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## Participatory health impact assessment used to support decision-making in waste management planning: A replicable experience from Italy

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### ABSTRACT

The lack of participatory tools in Health Impact Assessment (HIA) to support decision-makers is a critical factor that negatively affects the impacts of waste policies. This study describes the participatory HIA used in deciding on the possible doubling of the municipal solid waste incinerating plant located near the city of Arezzo, Italy.

Within the framework of the new waste management plan, a methodology for the democratic participation of stakeholders was designed adopting the Local Agenda 21 methodology. Communication and participation events with the stakeholders were set up from the plan's development to its implementation.

Eleven different categories of stakeholders including individual citizens were involved in 21 local events, reaching over 500 participants in three years. Actions were performed to build the commitment and ownership of the local administrators. Then, together with the environment and health agencies and a representative from the local committees, the local administrators collaborated with scientists and technicians in the knowledge-building and scoping stages. Focus groups of voluntary citizens worked together with the researchers to provide qualitative and quantitative evidence in the assessment stage. Periodic public forums were held to discuss processes, methods and findings. The local government authority considered the HIA results in the final decision and a new waste strategy was adopted both in the short term (increased curbside collection, waste sustainability program) and in the long term (limited repowering of the incinerator, new targets for separate collection).

In conclusion, an effective participatory HIA was carried out at the municipal level to support decision makers in the waste management plan. The HIA21 study contributed to evidence-based decisions and to make a broadly participatory experience. The authors are confident that these achievements may improve the governance of the waste cycle and the trust in the public administration.

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### 1. Introduction

Through a virtuous waste management system, direct and indirect impacts related to air and water quality, landscape deterioration, road transportation, social equity, and health can be

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prevented or minimized at the local level (Forastiere et al., 2011; Kim et al., 2011 and Martuzzi et al., 2010). The European Union encourages individuals, households, businesses, and local and national governments to take a prudent and environmentally responsible role in the sustainable use of resources and in waste reduction (EC, 2012a and EEA, 2013). In addition, the recent review by the European Commission on the current regulatory framework highlighted the need for more adequate waste management strategies and awareness to fully meet the objectives set in the waste legislation by 2020 (EC, 2013).

The setting of waste management policies is highly controversial and both the participation of those concerned and the use of

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scientific evidence are important components in the assessment of fair alternatives (Negev and Teschner, 2013). Particularly, public involvement may increase trust in the institution, which is paramount to the perceptions of risk in the public (Viklund, 2003). Decision making processes will take advantages from widespread consultation of communities to effectively understanding how groups willingly take a certain risk. However, risk perception is determined not only by knowledge but also by a mixture of individual factors (social, cultural, political and emotional). Also, different demographic groups within a population have been shown to perceive risk differently mainly due to their specific living conditions.

A framework on public participation has been laid down since the Rio Declaration on Environment and Development (UNCED, 1992). The conference stated that participation was a fundamental dimension of sustainable development and formally recognized the importance of public participation for environmental decision-making. Furthermore, the public access to environmental information was firmly established in the Aarhus Convention (UNECE, 1998). Also the European Framework Directive on Waste (EC, 2008) introduced the need for a democratic and transparent approach in the waste policy decision making. Specifically, the guideline for the waste management plan stated the general principle of including a consultation in each stage of the planning process in order to take informed decisions (EC, 2012b).

Participatory decision-making processes are fundamental to meet the need of a new right of citizenship - to live in an environment adequate for human health and well-being - which is expressed in taking part in the choices. More effective decision is contemporary ensured through the sharing of objectives and solutions about the problem, the inclusion of local knowledge, the listening to disadvantaged and different interest groups (Glucker et al., 2013). Structured participatory processes clearly define, in their early planning stage, basic features (timelines, extent and method of participation, expected effects) and factors (timeliness of involvement, representativeness of the participants, openness of the process, potential to modify the decision). Although a participatory process tends to a deliberative democracy, in most cases, the decision-making power remains in the hands of policy-makers who retain the right/duty of the decision (Regione Emilia-Romagna, 2012). However, it is crucial that the scope of the process is clarified and agreed in advance explaining the extent to which the institutions will be engaged about the recommendations (O'Faircheallaigh, 2010).

The decisional process, aimed at the best choice for the environment and all those concerned (including social components, professional corporations groups within the community), currently adopts tools from the impact assessment discipline (such as strategic, environmental and health impact assessment) in order to set up policy interventions (Bäcklund, 2009). Although shortcomings in the impact quantification have been recognized—mainly due to the lack of effective public participation (Gagnon et al., 2010; Glucker et al., 2013 and Hartley and Wood, 2005)—some applications have tried to advance learning, best practices and models in order to achieve real public participation (Chadderton et al., 2013; Greig et al., 2004; O'Faircheallaigh, 2010 and Saarikoski, 2000). As developed by WHO, the Health Impact Assessment (HIA), inspired by values of democracy, equity, sustainable development and ethical use of the evidence supports health issues outside the specific public health sector (Frankish et al., 2001 and WHO-ECHP, 1999). Fundamental stages in the HIA process answering key questions to facilitate a systematic assessment of the health impacts are: (i) screening – do we need an HIA?; (ii) scoping – how are we going to do HIA?; (iii) assessment – how do we get down in business?; (iv) reporting of recommendations – what goes in the report to decision makers? Reporting and recommendation

