

The Challenge of Greening Global Product Chains: Meeting Both Ends

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ABSTRACT

Greening of product chains has come up as an important means to systematically improve the environmental performance of products from cradle to cradle in Europe and elsewhere. Some experience with inter-firm co-operation aiming at reducing the environmental impacts has been generated in recent years. Most of these experiences involve cooperation between some of the links in product chains, very often stopping at European borders. Problems of market communication, information availability and information costs prevent companies from going beyond these lines. Also, anonymous markets may prevent communication between producers and end-users in the West and supplying firms in developing countries. Only very few documented case studies of global greening of product chains are available. Therefore, the challenge here is how to establish interactions with the first links in supply chains. Within the context of South Africa it is of cardinal importance to identify these links to ensure sustainable synergy. European countries are constantly changing the standards of products in order to meet environmental targets. Moreover, European consumer markets are increasingly sensitive to environmentally sound products. From the perspective of South African suppliers there is an increasing need for interaction in their global product chains. In this conceptual analysis we will present the way that should be followed from both ends of the global product chains. Copyright © 2005 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

THE OLD NOTION OF 'DEVELOPMENT VERSUS ENVIRONMENT' HAS GIVEN WAY TO A NEW VIEW IN which better environmental stewardship is essential to sustain development (World Bank, 2003). According to Todaro and Smith, environmentalists have used the term 'sustainability' in an attempt to clarify the desired balance between economic growth on the one hand and environmental preservation on the other (Todaro and Smith, 2003). As widely accepted since the Brundtland report, sustainability refers to meeting the needs of the present generation without compromising the needs of future generations, but often omitted in citing Brundtland are the subsequent lines where sustainability is linked to bridging the inequality in global economic exchanges (WCED, 1987). The cycles of production and consumption in practice are often global chains of human activity.

The critical issue is to find production procedures to meet the consumption demand of products in this growing global market, while promoting positive ecological and social impacts throughout the value chain. *This gave rise to the emergence of greening of product chains with a strong emphasis on managing supply chains.*

Todaro and Smith further point out that the natural base of a country and the quality of its air, water and land represents a common heritage for all generations. It is therefore important that development policy-makers incorporate some form of environmental accounting into their decisions to accommodate this philosophy. The further importance emanates from the European countries that are becoming increasingly sensitive to environmental sound products.

Welford adds another argument: the current world of globalization leads to an increase in the 'weightlessness' of corporations as companies externalize more of their production activities. Since systems are essentially an internal management tool, this externalization means that they cannot manage many of the environmental impacts of the modern corporation. He argues that a new emphasis must be placed on environmental supply chain management and extended producer responsibility running in parallel with new initiatives on social responsibility and fairer trading relationships (Welford, 2003).

Creating fairer trading relationships is one of the important issues on the global agenda for multi-lateral agreements between nations. It requires breaking down tariff barriers and export subsidies used by developed countries to dump their surplus products (Stiglitz, 1999). One might also suggest applying international agreements to introduce green requirements in international trade relations. Esty has shown that such an approach would face many practical obstacles: endless disputes on goals, controversies on valuation methods, intervention by powerful political forces in any of the many nations involved, leading to a high level of inertia (Esty, 1999). The greening of global product chains forms a challenging business-to-business shortcut for creating fairer trading relationships, avoiding the long and slow route of negotiating nations. However, globe-wide cooperation between suppliers, producers and retailers has its own practical obstacles to deal with. In this article we will discuss these.

Purpose of This Article

In this article we investigate the emerging challenge of greening of global product chains. First we discuss its origins and philosophy and then look briefly at the key methodology. In the fourth section we explore possible motives for producers at the end of the product chain and, based on early experiences, possible barriers that will need to be dealt with. Thereafter we will discuss a producer's perspective from the input side of the product chain. Only a few practical experiences with global greening of product chains have been documented, and we discuss some experiences in the fifth section. Finally, we formulate a research agenda.

