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What drives public acceptance of chemical industrial park policy and project in China?

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ABSTRACT

Chemical industrial park (CIP) policy is becoming a vital national strategy of circular economy in China and a means to enhance energy and resource efficiency, environmental performance, and economic competitiveness. It also aims to avoid environmental risks of the decentralized chemical plants that have been a subject of public protests as local citizens' fear for chemical pollution and human's health. Public acceptance is therefore a major factor determining the success of CIP policy and project. This paper aims to investigate what drives public acceptance and rejection of chemical industrial park policies and projects in China. Our focus is on citizens in three coastal cities located in high environmental and risk sensitive areas: Dalian at Liaoning Province, Maoming at Guangdong Province, and Xiamen at Fujian Province. This is where several chemical industrial parks are (proposed) located. Based on surveys in these three representative cities, we have examined the nature and level of public acceptance towards chemical industrial park policies and projects. Results show that respondents were more positive towards the national policy, but more negative of CIP policy at the city and project level. Public acceptance of CIP policy and project was significantly influenced by factors including income, environmental value, perceived risks, procedural justice, distributive justice, benefits of CIP, and the residential distance to a CIP project. The identified factors provide a basis for anticipating and understanding likely public acceptance and should be considered in decision-making of CIP policy and project.

1. Introduction

Governments worldwide are challenged to take an active role in the management of environmental risks associated with chemical industries such as pollutant emissions and accidents. Based on survey in China, the majority of 33,625 chemical facilities are concentrated in the densely populated east (Greenpeace, 2016). In this context, safety and environmental accidents in the industry have proliferated in recent years, increasing risk to the public and to the surrounding environment. Therefore, the last decade has seen a growing trend towards chemical clusters (a "concentration of specialized chemical industries in particular localities"), starting in the United States since the 1950s. Just as Denmark's Kalundborg eco-industrial park, an environmental paradigm that emerged in 1970s, it is widely accepted that chemical industrial clusters can facilitate to realize sustainable development goals developed by the United Nation in 2015 through enhancing environmental performance and fostering economic development (Festel and Würmseher, 2013; Reniers, 2013; López and Montalvo, 2015). Despite these potential benefits associated with chemical cluster development, chemical industry is increasingly seen as a producer of risk. Sectors that used as cornerstones of our industrial society, holding positions of privilege, are in the current Risk Society increasingly perceived as 'risk-positions'. As such, "their mode of existence changed from producers of goods into producers of bad threatening nearby communities" (Beck, 2016).

Industrial park/zone policy, similar to industrial cluster policies in other countries, has become a central component in the Chinese concept of a Circular Economy, which was drawn up in the late 1990s (Geng and Zhao, 2009; Wen et al., 2018). Chemical Industry Park (CIP), also known as Chemical Industrial Zone, is an area zoned and planned for the purpose of chemical or petrochemical industry development, normally as satellite sites at Economic and Technological Development Zones or as separate, independently operated industrial parks on the edges of, or outside main residential area and city center (Ding and Hua, 2012). CIPs have been set up since 2000s. According to a survey by China Petroleum and Chemical Industry Federation, 502 CIPs have

