

Environmental Management Accounting (EMA) Case Studies in Honduras – an Integrated UNIDO Project

Christine Jasch

Institute for environmental management and economics
IÖW Vienna, Austria

Daniel Ayres

Cleaner Production Centre
Honduras

Ludovic Bernaudat

UNIDO

Abstract

This article describes the outline and main first results of the UNIDO TEST (Transfer of Proven Practices for Environmentally Sound Technologies) program, which uses Environmental Management Accounting (EMA) for setting the baseline for calculating savings achieved by the Cleaner Production approach. The project focuses on the Rio Blanco basin in North Western Honduras and applies an integrated approach for improving industrial water management, pollution reduction and productivity.

Keywords: *Integrated environmental management, industrial water management, environmental management accounting, environmental costs, material flow cost accounting*

Background

Industrial pollution and poor water management are considered key priority problems in Honduras. There is limited experience in implementation of cleaner production in Honduran industries. The UNIDO National Cleaner Production Centre (NCPC) has conducted most projects. Therefore, the need exists to demonstrate cleaner production, environ-

mental management accounting and integrated environmental management approaches like TEST in order to convince industries to start-up their path towards a sustainable industrial development. Following a scientific study from the National Research Institute (CESSCO), the Rio Blanco basin has been identified as the best case study for implementation in Honduras.

Objective

The overall objective of this UNIDO project is to promote the adoption of best practices for industrial water management and pollution reduction. This is in line with UNIDO's holistic approach to Cleaner Production (1). Two industrial sectors, textile and food production, have been selected as target for the demonstration activities. The focus of the project is on integrated water management, but also pollution related aspects are addressed. The project's objective is in line with national priorities.

The project is expected to deliver the following results:

- Raised awareness of industries on the economical and environmental benefits of implementing TEST and EMA
- Enhanced technical skills of industries' staff to identify best practices for water management
- Implementation of demonstration solutions for better water management
- Identification of demonstration EST investment projects to achieve national and international standards for water consumptions and effluent release
- Established national capacity for streamlining TEST and EMA in the industrial sector with the support of the NCPC.
- Wide dissemination of project's results

Project outline of the overall UNIDO TEST approach in Honduras

The TEST approach developed by UNIDO is a need driven systematic ap-

proach integrating the preventive win-win strategy into enterprise operation. TEST is building on management of change within different levels of the management pyramid:

- the operational level
- the management system level and
- the strategic level.

Relevant tools of preventive environmental management or their parts are applied based on a complex diagnosis of enterprise needs (Initial Review). TEST is supporting the concept of the learning organization starting with the identification of potential leverage points and setting up the relevant baselines, ending with a reflection at strategic level of the improvements achieved and of the experience gained. TEST was already successfully applied within the Danube River Basin. Its integrated approach has been tailored for application to pilot countries within the Mediterranean Region (Egypt, Morocco and Tunisia) within the framework of the MED-TEST initiative (2008-2011) as well as Honduras and Mexico.

A TEST project is tailored to the unique conditions of the industrial sector as well as the institutional framework of the country where it is implemented. Introduction of the TEST integrated approach at the enterprise level follows this sequence: first, the existing situation is improved by better management of the existing processes, then the introduction of new cleaner technology (or if not sufficient also of optimized end-of-pipe solutions) is considered. Finally, the lessons learned from each TEST project's implementation is reflected in the respective company's business strategy.

Implementation of the integrated TEST approach is based on three basic principles:

1. At the level of processes, it gives priority to the preventive approach of CP (Cleaner Production - systematic preventive actions based on pollution prevention techniques within the production process) and considers the transfer of additional technologies for pollution control (end-of-pipe) only after the feasible cleaner production solutions have been explored. This leads to a transfer of technologies aimed at optimizing environmental and financial performance at the same time: bringing desired win-win solution for both areas.
2. At the level of management systems, the integrated TEST approach addresses the managerial aspects of preventive environmental management. It establishes the necessary information system on relevant material, energy and related financial flows necessary for linking the strategic and operational level within an enterprise. This is done by using the basic elements of an EMS (Environmental Management System) and EMA (Environmental Management Accounting).
3. At the strategic level, it puts environmental management within the broader strategy of environmental and corporate social business responsibilities (CSR), by leading companies towards the adoption of sustainable enterprise strategies.