phase includes a dialogue with the decision makers to agree on viable interventions and on how to track their implementation. The overarching framework in HIA is the use of a participative approach to quantify future impacts (PAHO, 2013; Quigley et al., 2006 and Winkler et al., 2013). Therefore, HIA recognizes the importance of quantitative assessment methodologies and also qualitative input data incorporating both scientific evidence on environmental and health issues and adopting participatory models in all the stages of the process to provide basic local knowledge (Scott-Samuel, 2005 and WHO, 2013). Specifically, the participation of representatives of the local society key aspect to an effective HIA, widens the knowledge regarding the local political and social circumstances (Ison, 2013; Negev, 2012 and Tamburrini et al., 2011). Questionnaires, interviews, focus groups and workshops are usually listed as qualitative methods in impact assessment. HIA practice, adopted internationally since the nineties, is an ad hoc process to guide policy decision-making in order to improve the health status of the population, particularly the most disadvantaged social groups. HIA can assess the negative impacts of different options and propose solutions to enhance the positive ones. As a consequence, HIA is a mechanism for public health prevention when avoids risks by tackling the determinants of health rather than the risks factors. In this sense, the acknowledgment of the perception of risks in the population affected has a great relevance (SCU-UWE, 2014). Experiences at the international level have clearly demonstrated that the success of HIAs in terms of the ability to influence the decision to be taken is enhanced by the broad participation (maximum inclusion) of the stakeholders and the transparency of information (Spickett et al., 2015). However, developing the waste sector strategies and facility plans require to address the social dimension in decision making to gain the necessary public support. Disclosure of analytical-deliberative process examples in waste management has been provided by Garnett and Cooper (2014). A participatory process may be of help in reducing objection of communities against new waste plants when are involved in a planning process from the very beginning (Salhofer et al., 2007). When HIA is not included in the planning phase and is carried out on new projects of waste facilities rather than on the waste management plan, the participation has a narrow focus and is limitedly representative (Chadderton et al., 2013). Often participation is intended to provide information or to realize a consultation and is not addressed to include external contributions to modify processes and decisions (O'Faircheallaigh, 2010). Although in the participation experiences several practical problems need to be addressed to satisfy performance and quality, many pragmatic solution-oriented approaches are available (Bobbio, 2004). The consideration of the social and cultural context has been provided by a new generation of participatory tools. In particular, the Local Agenda 21 (UNCED, 1992) has introduced a participatory reform, relating the dialogue on sustainability to any specific local circumstances, beyond the traditional consultation between local authorities and stakeholders (Coenen, 2009).

In Italy the government of public affairs is organized at a national, regional, provincial and municipal level. The regional government provides guidelines in relation to the capacity of waste treatment and on the upgrade of existing plants. They also define the optimal territorial units for waste management (“Ambito Territoriale Ottimale”, ATO), which are responsible for meeting the agreed targets. The provincial government develops plans for waste management in accordance with the regional plan as well as with the general national criteria.

In Tuscany, a region in central Italy, the “ATO South” (an area including 103 municipalities) in 2000 adopted a waste management plan that includes the incineration activity of a plant burning about 40,000 tons per year of urban waste, located in the industrial area of the municipality of Arezzo. In 2008, a transitional plan

described the actions to be adopted by the Arezzo City Council by 2013, which included an increase in the plant's capacity to 75,000 t/y. Soon afterwards, the regional government started drafting the new regional plan focusing on two items: the Waste Landfill Directive objectives of recovery, recycling, and reuse; and the completion and optimization of the plant. Difficulties in matching the regional guidelines led to a crisis in the local government in Arezzo before they were able to agree on whether to upgrade the existing municipal solid waste incinerator (MSWI).

Meanwhile, within the framework of the project "Participatory assessment of the health, environmental and socioeconomic impacts resulting from urban waste treatment" (EU 2011 Life + Environment program), an innovative model embedding the Agenda 21 processes within an HIA was in its early development stage. The goal was to develop a methodology to support local authorities in the definition of a waste management plan in order to minimize environmental and human health impacts. Thus, at the beginning of 2012, to address the controversy regarding the pros or cons of doubling the incinerator activity, the municipal council of Arezzo decided to join the Life HIA21 project and to use the results for the final decision. The context was particularly supportive of the participatory experience because in the Tuscan region a special law for the participatory planning was enacted in 2009.

This paper describes the democratic path of participation and the results of the HIA21 project in terms of sustainable waste governance. More specifically, the paper presents the development of the participatory health impact assessment of the existing MSWI and the improvement in knowledge of the socioeconomic context, including how the community affected perceives the risks involved.

## 2. Methods

### 2.1. The HIA21 participatory approach and model

To develop a local shared vision of the future waste management plan, the forum tool of the local Agenda 21 was selected to reach a broad spectrum of public. In the preliminary phase a contact list was arranged to engage the local stakeholders by e-mail and via personal communications; they received a formal invitation and the agenda of the day before each event. The forum provided the participants to the focus groups, including those who

voluntarily agreed on the general rules of participation. Numerous stakeholders were contacted including: municipal and provincial administrators and decision makers, departments from environmental and health agencies, professional corporations, civil associations for health and social promotion, business enterprises, citizen leagues, general practitioners. A process based on the participation of stakeholders to different local events was carried out to ensure the inclusion of the local knowledge and provide adequate awareness among key actors (Table 1). Participants indicated their affiliation in the form that they voluntarily filled in during each event. The forms were collected and the total participants were listed and allocated in wide categories of stakeholders.