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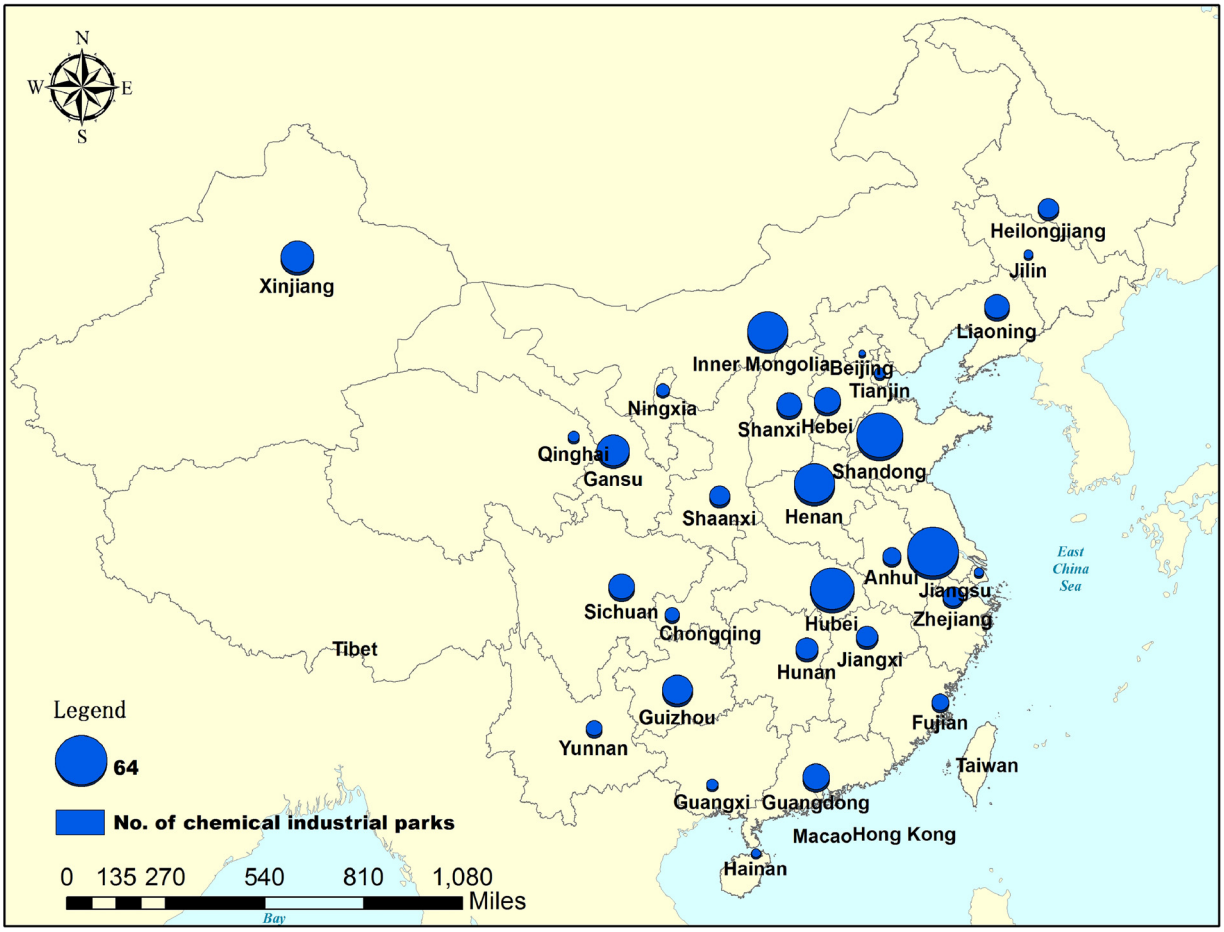

Fig. 1. Distribution of major chemical industrial parks in 31 provinces, mainland China.

been built all across China by the end of 2015 (Fig. 1). More than 15 thousand chemical enterprises have been established and operated within these CIPs. The gross output value of these chemical enterprises in CIPs is up to RMB 6.6 trillion (nearly USD 1 trillion). A series of regulations and policies on CIPs have been issued and implemented by agencies such as the State Council and Ministry of Industry and Information Technology (MIIT). After the serious chemical explosion accident of Tianjin Port in August 2015, the MIIT issued Opinions on Promoting the Orderly Development of Chemical Industrial Parks (MIIT No. 433, 2015) in November 2015. It planned to relocate and reconstruct high-risk hazardous chemicals producers in densely populated areas and environmentally sensitive areas. A *Work Program* of MIIT in 2015 proposed that the hazardous chemical production enterprises with high risks in densely populated cities and towns had to be relocated to CIPs before 2025. The main purposes of CIP construction are (1) to concentrate the dedicated infrastructure in a delimited area to reduce per-business expenses; (2) to promote recycle economy and clean production; (3) to set aside chemical industrial land use from urban areas and reduce the environmental and social impacts; (4) to adopt modern technologies and management approaches for the industrial structure transformation; and (5) to provide for localized and integrated environmental and safety risk controls. However, in the course of CIPs development, some problems emerged such as low threshold of project access, lagging behind of environmental-friendly infrastructure, imperfect chemicals environmental management, and potential environmental and safety risks. In the 13th Five-Year Plans for environmental protection, petrochemical & chemical industries, it was a nationwide initiative to shift the chemical industry exclusively to chemical industrial parks.

