

Improvement of hazardous waste management in Turkey through introduction of a web-based system for data collection and quality control

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Abstract

The Waste Framework Directive (WFD) requires the Member States to take the necessary measures to ensure that waste is properly recovered or disposed of. To improve the management of hazardous waste in Turkey, the project LIFE06 TCY/TR/292 'HA-WAMAN' was conducted in co-operation of the Turkish Ministry of Environment and Forestry (MoEF) and the GTZ from 2007 to 2009. The project covered several measures required by the WFD, including an inventory on the amounts of hazardous waste generated by industrial facilities. ARGUS, on behalf of GTZ, was responsible for the introduction of a web-based record system for the inventory on hazardous waste and a monitoring system, which included modules for data quality control and reporting. For reference year 2008 more than 1/3 of all facilities representing more than half of all employees recorded in the business register participated. Moreover, a large number of companies became aware of their duty to identify and record their hazardous waste.

Keywords

Hazardous waste, LIFE, Inventory, Turkey, Monitoring, Data collection

Türkei, gefährliche Abfälle, Inventar, Überwachung, Datenerhebung

1 Introduction

The Waste Framework Directive (WASTE FRAMEWORK DIRECTIVE, 2008) specifies certain measures to ensure that waste is recovered or disposed of in accordance with Article 13, i.e. without endangering human health or harming the environment. Specific measures laid down in the WFD include the introduction and common use of appropriate classification systems (LoW: Art. 7; recovery and disposal codes: Annex I and II), the principle of producer responsibility (Art. 14, Art. 15), the issue of permits for waste treatment facilities (Art. 23), the drafting of waste management plans (Art. 28), the requirement that the actors of waste management shall be subject to appropriate periodic inspections (Art 34) and their obligation to keep records on their activities (Art. 35).

It can be seen that several of the above measures require the recording of information on the amounts of waste generated by quantity, type, origin and destination (including treatment operation type and capacity).

Turkey as a candidate country had, in recent years, been beneficiary of some European funded projects aiming at the improvement of waste management and the implementation of the EU legislation on waste. Two twinning projects were conducted between 2004 and 2008, aiming at the implementation of more than ten EU directives focussing on the general management of waste (packaging directive, landfill directive) and of other particular categories of waste (directives on waste oils, batteries & accumulators, PCBs and end-of-life vehicles). Focussing on the management of hazardous waste, the project "Improvement of Industrial Hazardous Waste Management in Turkey" (LIFE06 TCY/TR/292 'HAWAMAN'), in the following been referred to as LIFE project, was conducted in co-operation of the Turkish Ministry of Environment and Forestry (MoEF) and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) between January 2007 and April 2009.

The project covered most of the measures laid down in the WFD as mentioned above, particularly the performance of an inventory on hazardous waste, the provision of guidance on the hazardous waste classification based on the List of waste (LoW), a concept on hazardous waste management and check-lists for the inspection of recovery and disposal facilities in the context of the permission procedure. These tasks were supported by measures of capacity building through guidance documents and trainings.

ARGUS with its extensive experience in the performance of waste surveys, data validation and analysis as well as the conception and development of databases was responsible for the activities related to data collection and management, i.e. the introduction of a record system for the inventory on hazardous waste from industrial facilities and the introduction of a monitoring system, which included modules for data quality control, reporting and inspection.

ARGUS provided the conceptual work for the adaptation and development of the database systems and the hazardous waste inventory, performed the data evaluation after the surveys and actively participated in the setup of the business and facility registers as well as the classification tables required for data collection and monitoring. Moreover, ARGUS provided an important communication link between the IT experts and programmers on the one hand and the technical department of MoEF and the other involved technical experts on the other. In the following, the related activities and results are described.

2 Development of survey and database concepts

2.1 Initial situation

The Turkish regulation on the control of hazardous wastes (REGULATION ON THE CONTROL OF HAZARDOUS WASTES, 2005) requires the industry to supply waste data for the annual inventory/data survey. The waste generators have to send the filled-in questionnaires for their hazardous waste record each year in April for the previous calendar year. In the past this was done by paper form sheets sent from the industry, which were manually digitalised by the administration in order to be usable for reporting and monitoring purposes. For reference year 2006 the MoEF collected the data via a questionnaire using a MS Excel form sheet. These systems did not permit the actual validation of data, did not produce applicable results within an appropriate time frame and overburdened the administration with work. Only a small percentage of the Turkish companies had sent their form sheets in the previous years (about 600 companies in 2006).