These objectives will be achieved in Honduras by reinforcing national technical capacities, demonstrating the effectiveness of the TEST and EMA inte-

grated approach in selected industrial sectors and disseminating project's results at the national level. The project targets local industries (large and medium) within selected sub-sectors in industries located in the catchment area of the Rio Blanco, one of the affluent of the ULUA river the Second's River in the country, located in the Sula Valley in the vicinity of San Pedro Sula, the country's industrial area.

The implementation is organised into three main phases. At project's start a consultation process was initiated with key stakeholders, such as governmental institutions and industrial associations, to discuss the project's implementation strategy and make the final selection on the industries to be targeted. A project steering committee was established. During the first phase a first training session was organized to train the national counterpart on the TEST integrated approach. Awareness raising meetings were organized for the selected industries. Formal agreements were signed with these companies to secure their commitment and co-financing to the project.

The project has now entered its second phase, where the environmental management accounting (EMA) tool was used to establish a baseline of current costs in order to be able to calculate savings. The second phase started with the implementation of an interactive training programme on the TEST and EMA approach for the targeting industries, national EST (environmentally sound technologies) experts and some municipal, industrial association and UN Technicians invited to assure the future national dissemination of the project. The programme consisted of theoretical lectures,

case studies from TEST projects implemented elsewhere and concrete cases from the participating industries. The training programme was organised in three main modules: in between each session national sectorial experts provided guidance and technical assistance to the enterprises' staff helping them to bridge the gaps between the existing and the desired level of knowledge for the implementation of EMA, sound water management measures and environmentally sound technology (EST).

The first module of the training programme focussed on EMA and was performed in the last week of August 2010. It is described in more detail further below. At the end of the interactive training programme, technical solutions for optimising the operation of the existing technology with improvements of the water management systems will be identified and implemented. Moreover the technical and financial feasibility for technology up-grade to reach international standard for the water usage and pollution control will be investigated. For each company opportunity studies will be prepared. In order to facilitate EST investments, the project shall create a link with financial institutions or national programmes that are offering soft loans to industries that want to implement cleaner technology. By the end of the second phase, the results achieved at each company will be evaluated, discussed with top management and presented to the local stakeholders.

The last phase of the project aims at dissemination of project's results for further replication within the country. A national conference will be organised in order to present project's results to the industrial community and institutional stakeholders. A guidance document with

case studies will be prepared and promoted during technical workshops/seminars targeting other industrial areas. An extensive communication campaign will be implemented to target local municipalities, local communities and NGOs with the aim to raise awareness and stimulate peer-group pressure on the polluting industries at the local level.

Stakeholders and implementation issues

The main counterpart for TEST in Honduras are the National Cleaner Production Centre (NCPC) based in San Pedro Sula, and the National Research and Pollutants Analysis Laboratory, CESSCO, based in Tegucigalpa. The NCPC has hands-on experience in implementation of Cleaner Production studies, ISO 14001 (2) implementations and good links with relevant stakeholders (local authorities, industrial associations, industries, NGOs). The national counterpart is responsible for: overall coordination of project's activities, quality assurance in line with the proposal, identification and engagement of qualified sectorial expertise for activities under phase II.

CESSCO is actively involved in each phase of the project. Its experience in the areas has been valuable for the selection of industries and its technical capacity will be valuable to confirm the benefits of the promoted techniques through the analysis of the pollution level variation in the Rio Blanco.