This growing contestation over chemical industries demonstrates that in addition to governments and companies, the public is a key player influencing and implicated by chemical industry transitions – not just as consumers of chemicals, but as active opponents or proponents of chemical infrastructures. However, in China "the often criticized Decide-Announce-Defend (DAD) approach to infrastructure policies and projects", including CIPs strategy, still prevails and lacks a focus on participation (Kostka and Mol, 2013). Several scholars have studied cases of public opposition to large chemical projects (He et al., 2011, 2014; Li et al., 2012). These protests represent an ongoing dilemma for local governments in China that are facing mounting protests from China's increasingly educated and wealthy middle-class. As such, public attitude and acceptance is becoming important in CIP policy-making and project construction, and presenting both opportunities and challenges for the chemical industrial transformation. Public perspectives are, however, often not included in chemical industrial strategies and scenarios (Hoffman, 1999; Hartings and Fahy, 2011).

Some studies have reported the environmental impacts, safety, risk of CIPs, and public acceptability toward reclaimed water in China (Chen et al., 2015; Ding and Bao, 2017; Gu et al., 2015; Meng et al., 2014). However, there is few research to study public opinions on the CIP policy and project (Huang et al., 2013). This article aims to contribute to a more evidence-based understanding of the level and nature of public acceptance of CIP policy. We present the results of an empirical study in three representative cities – Dalian at Liaoning Province, Xiamen at Fujian Province, and Maoming at Guangdong Province (you might want to label the three cities in Fig. 1). They are places where the government aimed or proposed to build CIPs. They are all high risk and environmental sensitive areas since they are located along the coast and have a higher risk to experience adverse weather events.

The remaining sections of the article is structured as follows. The

next section reflects on the theoretical insights of social acceptance. Section 3 presents the methodology. Section 4 shows results of public acceptance towards CIP policy and project, and the affecting factors. Section 5 gives concluding remarks.

2. Social acceptance and influencing factors

2.1. Various theories and themes of social acceptance

In literature a variety of terms are used to analyze acceptance issues, such as public perception, public acceptance, social acceptance, willingness-to-use, and public support. Broadly defined, we understand social acceptance as "a favorable or positive response (including attitude, intention, behavior) relating to a proposed or in situ policy or project, by members of a given social unit (country or region, community or town and household, organization)" (adapted from Upham et al., 2015). Though there are different dimensions of social acceptance (Wolsink, 2012), in this study we focus on community acceptance of CIP policy and project in China, that is acceptance among end-users, residents, and local authorities.

On social acceptance, the literature is large and spans across multiple contexts, methods, theoretical and disciplinary perspectives and paradigms. Initially, studies of social acceptance focused on attitudinal surveys to reveal (the lack of) public support and acceptance. "Not In My Backyard" (NIMBY) was a popular concept to explain why public protest was higher when infrastructural changes were planned close to one's home or neighborhood, whilst appearing more indifferent towards developments being further away from home. Other explanations come from economic, social and environmental psychology theories, for instance choice models, cultural theory, place theory, Triangular Model of Acceptance (Chin et al., 2014; Upham et al., 2015). User attitudes toward particular technologies have been explained by different behavioral theories. For example, Venkatesh et al. (2003) proposed a Unified Theory of Acceptance aiming to explain user intentions. They investigated the moderating effect of age, experience, gender and the effect of facilitating conditions including organizational and technical factors. These show that there are many frameworks, ranging from those focusing on individual behavior to those looking at broader societal trends and context to explain degrees of social acceptance.