In order to conduct these surveys more efficiently and improve data quality, the idea for a web-based electronic waste data record system was expressed by MoEF and the Turkish Statistical Institute (TURKSTAT) in 2005 already, when a framework agreement between both institutions was signed. This cooperation led to the development of a first prototype of a waste record system for MoEF which was programmed by TURKSTAT on the basis of the MS Excel questionnaires and presented to MoEF and the LIFE project in the middle of 2007.

Apart from the reporting obligation of the waste generators, the Turkish regulation on the control of hazardous wastes requires the waste treatment operators to deliver monthly reports on the amounts treated (waste mass balance forms) and detailed records of the amounts from the consignment notes of the transports delivered to their site (national waste transportation forms). The collection of these data is still conducted largely by using paper or electronic questionnaire formats. At the time of the LIFE project, a web-based collection was already prepared and a prototype for data entry was developed but the system was not fully implemented.

2.2 Definition of system requirements

ARGUS conducted a feasibility study with a comparison of three database systems existing at MoEF and TURKSTAT which could serve as a HWRS (including the central environmental information system at the MoEF). The comparison revealed that the prototype programmed by TURKSTAT was the best system to be adapted for the development of a HWRS. The prototype offered good structural opportunities to collect the data required by the waste department in one comprehensive data base and to run the

distinct applications needed. In addition, TURKSTAT was an experienced partner to carry out waste data collection surveys of such extent and offered appropriate technical and professional support.

ARGUS specified the technical requirements and the definitions for the HWRS and described the following elements required for a suitable HWRS:

- The business register section, which keeps the main data of the waste generators (name, location, NACE code, tax number, number of employees etc.). The basis to start the register had to be retrieved from external sources (see section 2.3.2).
- The facility register section, which keeps the main data of the recovery and disposal installations, such as name, address, licence code, licensed capacities and waste codes as well as the recovery and disposal code of the operation on the basis of Annex I and II of the WFD, as ratified in the Turkish regulation. Here, the content had to be supplied and maintained by MoEF.
- The waste data section, which keeps the raw data of each annual survey on waste amounts and types (6-digit LoW codes), measuring unit and recovery and disposal facility. They are directly accessible by the province administration for their respective province. MoEF has access to all data nationwide.
- The classification section, which keeps the hazardous waste list, based on the European LoW, the list with recovery and disposal codes and the regional classification according to the European NUTS levels (which is also used by TURKSTAT for reporting of data according to the Waste Statistics Regulation).
- The entry mask for password-restricted access by the waste generators, which allows the industry to enter and correct its data discretely. Several features facilitate the use of the system (pull-down menus on waste codes and links to the facility register to select the appropriate installation by mouse click, etc).

Apart from the structural requirements, the responsibilities for data collection and evaluation during the survey were defined by ARGUS in cooperation with MoEF. As a consequence, different user rights with different levels of access to the data from the database were proposed to be implemented in the HWRS in order to grant applicability and security at the same time. Figure 1 shows the responsibilities for data collection. Note that all data are entered and managed in one central database and that the symbols on provincial and local level merely represent those parts of the central database that are accessible at these levels, not separate client databases.

