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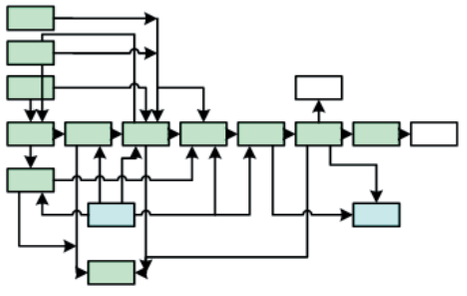
DIAS report

Life Cycle Assessment in the Agri-food sector

Proceedings from the 4th International Conference,
October 6-8, 2003, Bygholm, Denmark

Niels Halberg (ed.)



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How may Quality Assurance Systems in food chains include environmental aspects based on Life Cycle Methodology?

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Abstract:
The number of Quality Assurance Systems (QAS) for food products is increasing and the so is the topics they cover, from traditional intrinsic product characteristics such as percent meat in slaughtered pigs and protein content in milk to food safety issues such as zoonoses and pesticide residues and in some cases aspects of animal welfare. This development is linked to demands for risk controlling systems such as HACCP and traceability systems that would allow food safety problems to be traced to a small number of producers or farms. The large retail companies (supermarkets) are an important driving force for this development because of their efforts to build consumer trust in food products and loyalty to the companies own brands. Environmental characteristics of food products and information on their production methods are becoming part of some QAS but not mostly in the form of qualitative information e.g. certification that the farmers have used Good Agricultural Practice (GAP). The paper gives examples of this and then discuss this development in relation to LCA based environmental appraisal of food products. The development of quantitative (tools for) environmental appraisal of agriculture and food production is becoming more productoriented improving the possibilities of assessing the regional and global impacts of food production chains and consumption. But these systems building on LCA does not so far seem to be linked with the development of QAS for food. The paper finally discuss the possibilities for linking the food safety related traceability systems and gives an example of on-going work to establish LCA based QAS in a meat processing system.

Introduction

In the wake of the great European food scares of the 1990'ties a number of Quality Assurance Systemes (QAS) have been introduced or improved by food processing and retail companies in order to increase and regain consumers' confidence in food products (Schiefer, 2004) and to secure against liability from unforeseen food hazards. The more elaborate QAS build on a number of safety and control measures at critical points in the production process to avoid contamination and spread of food hazards. To secure transparency there is often an intensive information flow and assurance of tracking and tracing of product components between different steps in the product chain. Some slaughterhouses, for example, keep track of the meat quality from each primary producer thus keeping records that allow to track batches of meat from supermaket back to a very small number of farms. This increased interest in quality control and traceability has only to a limited extent included externalities of the production such as the animal welfare and environ-

mental impacts through the production chain even though these may be considered as equally important attributes of food products from a societal point of view.

Consumers appreciate a number of different quality aspects of food products among which are both intrinsic and extrinsic. Following Steenkamp (1990) the intrinsic characteristics include the organo-leptic or sensoric quality such as colour, taste, visible fat (called "quality cues" if they are observable before purchase and "experience attributes" if they may first be ascertained while consuming the product). Intrinsic characteristics that relate to food safety may often not be revealed immediately ("credence attributes") and it is off course no surprise that many consumers have become interested in information regarding the risk of zoonoses, bacteria or other food hazards when choosing food products. Extrinsic characteristics – besides price - relate to the conditions of livestock in the production chain (animal welfare), to the resource use and environmental impact from the production and to other aspects not observable from the product itself (e.g. GMO free, organic production, regional product)(Brom, 2000; Verbeke and Viane, 2000).