2.2. Factors associated with social acceptance

Many researchers reported the different factors affecting social acceptance. Here we summarized eight categories as follows.

First, procedural justice and public participation are perceived crucial in fostering social acceptance (Gross, 2007; He et al., 2013, 2016; Keramitsoglou and Tsagarakis, 2013; Nilsson et al., 2016). Accordingly, in order to "understand the extent to which public participation can contribute to increasing social acceptance it is important to evaluate assumptions about who is involved, in which capacity, and the level to which the public can co-decide" (Soma and Haggett, 2015). Overall, social acceptance is most likely to be achieved by "transparent, extensive and ongoing public participation, structured with clearly defined roles, focused on building trust and developing good relationships and communications between all concerned" (Glucker et al., 2013; Haug and Stigson, 2016; Schmidt and Donsbach, 2016).

Second, distributional justice takes an important role in social acceptance, as embodied by costs and benefits to the local economy and environment (Bearth and Siegrist, 2016; Gupta et al., 2015; Hall et al., 2013; Stigka et al., 2014). The benefits consist of economic benefits, increased employment opportunities, and community benefits (Cowell et al., 2011).

Third, trust and confidence are main factors for public acceptance of management practices and risks (Siegrist, 2000; Gordon et al., 2014; He et al., 2012, 2013, 2015). Some factors can affect people's trust in agencies including knowledge of management practices, agencies' perceived competence to safely implement practices, transparency in agency communications, public perceptions of fairness, distributional and procedural justice, the sincerity of agency communications and decision-making processes, and better coordination of all related stakeholders (Stigka et al., 2014; Vaske et al., 2007; Wagner and Fernandez-Gimenez, 2008).

Fourth, place attachment and geographical factors can play a role for social acceptance. This effect, termed "NIMBY", has been used to explain a potential source of resistance to proposed projects in their close vicinity (Achillas et al., 2011; Dear, 1992; Guo et al., 2015). Such statements suggest "the deep-seated nature of 'place attachment', where a new development can conflict with the identity and meaning that residents draw from dwelling in their location" (Devine-Wright, 2009; Hall et al., 2013). The general idea that "NIMBY is the single greatest barrier to project obscures the real reasons for local public opposition" (Wolsink, 2006; Petrova, 2016). However, the lack of robust conceptual models and theoretical frameworks of NIMBY was criticized to serve as the bases for generating hypotheses (Devine-Wright, 2005; Wolsink, 2000).

Fifth, the public awareness and knowledge about the policy/project in question and associated infrastructure could affect their acceptance (Haug and Stigson, 2016; Siegrist and Cvetkovich, 2000). Researchers have therefore pointed to the requirement for proactive communication to raise public awareness, as knowledge is a prerequisite for making informed decisions about individual projects (Ashworth et al., 2010). However, public awareness has been found to be relatively low for some projects and technologies and provision of information can lead to both decreased and increased level of support (Oltra et al., 2010; Yuan et al., 2017).

Sixth, environmental impacts can influence public acceptance, especially for lay people. Yuan et al. (2015) indicated that environmental benefits of wind power was the most salient advantages in the public views in Shandong, China. Wolsink (2007) identified visual evaluation as a dominant factor for public acceptance based on different European survey data on public acceptance from 1986 to 2002. There is only some documentation of the effects of positive and negative environmental impacts being drivers of public acceptance (Westerberg et al., 2015).

Seventh, values and ideological factors are important. Beliefs about natural resource management often differ among different residents (Shindler et al., 2011). Evidence shows that "individuals who hold an ecological worldview are more likely to accept local wind farm developments and less likely to display the NIMBY effect" (Söderholm et al., 2007). Demski et al. (2015) identify a value system in the UK, which are underpinned by six value clusters relating to efficiency, environment and nature, security and stability, social justice and fairness, autonomy and power, and processes and change. It provides "a basis for understanding core reasons for public acceptance or rejection of different energy system aspects and processes."