Stakeholders were required to participate with different levels of contribution. During the forums the general public was involved to provide input in the definition of the methodological project advancements. The focus groups participants were asked to cooperate in the HIA steps of the scoping and assessment phases and in the definition of the monitoring plan. The number of forums and focus was defined ongoing to help discussing about processes, methods, and midterm achievements. Additional technical and expert meetings helped to focus the content of the discussions. Administrative and institutional stakeholders contributed both during forums and focus with their knowledge and provided technical support during interim meetings. In addition to direct interaction between decision-makers and other stakeholders as part of the forums and focus, decision-makers kept a constant dialogue with the leading group. The decision-makers agreed with the leading group to change the draft plan integrating the new knowledge and suggestion emerging from the HIA activities.

The model of participation consisted of three main interrelated subjects as shown in Fig. 1.

The roles were defined as follows:

- The HIA21 leading group of researchers provided the terms of reference and the evidence on the impacts all along the project development.
- The forum, constituted by individuals from the community and a wide range of stakeholders, was aimed at sharing processes, results and final recommendations. Frontal sessions alternated communication on scientific, technical and methodological issues. External invited speakers enriched the input for the closing public discussion.

**Table 1**

Type, number and participants attending each event.

Type of event and stakeholders targeted	N° events/year	N° participants (total)	Content of each event
Forum – general public, local media	N°3/y2012	156	<ul style="list-style-type: none"> <li>• Setting up of Agenda 21 Forum and Focus groups. Project presentation and distribution of the questionnaire on risk perception</li> <li>• Indicators definition and interim project results</li> </ul>
	N°3/y2013	134	<ul style="list-style-type: none"> <li>• Seminar "Work in progress on waste management in Arezzo"</li> <li>• Interim project results and discussion on local waste policies</li> <li>• Midterm results on environmental monitoring</li> </ul>
	N°2/y2014	128	<ul style="list-style-type: none"> <li>• Preliminary health impact assessment results</li> <li>• Discussion on the preliminary health impact assessment findings and monitoring plan</li> </ul>
Focus groups – voluntaries from the forum	N°3/2012	18 (average)	<ul style="list-style-type: none"> <li>• Seminar "Medical days for the environment"</li> </ul>
	N°4/y2014	18 (average)	<ul style="list-style-type: none"> <li>• The waste management policies in Arezzo</li> <li>• Monitoring indicators for the HIA of the waste management system in Arezzo</li> </ul>
Technical meeting – local agencies for the environment and health, political and administrative subjects, citizens representative	N°2/2012–2013	45	<ul style="list-style-type: none"> <li>• Protocol definition for the epidemiological study</li> <li>• Health impact assessment methodologies near areas with incinerators of waste</li> </ul>
Stakeholder meeting – political and administrative subjects, citizens representative	N°4/2012–2013	60	<ul style="list-style-type: none"> <li>• Project presentation</li> <li>• Planning and project ongoing definition</li> <li>• Methods of public participation</li> <li>• Preliminary HIA findings discussion</li> </ul>

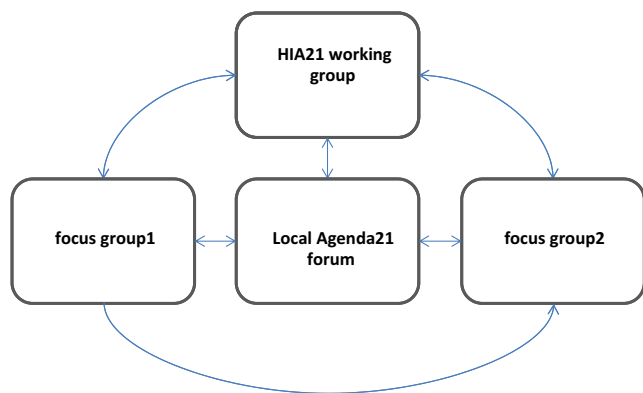


Fig. 1. The HIA21 model of public participation implemented in Arezzo, Italy (see text for details).

- The focus groups of local professionals and citizens worked on targeted themes. They integrated the content of the work carried out by the forum and the HIA21 leading group. Rules for joining the focus groups were drawn up detailing basic features and factors of participation according to previous experiences (Regione Emilia-Romagna, 2012) Table 2 summarizes the relevant dimensions of the focus groups. In particular, participants were asked to attend all the focus events necessary to fully explore the defined object of the working session. A facilitator guided the two focus group sessions for the preparation of the impact assessment and the drafting of recommendations including the monitoring plan.

Fundamentally, the participatory approach allowed to report criticalities and suggestions from the forum and focus groups to the leading research group. Valuable suggestions and feedback were used as input in the ongoing of the project about data gaps, analytical model, method selection and scope of the impact assessment, opportunities for local awareness initiatives and governance interventions. The input from the stakeholders was included in midterm and final dissemination material and in the report to decision makers summing up the final recommendations.