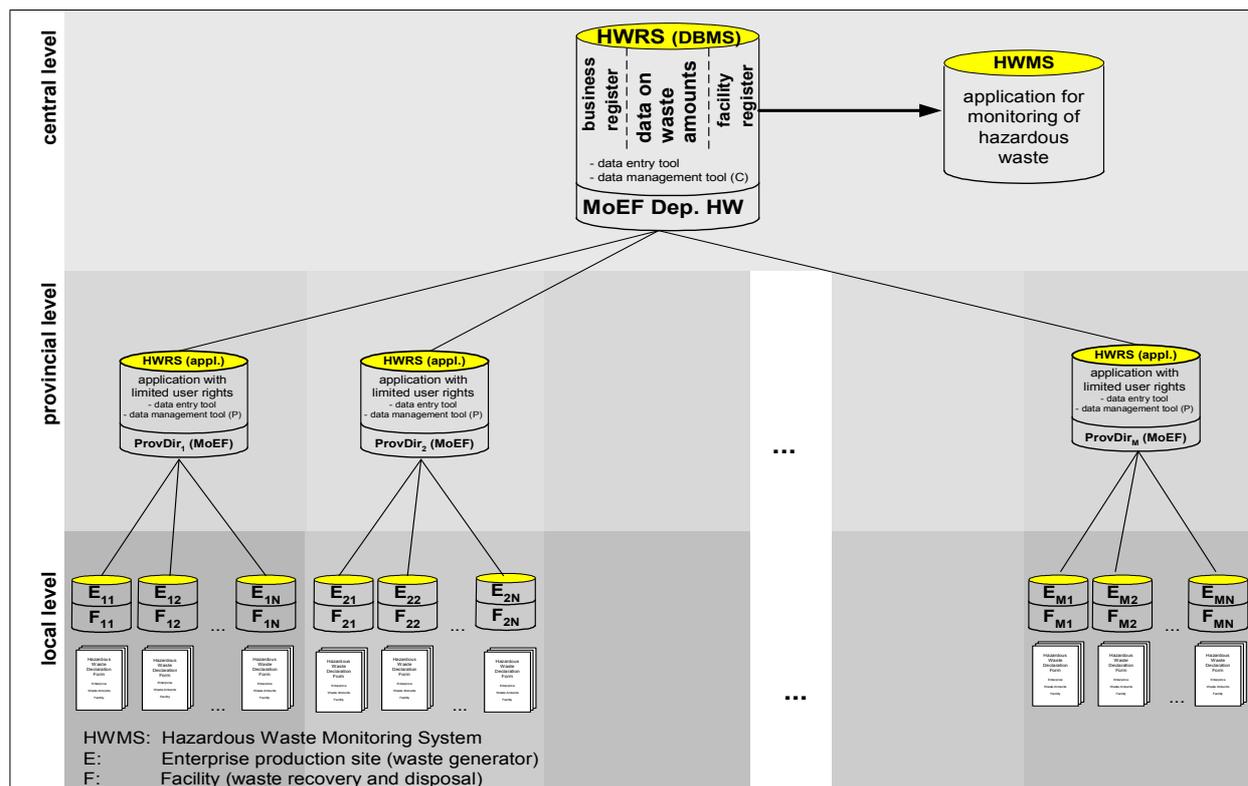


Figure 1 Organisational structure of data collection

As illustrated in Figure 1, the data collection takes place at the local level of the individual production sites of companies. A representative of the site has the right to read, enter and edit only the local data. The province departments shall conduct an evaluation of the data collected from the companies within their province. They get a management tool to view the waste generation data of their province, identify non-reporters and they can delete or enter companies to the business register, including the creation of additional user IDs and passwords. The only system user with full access to all national data is the hazardous waste division of the MoEF. It can access the data either by logging into the HWRS or by entering the application for monitoring of hazardous waste (HWMS) which was introduced in the further process of the LIFE project.

The purpose of the HWMS is to support the hazardous waste division at the MoEF to monitor and manage its administrative tasks efficiently, to fulfil the requirements of the hazardous waste regulation, to fulfil the reporting obligations towards national requirements and towards the European Union and to strengthen the data processing system of MoEF in general. The specific objectives of the HWMS are the creation and implementation of:

1. a data quality assurance system, safeguarding complete and reliable data;
2. a reporting and publication system, safeguarding information distribution from a central data source on a high quality level and without time delay; and

3. a control system for supporting recurrent tasks of the Hazardous Waste division, to save manpower for core tasks.

The data quality assurance system (1) should be designed to validate the data collected with the HWRS for missing and implausible data and to perform some essential transformations (conversion from volume to mass unit). Thus, the data quality assurance system can be regarded as a tool that assists the hazardous waste division in the preparation of a validated and corrected annual data set from the collected raw data.

In the reporting and publication system (2) mainly generates reports with typical aggregations of the waste data as required for regular reporting and publication or for replies on ad-hoc requests from senior staff. The reporting system also generates compilations for planning purposes (e.g. amounts of the provinces by source).

The control system (3) is a tool that serves to compare the amounts reported by the waste generators with the licensing data of the facility (capacity, recovery and disposal codes, LoW codes) and with data reported by the facilities themselves (waste mass balance forms / national waste transport forms).

The control system shall contain an additional module for the recording of inspections by means of the check-lists developed under another task of the LIFE project. The check-lists cover typical aspects that should be controlled during a site visit at recovery and disposal facilities as well as waste producers. The additional application module shall contain an electronic version of the check-lists and shall allow direct access to the data from the facility register and the business register. So the province level at MoEF can use and share real-time information on facilities and companies with the central level. Another benefit is that the information on the company/facility is available for the inspection prior to the control visit in a time saving and unified form. During control visits by province staff these base data can be updated together with the company/facility by logging in to the web-based application.