It has been proposed that the environmental information from e.g. Life Cycle Assessment (LCA) may be used to guide consumer choices (Nilsson et al., 2004) at least in public procurement (Anonymous, 2002). The EU Integrated Product Policy (IPP) considers LCA as one of the cornerstones (Anonymous, 2003) for improvement of the knowledge and transperancy concerning the environmental impacts related to production and consumption. However, it is not clear how significant environmental labelling is for consumers' preferences and other aspects of food quality are probably more important (Brom, 2000; Verbeke and Viane, 2000; Nilsson et al., 2004). It seems as if presently environmental aspects has less priority compared with food safety issues in the development of traceability and documentation in QAS (maybe because food contamination can have direct impact on specific consumers while most environmental issues have a less direct impact on particular consumers using a specific product). But in a larger context the environmental characteristics of food production chains are important because the food production and consumption is one of the larger contributors to a family's environmental impact (Anonymous, 1996; Wilting et al., 1999; Spangenberg & Lorek, 2002). Livestock products are particularly important for the emissions of nutrients and greenhouse gasses (see several papers in this volume) and for land use (Gerbens-Leenes et al., 2002) and projections of global food demands and production foresee a significant global rise in consumption of meat and milk (Delgado et al., 1999). Therefore, it seems relevant to seek ways to improve environmental appraisal of agriculture and food chains with the aim of reducing the environmental load per kg product produced and consumed.

There are examples of larger food companies - such as Arla, Unilever and Cerelia - performing LCA on specific projects (Larsson, 2004; McKeown, 2001; Rosing et al., 2004) either as part of their product development or in order to be prepared against criticism from environmentally con-

scious consumer groups. Also, a number of food processing plants like slaughterhouses and dairies have used energy accounting tools or other environmental management tools and some have become ISO 14001 certified such as the Danish slaughterhouse "Tican". However, often the most significant environmental impacts from food production are happening in the primary production rather than the processing stages. Therefore, attempts to describe, appraise and document environmental characteristics of food products should include the whole production chain. A number of European tools for farm level environmental appraisal and reporting exist for voluntary use, some of which are linked to advisory tools for farm planning (Halberg et al., 2004). But these tools are seldom linked with the rest of the food chain and existing labels for environmentally friendly production are usually not based on quantitative information of potential environmental impact from the specific producers (Nilsson et al., 2004).

The aim of this paper is therefore

- to discuss trends in Quality Assurance Systems (QAS) used in European food chains and the different methods used for appraisal of environmental characteristics of food products
- to propose that environmental appraisal as part of QAS should be based on quantified information through the product chain and be linked to traceability principles.

Quality Assurance Systems in European food sector

A number of QAS for food products exist in Europe and other countries differing in both their organisational set-up and in the degree to which they build on international certification standards (Schiefer, 2004). Meat and animal products have been at the core of food scandals in the last decade and not surprisingly some of the strongest QAS are to be found within pork production, such as the Dutch IKB (Trijp et al., 1997), a relatively new German system called QS (Quality and Safety for Food Products, from Producer to Consumer" (Nienhoff, 2004; www.q-s.info) and the "Danish" brand (Anonymous, 2003). These management schemes aim at securing a high degree of traceability through a strong information flow where results from tests and measurements along the production chain are continuously fed backwards with the aim of improving performance (e.g. feeding back information to farmers on carcass quality or bacterial counts in milk). Most often this relates to analyses of "classical" quality parameters such as fat content, freezing point and bacterial counts and for medicine residues and other more recent tests such as Aflatoxines. Thus, most often QAS builds on two key concepts: Traceability and HACCP. HACCP (Hazard Analysis and Critical Control Points (CFSAN, 2004; Danske Slagterier, 2003) is a systematic approach to monitoring quality and risks of contamination of food products during a production process and is standardised among others in Denmark and Holland and internationally in ISO 22000.