In the HIA21 project, the transfer of scientific knowledge to stakeholders and decision makers and the possibility of integrating HIA recommendations in the waste policy were grounded on a network of specific collaborations:

- the environmental agency provided knowledge regarding the industrial activities in the area, maps of pollution levels, and previous environmental studies;
- the local health department provided technical support, historical and current health data;

- the association of doctors for the environment (International Society of the Doctors for the Environment, ISDE), whose national headquarters is in Arezzo, provided training and expertise on the relationship between the environment and health, and supported the improvement in knowledge and public awareness. They also disseminated the project goals to general practitioners;
- a non-profit local association for social promotion was involved in the partnership with the specific task of recruiting the local stakeholders and carrying out the events.
- councillors in charge of waste policy for the municipalities of Arezzo and Civitella (neighbouring the incinerator area) provided contacts with the respective census offices. Also, the provincial head of the local service planning provided support in technical meetings, focus groups and public discussions.

## 2.2. Baseline construction

The baseline information for the impact assessment phase was enriched using two questionnaires specifically developed and tested by the project coordinator and the ARPA Emilia-Romagna partner. The questionnaires were filled out by the majority of participants in forum and focus groups and provided a descriptive picture of the risk perception in the community and of the socioeconomic context. The risk perception questionnaire was self-administered or compiled through the HIA21 website after the first and second forums, during the preliminary stage. The principal criticalities were about the recruitment methodology based on a voluntary compilation and the request of personal information regarding the address and a contact. (e-mail and/or phone number) Therefore, the number of respondents could not be known in advance and possibility for a second contact were limited. Four blocks of questions were addressed at exploring: 1. perception of risks and environmental hazards; 2. information about the incinerator; 3. information on local strategy of waste recycling; 4. socio-demographic information. Out of 39 total items, 17 questions on RP were transformed into 129 variables to elicit the level of Risk Perception (RP) and access and trust in the environmental information sources. For Likert-type scale items, respondents were asked to express their degree of concern, while multiple-choice questions were split into multiple questions with a dichotomized answer (“yes/no”).

Some variables were codified according to a modified 3-level Likert-type scale: subjects responding “don’t know” (level 5) were aggregated to “not at all” (Level 4) subjects responding “Very” (Level 1) were aggregated with “Enough” (Level 2) since there were few level 1 respondents (Signorino and Beck, 2014). In order to increase the interpretability of results, some questions expressed on a modified Likert-type scale were finally analyzed as dichotomous variables by aggregating “A little” (Level3) to Level 4 and Level 5. The Random Forest (RF) clustering method (Breiman,

**Table 2**  
Summary of characteristics of the focus groups.

Characteristics	Contents
Aim	Deliberative
Extent	Selection and regulated participant access by invitation or application form
Method	Structured involvement
Effects	Local scale
Promoting subject	Agreement between municipal administration and HIA21 leading group
Structure	Weak institutionalization - informal context and spaces
Duration	Limited to the achievement of project objectives
Institutional level	Municipal
Arguments	i. Assessment of current policies for waste management ii. Analysis and selection of monitoring indicators

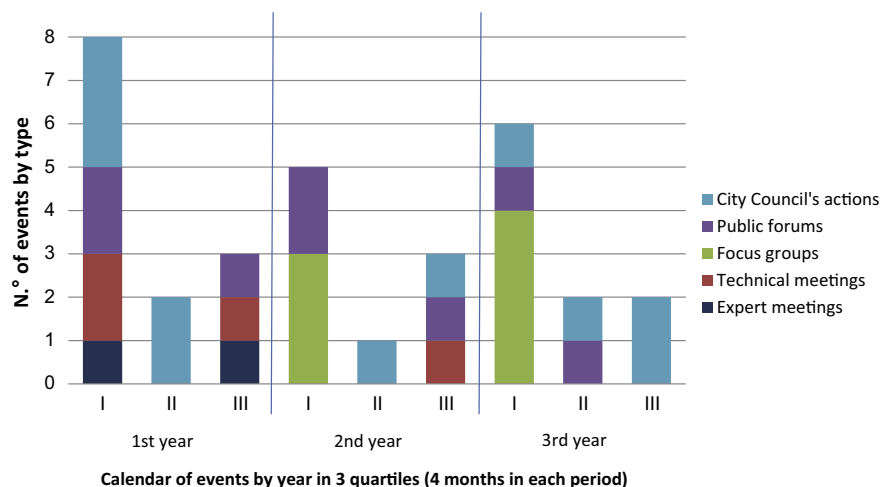


Fig. 2. Number and type of stakeholder events along with actions implemented by the City Council during the HIA21 Project time frame.

2001) was applied to identify the most informative variables, namely those able to best highlight the differences among respondents living within 4 km from the plant and those living more than 4 km away. Variable importance was calculated using the function importance, and selection criteria were followed (Strobl et al., 2008). Finally, Fisher's exact test was used to assess statistically significant associations between the variables selected by RF and the dependent variable. Associations with a p value <0.05 were considered statistically significant. Statistical analyses were performed using the R package (R Development Core Team, 2010) and STATA13 (StataCorp., 2013).