Emergence of Greening of Product Chains

Many companies have improved their environmental performance by taking advantage of clean production methodologies and by applying principles of environmental management to their organization (Vermeulen, 2002a). One can argue that these approaches focus on intra-firm activities, such as applying add-on cleaning technologies, wastewater treatment and treatment of hazardous waste. These activities are often costly and cause other environmental problems with remaining concentrated hazardous wastes. A second focus for improvement of business's environmental performance emerged with pollution prevention activities, still being mainly intra-firm activities, such as good housekeeping, process improvements, waste management etc. Companies taking another further step have also employed activities in selecting cleaner resources and input materials and rethinking the design of their products (Tukker *et al.*, 2001). Although also these steps may in practice be still mostly an intra-firm activity, here we see a first step towards working in the life cycle of products: companies try to identify opportunities for environmental improvements both inside the entrance gates of their production units and outside by cooperating with their main suppliers.

In the 1990s this trend has been taken a step further by a number of companies and research institutes. Following the line of the life cycle of products, a more fundamental approach can be taken, systematically trying to identify possible opportunities for environmental improvements in all phases of the entire life cycle, for all possible environmental effects (Sinding, 2000). This approach is known as life cycle management (Sharfman *et al.*, 1997; Frankl, 2002), integrated chain management (Vermeulen *et al.*, 1994; Cramer, 1996) or green supply chain management (Chouinard and Brown, 1997; Zsidisin and Siferd, 2001). See Sinding for even more comparable approaches (Sinding, 2000). The first two concepts mainly cover the same area of attention from cradle to cradle, as these approaches both look at the supply side and at the post-production phases of the product life cycles: improving the performance-in-use and post-consumption phase recovery of used material and energy incorporated in product wastes ('cradle to cradle' instead of 'cradle to grave' implies the inclusion of attention to organizing reuse of disposed materials in the post-consumption phase) (Vermeulen and Weterings, 1997). Green supply chain management may be more limited, being focused on the inputs for the company involved by applying green procurement policies (Wycherley, 1999). Here we choose to apply the term *greening of product chains* because of the new global trend, thus stressing the focus of many of these activities on improving finished products for the consumer market.

Still only limited cases of experience are reported in the scientific literature, but companies in many countries are making steps in this direction. Experience has shown that if companies are applying greening of product chains, in practice they tend to concentrate on the closest and best known supply chain links (Vermeulen *et al.*, 1994; Wycherley, 1999; Holt, 2004). A fundamental feature here is that product life cycles in our globalized economy are generally cross border. There are no known figures about it, but one can state that a large and growing share of all products consumed in Europe have their origins in resources or partly manufacturing in developing countries, which is also expressed in assessments of ecological footprints of nations (Wackernagel and Rees, 1996; van Vuuren *et al.*, 1999). Coming from this observation, the ultimate implication is that supply chain management needs to be taken up on the global scale: greening of global product chains, involving cooperation along the entire supply chain back to its sources in developing countries. Only a few such experiences are actually known, those described mainly stemming from fair trade initiatives. In this article we want to concentrate on these global supply chains and especially on activities by firms within their own supply chain.

Required Methods and Tools

Various scholars have suggested methodologies for greening of product chains (Vermeulen *et al.*, 1994; Six *et al.*, 1995; Cramer, 1996; Wolters *et al.*, 1997; de Groene and Hermans, 1998; Seuring, 2004). Although the perspectives and the emphasis on various stages of the life cycle may differ, a common methodology has emerged during the 1990s. In theory, greening of product chains should involve application of life cycle analysis, leading to improvement activities:

- producers analyse the entire life cycle of their product, identifying major environmental effects;
- they decide on objectives, either self-imposed, aiming at environmental excellence in niche markets, or applying readily available sector wide standards (such as ecolabel criteria);
- they analyse at these crucial points the level of reduction of environmental impacts resulting from possible improvements in methods of production, use and discarding of the product;
- they analyse the economics of suggested improvements (de Groene and Hermans, 1998) and select which improvements are to be implemented;
- they implement the improvements selected within their own production facilities;
- they engage in inter-firm cooperation aiming at implementation of identified improvements on the input side of their product life cycles (procurement, co-operation with main suppliers, co-makerships) and on the output side (organizing recycling, maintenance, information on proper use etc.);
- they develop systems of control, preferably including third parties able to generate legitimacy (Kogg, 2003).