Moreover, increasingly the QAS seek to include whole product chains in order to improve cross-border trade and share information not only backwards/upstream but also downstream in the

chain as documentation coming with the product. However, when it comes to information regarding the extrinsic characteristics such as animal welfare and environmental performance such information is presently not accumulated and exchanged through the value chain in a quantitative form. The QS system for example includes demand for compliance with other German regulation of manure use but no quantification of nutrient surplus or losses. Likewise, the French QAS "Agri Confiance" for certification of a variety of livestock products and processed crop products has only recently started to include environmental aspects in a separately managed ISO 14001 scheme called Agri Confidence® Quality-Environment (www.cooperation-agricole.asso.fr cit. Cederberg, 2004). The intention of labels such as IKB are to add value to a product (pork) in the eye of the consumer by guaranteeing that it is produced according to some criteria, which are believed to be important (Trijp et al., 1997). This added value should then give an advantage in the form of either higher prices or increased consumer loyalty to products labelled with the IKB brand.

In addition to the brands and QAS of the food processing industry large retail companies also begin to focus on traceability and documentation of the origin and quality of the products they sell. There seems to be a trend towards non-price competition (competing on the products' quality attributes) and building consumer loyalty towards the retail companies' own brands. An increasing proportion of the retail sale of food and household commodities happens under the retail companies' own brands (Arfini and Mancini, 2004). The British Tesco and Sainsbury for example both have their own brands that account for over 50% of their total sales, the French Carrefour and Intermarche sell 20 and 29% of their turnover in their own brands and this proportion is increasing also in the Nordic COOP chain. This has economical advantages for the retail business and gives them stronger control and flexibility (e.g. they may change their suppliers without the consumers noticing). To minimise the risk of loosing consumer confidence in these trademarks due to food scandals the retail business is now very active in quality assurance and therefore demand quality control measures and traceability backwards in the food chain.

Arfini and Manicini (2004) studied the British Retail Consortium (BRC) as an example of this involvement. The BRC is an association of major retail chains and distribution companies in the UK and has as its major function to translate consumer demands and interests into demands for the products' characteristics and performance through the supply chain. Thus, the BRC's so-called "Technical standard and protocol for companies supplying retailer branded food products" include demands that companies establish hygiene and safety control systems based on the HACCP method. Suppliers should also adopt a documented quality management system including requirements of minimum levels and recommendations on good practice, following a standard such as EN45011, which is basically in compliance with ISO 9001. This way (expected) consumer demands concerning food safety and product quality have been translated into contrac-

tual requirements that suppliers of food products (also foreign) have to comply with when dealing with the members of BRC, which is the majority of the large retail chains in the UK.

According to Krieger and Schiefer (2004) the primary agricultural production (e.g. the pig fattening facility) will become integrated in HACCP systems in the future and HACCP systems already exist for fruits and vegetables (Hernandez-Souchez et al., 2004). However, the authors do not find it likely that these quality assurance schemes will be used to claim higher prices for the certified products. Rather these concepts will be considered the standard or basic quality for a number of food items. Contrary to this Broom (2000) argues that food safety may be assured by labelling schemes if they are backed by government control systems. Other issues that are not necessarily relevant to all consumers in their role as consumers - such as animal welfare or environmental issues – may also be assured by labelling. The European Commissions study on "environmental product declaration schemes" (Anonymous, 2002) advise that information on the environmental performance of food products be considered in e.g. public procurement. Nilsson et al. (2004) find that existing labelling schemes often lack credibility in the sense that "they are perceived interesting and trusted by consumers" and should therefore be backed by a more factual appraisal of the actual production methods and their environmental impact. Whether the QAS will be used to give information to consumers or will remain primarily a process between agents in the food processing chain is not clear, but in both cases it seems relevant to discuss the potential role of LCA or other forms of environmental assessment to supplement such systems.

Good Agricultural Practice and environmental Quality management of food products

Some initiatives aim at securing minimum standards for the environmental performance of agricultural products, especially through the establishment of certification schemes[1]. A major objective among retail companies is to avoid pesticide scandals caused by either too high amounts of residues in the products or hazardous use by the farmers. This is primarily secured by either banning certain pesticides in specific products or demanding rules for pesticide use and storage, see below. Other aspects are included such as the prudent use of water and fertiliser but most often in a non-quantitative form, which seem less rigorous than for the above mentioned meat quality and food safety issues. Therefore, it is relevant to discuss the possibility of using quantified information based on actual use of inputs and/or estimated emissions in the environmental assessment of food products.