The monitoring system had to be designed for application with other relevant databases at MoEF, including the application for special waste and the waste section of the existing environmental information system (EIS). This was necessary to guarantee the sustainability of the programmed modules and to make the integration of the system into the EIS possible. This integration was particularly important for the business and facility registers, as these data are used by other departments of the MoEF.

2.3 Setup of registers

2.3.1 Facility register

In MoEF all staff members of the hazardous waste division were used to manage licensing data by their own standards. This had to be changed by common rules and a unified format for data supply in the facility register. ARGUS checked the facility register data and aligned them in order to transfer them from Excel-based data sheets into a data base format. The standardisation of the facility data proved to be a lengthy and difficult process, especially as almost every week new facilities were licensed and consequently added to the list.

These facility data are under supervision of MoEF and have to be kept in a structure, which has to be applicable with other relevant databases operational at MoEF. The alignment of structures to secure integration with the existing data base structures, e.g. the environmental information system (EIS) and the GIS applications at MoEF, was pursued by ARGUS so that the data content could be shifted without difficulty. For this reason a close cooperation with the IT department of MoEF was necessary under moderation of ARGUS.

2.3.2 Business register

Data on industry and employees are required for the business register. They were only available at TURKSTAT or at the Union of Chambers and Commodity Exchanges of Turkey (TOBB). The industry data / business register available at TURKSTAT was still under development at the time of the first survey. Therefore, the business register of TOBB for 2007, which contained about 65.000 establishments, was used as the basis for the HWRS and the HWMS.

Prior to its usage, the register was processed by ARGUS to exclude all establishments which were regarded by the LIFE project team and MoEF as not yet relevant, either because of their economic activity (e.g. services) or because of their size (units with less than 10 employees). The remaining information on about 38.000 establishments was used as the basis for waste data collection by the HWRS for reference year 2007.

Further steps towards a sound business register were undertaken in the course of the two surveys performed. In the process of the first survey on 2007 data, the province departments updated the list with about 3.000 additional facilities not registered before. In addition, prior to the second survey on 2008 data, the province departments voluntarily performed a major quality control of the business register, resulting in the reduction of the register from about 41.000 to about 38.000 sites mostly from removal of production sites that were closed. The review was a great improvement as it was the first major

review of the list. This improved business register was then used as the basis for the survey on 2008 data in the beginning of 2009.

3 Introduction of the systems

The TURKSTAT IT department programmed the HRWS including the entry masks and additional menus and created user IDs and passwords. The system was introduced to the users and stakeholders in March 2008. Representatives of all 81 provinces and about 70 associations, chambers and other relevant institutions and companies were invited. Almost all 130 staff members, who were invited, participated in the event. A representative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the General Director of MoEF opened the meeting.

Representatives of the MoEF and TURKSAT demonstrated the electronic data input in detail. ARGUS presented and explained the general and specific requirements of waste data surveys. All provinces received a CD with HWRS access details to be distributed to the waste generators in their province. The representatives of the industry associations and chambers were requested to spread their knowledge to the industry. Figure 2 shows the user interface of the HWRS.

As shown by the frames in Figure 2, the user interface consists of three parts as follows:

1. Company data from the business register
2. Waste data (small frame: summary table of waste data already entered)
3. Data on responsible person

Part 1 is partly pre-filled. Parts 2 and 3 are blank when the company enters the system the first time.



T.C. ÇEVRE VE ORMAN BAKANLIĞI
TEHLİKELİ ATIK BEYAN SİSTEMİ



LIFE06 TCY/TR/000292

Atık üreticisi ile ilgili kimlik bilgileri

Vergi Kimlik Numarası : 12345678 **identification No.** 1

İş yerinin adı : gokhan ltd sti **facility name**

İl adı : MANISA **province,** İlçe adı : AKHISAR
Bucak adı : PALAMUT **sub-province etc.** Köy adı : BÜKNÜŞ

Mevki : Öveçler
Mahalle : Huzur Mahallesi **address (street, number etc.)**
Cadde / Sokak : 19.Sok

Dış Kapı : 7 İç Kapı : 1
Posta Kodu : **postal code, telefon, fax, e-mail** Telefon Numarası :
Faks Numarası : Elektronik Posta :

1 - İşyerinizde 2006 yılında ortalama çalışan sayısını yazınız : 1291 **number of employees**

