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Transferring the Integrated Pollution Prevention and Control (IPPC) Approach and Best Available Techniques (BAT) Concepts to Egypt, Tunisia and Morocco

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Abstract: The principles introduced by the Directive Concerning Integrated Pollution Prevention and Control (IPPC) (currently known as the Industrial Emissions Directive (2010/75/EU)) are innovative and have raised interests in the framework of the literature debate on environmental regulation. Many articles describe and analyze the application of the Directive in European countries, but only a few articles focus on how the interest for the Directive's principles, including the integrated approach, have reached countries outside the European Union. This paper aims to contribute to this topic, describing the experience of the authors in carrying out an EU-funded project on transferring the IPPC approach and Best Available Techniques (BAT) concepts to three Arab countries, *i.e.*, Egypt, Morocco and Tunisia. The paper presents the experience referring to two sectors falling within the scope of the IPPC Directive: the textile and dairy sector. The objectives, methodologies, activities and experiences are described and can be used and valorized to integrate the IPPC approach and BAT concepts in the current environmental legislation of the three countries.

Keywords: best available techniques; Integrated Pollution Prevention and Control; environmental regulation

1. Introduction

Considering the wide impact of pollution originating from some industrial processes, the pollution prevention and control approach is a key aspect to point out.

The European Integrated Pollution Prevention and Control (IPPC) Directive is the main European regulation on this aspect. The Directive was emanated for the first time in 1996 (Directive 96/61/EC) [1] and nowadays revised by the Industrial Emissions Directive (IED) 75/2010/EC (European Commission [EC], 2010) [2]. The core of this regulation is the integrated and preventative approach to pollution of some industrial processes included in the scope of the Directive [3,4]. One of the main novelties of this regulation is that it authorizes industrial activities through a unique integrated approach [5–7]. The integrated approach means that the permit system must consider the whole environmental performance of the plant, covering all environmental aspects. The core of the integrated approach is that each environmental aspect (e.g., air, soil, water, *etc.*) must be considered and treated in an integrated way. Regulators (environment agency or local authority) should define permit requirements in order to reach a high level of protection for the environment as a whole. The Directive mainly addresses large installations and indicates specific production capacity thresholds [8].

The Best Available Technique is one of the key aspects of the IED [9]. It is defined by the IED as “the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole”:

- (a) “Techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;
- (b) “available techniques” means those developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;
- (c) “best” means most effective in achieving a high general level of protection of the environment as a whole.

The Best Reference Document (BREF) are the reference documents on Best Available Techniques. They are elaborated by the European IPPC Bureau. A BREF represents the tools to meet requirements of the IED [10]. Most of the BREF apply to a specific industrial sector and they contain information on techniques and processes of that sector, emission levels and techniques to consider for determining Best Available Techniques (BAT) and emerging techniques [11].

Since the IED is referred to in the European context, there are many studies in the literature about the effects of this regulation on European sectors and companies [12–16]. Most of these studies focus on BAT [17,18]. Cikankowitz and Laforest [19] state that there is an increasing number of studies on the implementation of this kind of regulation.

On the other hand, in the literature, we can observe some papers related to application of the pollution prevention and control principle outside of the EU borders, but not directly linked to the adaptation of IED. In this framework, there is a paper [20] that deals with some pollution prevention and control initiatives in the United States, describing examples of pollution prevention programs developed in the last 20 years, also with reference to a permitting system. Another study [21] focuses on pollution prevention programs adopted in the USA. In particular, the paper finds evidence that the performance of a pollution prevention program, referred to as a USA multinational company, improved after the adoption of a methodology for process improvement. Trucco and Tardini [22] in their study analyzed 134 pollution prevention program projects in many companies and countries. Most of the analyzed projects refer to the USA, but also other countries were analyzed. The main results of the study show that these projects have cost efficiency as the scope and that the environmental management of processes is considered a strategic issue. The study of Chittock and Hughey [23] deals with pollution prevention programs in different countries: the United States, Japan, Australia, Canada and the United Kingdom. The paper represents an international review of adopted programs in these countries in order to make out some characteristics of these kinds of actions. Also, Burke, McComas and Dick [24], in their paper, present pollution prevention initiatives with reference to the United States, also, by analyzing some existing studies on this theme.