A number of food products are produced and sold under labels claiming some form of environmental consideration. One example is the bread wheat and rye sold under the *NATUR+* label

[1] Certified organic farming is off course also a certification that certain practices have been followed and that no pesticides have been used but it does not quantify the environmental impact as such and will not be considered here.

(Cederberg, 2004; Swedish Seal, 2004) owned by the Swedish farmers and used for most bread and flour sold in Scandinavian supermarkets such as COOP in Denmark and Sweden. The *NATUR+* label guarantees that no chemical "plant growth regulators" have been used (following specific worries for food safety of this otherwise legal crop treatment) and the rules also ban pre-harvest Round-up use and use of sewage sludge. It may be discussed whether these rules in reality address a consumer concern for chemical residues in the bread rather than care for the environment, but recently also rules for fertiliser planning and minimum requirements for "green zones" on the farm have been included.

Under the British Farm Standard logo of a "Little Red Tractor" exists a number of guidelines for assured production with rules of how farmers should take environmental considerations in their planning and management. One example is the Assured Produce Scheme (APS), which promotes safe and environmentally responsible production of fruit, salads and vegetables through the use of integrated crop management (ICM). According to the home page (Anonymous, 1993) APS "is designed to maintain consumers' confidence in the safety and integrity of the produce they eat". Growers must follow the best production advice contained in the crop specific protocols that form the basis of the scheme. For example, the use of fertiliser should be based on crop norms and soil analyses and pesticides should only be used after observation of a critical level of a pest in the crops. APS thus follows a logic of Good Agricultural Practice (GAP) and is crop/field level based, not product oriented. APS is an independently assessed assurance scheme and farmers have to be certified and inspected to sell products labelled with the Little Red Tractor. Other QAS under the little red tractor cover e.g. pigs (Assured British Pigs) and chicken (Assured Chicken Production).

The APS is one of many examples of a labelling scheme certified under the umbrella EurepGAP, which is an initiative owned by a consortium of European retail companies (supermarket chains). The EurepGAP is based on the socalled *FoodPLUS / STATUTES which have the objectives to:"Encourage adoption of commercially viable Farm Assurance Schemes, which promotes the minimisation of agrochemical inputs, within Europe and world wide.*
Develop a Good Agricultural Practice (GAP) Framework for benchmarking existing Farm Assurance Schemes and Standards including traceability." (EurepGAP, 2003).

The Danish IP label (Integrated Production) for vegetables (outdoor as well as greenhouse crops) is owned by an independent group of horticulturalists organised under producer organisations (GAU/DEG/GASA) (Anonymous, 2004a). Danish IP is based on the idea of promoting the use of good crop rotations and other preventive measures to reduce the need for pesticides as much as possible. As an example the producers of IP tomatoes and cucumbers have to record and document that they purchase and use biological control of pests. It was originally the hope among the initiating producers that the IP label would qualify for a price premium but this has

not been realized. However, the Danish IP label is credited for the relatively high proportion of Danish produced vegetables sold in supermarkets. The Danish IP is currently undergoing adjustments to comply with the EurepGAP standards. This implies some changes in the level of documentation and in specific rules for e.g. storage of pesticides but not in the actual environmental performance of the farms. This is because the EurepGAP standards do not include specific quantified limits for e.g. fertiliser use or environmental impact.

Environmental assessment as part of quality assurance schemes

Why should the food business use precise documentation of environmental impacts of food products? There are a least two reason why documentation of environmental characteristics should be included in QAS. The first reason is related to the interests of the brands and food companies and the second is related to the societal interests in environmental improvements in the food chain.