Relevant stakeholders involved in the project's advisory board are, in addition to the two stakeholders above-mentioned, the municipality, industrial

Table 1. Project activities and success indicators

Phase 1 - Outputs: <ul style="list-style-type: none"> Secured commitment and active participation of major stakeholders Local consultants trained Participating industries selected 	Success indicators: <ul style="list-style-type: none"> Agreement signed with 3 industries for participating in TEST demonstration activities
Phase 2 – outputs <ul style="list-style-type: none"> Enterprises trained on TEST tools Enterprises and consultants trained in EMA EMA assessments performed in participating enterprises Improved water systems based on existing technology Identified investment options for technology up-grade (EST) National capacity to replicate TEST and EMA established 	Success indicators (at demonstration companies): <ul style="list-style-type: none"> Number of implemented CP measures Water savings and pollution reduction Number of people trained Savings and improved information systems achieved
Phase 3 – outputs <ul style="list-style-type: none"> Project's results disseminated to relevant stakeholders at local and national level Awareness raised at other industrial areas to promote replication activities 	Success indicators: <ul style="list-style-type: none"> Number of demonstration industries willing to continue with TEST and/or EMA activities Number of new industries interested to start-up TEST replication

associations, NGOs and local industries. The involvement of the industrial associations within the TEST project is important to ensure enterprises participation and proper dissemination of project results within the industrial community.

Project outline of the EMA counterpart

The above mentioned second phase started with the implementation of an interactive training programme on the TEST and EMA approach for the targeting industries and national EST experts, as well as the identified stakeholder groups. A one day seminar was held in San Pedro Sula with the active participation of 2 representatives of each company (the environmental manager and an accountant), the consultants for the later

cleaner production assessments nominated by the NCPC, a national accountant hired as national consultant for the NCPC as well as representatives from the stakeholder groups, e.g. the sector specific industry representatives, the local International Labor Organisation (ILO) and the FAO, which are both also involved with environmental and health issues in Honduras. The training was performed by Ludovic Bernaudat, UNIDO, Daniel Ayes, technical director of the NCPC in Honduras, and Christine Jasch, Institute for environmental management and economics in Vienna, performing the EMA training.

The second day, an internal train-the-trainers workshop was held with the environmental managers of the companies and the national consultants. The brewery case study presented in chapter 8 of

the book on Environmental Management and Material Flow Cost Accounting by Christine Jasch (3) (see also book review in this journal) and the related EMA assessment tool in an Excel-template (available for download at www.ioew.at) were used as a starting point for the training. The participants were asked to come up with a structure for the mass balance and a process flow chart for their operation and discuss where the most significant environmental impacts occur. This joint training significantly facilitated the upcoming company on-site assessments.

In the following days one-day workshops to assess the total environment related costs of the previous business year were performed at each company. As described in (4) the first EMA assessment can be performed in a one to two days workshop in any company based on the list of accounts for the previous business year. It is essential that the accountant is present and has direct access to his files. The assessment is performed into an assessment template in Excel format, which automatically aggregates to a one page summary, which is converted into a percentage distribution of the environment related costs by environmental media impacted and by the cost categories described below.

On the last day in Honduras of Mrs. Jasch, the protocols of all companies were discussed with the group of consultants and recommendations developed. In addition, an ad hoc presentation to key executives of local industries had been organised, which received high interest in applying EMA also from other companies outside the Rio Blanco project. With the national capacities al-

ready built in the NCPC, future projects are thus likely.

The companies have performed the assessment of EMA for the last business year 2008. They will themselves with assistance of the local national consultants perform likewise in depth investigations for the identified most polluting processes and an update on the total environment related costs for 2009. In the meantime also the cleaner production options as described for the project phase 2 will be implemented. For the year 2010 it is envisaged, that the cleaner production options will have been implemented and so for the total year of 2010 the improvements in environmental and financial terms should become visible. The current assessment of 2008 thus established the baseline in order to be able to actually measure improvements and at the same time clearly focus on the hot spots from an environmental as well as a financial point of view.

Description of the participating companies

Between 2005 and 2006, the National Research and Pollutants Analysis Laboratory, CESCO, conducted a pollution survey of the river basin and concluded that four large industries were partly responsible for the pollution observed. The level of pollution represents a high risk for downstream populations. Since then, one company has closed down and the three remaining companies are part of this project.