The second questionnaire was administered during the scoping phase to the general public by 4 trained general practitioners of the study area. The aim was to describe the socioeconomic pattern in the participants to the survey. Five thematic blocks of questions were collected on general personal information including the distance of the residence, employment and income, lifestyles and access to services, separate collection pattern, social participation. Due to the nature of information required, missing data (mainly on income and contact information) were expected.

Finally, the health impact assessment was carried out through a retrospective cohort study considering the people residing for 10 years in a subarea of Arezzo around the incinerator (Minichilli et al., 2016).

### 3. Results

#### 3.1. Participation figures and policy outputs

Participants at the events that were held during the project included those subjects who:

- wanted to be better informed,
- represented the interests of local corporations,
- had a public/institutional role, also in cross-cutting areas,
- supported sustainable thinking regarding human activities,
- simply had an interest in the issue.

The affiliations included numerous public and private stakeholders, and citizens. They were grouped in 11 wide categories as follow: 14 civic associations of neighbouring residents, 2 non-governmental organizations, 7 social cooperatives, 5 professional corporations, 7 local government institutions, 4 private research

institutes, 5 political parties, 1 financial institute, 2 local media, 2 economic enterprises, and citizens. During the project, the civil society maintained a close relationship with the city councillors who managed the decision-making in relation to the new plan. A total of 8 forum, 7 focus meetings, 4 technical meetings and 2 experts meetings were held. While forums were the most inclusive events, allowing the wider stakeholder representativeness, the technical meetings represented a selected arena to discuss processes and findings advancements, attended by the technical and administrative representatives of the institutions and of the civil associations, the local departments of health and environment.

As shown in Fig. 2, a total of 21 events were coordinated by the research group with local stakeholders, and 11 concurrent actions on waste management sustainability were carried out by the public authority (light blue blocks in Fig. 2).<sup>2</sup>

The whole participatory process took more than three years (from November 2011 to March 2015) during which the HIA fundamental phases and various policy actions were implemented in accordance with the decisional stages and provided different outputs as shown in Table 3.

#### 3.2. Stakeholder selection and launch of participation

The preliminary effort-intensive phase was essential to build trust among participants. The output of the preliminary phase was the definition of two main stakeholder recruitment areas: political-administrative and civil society, mainly through its representatives (organizations, professional corporations, businesses, etc.).

The involvement of the local government institutions was important in order to provide basic data access and to promote inter-departmental collaboration. Technical stakeholders from the local administrations (at municipal and provincial levels) and the Environment and Health agencies (at the municipal level) supported the laboratory work with citizens within the focus sessions. The early involvement of the community was targeted at information, communication and the transfer of knowledge. The research group introduced elements of the epidemiological approach. Also, medical information on pollutant exposure effects was presented at various stages. Environmental local data regarding the plant's activities were illustrated and also compared to current levels in

<sup>2</sup> For interpretation of color in Fig. 2, the reader is referred to the web version of this article.

**Table 3**  
Characteristics of the phases and policy maker actions supported by HIA21 project activities during the decisional stages.

Decisional stage	HIA phase		Output
Planning	Communication	1 Stakeholder selection and engagement <ul style="list-style-type: none"> <li>• Commitment &amp; Ownership of decisions on the project objectives</li> <li>• Information and dissemination of objectives</li> <li>• Administrative measures</li> </ul>	<ul style="list-style-type: none"> <li>• Urgent questions to the City Council</li> <li>• Public hearing with the affected community</li> <li>• Formal answers from the Project Manager</li> <li>• Debate with the regional government</li> <li>• Membership adhesion to the project</li> <li>• Arezzo Municipality adhesion to the European Week of Waste Reduction</li> </ul>
Preliminary inquiry	Participation	2 Scoping of impacts and construction of the evidence <ul style="list-style-type: none"> <li>• Share protocols with experts and stakeholders</li> <li>• Evidence building</li> <li>• Development of technical and scientific data</li> <li>• Reiteration of data collection for upgrade</li> </ul>	<ul style="list-style-type: none"> <li>• Characterization of environmental background</li> <li>• Cohort of exposed residents for surveillance</li> <li>• Local socioeconomic stat</li> <li>• us and risk perception</li> </ul>
Implementation		3 Impact assessment <ul style="list-style-type: none"> <li>• Identification of the limitations of the study</li> <li>• Discussion on results with civil society</li> <li>• Identification of new policy strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Results and disclosure to public</li> <li>• Publication of the plan</li> <li>• Observations regarding the plan by the focus group</li> </ul>
		4 Recommendations to decision makers <ul style="list-style-type: none"> <li>• Identification of interventions with decision makers</li> <li>• Indicators for the monitoring plan</li> </ul>	<ul style="list-style-type: none"> <li>• Launch of awareness campaign</li> <li>• Summit to promote recycling and abandon the option of doubling the incinerator capacity</li> <li>• Measures for increasing kerbside collection</li> <li>• Adoption of the 4 R's Program (Reduce, Reuse, Recycle, Recover)</li> </ul>

the study area. A democratic participatory process took place after trust had been built, and terminology, background and intended methodologies shared.