To identify major environmental effects and set improvement targets the three following principles of greening of product chains may be applied (Daly, 1990; Vermeulen *et al.*, 1994; Cramer, 1996):

- reduction in the use of fossil fuels and the maximum possible use of sustainable energy sources;
- retention of biogenic and mineralogenic (non-renewable) raw materials for as long as possible in the cycle, unless this is environmentally inefficient (this means on the one hand promoting *longer product life*, and on the other hand cascade-fashion production of as *many recycling levels and recycling loops* as possible);
- maintenance of a balance throughout the entire process of composition and decomposition of biogenic (renewable) raw materials.

Looking from the perspective of actors inside a product chain, these general principles seem to be just a first rough pointer. Companies taking first steps in this direction, from pollution prevention, environmental management or maybe total quality management, will need to take a pragmatic approach (Six *et al.*, 1995). Starting with already known bottlenecks in the supply chain, co-operating with trusted partners may very well be a indispensable first step, before upgrading to a more comprehensive approach.

Another issue here is the question of perspective: who is to apply greening of product chains and what are implications for the use of tools and methodologies? A distinction can be made between '*inside chain actors*', being a part of the supply chain they study, versus '*actors from outside*' (such as research institutes or government agencies). The first group will naturally have a tendency to restrict their search to options they can decide upon, while the degree of freedom in identifying opportunities will be much larger for the second group. Implementing options for improvement may often require government assistance (Cramer *et al.*, 1995; Vermeulen and Weterings, 1997; de Groene and Hermans, 1998), thus making *inside chain actors* dependent on government policies (e.g. in the form of recycling policies, or pricing policies).

Another distinction to be made refers to the position in the life cycle: are products analysed from the perspective of a virgin resources supplier, a raw material producer, an end-manufacturer, a wholesaler or retailer, or even the consumer? For the first two perspectives post-production issues dominate the agenda, ensuring proper use of the substances they provide. From this *substance perspective* looking from the 'input side' or the source of the chain, the environmental impact of the mining of (raw) materials, via production to the final disposal or rather re-use, is studied. The limiting factor here is that the range of applications of a specific substance can be very large.

From the position of end producers and retailers, the focus will be on the end product. From this *product perspective*, at the end of the production phase the environmental impact that occurs throughout all life-stages of the product is taken into account: looking both backwards and forwards through the life cycle. At this stage post-consumer waste management will be more prominent and end producers will be in a position to apply design for environment activities (Brezet and van Hemel, 1997). The limiting factor here for both producers and retailers may be the large number of products they handle: a start needs to be made with the largest volume product they select.

From the consumers' position an even more challenging perspective emerges. Consumers use products to provide certain needs, needs that might be satisfied with entirely different products, thus requiring comparisons between completely different competing life cycle systems. From this *system perspective* life cycle systems may be substituted by others that fulfil the same function (e.g. wooden versus plastic or aluminium window-frames; or use of airplanes versus high speed long distance trains). To get optimal substitution possibilities it might be necessary to take into account the whole life cycle system in which the products function, and to make comparisons. A limiting factor here is that both producers and consumers will hardly do so. For the producers looking at competing systems does not usually represent opportunities for action (but they may analyse competing systems to identify threats from competitors). The consumer will not be able to do so, but here consumer organizations and other NGOs may very well play this role.

End Producers' Perspective: Why and How to Do It

Why would end producers (or retailers) take steps in this direction? Greening of product chains may be expected to be the most fundamental approach in improving environmental performance of commodities and can easily be extended to the social dimension of sustainability as well, taking into account fair prices, stable employment and stable partnership relations with global suppliers (Ytterhus *et al.*, 1999), thus the ultimate consequence of corporate social responsibility (CSR) may very well be the adoption of greening of product chain strategies.

But what's in it for the entrepreneur; what reasons could he have to step into such an uncertain (global) adventure? Scholars give various reasons, some theoretical, some found in research. Many of the early starters have been driven by environmental awareness and corporate social responsibility, often addressing green niche markets. Growing consumer demand has been reported for many classes of products in both Europe and North America, albeit still rather small, but growing niches (Vermeulen, 2002b). More important may be various product and recycling related policies in European countries and development of the EU Integrated Product Policy (Rubik and Scholl, 1999). This Integrated EU Policy for Products (IPP) will probably be based on a mixture of (1) getting the prices right, (2) stimulating demand for greener products and (3) strengthening green production, strengthening the other motives mentioned here.