Analyzing the literature more in depth, in order to identify hypothetical previous experiences aimed to adapt IPPC approaches and principles outside European borders, we found only two previous experiences described in the academic literature and in technical reports. The first is the study of Schollenberger, Treitz and Geldermann [25]. The authors focused on a method for the determination of BAT, considering case studies referring to Chile and China and giving attention to different local conditions. The second is a technical report issued by the National Center for Environmental Innovation of United States Environmental Protection Agency—US Environmental Protection Agency Office of Policy, Economics & Innovation [US EPA] [26]—entitled “In-depth Look at the United Kingdom Integrated Permitting System”. The Report describes an assessment of the IPPC system implemented in the UK in order to verify its transferability potential to the US legislative framework. Even though the whole UK context is different from the US one, the aim of the study was to improve the US environmental permitting system, starting from the characteristics of the IED implemented in the UK.

We can state that the IPPC and BAT approach has raised interest also beyond European borders, but these experiences are not so much described in academic literature. In addition, the draft of the new EU Environment Action Programme that is going to be approved by the European Commission during 2013 shows several invites to spread the BAT approach outside Europe.

Our paper aims to contribute to this literature niche, contributing to the larger debate on pollution prevention and environmental regulation. This paper wants to show the empirical results of a research activity focused on BAT for two specific industrial sectors, considering the local context of three African countries.

The paper is organized as follows: In the next section, the method used for the paper is explained. Then, in Section 3, we will outline the characteristics of the case study describing the approach, methods and results achieved. The paper will be closed with some conclusive remarks.

The method adopted is action research. The paper has no proper research question, but aims to bridge the literature gap described.

2. Methods and Results

2.1. Aims and Methods: Case Study Profile

The BAT4MED project analyses the potential impact of the introduction of the IPPC approach in the Mediterranean Partner Countries (MPC) and, more specifically, if and how this can contribute to minimizing the negative impacts associated with the activities from key industrial sectors in the MPC in order to ensure a higher level of environmental protection in the region.

The project aims to help implement the EU Technologies Action Plan by supporting the transfer and uptake of environmental technologies in developing countries. To that aim, the possibilities for and impact of diffusion of the EU IPPC approach to the MPC will be assessed and the implementation of BAT in the national environmental programs will be promoted and supported.

Specific objectives of the project are as follows:

- To identify, assess and select the BAT for pollution prevention and control in key industrial sectors with the highest environmental potential benefit;
- To promote and spread the use of BAT through dissemination activities;
- To assess the possibility and the impact of disseminating the EU IPPC approach to the MPC;
- To achieve these objectives, the project relies on a concise working methodology and structure.

Firstly, the BAT4MED project analyzed the industrial context in the MPC to select the most promising sectors with the highest environmental benefit potential. This preliminary analysis includes a benchmarking exercise of national analysis reports that identify possible synergies and selects those sectors that can ensure the highest global impact in the region for further study. Through an in-depth analysis of the potential transferability of results, the two most promising industrial sectors with the highest environmental potential benefit selected were the textile sector and the food sector, specifically, the dairy sector. Though the industrial and economic situation may vary notably between the different MPCs, the analysis carried out reveals that most of the problems faced by the Mediterranean industries are common to the majority of countries, which will be the key to spread results and ensure their transferability.

Secondly, a methodology for the assessment of available environmentally friendly techniques, so-called candidate BAT, and the selection of BAT was developed. For each target sector, the BAT were selected accordingly, taking into account specific sector and local conditions in the participating MPC. The methodology assesses the candidate BAT at a sector level, with respect to their technical and economic viability and environmental benefit.

The methodology was used to assist the MPCs and the technical working groups (TWGs) in drafting national BAT sector reports. It provides not only a clear and transparent evaluation tool for candidate BAT, but also guidelines on the elaboration of BAT sector reports, e.g., it indicates that the data needs to be used to conduct a BAT analysis. In the future, the methodology will inevitably provide support to policy makers and permit writers, in general, in the selection of BAT.

During the process of writing the methodology and elaborating the BAT sector reports, an Expert Group (EG)—consisting of key experts in the field of IPPC at the European level—was called upon to help guarantee the scientific and technical quality of the project's outcomes. This part of the project is further discussed in paragraph 2.2 on the elaboration of the national BAT sector reports.