In parallel, outputs regarding the decisional process included: urgent questions at the city council and the regional office, a bottom-up promoted public event, a commitment to waste sustainability, and a public educational event (phase 1, Table 3). The project leader played a third party role in favour of the re-establishment of the city council which had resigned for lack of agreement between the political parties.

### 3.3. Scoping and assessment

A total of 326 questionnaires regarding risk perception were collected. Here we report the results of 76 questionnaires from those residing within a 10 km radius from the MSWI. Residents within 4 km ( $N = 17$ ) had a higher risk perception associated with the MSWI compared to residents between 4 and 10 km ( $N = 59$ ). The close presence of the plant also created “a lot of anger” ( $p < 0.01$ ). In addition, more than half (53%) of subjects living within 4 km from the plant considered the general situation in the area as “serious”. Among the subjects declaring their propensity to change their place of residence (27% of the entire sample), 86% of those living within 4 km wanted “to move to a healthier area”. Finally, residents within 4 km considered the level of information provided by the local administrators as insufficient ( $p < 0.05$ ) and key informers were perceived as being absent. Further details are shown in Table 4.

The small sample size allowed to provide a descriptive information about RP, access to environmental information and to trust the sources of information. To increase the accuracy of the estimations a multicentre study is required. Some other surveys on small samples are in progress in Italy and a pooled estimation of their results could improve the indication here obtained. Regarding the socioeconomic survey, 250 questionnaires were collected and provided a baseline description of the socioeconomic status of those involved in the study. The knowledge of the population socioeconomic status helped to explore unequal distribution of social determinants in the community. Most respondents had lived in the area of interest for at least 15 years, were home owners and claimed to be very involved in the local planning activities. The overall sample did not

**Table 4**

Variables differentiating people living within 4 km from the plant from people living more than 4 km away.

Questions	Within 4 km (%)	Between 4 and 10 km (%)	p
The environmental situation in my residential area is “serious”	53.0	29.3	0.07
I would move from my residential area “to go to a healthier area”	85.7	30.8	0.02
The incinerator is a health hazard	91.7	66.7	0.09
If I had doubts about the incinerator, I would not know who to ask	58.8	33.9	0.06
The incinerator makes me “very angry”	64.7	27.1	<0.001

Note: All the items about the risk perception in the questionnaire are available as [Additional material](#).

declare any economic difficulties. In particular the descriptive analysis did not highlight significant differences between people living within 4 km from MSWI and people living between 4 and 10 km, in terms of composition of family, lifestyle, education, occupational status, income and personal feelings about the local waste management system.

The residential cohort study showed increased risks of cardiovascular and respiratory causes of death and hospitalization associated with exposure to incinerator, in agreement with the scientific evidence on health effects of incinerators and other pollution sources (Minichilli et al., 2016).

Within the scoping phase, the involvement of local stakeholders enabled the cohort study design to be improved, promoting the inclusion of: (a) other sources of exposure (such as the presence of major roads), (b) an additional year of health data, (c) an additional disease group, and (d) wider geographical boundaries.

Within the focus group, specific suggestions were discussed to enhance the waste governance. Among the participants, the main concern was the “knowledge and transparency of the waste cycle”. Critical and positive aspects were discussed for the categories of “Information”, “Controls” and “Target areas”. In particular, information was considered scanty on the input and output of waste flows and in terms of quality–quantity of waste treated by category. In addition, the details regarding the associated costs of treat-

ment options were poor, including only the downstream economic aspects. Many suggestions were made to improve communications. Specific ideas were developed regarding the adoption of new technologies besides the traditional information channels, the setting up of cultural events and guided tours at the plants. Young people and different language speaking groups were also focused on. In addition, the civil associations involved in the focus groups and the local department of health prevention, the project partner, drafted two lists of independent observations during the public hearing phase of the plan (phases 2 and 3, Table 3).

#### 3.4. Recommendations to decision makers

In the development of the monitoring plan, the focus group provided tables describing the indicators for the long-term monitoring of impacts on health, environment, communication, and governance. Recommendations were included in a technical report used to inform decision makers, and the overall results were disseminated to the public through brochures. In the short-term, waste governance interventions were implemented soon after the public discussion of the HIA results. An information campaign on critical issues was started at the municipal level. The campaign “For a more beautiful city” incorporated all the advice from the first focus group. A summit on the waste policy of provincial administrations of the ATO South area defined an agreement on a new direction for waste management, including many observations from the project. The interventions approved through the City Councils Acts included: total coverage of the municipality by the kerbside service, promotion of awareness raising campaigns on the correct waste cycle, and a program for reduction and recovery (phase 4, Table 3). The final result was the agreement to repower the incineration plant to a maximum of 55,000 t/y, instead of doubling its capacity. The additional ambitious target of 70% separate collection by 2020 was a strong commitment by the decision makers. In fact, the national target (60%) on separate collection set by 2011 had still not been achieved, and a low increase was observed up to 2014 in the areas of Arezzo, ATO South and the region of Tuscany. A general decrease in total waste production and a slight increase in population also need to be taken into account (Table 5).