Simultaneously in the 1990s businesses started to address each other with business-to-business demands on environmental performance, either related to very specific environmental issues, or more

generally demanding corporate environmental policies or certified compliance to the ISO 14001 system. There is some debate on to what level a 'multiplier effect' of supplier pressure can be witnessed. Ytterhus reports a strong case, whereas Holt shows that only a few companies actually cease purchasing from suppliers who fail to meet environmental criteria (Ytterhus *et al.*, 1999; Holt, 2004). Ytterhus *et al.* drive the argument even further by stating that business pressures may eventually be more effective in greening production than government intervention (Ytterhus *et al.*, 1999).

Wolters *et al.* point at other (internal) drivers for greening of product chains: possible cost reductions, competitive advantages stemming from improved product qualities and improved reputation and image (Wolters *et al.*, 1997) and reduced liability risks. The process of cooperation itself with chain partners in the greening of product chains also proves to be advantageous: as Chouinard and Brown from Patagonia Inc. stated,

We are now capable of buying off-the-shelf goods when they meet our needs and developing new fabrics when necessary. Our products are better because our designers, rather than making do with commodity fabrics, are involved in the fabric creation process itself. In effect, we became a learning organization with the ability to assimilate new information rapidly and to be innovative in our approach to production (Chouinard and Brown, 1997).

We see many possible reasons, but they are countered by various demanding requirements needed to be successful in the greening of product chains. Looking at the steps in the third section, greening of product chains requires additional expertise and new information needs not yet provided in business as usual. Companies embarking on this uncertain voyage need to skill themselves in new fields of material flow analysis (MFA), substance flow analysis (SFA), life cycle assessment (LCA) and the specialties of production of resources and semi-finished products they use. In addition, they need to collect and handle data on economic impacts throughout the product chain and develop methods for choosing options for improvement, in cooperation with chain partners involved. Such cooperation with suppliers in this field and across the globe may require new socio-cultural skills, because of the economic interests at stake.

Experiences reported in the literature suggest various serious barriers.

- *Motivation.* Both key actors within the initiating firm and the chain partners addressed need to be motivated to take steps. Their motivation will depend on their perception of the urgency of environmental issues, the opportunities in the market and their possibilities to invest human energy in this innovative, but uncertain, voyage. Following Freeman's typology of attitudes towards innovation, we know that innovators and early adopters are generally just a small proportion of the business community.
- *Knowledge and expertise.* As shown above, new forms of expertise and information not yet available to the initiating company about modes of production, their impacts and alternatives are needed (Kessler *et al.*, 2003). Some of the projects discussed in the literature were government supported, providing academic or consultancy advice, which may not always be available to others. Other scholars also stress required internal capabilities (Bakker and Nijhof, 2002).
- *Costs and benefits.* Some estimation of probable costs (of knowledge generation, investments in environmental improvements etc.) and benefits (possible cost reductions, market gains) will be needed for key decision-makers to start up projects in this field (Sinding, 2000). Little empirical exemplary evidence is available about the benefits (profits or market shares). This makes key decision-makers within businesses depend on their experienced judgments on the profitability of greening the product chain. As a consequence, firms may face a fair deal of mistrust and scepticism on this issue when

they start up co-operation with suppliers. This was shown in an analysis of suppliers' reactions to greening by Body Shop International (Wycherley, 1999).

Seuring adds that for implementation of integrated chain management three issues can be spotted: time, production amounts and complexity. Time is needed to design and operate products and production networks. Significant amounts of fibres and clothing are needed (in this case) to allow economies of scale to be used. Complexity arises from the management of the chain, which places far greater demand on the focal companies and the supply chain partners than is the case in conventional textile chains (Seuring, 2004).

