Ecological Indicators 79 (2017) 106–113

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Developing environmental performance indicators for food and beverage processors in the USA

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ARTICLE INFO

Keywords:
Toxic Release Inventory (TRI)
Sustainability
Waste management
Cleaner production
EPA
Recycling

JEL classification:
Q53
Q58
A13

ABSTRACT

Despite consumer and regulatory focus on the quality of final food and beverage (F & B) products, little attention is given to the release and management of toxic chemicals by F & B processors. This study develops five plant-level indicators of environmental performance specific to toxic chemicals. Our findings suggest that (i) only few F & B processors invest in toxic chemical prevention activities; (ii) the major toxic chemical management strategy is treatment rather than recycling or energy recovery; (iii) F & B processors, on average, have improved their toxic chemical management rates between 2001 and 2012; and (iv) there is evidence for homogeneous performance across similar producers in the F & B processing industry but there is no evidence for the role of socio-economic characteristics of surrounding communities on the environmental performance of F & B processors.

1. Introduction

Among other things, rising consumer awareness and stricter food regulation has driven food and beverage (F & B) processors to monitor the quality and safety of final products. For instance, the use of antibiotics (The Wall street Journal, 2014), healthier and safer ingredients (CNN, 2014) and misbranding have received repeated media coverage (Food Safety News, Oct 7, 2014; Food Safety.gov, 2015). Furthermore, the Food Safety Modernization Act, signed into law in 2011, is expected to impose stricter requirements and give the Food and Drug Administration (FDA) 'more authority to recall products suspected to be unsafe' (FDA, 2012; Ho, 2014).

Despite the special concern for the safety and quality of final F & B products, little attention is given to the management and emission of *toxic chemicals* by F & B processors.[1] Managing toxic chemicals is an important component of environmentally sustainable F & B operations (Akkerman and Donk, 2010).[2] This is because food processing and packaging generates large amounts of wastewater with chemical residuals, organic wastes and inorganic wastes (UNIDO Document, Undated). Furthermore, several F & B processes use toxic chemicals which later end up being released to the environment or collected for management (EPA, 1998). For example, ammonia is used as a starter in the processing of cheese; zinc compounds are used as additives in dog food; phosphoric acid is used in the preparation of baking ingredients and soft drinks, etc.

The purpose of this study is to examine the extent to which F & B processors release and manage toxic chemicals. We achieve our objective by constructing plant-level environmental performance indicators specific to toxic chemicals generated in the processing stage. Most studies focus on either greenhouse gas emissions or global warming impact of F & B products (Roy et al., 2009). For example, Weber and Matthews (2008) estimate the total greenhouse gas emission impact of different F & B products during the production, transportation and distribution stages. Peano et al. (2014) present the carbon footprint of some specific food products. Indicators that capture the release and management of toxic chemicals as an impact category in the F & B processing industry are not yet widely available. The contribution of this study is to fill this gap. We argue that environmental performance should not be viewed as a one-dimensional concept, but rather should incorporate a broad spectrum of environmental initiatives undertaken by facilities (Lefebvre et al., 2003). So far, studies characterizing the environmental performance of manufacturers rely on a one-dimensional concept such as emissions per unit of output (NLWRA, 2006) and total air emissions (Shadbegian and Gray, 2003). This current study

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[1] Toxic chemicals are chemicals with significant adverse acute and chronic (cancer and non-cancer) human health effects, and significant adverse environmental effects (EPA Website, 2017).

[2] Environmental sustainability involves business decisions and actions that protect the natural environment. In this study, we do not address the social dimension of sustainability.

http://dx.doi.org/10.1016/j.ecolind.2017.04.005
Received 18 April 2016; Received in revised form 31 March 2017; Accepted 3 April 2017
1470-160X/

develops five standardized indicators to measure the different efforts of a facility to manage and prevent the release of toxic chemicals.

These indicators are used to study differences in performance across facilities, sub-industries and over time. There are several studies examining differences in environmental performance and determining factors based on theoretical considerations and industry experiences (e.g. Bouvier, 2009; Brammer et al., 2012; Delmas and Toffel, 2004, 2008). We present four testable hypotheses to examine whether the same determining factors discussed in the literature are applicable to F & B processors' environmental performance specific to toxic chemicals. The hypotheses are listed below and their rationale is explained in the following paragraphs:

Hypothesis 1:. F & B processors located in the same administrative region achieve similar rates of environmental performance.

Hypothesis 2:. F & B processors located in communities with higher income, higher education and fewer minorities are more likely to have relatively higher environmental performance.

Hypothesis 3:. F & B processors which are part of the same industry achieve similar rates of environmental performance.

Hypothesis 4:. F & B processors which have an onsite toxic chemical management system have relatively higher environmental performance than plants which do not own such a system.