Additionally, an analysis of the potential convergence of MPC policies with the EU approach is carried out in order to assess the potential for the future adaptation of the existing MPC, permitting procedures to integrate principles based on the IPPC approach. This stage aims at analyzing and benchmarking policy and legislative frameworks regarding IPPC in the MPC. In particular, the methodological approach for the analysis will help the MPC to collect the information and to ensure the comparability of project results in order to assess the possibility and the impact of diffusing the EU IPPC approach to the MPC and other Mediterranean countries. In addition, the conclusions of this analysis will provide policy recommendations to support the implementation of BAT in the MPC.

Though BAT4MED is tackled from the perspective of the two particular industrial sectors selected (textile and dairy), all tools and methodologies have been designed and implemented in a universal way, allowing the replication of the whole project in other countries and industrial sectors. To this end, particular efforts have been put into the development of each methodology, to ensure its applicability within the context of the project, but also beyond it.

2.2. Elaboration of National BAT Sector Reports.

The primary objective of determining BAT at a sector level is to provide support to policy makers and permit writers. For the elaboration of a BAT report, both a procedure on how to tackle this type of study, as well as a methodology for BAT evaluation is required. Since the concept of BAT and its application in a regulatory framework is mostly known and used in Europe, it is important to perform a consistency check with the situation and practices in the MPCs. A translation of the methods known and applied in Europe is therefore needed.

Generally, when performing a BAT evaluation, expert involvement is of high importance. Therefore, a sector technical working group (TWG) is called together on a regular basis. This TWG should consist of representatives from the sector (from companies or sector associations), public agencies and independent experts. All parties involved should preferably be represented in order for the results to be widely supported. The role of the TWG is to assist in the data collection and to present their view on the criteria to be evaluated in selecting the BAT. In total, three TWG meetings were organized in the course of the BAT4MED project, each focusing on specific parts of the BAT evaluation.

In the first phase of a BAT study, information collection is the focus point. In order to get a clear description and positioning of the sector for what economics and regulations are concerned, different types of information and data are gathered: general sector information, sector-related national and international legislation and sector-specific economic data. The general and economic information on the sector concerns mostly number and size of companies, yearly turnover values and other financial ratios. These data are grouped to assess the financial strength of the sector as a whole. Data on the number and type of suppliers, on the number and type of customers, on the threat of substitute products, the attractiveness of the market for new enterprises and on international competition

are obtained, to be gathered in a Porter's Five Forces evaluation to assess the competitiveness of the companies in the sector. All this information can be retrieved either from statistical agencies or reporting (similar to Europe) and/or from sector experts. Legislative information is, then again, mainly gathered from official agencies and is needed to clearly describe the framework in which the sector operates.

In order to come to a selection of BAT, first a list of candidate BAT must be compiled. Candidate BAT are all techniques with potential environmental advantages. Candidate BAT are found in the literature (BREFs, research articles...), observed during plant visits or proposed by sector experts. For each candidate BAT, a number of aspects are to be studied, such as the achieved environmental benefits, cross-media effects, the economics and example plants. More information on the necessary information can be found in the guidance document (2012/119/EU). There is an important role for the TWG in gathering this information, *i.e.*, to clearly indicate the specific local conditions. These local issues, e.g., very low price of water and electricity, might have a decisive influence on the evaluation of candidate BAT.

To evaluate the candidate BAT, a stepwise methodology is followed. In the first step, the technical viability of the candidate BAT is evaluated. A good indicator for the technical viability is the application in the sector or under conditions that are considered relevant for the sector as a whole. A technique only tested on an experimental scale is, in principle, not technically viable. The technique may, when properly applying the appropriate security measures, not lead to an increased risk of fire, explosions or accidents in general and may not influence the quality of the end product. Secondly, the environmental performance of the candidate BAT is evaluated, either qualitatively or quantitatively. Finally, the economic viability (cost feasibility and effectiveness) of the candidate BAT is evaluated. A quantitative approach can supplement or replace a qualitative approach, but is highly dependent on the availability of data on investment and operational costs of the candidate BAT and the environmental effects/benefits. Based on the scoring of these three criteria, the BAT are selected. When only limited data are available and a solely qualitative approach is followed, conclusions are especially subjected to the expert judgment of the TWG members.