- *Power.* Working in product chains may vary in its form of interaction from close cooperation (partnerships, coaching, co-makerships) to simply employing market power (selecting suppliers, threat of ceasing purchase). Small companies or companies being just one of the many clients of their supplier may not have much power down their supply chain, making them dependent on the willingness of others (de Groene and Hermans, 1998; Holt, 2004).
- *Trust and continuity of supplier relations.* Continuing the argument above, businesses tend to profit from durable relations with at least a selection of their suppliers: costs of putting pressure down the product chain may be higher than the uncertain benefits.
- *Anonymous markets.* Going down the global product chain, producers may very well get lost in anonymous links in the chain. In many product chains wholesalers buy, store, mix and maybe speculate with stocks of raw minerals, agricultural products (such as cotton, coffee and meat) or semi-finished products (such as fabrics). This makes it hard to track down the original producers.
- *Perception of consumer demand.* Greening of product chains only makes sense if the products can compete in the marketplace. Green markets are emerging in both Europe and North America, but despite promising growth figures most green product markets are still small niches (Kessler *et al.*, 2003; Doherty, 2004), making producers sceptical. Wycherley, in discussing experiences of Body Shop International (BSI), showed that very few customers of their suppliers were really interested in 'green' products, making their suppliers hesitate to cooperate (Wycherley, 1999).
- *Lack of political support.* Government policies in the field of green products (eco-labelling, pricing, standards, voluntary agreements etc.) (Cramer *et al.*, 1995), extended producer responsibility (Vermeulen and Weterings, 1997), waste management and recycling policies prove to be supportive for the cases described in the literature, but the other side of the coin is that lack of policy, due to unwillingness or long procedures, may also hamper initiatives where political support is needed (de Groene and Hermans, 1998).
- *Institutional barriers in international trade.* Last but not least, various types of trade barrier (import tariffs and non-tariff barriers such as quotas and specific product requirements) may form an obstacle for global trade of green products. According to the World Bank there is a shift toward high-value perishable commodities such as fresh fruits, vegetables, meats and fish (World Bank, 2004, p. 115). However, with this have also come consumer concerns over food safety and this has led to an array of rules, regulations and standards. An entrepreneur could explain this as barriers constraining the free flow of business. However, according to Nieman *et al.* such barriers should be seen as opportunities (Nieman *et al.*, 2004, p. 75).

Resource Suppliers' Perspective: What is In It for the South?

Greening of product chains has mainly been proposed by scholars in Western countries, being triggered by either taking full responsibility as 'enlightened' entrepreneurs, or responding to external pressures

(Kogg, 2003). Only a few reports are available on benefits as perceived by supply chain partners at the resource site. Further study would be fruitful at this issue. However, some remarks can be made here. Self-interest for downstream suppliers has been identified at both the individual level and the collective level.

Obviously, both environmental and health benefits may be strong drivers for participating in greening of product chains. One of the few examples, a project on 'sustainable chain management' of cotton in Benin, shows clear proofs of perceived benefits. Starting from 1996 efforts have been made to organize an organic cotton chain, supplying organic cotton to the European market. Participating in this program implies higher costs and reduces yields, but also a 20–30% premium compared with conventional prizes for producers. A quote of one these farmers illustrates their perception of benefits:

We used chemicals on our cotton crop and we had higher yields than now, but we were often sick, and had to spend some of the money we earned on medicine . . . This season I grew cotton without any chemical fertilizers or pesticides. We used palm oil cake, ash and cattle manure as fertilizer and we put organic matter back into the soil through cotton leaves (Kessler *et al.*, 2003).

Farmers were motivated to adopt organic cotton growing primarily because it is less damaging to their health. Changing towards organic cotton also reduces financial risks for farmers, because the Benin national organization for organic farming, the OBEPAB,¹ is active in establishing cooperation in the product chain towards Dutch partners. This approach empowers the many very small producers in international trade by means of collaborative action, thus reducing the risk of not being able to sell the product for a good price (Kessler *et al.*, 2003).