1. The advantages for the food companies of branding builds partly on the ideas that the perceived better quality associated with the brand and other brand associations increases the consumers experience and satisfaction with a product (van Trijp et al., 1997). As discussed in the introduction "quality" is more than the intrinsic characteristics of a product and includes external characteristics such as environment and animal welfare aspects of the production process. Therefore, it may be an advantage towards at least some parts of consumers to have documentation that environmental care is part of the brand policy. Or, at least the retail companies and the brand owners should try to avoid critical stories concerning the environmental impact from their suppliers, e.g. damaging losses of critical pesticides.
2. From a broader environmental perspective there could be an advantage of including environmental assessment in QAS because important environmental impacts from food consumption are regional and global such as nutrient losses and greenhouse gas emissions. The larger part of these environmental impacts happen in the primary production and there seems to be a potential for improvement as demonstrated by both LCA studies (de Boer, 2003; Haas et al., 2000; Halberg, 1999; Erzinger, 2004) and the tests of farm level green accounts (Halberg et al. in press). To record and report environmental information would facilitate better control, regulation and improvements based on incentives from e.g. the retail companies with their own brands. Following the ideas of the IPP information regarding the environmental impacts accumulated through the food processing chain would also facilitate better choices among retail companies and professionals in kitchens and restaurants.

As mentioned above, quality parameters like carcass quality is communicated up- and downstream in the food chain partly as quantitative information but the environmental information - if

used at all - is based mostly on GAP, adherence to decision rules etc., not on the actual result, e.g. resources used per kg product or LCA type of information. It should however be possible to use quantified environmental assessments because this type of information is the baseline of many types of green accounts for farms in Europe (Halberg et al., 2004), but these are most often not integrated with the product chain QAS. Nilsson et al. (2004) analysed the credibility of 58 eco-labelling schemes and conclude that presently ”There is no labelling system that covers the entire food production chain which could install ecoefficiency in the production chain”. The authors call for an “alternative approach [that] could measure appointed quality aspects in indicators for the whole food product chain and report them to interested parties and consumers” (Nilsson et al., 2004).

Some of the objectives for including environmental characteristics in QAS may be fulfilled by GAP type rules to be followed by the farmers, e.g. certification that they only use legal pesticides and only after pest-infections above a certain threshold have been observed by the farmer in his fields (such as is the generic rules in EurepGAP standards). From the point of view of the retail sector this approach seems to limit the risk of food scandals caused by misuse or overuse of pesticides by the primary producers. They may claim that they have done their best to limit this and thus avoid liability in case of such a case becoming public.

However, this rule based method for environmental QA does not significantly document any improvements in environmental performance compared with standard practice, especially not in countries with a high standard for public regulation. Rules for GAP that simply demand the farmer to make a fertiliser plan or to use pesticides only after inspection in the crops do not distinguish between farmers who use only small amount of pesticides or fertilisers (e.g. because they have a better crop rotation) and those who in reality rely on standard dosages. Halberg et al. (2004) compared different European concepts for farm level environmental appraisal (Input output accounting, Green Accounts etc.) and found a similar distinction between management (rule) based indicators and quantitative indicators based on results of environmental performance on farms (e.g. nutrient surplus per ha or energy use per kg product). It was concluded that the results based indicators were more suitable to link with advisory tools for improving farm performance based on e.g. benchmarking. Benchmarking is here understood as “the process of improving performance by continuously identifying, understanding and adapting outstanding practices and processes found inside and outside the organisation” (Amer. Prod & Quality Center, 1999, cit. EEA, 2001). In other words, benchmarking is to compare one’s own results with other producers’ performance and thereby identifying ”best practices” among comparable producers. The process also involves the tasks of understanding these differences, thus learning from others and using this to set goals for one self and the engage in activities to improve one’s own practices. To perform benchmarking and facilitate improvements there is a need for quantitative assessments of environmental characteristics of food products based on the actual processes and resource use.