1. Novave s.a.

Farm Villalobos, later renamed the Poul-

try Villalobos, was founded in 1964. In 1965 Villalobos Farm absorbed a small chicken operation in Guatemala. This poultry operation called Pollo Rey, in 1972 El Salvador, beginning operations and marketing poultry products under the brand Indian Chicken. It is on the market only recently in Honduras and Costa Rica, using the prestigious brand Pollo Rey here. These poultry operations are part of the Animal Industry Division (DPI) Corporacion Multi-Inversiones. The division has own farms for growing and fattening, hatcheries and chicken processing plants, generating more than 14,000 jobs in the region.

The company Noraves as a daughter of DPI has 400 employees and is processing about 75.000 chickens per day. The organic wastes (feathers, blood, meat and chicken bones) are processed in the flour plant attached to it, which has huge water consumption and related wastewater treatment issues.

2. Aquacorporacion de Honduras

Aquacorporacion de Honduras is a fully integrated tilapia fish farm and processing facility with about 360 employees. The company is located just outside of the town Rio Lindo, at the base of mountain range in which Lake Yojoa resides. The farm is approximately 120 hectares in size.

The production of the tilapia occurs in a variety of aquaculture systems ranging from moderate density mud bottom ponds to high density concrete raceways. All facets of the tilapia life cycle are managed within the production systems, from reproduction to market. The production facets include: reproduction, larval, nursery, juvenile, and adult stages

of the fish life cycle. The processes are identical to the ones described for the Danish fish processing industry in (5), and many of the experiences could be transferred, if the economic benefit would be clearly visible.

The water source is actually Lake Yojoa, but first passes by river and pipeline, through the turbines of the ENEE (Empresa Nacional Energia Electrica, in other words the national electric company), and later arrives at the farm. Approximately 14 cubic meters of water per second are available to the company.

The farm has the capacity to produce 8200 metric tons of whole tilapia or 5500 pounds of tilapia fillets per year. Other products generated by the company include: skins, scales, fishmeal, and fish oil. The company manages and has the facilities for all processed products: fillet product plant, fish meal and fish oil plant.

The company exports both fresh fillets and fresh gutted whole fish to the USA. Skins and scales are also exported. Whole gutted whole fish, fish meal and fish oil are sold domestically.

Also included in the infrastructure of the farm are basic water treatment systems (sedimentation ponds and oxidation ponds) which pre-treat waste waters prior to their re-entering the natural river systems. Probiotic products are also regularly added to these oxidation ponds in order to more rapidly break down solid waste.

3. Caracol Knits and Coral Knits

Caracol and Coral Knits are Textile Plants Located in the municipality of

Potrerillos, Cortés Honduras that started operation in 2001. The Companies are known both locally and internationally as a leader in the textile sector and are one of the major employers in northern Honduras.

The facilities include warehouses for storing raw materials, finished products, and spare parts, as well as a steam generation system with boilers operated on bunker and diesel fuel. The project also calls for an untreated sewage water treatment plant and a plant for treating domestic sewage and industrial wastewater from the dyeing process.

The Companies are a model in the Honduran textile industry that are adding value to traditional maquila operations by making greater industry integration and consolidation possible.

Caracol and Coral actively take care of their environmental responsibility, knowing that one of the biggest environmental aspects related to textile production is waste water treatment that comes from the dyeing process. The sites have two Waste Water Treatment Plants, both based on activated sludge and proudly carries an ISO 14.001 certificate.

EMA Methodology

According to the definition developed by the United Nations EMA Expert Working Group (6), Environmental Management Accounting, **EMA** is the identification, collection, analysis and use of two types of information for internal decision making:

- physical information on the use, flows and destinies of energy, water and materials (including wastes) and

- monetary information on environment-related costs, earnings and savings.