Eighth, socio-demographic factors, including age, income, and education have a consequence on respondent preferences for some policies, projects, technologies, and products (Petrova, 2016; Westerberg et al., 2015). Literature has paid scant attention to differences in preferences across nationalities. Our expectation is that the citizens in one country may have significantly different preferences than citizens in another country, because of cultural circumstances and the prevalence of trust in government and democratic institutions. This hypothesis is supported by many researchers' evidence.

In addition, conditionality (e.g. on particular policy, social contexts, and geographic) is an important factor when understanding public perspectives. Personal technologies experience had a bearing on attitudes to and preferences for additional installations (Ladenburg, 2010, 2014). Information disclosure is becoming important for decision-making and public acceptance (Ford et al., 2009; Lienert et al., 2018).

Furthermore, the above factors are interdependent as each can influence the other. It is likely that all items would need to be addressed

to improve public acceptance (Hall et al., 2013). Some examples of these interdependencies are between trust and procedural justice (Ashworth et al., 2012), and between place attachment and procedural justice (Huijts et al., 2012). 'Social license to operate' (SLO) discourse is one emerging approach that may comprehensively address these interdependencies (Wilson, 2016). It is often proposed as a concept to consider physical, economic and social aspects of a development beyond the formal regulation for impact and risk assessment, with the intended goal of achieving social acceptance.

As mentioned above, previous research has studied public perceptions and acceptance in various issues using different theories and models. Previous research on public perspectives, acceptance, and participation has largely focused on single chemical project and event in China. Little studies have been done on this to scientifically support the industrial policy making and implementing. Therefore, we conducted the first large-scale empirical effort to investigate how and why public accept CIP policy in China. We hope to provide evidence and deduct reasons why people support or oppose chemical industrial policies in China.

3. Methodology

3.1. Research questions and hypotheses

This study aims to explore public acceptance and key factors that affect public acceptance of CIP policy and project in coastal China. There are three research questions were asked:

(1) To what extent is the chemical industrial park policy and project acceptable in China?
(2) How does the public acceptance of the national chemical industrial park policy differ from the local level and project level?
(3) What are the main factors influencing public acceptance of CIP policy and project?

The intention was not to test a particular theoretical perspective, but to examine and profile a relatively under-researched area by identifying factors driving public acceptance of CIP policy in China. Therefore, we will give some main insights from previous studies and identify possible factors relevant of the Chinese CIP policy. The selected explanatory variables were public knowledge on CIP, the environmental values, trust, perceived risks, procedural justice, public participation, information disclosure, the distributional justice (including side-effects and benefits), and the socio-demographic factors. We therefore wish to test the following hypotheses:

Hypothesis 1. There has been a positive relationship between public acceptance and demographic characteristics of the interviewees (gender, age, education, occupation, income, and place of residence) for CIP policy.

Hypothesis 2. Ten variables (knowledge, the environmental values, trust in agencies, perceived risks, procedural justice, public participation, information disclosure, benefits, side effects, and distributional justice) would attribute to public acceptance of CIP policy.

3.2. Study area

Through a pre-survey, Dalian, Xiamen, and Maoming were selected to understand public acceptance of chemical industrial park policy and project. The important criteria for city selection were the city size, the location and distance to the sea, CIP planning and operating, and public concerns over the chemical project. Population in Dalian, Xiamen, and Maoming are 6.99 million, 3.86 million, and 6.08 million respectively. The three cities are all coastal cities in the environmental sensitive areas and have a higher risk to experience adverse weather events. Chemical industry is a major economic contributor for Dalian and Maoming where the government aims to build CIPs and had four and two CIPs now, respectively. Xiamen officials have also considered chemical industry as one of support industries but stopped by the public opposition. The siting and operating of the chemical projects has caused wide public concern in these three cities.