The quantitative, results based environmental information also has the advantage that they may describe the environmental impacts accumulated through the production chain, such as energy use and nutrient losses per kg product using LCA methods (as demonstrated in several papers in this volume). This would facilitate a product based environmental appraisal of food products in line with ideas of IPP (Anonymous, 2003). Therefore, it should be recommended to use quantitative environmental information based on the actual results from the production processes as part of QAS in the future. The existing LCA methodologies could be used as a starting point for this merge between IPP and QAS and supplemented with processes to include environmental aspects in product development (Nielsen & Wenzel, 2002).

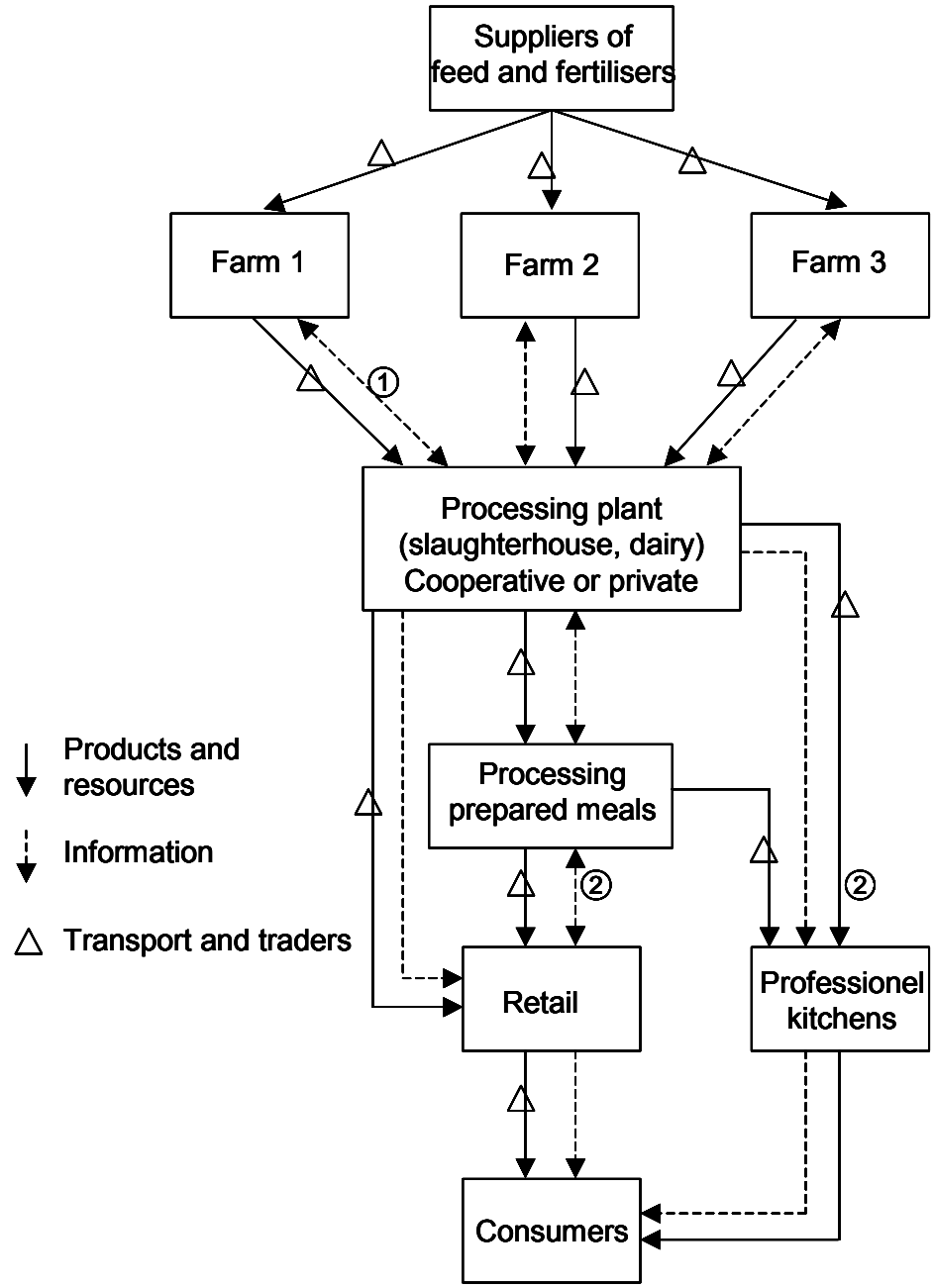
To our knowledge the Dutch system "MPS" (Anonymous, 2004b) for green house production of flowers is the only environmental QAS for agricultural products which is both accredited by the retail sector in Europe, and builds on quantified information in a way that would fit in a product oriented environmental appraisal building on IPP/LCA principles. The MPS is accredited under EurepGAP but unlike most other GAP approaches this system is based on a quantification of the actual use of energy, pesticides and fertiliser per batch of flowers finished by the certified growers. Thus MPS is an example of how environmental QAS may be used for both documentation towards retail chains and benchmarking between growers. Some of the major retail chains have recently demanded MPS certification of flowerpots for their stores. The growers under MPS have to report their use of energy, pesticides and fertiliser every four weeks to the MPS organisation, where quarterly reports are compiled and sent out to growers with comparisons of their performance against standard limits and results of other growers. If a grower uses more of one input factor than the standard different measures are taken – depending on the severity of the exceeding and ultimately a grower may loose the certification for a period of time. The MPS approach demonstrates the feasibility of benchmarking between producers but the pot flower enterprises have a relatively short production chain from grower to retail compared with e.g. livestock products. However when looking at the existing dataflow on product quality in the pork sector including environmental data does not seem impossible from a practical viewpoint.