2 - İşyerinin ana faaliyet konusunu belirtiniz : 2922 **economic branch code (NACE)**

3 - Tehlikeli atık tablosu

**treatment location
(internal/external/export)**

Atık kodu	Atık yağ kat.kodu	Ölçü birimi	Miktar	Bertaraf/Geri Kazanım işleminin nerede yapıldığı	Uygulanacak işlem	İşlem kodu	Tesis kodu
waste code (waste type)	unit	amount		recovery/disposal (R&D) type	R&D facilities		
<input type="text"/> Seç	<input type="text"/> Seçiniz:	<input type="text"/> kg/yıl	<input type="text"/>	<input type="radio"/> Tesis içinde(TI) <input type="radio"/> Tesis Dışında(TD) <input type="radio"/> İhracat(IH)	<input type="radio"/> Geri Kazanım(GK) <input type="radio"/> Nihai Bertaraf(B)	<input type="text"/> Seç	<input type="text"/> Seç
<input type="button" value="Listeye Ekle"/>							

Atık Kodu	Atık yağ kat.kodu	Ölçü Birim	Miktarı	T.İ / T.D	G.K / B	İşlem kod	Tesis Adı	Değiştir	Sil	Kopyala
080115	II.Kategori	kg/yıl	20	T.D.	G.K	R7	R134001	Değiştir	Sil	Kopyala
130109	I.Kategori	kg/yıl	1000	T.İ.	B	D15		Değiştir	Sil	Kopyala

Sorumlu Kişinin:

Adı : **responsible staff:**
Soyadı : **name/surname**
Ünvanı : **position** 3

Sorularınıza 0.312 207 65 07/0.312 297 65 16/0.312 207 65 20/0.312 207 65 21 nolu telefonlardan cevap alabilirsiniz.

Figure 2 User interface of the HWRS

From May to August 2008 the coordination and integration with the different databases into one joined application system were discussed based on the proposals of ARGUS. In the end the registers were fully integrated with the environmental information system (EIS). On this basis, the terms of reference for tendering and contracting a company to programme the HWMS were prepared. In August 2008, Stratek Stratejik Teknolojiler Ar-Ge was contracted on account of the LIFE budget. In the beginning of December 2008, the programming finished on time and on 18th of December, training on HWMS was conducted by MoEF and ARGUS.

In February 2009, ARGUS compiled the terms of reference for the additional module for the recording of inspections by means of electronic check-lists. The contracting proce-

ture for programming commenced in March 2009. The programming of this addition was finalised in April 2009.

4 Conducting of the surveys 2007 and 2008

In the course of the LIFE project, ARGUS could assist MoEF in the performance of two survey on hazardous waste covering the reference years 2007 and 2008

The first electronic data collection and inventory on hazardous waste 2007 was conducted from April to June 2008. In these three months, the province departments did not succeed to notify more than 60% of the about 38.000 companies identified. One reason here is that provinces like Istanbul or Kocaeli, which had to address more than 10.000 companies, could not keep up with the work load. In addition, 3.000 companies not registered yet had to be added to the business register in this period.

As a consequence, many companies had not received their access data on-time, so that it was decided to grant the densely industrialised provinces additional time for notification and to re-open the electronic data collection from September to November 2008 for a second round of data input for reference year 2007.

The second survey was conducted with the new data collection tool in the last months of the LIFE project. From February to April 2009 the system was opened for the survey for reference year 2008, after the major review of the business register by the province departments (see section 2.3.2).

When the surveys were finished, the validation and rough analysis of the raw data for reference years 2007 and 2008 were conducted by ARGUS. The results are briefly summarised in section 5 below.

During the surveys, MoEF staff had to answer numerous requests by companies. They were claiming to be unable to supply data because they were unaware of producing hazardous waste. Often MoEF needed to inform the companies about possible waste production in their industrial branch. Many companies could not classify hazardous waste from non-hazardous waste or were not familiar with the recovery and disposal methods. Others had to be told that even waste, which is sold by them because of its positive market value, still has to be classified and reported as waste.

5 Results of the surveys 2007 and 2008

After the conclusion of the surveys ARGUS performed a preliminary data analysis on company response rates and a validation aiming at the identification of missing and im-

plausible data, that require correction. For internal use at MoEF, ARGUS produced some preliminary aggregations of waste amounts by province, LoW chapter and recovery and disposal method.