Simply defined, environmental management accounting (EMA) is management accounting (MA) with a focus on **physical information** on the flow of energy, water, products and materials as well as **monetary information** on environmental costs and revenues and projects related to environmental protection. EMA is closely related to process costing as well as to environmental performance and management systems. Well-designed and implemented EMA helps to ensure better internal management and decision-making e.g. for investment appraisal, cleaner production, improving Eco-efficiency and calculating savings within organizations. EMA also serves as a basis for external reporting and life cycle assessments of products (1).

Starting point for EMA is the assessment of a material flow balance, also called mass balance or input output balance in volumes and monetary terms on the system boundary of the organization for the complete previous business year, as most data is available only for this system boundary (7). This is especially the case for small and medium sized companies (SMEs), which often don't have well developed cost accounting structures. In the first step of developing the material flow balance sheet, only a rough overview analysis may be performed, instead of a detailed data collection.

The upcoming ISO standard on Material Flow Cost Accounting, ISO 14051:CD, 2009 (8), defines **MFC**A as "a system for measuring the flow and stock of materials in processes or production lines in

both physical and monetary units". MFCA is a tool for improving material productivity in order to reduce the relative consumption of materials, energy and water and closely linked to EMA. MFCA is regarded as an effective means by which organizations can simultaneously seek environmental and economic benefits. MFCA improves material productivity in processes or production lines and may consequently help reducing related environmental impact. In MFCA, the flow and amount of the inventory of materials used within an organization are measured in physical units (e.g. weight, capacity, and volume) and subsequently evaluated in monetary units, which are based on the manufacturing costs incurred.

EMA places a particular emphasis on materials and related costs because (9):

1. the use of energy, water and materials, as well as the generation of waste and emissions, are directly related to the environmental impacts of organizations and their products (10), and
2. material purchase costs and materials lost in waste and emissions are the most prominent cost drivers in many organizations. Especially in countries with low enforcement of legal compliance and relatively low labor costs, material and energy use and related losses are a significant cost driver (12).

Both, the EMA and MFCA approach have the underlying assumption, that all purchased materials must by physical necessity leave the company either as product or waste and emission. Waste is thus a sign of inefficient production:

- All purchased materials must by physical necessity leave the company either as product or waste and emission.
- Waste is a material which has been purchased and paid for but which has not turned into a marketable product.
- Waste is being paid for 3 times: at purchase, at production and for disposal
- Waste comprises all **non-product output of input materials** including water and energy.

The **EMA Assessment Template** (in Microsoft Excel format, available for download at www.ioew.at) assists at the assessment of total annual environmental and material flows and related costs and provides the option to distribute them to different cost centers, which should be equivalent to production processes and therefore provide good quality data for investment appraisal of specific processes. For material flow cost accounting (MFCA) the system boundary for the material flows can focus on more detailed processes within a cost centre.

The EMA Excel-template consists of four sheets – Mass balance, Detail, Sum and Structure. Information is only added into the Mass balance and the Detail sheet.

The Mass balance records the physical and monetary values of material inputs and product outputs in one work step, as these amounts should be consistent. The excel template contains two columns for the source of information for both values. The enterprise resource planning system and the accounts for materials used for production should provide this information in a consistent and detailed

manner.

The actual cost assessment is performed in the Detail sheet only. It can be done in any currency, which should be noted in the heading where EURO stands in the tool.

All the cost categories are already set but the several different cost items related to cost accounts or taken from cost centre reports should be listed with indicating the reference.

The program automatically aggregates the costs of each cost category, but when adding lines to fill in more details a last cross check is recommended to make sure all aggregates are complete.

The sum of the costs of all categories in the sheet Detail is automatically trans-

ferred to the sheet Sum to have an overview and a better presentation layout which shows the aggregated totals by cost category and calculates the costs into percentages to show the most relevant environment related costs. This figure can also be compared to total production costs.

The main EMA cost categories described in the IFAC EMA guidance document (10) are shown in Figure 1.