In addition, benefits of greening of product chains can also be found at the collective level. Business leaders must respond to growing concerns about pollution, but both the environment and corporate coffers can be green. When producers hear these statements and read articles with content such as 'is your weekly shopping just a trolley of pesticides' they should pay serious attention. Consumers along the supply chain centre their expectations on organics, food safety, fair trade, choice and lower prices. For example, in South Africa, one worrying aspect for the industry is that a poor or unsafe product, if tracked back to a local grower, not only tarnishes the reputation and reduces the prospects of future marketing for that grower as an individual producer, but may easily prove to be the one rotten apple that spoils the basket (van Hooven, 2004). In the light of South African economic priorities to become a global player and make a contribution to the NEPAD growth figure, it will have to meet the European standards in adopting of modern supply management techniques and stimulate public–private collaboration (Jaffee, 2003). Should the South African market respond in meeting the requirements it will remove the rotten apples and become a sustainable market with the potential to grow, and gain a competitive advantage in the 'going green makes good business', for example the wine industry in South Africa. The wines produced in South Africa are well renowned in countries such as the United Kingdom, Germany, Netherlands and Canada (Erler, 1998) and have received various international awards and recognitions, even though they have not yet implemented ISO 14001 but intend to do so in the future. For the South African wine market this future is very short as the global wine industry has recently begun to investigate voluntary environmental initiatives, such as ISO 14001 environmental management systems (EMSs) or industry based guidelines (Knowels and Hill, 2001). One of South Africa's competitors in the global wine market, New Zealand wineries, have attained eight ISO 14001 certifications. In response to New Zealand and other global trends the South African wine industry has developed an industry-wide, voluntary environmental initiative called Integrated Production of Wine (IPW), which

¹OBEPAB stands for Organisation Béninoise pour la Promotion de l'Agriculture Biologique.

aims to improve the environmental performance of the entire industry and plan for the future of the industry (Knowels and Hill, 2001).

This type of development on the resource side is not yet, but might possibly very well be, linked with developments on the demand side of product chains.

Some Experiences with Global Greening Product Chains

Most of the cases discussed in the literature cited here have their limitations. Product chains can be long, both in numbers of actors and in distances covered, connecting companies engaged in mining of raw materials or growing crops, through various steps of transformation into semi-finished and finished products, transferring these products to consumers and finally covering actors working on disposal or recycling. Almost all cases reported discuss limited steps backwards or forwards into the product chain: just one supplier back or organizing recycling with domestic partners. We have already mentioned the debate about a possible multiplier effect (Ytterhus *et al.*, 1999; Holt, 2004). Hardly any examples of cross-globe greening of product chains have been discussed in the scientific literature yet, although appealing examples exist in practice. Examples of cooperation in the product chain all the way back to the production of raw materials in developing countries or countries in transition can be found in the palm oil chain, the cotton chain and the paper chain. Some of these examples of global greening of product chain partnerships were discussed at the Johannesburg Summit in 2002 and were granted the World Summit Business Awards for Sustainable Development Partnerships by the International Chamber of Commerce (ICC) and the United Nations Environment Program (UNEP). One of these is the partnership of Axel Springer, Norske Skog, UPM-Kymmene, 8900 Norwegian wood owners, Otto Versand, WWF and Greenpeace Russia with the meaningful title 'Newspapers that know their trees' (ICC, 2004). Experience shows that such projects become powerful if actors from outside the product chain look over the shoulders of the chain partners. Environmental NGOs with their critical attitude may contribute to legitimizing the project to the consumer and general public (Vermeulen, 2003).

Going global in greening the product chain may pose additional barriers to those already mentioned above, but most of these barriers may be extra high in the case of greening of global product chains. Two examples may illustrate this (Bergenhengouwen and Buysrogge, 1997).

The first example is a clothing chain store, Peek & Cloppenburg, that participated in a government project aiming at greening the assortment in retailing. About 70% of the clothes sold are produced in South-East Asia, coming through a complex network of home-workers, agents and anonymous markets to the Netherlands. A general life cycle analysis of their products showed that roughly one-third of the environmental impacts were linked with the first part of the product chain (before refining of the fabrics), one-third in the stage of refining the fabrics and one-third in the subsequent stages (factory tailors, retail and use). Agents and factory tailors did not cooperate in giving information or cooperate in identifying opportunities for improvement. In their analysis Peek & Cloppenburg could not 'look' beyond the fabric wholesalers and refiners. This forced them to restrict their selection of improvements to options inside Europe. Some of the improvements selected are reduction of use of hydrogen peroxide in washing and bleaching, 30% reduction of dye containing water emissions and reduction of cutting wastes in tailoring. With this selection of improvements they started to assess and selected their suppliers (existing and new), progressing with 'declarations of intent' with selected suppliers. Research revealed that consumers do not yet link clothing with the environment, so they decided to add tags to the clothes with explanations about their efforts in reducing environmental impacts.