Table 1 shows the results for the coverage of the surveys 2007 and 2008. The data in the row "response" show the number of companies, and the respective sum of employees represented, which registered to the system and updated their company data. As a part of these companies claimed to generate no hazardous waste, the third line represents the number of companies who had entered their waste data.

Table 1 Response rates by number of firms and employees for the surveys 2007 and 2008

Type of data provided	No of companies		Share from total		No of employees		Share from total	
	2007	2008	2007	2008	2007	2008	2007	2008
No data	33.496	25.299	80%	66%	1.512.411	1.074.618	62%	45%
Response	8.120	13.153	20%	34%	944.894	1.315.078	38%	55%
of which provided waste data	4.275	6.032	10%	16%	727.330	888.304	30%	37%
Total	41.616	38.452	100%	100%	2.457.305	2.389.696	100%	100%

It can be seen that for year 2008, roughly 38.500 companies were listed in the system (approximately 3.000 fewer than for 2007 due to the review of the business register), of which about 13.200 (34 %) had entered the electronic system and supplied detailed data on their company (2007: 8.100; 20 %). Ca. 6.000 (16 %) of these companies recorded their waste data (2007: 3.600; 10 %).

Thus, the response rate based on number of companies has greatly improved during the inventories on 2007 and 2008 data and largely exceeded that of previous years prior to the introduction of the HWRS (about 600 companies delivered their MS Excel questionnaires in 2006).

If the number of employees is considered, the companies who responded represent 55 % (2007: 39 %), with a corresponding share of 37 % (2007: 30 %) with waste data. Thus, the response rate related to employees improved significantly compared to 2007 and exceeded half of all employees registered in the HWRS system, which is very satisfactory.

The total number of records requiring correction decreased from 3.670 in 2007 to 2950 in 2008, i.e. by one third. At the same time, the total number of waste records increased from 10.360 to 16.500, i.e. by 40 %, resulting in a considerable reduction of the total share of errors to only 17 % of all records (2007: 35 %). In the two years, more than 70 % of all errors were missing entries for treatment facilities.

As these errors can only be resolved by consultation of thousands of companies involved, the required data corrections have not been performed for the data 2007 and 2008 due to the high work load of the MoEF and its provincial directorates. According to a decision of the hazardous waste division at the MoEF, a comprehensive consultation of the companies aiming at the correction of missing and implausible data is only envisaged for the data of 2009 and later. For this reason, the waste amounts can not be presented.

6 Conclusions and Outlook

The LIFE project successfully developed a data collection and management solution for Turkey. The rapid increase of data supply by the industry has demonstrated high acceptance of the hazardous waste record system in the companies. An important effect of the survey was that the awareness of the companies on their duties stipulated by the regulation on control of hazardous waste was strongly increased. For the first time, waste generators were notified directly by the authorities to classify and register their hazardous waste through the supply of individual access codes which enabled them to report their waste electronically.

The voluntary effort of the province departments to further improve the business register for each province proved, that the benefits were well understood and the system is regarded as useful. In addition, the province departments have a new and more important role as they are in charge of checking the inventory for non-reporters and data errors and notifying the affected companies in their province. These activities have had a large impact on Turkish industrial waste producers, as many understand now, that their non-reporting is not going unnoticed by the authorities.

Even in many Member States the environmental and the statistical administration collect environmental data separately at the same sources/stakeholders and report them independently of each other. With the support of the LIFE project, the MoEF and TURK-STAT strived to cooperate and collect one set of hazardous waste data from industry, which may then be shared by both institutions for their different purposes. This is a unique and innovative approach and has not been tried in many MS so far. It is supporting the waste producers in their efforts to comply with legal environmental requirements and reduces the burden especially for small and medium size enterprises. Both institu-

tions have shared their specific expertise. TURKSTAT contributed its experience in large-scale data collection and validation, MoEF its capacity with regard to technical and organisational aspects of waste management, e.g. its specific knowledge of the existing recovery and disposal facilities licensed by the hazardous waste division.

For the improvement of industrial hazardous waste management this is a very important step forward though the way to complete coverage and correct data in Turkey is still a long one. Data validation and interpretation remains a challenge for the future, as the data collected in the course of the LIFE project were the first two comprehensive datasets on hazardous waste.

The hazardous waste record system and the coordinated waste data collection initiated by the LIFE project is transferable to other countries inside, but also outside of the EU. The IT department of the Egyptian Environmental Affair Agency recently studied the Turkish HWRS system and aims to transfer it with adaptation for their own hazardous waste data collection system.

7 Literature

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|---|------|--|
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