3.3. Data collection and analysis

A mixed-method approach was adopted, combining qualitative and quantitative research in this study. Some governmental documents and media reports were collected and analyzed in the last decade. In addition, a survey was carried out using a specifically designed questionnaire. The questionnaire design was pre-tested in three rounds of face-to-face interviews with 6 experts and 20 local residents in February and March of 2016. The final questionnaire was composed of three sections: (1) socio-demographic characteristics of the interviewees; (2) public acceptance of the chemical industrial park policy and project; (3) public perception on procedural justice, distributive justice (costs and benefits), local people knowledge, concerns/awareness, and values of CIP decision-making.

The survey was conducted in April and May 2016. The samples was recruited randomly by the researcher among residents from different districts in Dalian, Xiamen and Maoming. A total of 2436 residents were selected and surveyed and 1238 valid questionnaires were returned (average response rate of 50.8%). Samples of the previous surveys changed from hundreds to thousands. Gordon et al. (2014) used a mail-back questionnaire to a random sample of 698 residents in three urban (Boise, Reno, and Salt Lake City) and three rural communities (counties in Nevada, Oregon, and Utah) in the Great Basin, USA in 2006 and in 2010. In a study about Genetically Modified Foods conducted by Gaskell et al. (1999), 16,500 samples (about 1000 respondents per country) in 17 European countries and 1067 samples in the US were surveyed. Respondents with a complete set of responses were 12,178 (response rate 73.8%) and 863 (response rate 80.8%) in European countries and the US, individually. Therefore, a sample size in our study is large enough for this kind of public acceptance survey.

The social and demographic information of the respondents in our survey is showed in Table 1. Table 2 gives detailed characteristics of the population demographics in three cities based on 1% population sampling survey in 2015 (the data in 2016 is not available). The sample in our study is slightly skewed. Compared to the population in three cities, the sample is composed of more women and less older people, the respondents are more educated than would be expected. The quantitative data were subsequently coded and inputted into the SPSS 22.0 computer package. We conducted the descriptive analysis, correlation analysis, and hierarchy regression analysis of the survey data.

4. Results

4.1. Public acceptance of chemical industrial park policy and project

In order to elicit the resident's acceptance of the general CIP policy (aimed at achieving economic performance, emission reduction targets and effective risk management), we asked how acceptable the chemical industrial policy is on the national, local, and project level on a 7-point scale. Respondents were also asked about their acceptance of the CIP policy as future direction in the next decade. The scale ranged from 1 (not at all acceptable) to 7 (completely acceptable). Each acceptance variable was calculated for the participants: national level ($\alpha = 0.80$), city level ($\alpha = 0.80$), project level ($\alpha = 0.80$), and future direction ($\alpha = 0.80$). Results showed a high acceptance (43%) of the national level CIP policy (Fig. 2). Respondents' acceptance rate of CIP policy at city (27%) and project level (20%), respectively. Over 47% participants thought of the CIP policy as a promising industrial policy in next ten

Table 1
Socio-demographics of the respondents in three cities, China.

Item	Status	Percentage (%)	Item	Status	Percentage (%)
Response rate	Dalian city	95.2	Profession	Farmer & fisherman	16.3
	Xiamen	43.5		Worker	27.9
	Maoming	38.8		Government employee	7.8
	All cities	50.8		Self-employed	22.5
Gender	Male	49.8		Researcher and educator	5.6
	Female	50.2		Student	8.7
Age	18–30	43.5		Retired	4.8
	31–40	25.4	Education	≤Middle school	18.1
	41–50	17.1	level	High school	32.3
	51–60	7.5		College & university	47.7
	> 60	6.5		Graduate	1.9
Distance to CIP (km)	1.0	7.7	Household	≤20	7.0
	1.1–5	29.7	annual income	20.1–50	16.6
	5.1–10	28.1	(thousand RMB)	50.1–100	31.5
	10.1–20	27.1		100.1–150	25.7
	> 20	7.4		150.1–200	13.1
Living place	City center	34.5		> 200	6.1
	Suburb	43.8	Family members	Average 3.5 person	
	Rural area	21.7	Distance to coast	Average 23.5 km	

Table 2
The population demographics in three cities.