## 4. Discussion

The implementation of the HIA21 project resulted in more effective planning in local waste management allowing some general considerations. An effective planning of waste management should be supported by an HIA framework which considers human and social capital fundamentals components of the environment, depicting a more comprehensive view of sustainability. As part of this goal a strategic view should be developed as a common objective for different government levels of decision makers, from local to national, to achieve the waste targets. Also, to make waste management a leverage of mid and long term health and environmen-

tal benefits, investment should be put on green economy development. The HIA framework contributes to more effective and robust decision in waste planning. The evidence that HIA21 resulted in a change of plan is proven by the decision to allow a modest repowering of the incinerator (+20% compared to the current nominal power) instead of the previously forecast doubling. Furthermore, a general agreement to continue the environment and health monitoring was established between the local health authority and the direction of the plant. Also, establishing an awareness rising objective strongly can improve the effectiveness and applicability of the plan. Comprehension of the waste issues by the communities affected motivates and enables users to behave responsibly (Salhofer and Isaac, 2002).

The transversal nature of the political consequences need to be analyzed using HIA integrated approaches, based on environmental, medical, engineering and also social disciplines. Therefore, inform and train stakeholders is a major objective for the planning of waste management and competence should be developed. The experimentation of participatory methods, which connects to each other scientific research, public administration and citizens, must be encouraged to account for the social concern within transparent and democratic decisional processes. This section outlines point features that emerged from the HIA21 project.

#### 4.1. Participation plays a pivotal role in democratic decision-making

Public participation has become a major issue in environmental and environmental health policy and assessment, and the debate continues as to how it should be undertaken (O’Faircheallaigh, 2010). Participation can be limited to filling information gaps in order to obtain public input for decisions taken elsewhere or to share information with the public without giving them an actual role in decision-making (Mahoney et al., 2007 and Saarikoski, 2000). However, a broad participation by the public, together with the identification of specific purposes and related activities, can represent an opportunity to influence decision-making. The integration of the Agenda 21 participatory model, an international agreement on local governments’ commitment toward sustainability, has strengthened the role of public participation in decision-making, achieving beneficial outputs such as those already reported in the literature (NCCHPP, 2012 and Glucker et al., 2013). The “weak degree of institutionalization”, structuring the participatory process, has empowered citizens in decision-making. The legitimacy of the contribution from participants in decision-making was closely connected to the building of knowledge, the assessment of proposals and the evaluation of results, and thus has greatly contributed to a more equitable structure of decision-making. All the parties involved collaborated toward a shared decision regarding the new waste plan by working together in forums, focus groups and meetings. The empowerment of communities was therefore a tangible result of this process. Being made aware of the technical knowledge from direct sources

**Table 5**

Resident population, total production of Municipal Solid Waste (MSW) and separate collection at beginning and conclusion of the HIA21 project. Targets for the separate collection established by acts are included for the interprovincial and regional plans. Source: ARRR (Regional Agency Resource Recovery).

Year	Population (n.)		Total production of MSW (tons/year)		Separate collection (%)		Separate collection (policy goals, %)	
	2011	2014	2011	2014	2011	2014	2011	2020
Arezzo municipality	98,018	99,434	61,374	57,426	40.3	39.9		
ATO South	883,220	908,481	524,112	550,159	38.1	38.9	60 <sup>a</sup>	70 <sup>b</sup>
Tuscany	3,667,780	3,752,654	2,374,303	2,263,154	39.2	44.9	60 <sup>a</sup>	70 <sup>c</sup>

<sup>a</sup> National Law No. 152/2006.

<sup>b</sup> Interprovincial plans on waste management of ATO South, Tuscany. Resolution of the Provincial Council No. 8, 6/02/2014.

<sup>c</sup> Waste Management Plan, Regional Council Deliberation n. 94/2014.

enabled participants to actively exercise citizenship and social learning. The participatory HIA achieved the fairly consideration of community and stakeholder opinion and provided a tool to integrate the democratic participation in the decision-making process.

#### 4.2. Participation is affected by the socio-political context

Democratic participation contributes to better decisions if it is integrated into the entire decision-making cycle (Illsley et al., 2014; NCCHPP, 2012 and Pohjola and Tuomisto, 2011), and takes into account the constant engagement of institutional stakeholders and the general public (Davenport et al., 2006). The integration of the Local Agenda 21 methodology with the HIA process ensured extensive stakeholder contribution in all the stages of the decision-making process. However, although the early and wide engagement in the process helped public institutions and community groups to gain a better understanding of each other's positions, the preliminary phase of the project was delayed by the lack of formal commitment from the local administration. This hindered setting up the network required and involving local communities, in fact the "waste crisis" had created barriers and mistrust in the local community. To tackle this, many meetings with stakeholders and public forums were held to explain objectives, methodologies and relevant issues regarding the relationship between waste management and environmental health improvements. In the end, the decision of the City Council to join the project enabled it to move forward. The external funding, scientific methodology and the openness of the participatory process also persuaded citizens that HIA21 represented an opportunity to collaborate with the institutions in the new proposal. Hence, the participation model in HIA21 was proven to fit the policy decision and the local context. The negotiation regarding an alternative to the increased activity of the incinerator and the recommendations for policy interventions modified the preliminary impression, shared by participants, of a "closed" decision that had already been taken. The survey by questionnaire did not show significant differences in socio economic condition among participants to the project development. On contrary a different perception of risks and trust in source of information was found by the ad hoc developed questionnaire. The main discriminating factor appeared to be the risk perception.