2.2.1. Dairy BAT Reports

The dairy sector in the three MPCs is characterized by a large number of very small dairy producers that produce their products in an artisan way. Besides these micro-, traditional dairy processing companies, there are mostly SME's (Small and Medium Enterprises) and only a few large companies (on average > 150 employees). Companies above the IPPC size threshold (quantity of milk received daily is >200 tones, average on an annual basis) are rather rare or even nonexistent. In Egypt, for example, the dairy sector is quite important. It is responsible for about 15.9% of total manpower in Egypt and 9% of all production facilities. In Tunisia, the dairy sector has a strategic role in the food industry. It is responsible for about 8% of production volume and 5% of investments.

The scope of the BAT evaluation includes the production of all dairy products. Only for Tunisia, cheese and milk powder production are not included in the evaluation, due to the lack of data.

The TWGs in each MPCs were composed, taking the importance of diversity in members into account (see the previous section on methodology). For Morocco and Tunisia, this led to a TWG with

an almost equal presence of sector representatives (companies, sector federations), independent experts (consultants and university professors) and public administration representatives. For Egypt, however, this was not the case. Only independent experts and one representative of a public administration constituted the TWG.

As was mentioned, data on the competitiveness, investments, turnover, employees, *etc.*, forms an important basis in order to get a clear picture of the sector's financial strength and resilience. This type of information was, however, quite hard to gather, especially when the data had a confidential character. Some information on the financials of companies in the dairy sector was provided in Egypt and Tunisia. However, these data were rather outdated. Expert judgment remained necessary to evaluate the relevance of these numbers. For Morocco, only very limited information was available. Overall, it was clear that this type of information is not reported as transparently as it is done in Europe. The confidential aspect towards competitors is the main obstacle. As far as the legislative framework in the MPCs is concerned, it is clear that this is quite different from the European legislative framework in the sense that emission limit values are general, no sector specific approach is applied and, in many cases, implementation of the legislation and control on compliance is inadequate and, therefore, often ineffective.

The candidate BAT were listed based on the European BAT reference document (BREF), Food, Drink and Milk, the Flemish BAT study for the dairy sector [27] and input from the TWG members in the different MPCs. A list of, respectively, 56, 55 and 56 candidate BAT for the dairy sector in Egypt, Tunisia and Morocco was compiled (Table 1).

Table 1. Number of (candidate) Best Available Techniques (BAT) per Mediterranean Partner Countries (MPC) for dairy sector.

MPC	Candidate BAT	BAT	Conditional BAT	No BAT
Egypt	56	48	6	2
Tunisia	55	46	8	1
Morocco	56	47	8	1

The techniques focus on the use of water and energy, the emission (discharge) of waste water and the generation of waste, plus a number of general techniques that are related to the plant level instead of the process level.

Although for each of these techniques, quite a bit of information is already available in the literature, specific information related to the circumstances in the MPCs is important in evaluating the techniques and selecting the BAT. Therefore, the TWG members were asked to provide data on the applicability, the environmental performance, economics (investment and operational costs), driving forces for implementation and example plants in the MPCs. Especially, qualitative aspects were known and made available in the course of the study. Quantitative information on environmental performance and the economics was hardly ever provided or even available to the TWG members.

The information provided by the TWG members on local issues was considered of great importance for the final results of the study. When evaluating the candidate BAT for dairy in the different MPCs, most of the techniques, however, were equally considered BAT or not, independent of the country.

For some techniques, the information on local issues did in fact make a difference towards the final conclusions. For example, the use of self-neutralization to reduce the amount of waste water was considered BAT under certain conditions in Morocco, but was not considered BAT in Tunisia. This is due to the fact that the technique is not considered applicable in Tunisia today. No installations have the required pH variation for the technique to properly work. In Morocco, however, there are installations that can apply the technique, and therefore, it is considered BAT. Another example is the use of CHP (combined heat and power). In Egypt, current fuel prices make it hardly impossible for CHP to be economically viable for dairy companies, while in Tunisia, this is currently not the case. Of course, factors, such as fuel prices, vary over time and can make a difference in conclusions when changes occur. This, again, stresses the added value of quantitative information in a BAT evaluation. Economic viability can be evaluated more objectively and price fluctuations can be taken into account to determine the robustness of the BAT conclusion.