For company internal calculation of environmental costs, expenditures for environmental protection are only one part of the coin. The costs of waste and emissions include much more than the respective treatment facilities and disposal fees. Several EMA and MFCA case

Material Flow related Costs
1. Materials Costs of Product Outputs
2. Materials Costs of Non-Product Outputs
Environmental Protection related Cost
3. Waste and Emission Control Costs
4. Prevention and other Environmental Management Costs

Figure 1: MFCA and EMA cost categories

studies have shown that the costs of waste disposal and emission treatment are typically 1 – 20 % of total environmental costs, while the purchase costs of the wasted materials represent 40 to 90 % of environmental costs, depending on the business sector examined (13), (14), (15).

Adding the purchase value of non-product output to the corporate environmental costs increases the share of envi-

ronmental costs in relation to other costs. However, it is not the goal to show that environmental protection is expensive, but rather to highlight the scope for savings potentials. It is also not the most important task to spend a lot of time defining exactly which costs are environmental or not, or what percentage of something is environmental or not, or if Energy belongs to NPO and to what degree. Environmental protection projects not only have effects on

	Environmental protection expenditure (emissions treatment, control and waste prevention costs)	
+	Costs of Non Product Output (Costs of unproductive material, capital, and personnel)	
=	Total corporate environment related costs	

Figure 2: Total corporate environment related costs

nature, but also on neighbors (noise, odors, pollution) and employees (health and safety), if related to material and energy flows. In addition they result in a reduction of risks for employees, nature and neighbors in case of accidents and other occasional production events.

It is often difficult to determine the environmental portion of these costs. As with integrated cleaner technologies that are often more cost and material efficient, the environmental portion of health and safety or risk prevention activities usually cannot be determined precisely. In general, it may be stated that assets that are allotted 100% to the environment are bad for the environment as they are often end-of-pipe technologies that do not solve the problem at the source, but rather shift it from one environmental medium to another (e.g. from the air to the soil and then into the water). These approaches are expensive and inefficient.

The most important task is to make sure that ALL relevant and significant costs are considered when making business decisions. This is why Figure 2 calls the total sum: **total environment related costs**. This is the **universe of costs**, that the environmental manager deals with and that can possibly be reduced by pollution prevention and material and energy efficiency projects.

In other words, corporate environmental and material flow costs are just a subset of the bigger cost universe that is necessary for good decision-making. Environmental costs are part of an integrated system of materials, energy and money flows through a corporation, and not a separate type of cost. Doing EMA and MFCA is simply doing better, more comprehensive Management Accounting, while wearing an environmental hat that opens the eyes to hidden costs. Therefore, the focus of MFCA is no longer on assessing total environmental costs, but on a revised calculation of production costs on the basis of material flows (including energy and water).

Results of the EMA assessments

Starting point of an EMA project is putting the right team members together. Experience shows that the environmental manager barely has access to the actual cost accounting documents of the company and only is aware of a tiny fraction of aggregate environmental costs. On the other hand, the financial accountant/controller does have most of the information but is unable to separate the environmental part without further guidance. In addition, he or she is limited to thinking within the framework of existing accounts. Also, the two departments tend to have a severe language problem.

So combining the competencies for monetary accounting and process engineering/environmental management and gaining support from both sides is vital for the success of any EMA project.

Another important guideline on the way is to focus the assessments on what is easily available from existing records and to note, where improvements to the information system would be recommended, so that future assessments will provide better data in shorter time. It is NOT the goal of an EMA assessment to come up with "complete data" for the past and spend a lot of time tracing old invoices. It is rather the goal to open the eye for improvement necessities and develop an overview on the most significant material flows and related costs.

The resulting recommendation for the assessment is: don't be shy to use estimates! The people at the production processes often can provide very good estimates for loss percentages, which are much more accurate than the figures used in the cost accounting department. Estimates can at a later stage be improved by more detailed measurements, but for the first assessment don't worry not to be perfect. It is better to have an estimate than no figure. But the calculation procedure or the information source for the estimate should be recorded.

The goal of the first assessment is to

- be able to present the entire material inputs and total environmental costs of the previous business year to top management, and
- come up with improvement recommendations and
- gain support to improve the information system and technical processes.