Fig. 1 gives an overview of the idea of creating an information flow on environmental profiles of livestock products along the physical flow of agricultural products from primary producers to retail. This idea is presently being tested in a case study involving a private Danish slaughterhouse and a number of its major suppliers of fattening pigs. The involved farms will establish Life cycle based green accounts of their production of fattening pigs with the help of local production advisors. These will be collected at the slaughter house for two purposes: 1.The accounts from different farms will in anonymous form be compared and fed back to farmers in a benchmarking exercise, where each farmer may assess his environmental performance in comparison with other producers delivering to this specific company. 2. The information on resource use and emissions

in the primary production will be supplemented with environmental information from the slaughtering and other processes including transport to give an environmental profile per kg product delivered to the retailers and professional kitchens. It will be part of the project to explore which type of information the professional buyers will be interested in and how to convert LCA type of information into a format that is understandable for these stakeholders. It is not the idea to present this information to ordinary consumers because the LCA based information itself is assumed to be too complicated for laymen to relate to in the purchasing situation.

Conlusions

Rule based environmental quality assurance based on GAP is becoming part of the overall QAS in the food sector. The GAP approach may give some quality assurance for the food retail sector helping to reduce risks of food scandals from e.g. pesticide misuse analogously to HACCP systems reducing other food hazards. But the GAP approach found in most environmental QAS presently does not satisfactorily quantify the actual environmental performance on the farms nor does it allow benchmarking between farms, supplier cooperatives and products. Moreover, the GAP approach is not suitable for a product-oriented appraisal of environmental impacts from food products in line with the increasing interest in Integrated Product Policy. There is a need for development of an environmental quality assurance scheme that records and exchange information up- and downstream in the food chain and allows both primary producers and the food industry to continuously benchmark their performance and the retail sector to assure their customers that products are environmentally sustainable. Life Cycle Assessment and Life Cycle Management seems obvious tools for this and will be used in an attempt to develop such a system within a Danish slaughterhouse company.



① Input/output accounts on farm level transformed into environmental profile per kg product from farms. Data for comparisons between farms re. ressource use and emissions per kg product, (benchmarking).

② Documentation of environmental profiles of products accumulated through the chain in life cycle terminology

Figure 1. Simplified description of a food chain with physical flow of products and (potential) flow of information regarding quality and enviromental characteristics.

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