Due to the lack of quantitative data, several aspects of a typical BAT study could not be elaborated in detail in the reports. A good example is the final stage of the BAT studies as made in Europe: the setting of BAT-associated emission levels (BAT AELs). In order to make this possible, a clear picture of the environmental performance of the companies and the techniques is necessary. The BAT analysis eventually indicated 54 (Egypt and Tunisia) and 55 techniques (Morocco) to be BAT, however, with a number of techniques being limited in applicability or through economic viability (Table 1).

For example, BAT to minimize waste water in the Egyptian dairy industry is to apply one or a combination of the following four techniques:

- Minimizing the use of EDTA (ethylenediaminetetraacetic acid)
- Provision and use of catchpots over floor drains
- Minimize the blowdown of a boiler
- Maximize condensate return

Same account for the Moroccan and Tunisian dairy industry.

Overall, the BAT considered as a priority in Egypt were mainly good management practices (e.g., repair leaking valves), monitoring and control (e.g., of water) and energy conservation. For Tunisia, the priorities are mainly the reduction of water and energy consumption and raising good environmental practices to be implemented. The main focus there lies with the preventative measures due to cost constraints. In Morocco, the TWG members indicate good housekeeping, monitoring of water and energy consumption and training and awareness of employees to be top priority.

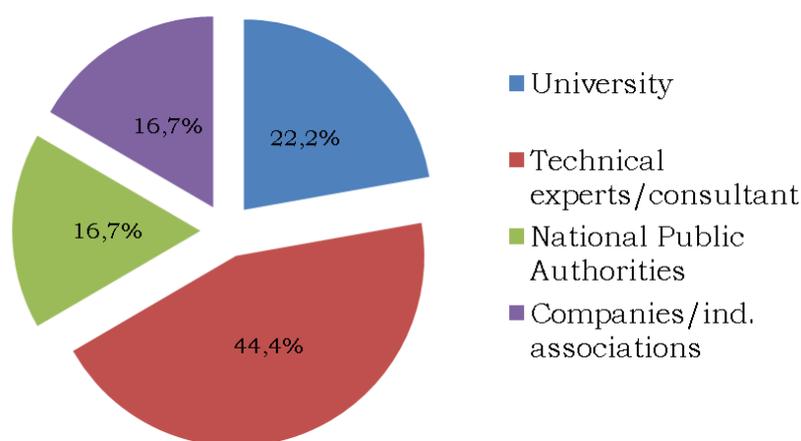
2.2.2. Textile BAT Reports

In Egypt, the textile and clothing industry plays a crucial role in the economic, social and political context of the country. In particular, the cotton sub-sector is very important in the economy, also for export. The textile and clothing sectors include 4,500 companies and employ around 700,000 direct workers. If indirect employment is considered, that number increases to over one million. In Egypt, there is still a strong presence of public textile companies. There are around 27, and they employ around 100,000 workers. The main textile products are apparel fabrics, terry towels, bed linen, furnishing fabrics, industrial/technical fabrics and non-woven fabrics. Furthermore, in Morocco, the

textile sector is one of the most important ones. It plays a strategic role for the Moroccan economy. There are about 200,000 employees, corresponding to 40% of the national industrial employment. Despite a difficult world economic crisis, in 2012 and 2011, the textile exports of Morocco to European countries grew. In Tunisia, the textile sector is the largest one in the country in terms of exports, employment and added value. There are about 2,000 textile companies (with about 10 employees for each); most of them are small and medium enterprises. About 85% of the Tunisian textile companies are producing only for export. Most firms receive foreign direct investments: French companies are the leading foreign investors in the textile and clothing sector in Tunisia, followed by Italian companies.

As described in the previous section, to support the selection of BAT and the elaboration of the reports, a key contribution was made by TWG members. The elaboration of reports aimed to valorize skills and knowledge on textile processes and characteristics of the TWG members and to include them in these documents. In Figure 1, the representativeness of economic and public categories of TWG members is given.

Figure 1. Technical working groups (TWGs) members for representative categories (for the three countries).