The second example is a Dutch top quality brand shoe producer, Van Bommel, which started a greening of product chain project in the mid-1990s, also participating in a government program on recycling.

This medium sized company is one of the last remaining shoe producers in the Netherlands, with a market share of 2%. Suppliers in various European countries and India supply leather. They know all their suppliers. In a quick life cycle analysis, after an initial general literature study, all suppliers were addressed with a questionnaire. The Indian supplier refused to co-operate and wanted to stop this dialogue with Van Bommel by just writing down an official declaration on paper stating that they produced clean (without any proof). They saw the request as a typical Western interference and wished to protect their secret 'family recipe'. First, Van Bommel started to look for alternative, more cooperative Indian suppliers, but without success. Later, the managing director himself personally visited the supplier, convincing him of their common interest. His site visit, a declaration of intent about cooperation and the involvement of an independent, international assessment organization persuaded the Indian supplier to adopt a more cooperative attitude. In addition, Van Bommel offered to pay costs of assessment of the supplier's performance by the international assessment organization. For the entire product chain 31 potential improvements were selected, 20 being implemented, some also in India. After the initial hesitation positive local effects on employment and coaching on efficiency improvement contributed to a positive attitude of the Indian supplier. Consumers were in this case also informed by using an eco-label and information tag.

Both examples are an illustration of the various barriers and efforts in dealing with them. Both anonymous markets and distant intermediaries may be unwilling to cooperate with isolated greening initiatives. Cultural differences with respect to acceptance and perception of responsibility for sustainability issues may hinder both the analyses and the intended cooperation in implementation. Using market power may in many cases prove to be ineffective. The Van Bommel case shows the importance of personalizing the product chain. This is probably a reason why many of the examples of global greening of product chains come, in contrast to these two examples, from the fair trade market. The challenge is however to transfer these experiences to mainstream markets.

Research Agenda

Concepts of greening of product chains emerged over a decade ago. Methods and tools needed to be developed and tested. Producers have (with and without governmental support) tried to build their own business cases. Scientific literature about these methodologies and about dominant factors in success and failure is still very limited. In particular, cross-globe efforts in the greening of product chains are scarcely described. Global green product chains may be seen as the direct physical and social lifelines in the globalized economy. Sustainable development may in practice be advanced via the routes of government policy and supranational cooperation, being a long and complex route of negotiation. However, in addition, greening of product chains as the direct physical and social lifelines between (Southern) resource suppliers and (Western) consumers may offer a much more direct (i.e. effective) form of sustainable development via the global market.

Ongoing scientific research may contribute to the number and effectiveness of greening of product chain initiatives. It requires cooperation between opposite sites of the product chains and cooperation between businesses and science. Various approaches have been developed throughout recent years, yet availability of empirical data on green global product chain cases in practice is still meagre. An important reason for this is the closed nature of product chains, which makes it difficult for researchers to gain access to an entire product chain. Most case studies that have been conducted so far are aimed at one key player (usually the *focal company*, Seuring, 2004) in a specific chain, revealing only a small part of it. Many studies focus on the description of material flows in product chains and on economic assessments, this mainly being an academic exercise. Some scholars however commit action research

approaches, closely working with focal companies on the demand side of the product chain. Very few have yet analysed the social process of these forms of inter-firm collaboration. One of the reasons for meagre practice is that establishing global collaboration all the way to resource suppliers in developing countries is very difficult.

Yet, cases of evidence are emerging for which it seems at first sight viable to analyse the entire chain. As we also discussed in developing countries, as we discussed for the case of wine production in South Africa, industry has started its own programs to structurally control the product's quality. However, such developments have not yet been linked with trends in greening products on the demand side in Europe.

This brings us to a research approach that is a mix of a *case analysis*, a *descriptive study* and *action research*. We can analyse specific product flows between a developing and a developed country, representing both supply and demand sides. Using a descriptive product chain analysis of such product chains and exemplary cases of established global green product chains, action research might be conducted, identifying opportunities and potential barriers as perceived by businesses on both sides of the product chains.

Such an approach may add to better understanding of the management of these global greening initiatives, analysing the forms of cooperation and promising ways of dealing with the barriers identified in this article. Cases of successes (both ecologically, socially and economically) documented in detail may serve as illustrative examples, persuading others to join in this voyage.

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