One of the most cited determinants for good environmental performance is regulatory pressure. Fikru (2014) finds that local regulatory requirements influence adoption of environmental practices; Lefebvre et al. (2003) find that existing and anticipated environmental legislations considerably improve several dimensions of environmental performance; Shadbegian and Gray (2003) find that local regulatory stringency affects the environmental performance of manufacturers; and Bouvier (2009) shows that a plant's environmental decision-making may be influenced by the regulatory structure of its surroundings. Gray and Shadbegian (2007) argue that location specific regulatory pressure may affect the environmental performance of plants in the USA. That is, plants in the same jurisdiction may face the same regulation and regulatory guideline. Their study finds that plants located near each other, irrespective of their industry, tend to have similar compliance to environmental regulation as long as they are in the same state. This is because most environmental regulations are enforced at the state rather than the federal level. Similarly, we test whether F & B processing plants located in the same administrative region achieve similar rates of environmental performance (Hypothesis 1). DiMaggio and Powell (1983) describe this as 'coercive isomorphism' where facilities which face the same regulatory framework adopt comparable degrees of environmental performance. For the purpose of this study, we define an administrative region at two levels: zip code and state level.

The second most important determinant for good environmental performance is local communities. Bouvier (2009) shows that information about a plant's emission and the growing environmental consciousness of society have significant influence over firm-level environmental decision-making. Delmas and Toffel (2004) argue that local communities can impose coercive pressure on facilities through their vote in local elections and by filing citizen lawsuits. Hence, facilities may adopt environmentally sustainable practices in order to form a good relationship with the local community. However, not all communities are able to exert the same level of coercive pressure on companies. Several studies indicate that a community's socio-economic characteristics influence its power over local companies. For instance, Arora and Cason (1999) and Brooks and Sethi (1997) found that neighborhoods with a larger percentage of minority race and poor income households are more likely to be exposed to industrial toxic emissions. Similarly, Khanna and Vidovic (2001) find that firms are more likely to participate in environmental programs if they are located in communities with higher income. Likewise, Gray and Shadbegian (2007) control for the effect of demographic characteristics on a plant's environmental performance. Gray and Shadbegian (2004) find that plants located in areas of high unemployment and a large percentage of people living below the poverty line generate more air and water pollution. Similarly, Pargal and Wheeler (1996) find that plants located in communities with higher income and education level have a significantly lower pollution rate because communities can act as 'informal regulators'. Similarly, we test whether F & B processing plants located in communities with higher income, higher education and fewer minorities are more likely to have relatively better environmental performance (Hypothesis 2).

We expect facilities in the same line of business to exhibit similar rates of environmental performance for at least two reasons (Jennings and Zandergen, 1995). First, plants in the same industry have similar production processes and those processes may have similar rates of management and disposal of toxic chemicals. Secondly, industry norms may arise when there is a standard for a given industry and all plants in that industry are expected to follow the norm irrespective of their location. According to DiMaggio and Powell (1983), 'normative isomorphism' results when members of an industry association define common conditions for their operations. For instance, trade associations, such as the Seafood Products Association, may provide technical assistance for members in the implementation of sustainable practices (Seafood Products Association Website, 2014). Hence, plants which are part of the same industry achieve similar rates of environmental performance (Hypothesis 3).

Finally, we control for plants which own capabilities to manage toxic chemicals. Some F & B processors may have an onsite equipment, technology or system to manage their wastes, whereas others may rely on transporting their wastes offsite to a specialized waste-handler. We test whether F & B processors which have an onsite toxic chemical management system have relatively higher environmental performance than plants which do not own such a system (Hypothesis 4). On the one hand, F & B processors which own their own toxic chemical management system onsite may possibly face stringent technical standards; such plants may also face stricter state and federal regulatory oversight compared to similar plants which do not undertake toxic chemical management onsite (EPA, 2012). On the other hand, ownership of an onsite toxic chemical managing system can minimize cost of transporting large amounts of toxic chemicals elsewhere. Furthermore, facilities which have an onsite waste recycling center (or energy recovery technology) may use recycled materials, resources (e.g. water, packaging) or heat as an additional input for their operations.

2. Data and methods

2.1. Data source

Data used in this study come from the US Toxic Release Inventory (TRI) which is a mandatory disclosure regulation that requires all industrial facilities including F & B processors to collect, report and make publicly available data on quantities of toxic chemicals released or disposed, toxic chemical management plans and source reduction activities, among other things (Sullivan and Gouldson, 2007). The TRI operates under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) whose purpose is to inform communities and citizens of chemical hazards in their areas and support informed decision-making by industry and government (EPA, 1998).

The sample used in this study includes a total of 2572 F & B processors between 2001 and 2012, all of which operate in the USA. These plants are owned by 714 parent companies where the average company owns 3 plants (facilities) reporting to the TRI. To ensure