For each of the three MPCs, some specific processes to which the BAT reports focus were selected. The selection was justified by two main reasons: the high environmental relevance of these processes and the large number of companies in each of the three countries that are focused on them. For Egypt, it was decided to focus on all processes for the production of cotton textile products. In particular, techniques belonging to pre-treatment, dyeing, printing, washing, drying, finishing, coating and laminating processes were included in the BAT report. In the case of Morocco, the processes considered were focused on pre-treatment and dyeing. They included all kind of fibers, such as cotton and other natural, artificial and synthetic fibers. Since wool is not a key fiber in the textile processes in Morocco, techniques referred to wool were excluded from the BAT report. In the BAT report of Tunisia, dyeing and finishing processes were considered.

In order to identify the candidate BAT, partners collected information about techniques through the consultation of a wide number of sources. Candidate BAT included in the BAT reports consist in both vertical techniques (e.g., techniques that can be applied only to textile sector) and horizontal techniques (e.g., techniques that can be applied to all IPPC sectors and also to the textile one). In the

case of vertical candidate BATs, first of all, partners of the project consulted the European Best Reference Document (BREF) for the textile sector, (EC, 2003). Considering that the issuing date of the current version of BREF is the year 2003, partners know that the main challenge in this sense was to check other sources, where they can find results of recent researches on textile techniques. For this reason, other important considered sources were, for example, the Flemish BAT report for the textile sector (Flemish Institute for Technological Research, VITO, translated version, 2011); pollution prevention in the textile sector within the Mediterranean Region (Regional Activity Centre for Cleaner Production, CPRAC, 2002); technical reports of EU-funded projects on the textile sector (e.g., Funded through Life Programme); and many scientific and academic articles about technologies and techniques adopted and/or experimented upon in the textile sector.

The candidate BATs that were identified were classified according to specific classes and subclasses. For example, one of the identified classes is “end of pipe techniques” for abatement pollution techniques. Under this class, some subclasses were created (e.g., wastewater or air emissions abatement techniques), grouping the identified techniques through sources consultation. In total, for the textile sector, about 90 vertical candidate BATs were identified in the project.

One of the end of pipe techniques identified through a scientific article was named “removal of disperse dyes from textile wastewater using bio sludge”. The technique is characterized by the high adsorption capacity of bio sludge on dyes and organic matter in wastewater, allowing the reduction of some polluting parameters and dyes in wastewater.

All identified candidate BATs have been assessed according to the methodology elaborated earlier on in the project. A key aspect about the evaluation and the assessment of candidate BAT was the bottom-up approach; BAT were identified “on the field”, paying attention to local issues and aspects referring to specific conditions and characteristics of each MPC. A sample of textile installations was audited for each of the three countries. Two of the candidate BAT were identified internally to industrial processes of audited companies. One of these two candidate BAT was named “dry bleaching using ozone instead of wet washing using chlorine or hydrogen peroxide”. It consists of placing garments in a dry rotary washing machine (that is connected to an ozone generator). The technique is used, for example, to bleach the fabric lightly using ozone instead of wet washing using chlorine (or hydrogen peroxide). This technique does not imply the use of water and chemicals.

Moreover, also, the involvement and the active participation of TWG members guarantee the consideration of local aspects.

The results are presented on the following (Table 2).

Table 2. Number of (candidate) BAT per MPC for the textile sector.

MPC	Candidate BAT	BAT	Conditional BAT	No BAT
Egypt	60	32	15	13
Tunisia	51	26	15	10
Morocco	59	32	9	18

The main reasons for which candidate BAT resulted as no BAT are linked with them being not economically or technically viable. In the first case, often, techniques require high investments or additional costs compared to the traditionally used methods, and the payback period related to the

savings achievable was not always acceptable. In the second case, a negative assessment of technical viability criteria was related to the fact that some techniques (especially the ones collected from scientific articles) are not yet proven on an industrial scale, but only on a pilot scale. For this reason, this group of techniques can be considered as emerging techniques.

The identified BAT were related mainly to the main important environmental aspects for the textile industry: water consumption and water emissions. To improve water emissions, the techniques involve mainly the substitution of chemicals prioritizing preventive measures instead of end of pipe actions. The identification of BAT related to the substitution of chemical with other more environmental friendly techniques was also one of the topics requested by the textile companies that were involved. Many North-African companies are suppliers of European firms, and there has been increasing attention by the consumer on the health issues linked to textile products.

2.2.3. Discussion on the BAT Sector Reports

When elaborating a BAT sector study, data availability is always a key factor. This is true for Europe when elaborating a BREF, but the same can be concluded when transferring the approach to non-EU countries.

