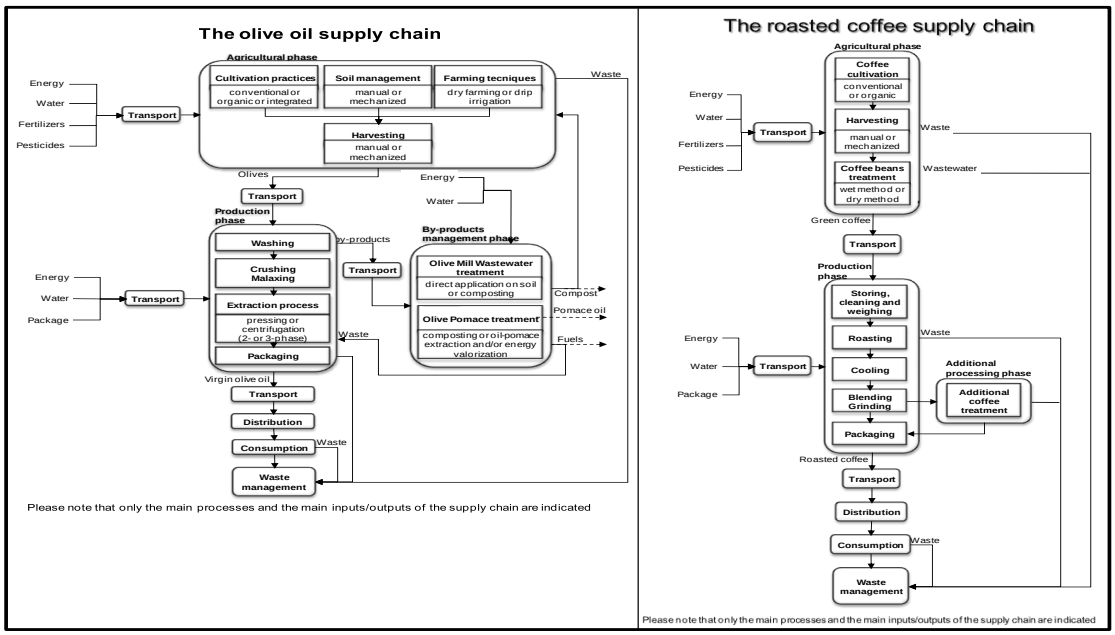
4.2. Early POEMS implementation experiences in a coffee pilot company

In order to verify the effective functioning of the POEMS model, its application in pilot companies, operating in two different agri-food supply chains, has already been started up. The two supply chains were chosen in order to involve firms operating in important Italian sectors from an economic and/or environmental point of view: the olive oil production sector and the roasted coffee one. In fact, olive oil

is a typical Mediterranean product of great economic importance in the European Union, but, the olive oil industry causes diverse environmental impacts in terms of resource depletion, land degradation, air emissions and waste generation. After vegetable oil, coffee is the most important traded commodity in the world and, although it is grown only in tropical and equatorial areas most of the coffee produced is consumed in developed countries; after Germany and France, Italy is the major importer of green coffee.

The first applicative steps of the POEMS implementation have been started in both the productive contexts, carrying out: a) a supply chain analysis (Fig. 5); b) the study and optimization of the IMS of the involved firms; c) the LCA data gathering of the main products identified by the companies themselves (as mentioned in § 2.2., also in these cases a full LCA has been considered as a starting point). Once the LCA will be completed, the results will be used to realize the product orientation of the IMS and to implement the environmental communication guidelines.

Figure 5. The supply chains studied for the POEMS implementation



Conclusions

The innovative character of the Eco-Management for Food Project (EMAF Project) has a double dimension connected to the fact that each environmental management tool included in this study is observed both with a single and an integrated approach, offering to agri-food organizations a "modular" format that refers to each tool separately (IMS, LCA, product environmental labeling guidelines) and to the POEMS in general; in this way, whatever the starting point of the firms is and whatever their targets are, they will find an answer and a strategy via which they may formulate their own route to eco-compatibility. The IMS model aligns and integrates the specific requirements of Management Systems and represents an essential starting point for the adoption of many other environmental tools that can be used by companies of the agri-food sector. In fact, it may be considered the backbone necessary to encourage the diffusion and the progressive growth of innovative tools to improve the competitiveness and sustainability of the agri-food sector. Referring to LCA, enterprises, especially small- and medium-sized (SMEs) ones, hardly have knowledge and resources necessary to implement this methodology. For this reason, simplified approaches and procedures have been developed, in order to facilitate the access to reliable, accurate and relevant life cycle information. The topic of simplification has long been

discussed, but a general agreement on which strategy towards simplification is more robust and thus applicable than others has not been found yet. Moving from these considerations, a framework of simplified LCA, specifically suited for SMEs in the agri-food sector is going to be identified, among the methodologies/tools already existing, which meet a number of established criteria. The ecological labeling guidelines are tailored as for being applied in different production chains, regardless of size, sector, location, environmental impacts. Their purpose may be: to "market" greener products to obtain a market advantages; to help firms management to develop more sustainable production systems; to raise consumers' awareness of the environmental impacts of their food they eat and enable more informed purchase decisions. The effectiveness of environmental labels intended to educate and empower consumers to make informed choices can be expected to benefit from consumer understanding of the strengths and limitations of labelling, and environmental impacts to which labels relate. Participation in, or cooperation with, any such education initiatives would be a positive action. The POEMS model enable to combine traditional environmental management systems for organizations (EMS) with other tools that are more orientated towards the management of the environmental performance of products (LCA, EPD, etc.). This ties in closely with the idea of extending the concept of continuous improvement: in traditional environmental management systems this is limited mainly to environmental performance in the production phase, while in POEMS it applies throughout the product life cycle from raw materials extraction, to the distribution, use and disposal of the product. In addition to the methodological outline of useful environmental management tools, a fundamental and significant part of the EMAF project is the application of its individual modules and the POEMS model in its entirety in various businesses in the agri-food sector (involving businesses of various sizes, with different organizational structures) that will allow us to better highlight the general character of the model, which is well suited and easily adaptable to the numerous differentiations to be found in this highly complex sector of production.

Finally, another aspect of the proposed model needs to be underlined: it is specifically designed to answer the particular requirements of the agri-food production chain, but can also be applied in other sectors of production, with slight modifications, thus "amplifying" the results of the EMAF project.

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