#### 4.3. The multiplicity of stakeholders is a challenge in policy decision-making

Differences among stakeholders in terms of knowledge, conflicting interests, perception of risk, and priorities are all key elements in the participatory process (Chadderton et al., 2013 and Negev, 2012). Knowledge is a significant factor in decision-making and each stakeholder can hold multiple types of knowledge simultaneously. The combined model proposed in the HIA21 project followed a multidisciplinary approach where scientific, medical, environmental, technical and social elements coexist and enabled all aspects of health including its determinants to be evaluated more thoroughly. This is in line with the multi-type approach which overcomes the dichotomy between technical and local knowledge (Negev and Teschner, 2013). The prerequisites to the successful integration of different data and knowledge were (a) openness which provided the context for the circulation of information (forums, focus groups and stakeholder meetings), the evaluation of information and constructive criticism (Pohjola and Tuomisto, 2011), and (b) shared information among participants: a website for data collection, reports and documentation of interest, dissemination materials (including acts and minutes of events). Throughout the planned events, knowledge of the needs and characteristics of the local area, the environmental health

risks, and the waste plan formulation was shared by those participating. Increasing the knowledge within the community was the first objective achieved in order to share collective language and responsibility for the waste plan. During the meetings, a different perception of the relevant pollution sources in the area (i.e. industrial sites, a stretch of highway and other busy roads) was highlighted by the various points of view of the stakeholders. Also, there were varying levels of concern regarding the selected diseases and the geographical boundaries of the study.

#### 4.4. The evaluation of HIA effectiveness requires a follow-up phase

The extent to which the recommendations drafted in the final report are actually implemented depends on how the local action groups continue to be committed to the waste issue together with local administrators (Greig et al., 2004). After the approval of the draft plan, public meetings were less well attended and there was a decline in participation in the action group. This confirms that a "follow-up" phase is needed to evaluate the surveillance and monitoring activities in the long term. The HIA21 project provided important indicators regarding diseases, consumption of resources, and concentrations of tracer pollutants. These indicators have been recognized as helping in the evaluation of the HIA effectiveness (Giusti, 2009; Ranzi et al., 2011).

#### 4.5. Communication matters

In the HIA21 project, the health impact quantification was provided by an epidemiological study focusing on plausible causes of mortality and morbidity. Individual risks attributable to the plant were calculated for the cohort of residents nearby. However, difficulties were encountered in explaining findings and their role in policy interventions. Due to their different backgrounds, the participants revealed different levels of concern about the health risks. Political and administrative stakeholders had a limited comprehension of the findings per se, and wanted the suggestions for more effective interventions or public health strategies to be expressed in layman's terms. Communities were interested in identifying the future risks for those living in the surrounding area, also considering the presence of other significant pollutant sources in the area. The owner of the plant was interested in exploring the contribution of other sources in the area to identify a future strategy for the plant's management. Specifically, people living close to the plant were mainly interested in the monitoring of environmental levels of pollutants and in following up the cohort of exposed subjects. In general, information and communication were perceived as poor in the area nearest to the waste treatment plant and awareness campaigns were prompted by the local administration and the plant manager to address equity issues.

#### 4.6. Limitations of the study

There were some limitations in the design of the project. In the socioeconomic survey, only those who were aware of the waste/health issue were included, thus the sample was not representative of the general population. Consequently, on the basis of these preliminary findings, a large and well designed survey is needed to gain a better insight into the significance of the socioeconomic context to support effective policy interventions.

Another aspect concerns the choice of the risk indicator adopted. In fact, in our cohort study, the risk estimate for those exposed was calculated for specific diseases, whereas it would also be useful to estimate the burden of disease (Prüss-Üstün et al., 2003), for example the use of measures of disability adjusted years of life lost (DALY) is particularly used in public health decision-making (Forastiere et al., 2011).



## 5. Conclusions

The experience carried out in Arezzo, Italy, showed that a participatory HIA was effective in supporting decision-making regarding the new interprovincial waste plan. The participatory approach in the HIA21 project contributed greatly to changing the waste policy both in the short-term by local interventions and in the long-term by the limited repowering of the plant and the new targets in the separate waste collection. Overall, three parallel outputs were achieved by the project: 1. providing information and knowledge regarding the issue of waste management and environmental health for the local population, empowering them in the decision-making process; 2. giving participation as an important role as scientific research in environmental and public health issues; 3. supporting sustainable waste management strategies through comprehensive and area specific data collection. The last point has demonstrated to be of great relevance to tackle public health interventions. Individual risks estimates, adopting an advanced epidemiological study design, and a thorough insight of the communities feeling by the use of questionnaires about the policy and the perceived consequences of its realization, both provide operational recommendations for targeted governance and policy interventions. In particular relevance should be attached to the perception of risks and trust as discriminating factors in communities exposed to environmental pressures.

Despite the HIA21 project being highly-demanding in terms of resources and time, standardization and extensive use of the proposed methodology would enhance its efficacy and reduce the costs and implementation time.

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## Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.wasman.2016.09.035>.

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