The experiences when drawing up the BAT sector reports shows that data availability, especially quantitative data, on all the aspects involved (financial data on the sector, environmental performance data, investment and operational cost data on techniques, *etc.*) was hard to come by. This, of course, greatly affects the results and the quality of the results.

When quantitative information on the financial strength and resilience of the sector is missing, it is hard to verify the economic viability of techniques. Of course, to do this, investment and cost information on the different candidate BAT is needed, as well. For most of the candidate BAT in the studies, information from the EU BREFs was used: no specific data were available for the supply of the techniques in the MPC markets. Data on the environmental performance of the sector is of great importance, since this creates the opportunity to identify the reduction potential and cost-effectiveness of the candidate BAT. Furthermore, when the BAT environmental reduction potential is known, BAT AELs can be determined. In the reports now, due to the lack of this type of information, no BAT AELs were determined.

During this phase of the project, the involvement of the TWG members was an important success factor. Although not each TWG had the perfect composition, this was not necessarily problematic for the outcome of the project. Since the principle of BAT and, therefore, the principle and role of a TWG is new in the MPCs, this first experience did indicate how environmental issues are valued amongst the people involved. A clear push towards more environmental awareness in industrial sectors was experienced.

An important factor when trying to raise environmental awareness and involvement in industrial sectors, still, is legislation. Each of the MPCs involved indicated that today, that their environmental legislation is a general one, not making any distinction between different activities when setting Emission Limit Values (ELVs). Besides this aspect, environmental permitting is tackled in a totally different way than is done in Europe. It is clear to say that the legislative approach is thus very different from the IPPC approach that we are trying to transfer to the BAT4MED project. The lack of

monitoring and obligated reporting make it very hard to facilitate BAT evaluations: the lack of data is inevitable when monitoring is absent. Monitoring can be seen as one key element when trying to implement the IPPC approach: no monitoring means no available data and, therefore, no possibility to state BAT AELs and set ELVs. No monitoring (and reporting) also means that compliance with stated ELVs is very hard to check and, thus, legislation risks being ineffective.

From the experience of the authors, it is clear that there is still a significant legislative gap to be overcome before the IPPC approach and BAT principle can be transferred for real to the MPCs. In order to determine the real potential for future adaptation of the existing MPC legislative procedures and to permit the integration of the principles based on the IPPC approach, the project included an analysis on this matter.

3. The Valorization of BAT Reports in Mediterranean Partner Country Legislation

The BAT4MED project has assessed the possibility and impact of the establishment of the EU IPPC scheme in the MPCs. One of the fundamental premises of the study that was developed was that the BAT will spread through the interested industrial sector only if this process is feasible and economically sustainable and if it is accompanied and spurred by effective policy measures.

To this end, the BAT4MED project will target the following objectives:

- To analyze and benchmark policy and legislative frameworks regarding pollution prevention and control in the MPC;
- To provide the MPC with information on the EU IPPC approach based on the IED;
- To assess the possibility and the impact of diffusing the EU IPPC approach to other MPCs;
- To bring together the previous experience of the EU in pollution prevention and control and the conclusions of the BAT4MED project for providing policy recommendations to support the implementation of BAT in the MPC.

From a scientific point of view, the methodological approach of this study was that grounding on a strong policy analysis of the current legislative framework in each MPC. For this purpose, MPC partners will work on the development of three national analyses of policy and legislative frameworks to support BAT implementation in those countries. On the basis of the results of the national analyses, a comparative analysis of policy and legislative frameworks that support the prevention and control of industrial pollution in the MPC will be carried out. This benchmarking exercise will be the basis of a cross-country analysis that will highlight the most relevant aspects regarding the pollution prevention and control approach both at the EU and in the MPC in order to identify synergies and opportunities for convergence with EU policies. The conclusions drawn from this report will provide a series of policy briefings to foster the implementation of BAT and the mainstreaming of the EU IPPC scheme in the MPC. The integrated approach means that the permits must take into account the whole environmental performance of the installation. The purpose is to ensure a higher level of protection of the environment taken as a whole. Preliminary information gathered in the MPC shows that the permitting procedure is based on environmental impact assessments and not on the integrated approach. Therefore, the current legislative orientation in the MPC should shift to an integrated permitting system that ensures a high level of protection of the environment as a whole.