Using the explanations of the EMA books and the Excel Template provided with it, the first EMA assessment for the previous business year for any given company should not take longer than a 1 to 2 days workshop with the accountant and process engineer.

The cost assessment reveals improvement options in two areas:

1. What always can be found, are options and measures necessary to improve the quality and consistency of data and information flows in an organisation. This is the starting point of EMA most projects and the focus of most follow up projects.
2. In companies, that have not done environmental management projects for several years, also technical improvement options may immediately become obvious. What always is made visible, mostly for the first time, are the costs related to inefficient production, wasting materials and energy. So even if the technical solution might not be known at the end of the first assessment, the priority areas for deeper investigation will have been defined and the total range of environment related costs will be clearer.

The following table shows an aggregated result of the 2 companies in Honduras from the food industry. As both companies have not installed an environmental management system yet, their costs relating to environmental protection are negligible (2 % for end of pipe treatment, most related with the waste water treatment plant and 0,2 % for internal personal dealing with pollution prevention). In all the EMA case studies, the actual costs are subject to secrecy.

Figure 3: Average cost distribution in the food industry in the Honduras case studies

Environment related costs by environmental domains and cost categories	Air and climate	Water and Waste Water	Solid Waste	General environmental Management	Total in %
1. MATERIALS COSTS OF NON-PRODUCT OUTPUTS	20,0%	2,4%	75,3%		97,7%
1.1. Raw and Auxiliary Materials			70,0%		70,0%
1.2. Packaging Materials			0,1%		0,1%
1.4. Operating Materials		2,4%	4,7%		7,1%
1.5. Water					
1.6. Energy	20,0%				20,0%
1.7. Processing Costs			0,5%		0,5%
2. END-OF-PIPE		1,6%	0,2%	0,2%	2,0%
2.1. Equipment Depreciation		0,4%		0,2%	0,6%
2.2. Operating Materials		0,4%			0,4%
2.3. Water and Energy					
2.4. Internal Personnel		0,4%	0,1%		0,5%
2.5. External Services		0,3%			0,3%
2.6. Fees, Taxes and Permits		0,1%	0,1%		0,2%
2.7. Insurance					
2.8. Remediation and Compensation					
3. INTEGRATED PREVENTION			0,1%	0,1%	0,2%
3.1. Equipment Depreciation					
3.2. Operating Materials, Water, Energy					
3.3. Internal Personnel			0,1%	0,1%	0,2%
3.4. External Services					
3.5. Other					
4. RESEARCH and DEVELOPMENT COSTS					
5. FINES		0,2%			0,2%
TOTAL ENVIRONMENT-RELATED COSTS (1. + 2. + 3. + 4. + 5. + 6.)	20,0%	4,2%	75,6%	0,3%	100,1%
7. ENVIRONMENT-RELATED EARNINGS					
7.1. Other Earnings			-0,1%		-0,1%
7.2. Subsidies					
TOTAL ENVIRONMENT-RELATED EARNINGS			-0,1%		-0,1%
TOTAL ENVIRONMENT-RELATED COSTS & EARNINGS	20,0%	4,2%	75,5%	0,3%	100,0%

Therefore the table shows the average percentage distribution, which allows interpretation of the most significant cost carriers.

As energy is not regarded as a product in the food industry, the 20 % costs for energy can be taken as a reference point. The by far most significant costs are related to the loss of raw and auxiliary materials, which are not processed into a marketable product. They account for 70 % of the total environment related costs. Even though part of the skin, blood, etc. are being processed into animal feed, the related income of 0,1 % is negligible in relation to the material input costs lost. Any improvement of the raw material processing efficiency would thus significantly reduce costs and environmental impact, as most of the organic waste ends up in the wastewater stream. However, both companies neither monitor the actual volumes of organic waste being processed in the animal feed plant nor the waste volumes discharged into the river.

By installing an environmental management system the costs for internal and external people working on integrated prevention will go up. At the same time they would be working on reducing the material costs of non-product outputs. Case studies in Austria from the brewery industry have seen a reduction in the relative costs of non-product outputs to as low as 55 %.

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