The permit conditions, including Emission Limit Values (ELVs), must be based on the BAT. BAT conclusions (documents containing information on the emission levels associated with the Best Available Techniques—BATAEL) shall be the reference for setting the permit conditions. Regarding this issue, the legislative framework in the MPCs is quite different from the European legislative framework in the sense that ELVs are general and not associated to BAT. To assist the licensing authorities and companies to determine the BAT that can be the reference to establish the ELV, the BAT4MED project organized an exchange of information between experts from each MPC, sector and environmental organizations, as explained in Section 2. Therefore, permit conditions should be thus set by the competent authorities following this integrated approach, also including ELVs associated to BAT, instead of general limits, allowing, thus, the applicability, when possible, of the flexibility criterion, for which competent authorities may set ELVs that differ from the BATAEL in terms of values, periods of time and reference conditions, so long as it can be demonstrated that the actual emissions do not exceed the BATAEL.

The environmental inspection plans must be drawn up using “risk-based criteria” that evidence the compliance with ELV, taking into account the emissions data available. Although certain monitoring and inspection activities are carried out in the MPC, recorded environmental data are only used to assess the legal environmental compliance, but not to set BAT-associated emission levels, which are, at the same time, the reference for establishing ELV through the permitting procedure. Thus, in order to bridge the existing gap in this regard in the MPC, a risk-based system for the planning of the environmental compliance monitoring (monitoring and obligated reporting) should be implemented not only to meet the legal requirements, but to set BATAEL, which could be, at the same time, the ELV established through the permitting system.

Public participation is key in the decision-making process in order to be informed of its consequences, by having access to permit applications, waste monitoring and reporting, emission data reporting, *etc.* Given this, it would be necessary to adapt the public information process to the requirements of the EU IPPC scheme by having access to environmental information in a simple way and involving the public in the decision-making process.

These initially identified legislative gaps (in comparison with the EU IPPC scheme) represent a series of challenges for the MPC that will be translated into policy recommendations aiming not only at fostering the implementation of BAT at national scope, but at showing how the MPC can improve their pollution prevention and control scheme by following the EU approach, which has shown effectiveness in minimizing the negative impacts associated with polluting industries from the industrial sector.

4. Conclusions

Transferring the principles from the IPPC approach as we know it in Europe to non-EU countries, like Egypt, Morocco and Tunisia, is not straightforward. Through the elaboration of BAT sector reports in the three MPCs, it became clear that there are a number of obstacles when doing so. An important aspect, which created a hindrance in the course of the BAT evaluation, was the lack of available, useful quantitative data. Since obligated reporting of financial and environmental performance is missing and confidentiality issues on this type of information makes companies

reluctant to provide it, it is very difficult to obtain the BAT results of quality, as striven for at a European level.

Another important aspect that makes transferring the IPPC approach difficult is the legislative gap, which is seen when comparing the IPPC principles with the current legislation in the MPCs. No sector-specific legislation is used, permitting systems are non-existent and compliance control is lacking. Although this gap seems difficult to bridge in the short-term, one needs to remember that in Europe, also, a significant amount of time passed in implementing and fine-tuning the IED through the identification of the potential, in the later stage of the BAT4MED project; convergence between both approaches might become possible: policy recommendations to support this implementation of BAT may form the roadmap towards convergence. Through a number of dissemination activities, such as national workshops in each MPC and six non-MPCs plus an international final conference, the experiences, conclusions and advice towards policy convergence, obtained in the course of the project, are shared with stakeholders.

Despite this, we retain IPPC as a very well-designed Directive, using Porter's terms [28], an example of environmental regulation that can encourage companies to move toward eco-innovation, becoming better environmental and economic companies. The integrated permitting system, the use of BAT as a flexible mechanism instead of mandatory techniques to impose on companies and the public participation in the permitting process are very well-designed principles worthy of being transferred to other legislative contexts. For this reason, we will continue to monitor the effects of the BAT4MED project in southern Mediterranean countries and the evolution of their environmental legislative framework. At the same time, we invite scholars to further contribute to this field, describing other case studies aimed at transferring the IPPC approach outside of Europe.

Conflict of Interest

The authors declare no conflict of interest.

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