Demographics	Items	Cities			Average
		Dalian	Xiamen	Maoming	
Gender	Male	50.5%	49.5%	52.5%	50.8%
	Female	49.5%	50.5%	47.5%	49.2%
Age (years old)	0–14	9.9%	16.5%	24.9%	17.1%
	15–64	79.4%	77.5%	64.8%	73.9%
	≥65	10.7%	6.0%	10.3%	9.0%
Family members	Per household	2.6	2.4	3.9	3.0
Education	Primary school	20.7%	21.4%	31.7%	24.6%
	Middle school	38.9%	38.1%	42.3%	39.8%
	High school	18.6%	20.8%	19.9%	19.8%
	College & university	21.2%	19.6%	6.1%	15.6%
Living place	City and town	75.0%	88.9%	40.0%	68.0%
	Rural area	25.0%	11.1%	60.0%	32.0%

years in China.

According to respondents, the environmental reasons for acceptance of CIP are its inevitable pollutants emission and environmental pollution, facilitating the circular economy and clean production, improving the efficiency and effectiveness of enterprise environmental management, reducing the difficulty of decentralized government environmental regulation, and a unified environmental monitoring and emission standards. The frequently mentioned reasons for unacceptance of CIP are serious impacts on public health, close to home, the existing technologies incompletely reducing environmental emissions and impacts, failure of risk control and management, the centralized and higher environmental risks.

4.2. Geographical differences of public acceptance

Interviewees from different places were asked to indicate their acceptance of CIP policy, which might build some chemical plants in their local neighborhood. The corresponding results are shown in Figs. 3–5. In general, as Fig. 3a–d shows, compared to the participants in Xiamen and Maoming respondents in Dalian especially oppose to construct CIP nearby their home (opposition vs acceptance equals to 370 vs 23). People prefer a national CIP policy than the city level and project level. Over 41% of the respondents in three cities responded that they would accept CIP policy as a future direction in next ten years.

Respondents living in city center, suburb, and rural area indicate different acceptable level to the CIP policy (Fig. 4a–d). Residents in rural area (58%–79%) are not likely to accept CIP policy at different levels more than residents in suburb and city center are. Citizen prefer the national CIP policy (45%) to the city CIP policy (31%) and to the local project (25%). However, respondents in rural area showed the least acceptance to a CIP project close to their home (7%). Still, 39%–48% respondents thought a CIP policy as a promising industrial policy in next decade.

The distance to a CIP project, influenced the public acceptance of the CIP policy (Fig. 5a–d). The further the respondents were away from the CIP project, the more likely they are to accept it. Approximate 64% of the respondents (with homes more than 10 km away from a CIP project) would accept a national CIP policy. For shorter distances, however, Fig. 5a–d reveal strong differences between the acceptance of CIP policy at the national level and the local level. No respondents within 1 km from a CIP project would accept it. At the same distance, acceptance of the national level CIP policy is higher, also higher than

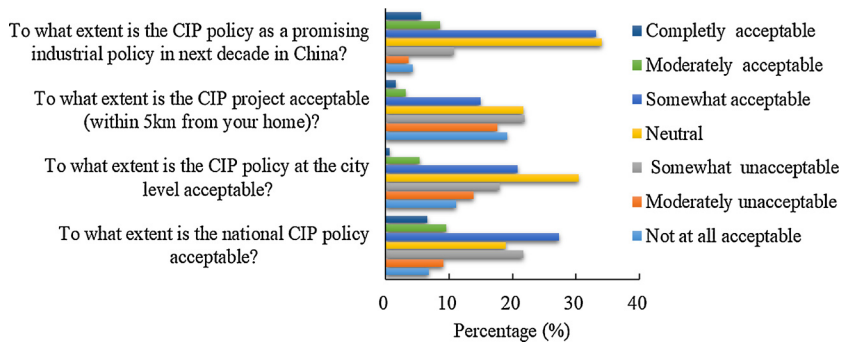

Fig. 2. Respondents' acceptance of the chemical industrial park policy (n = 1238).

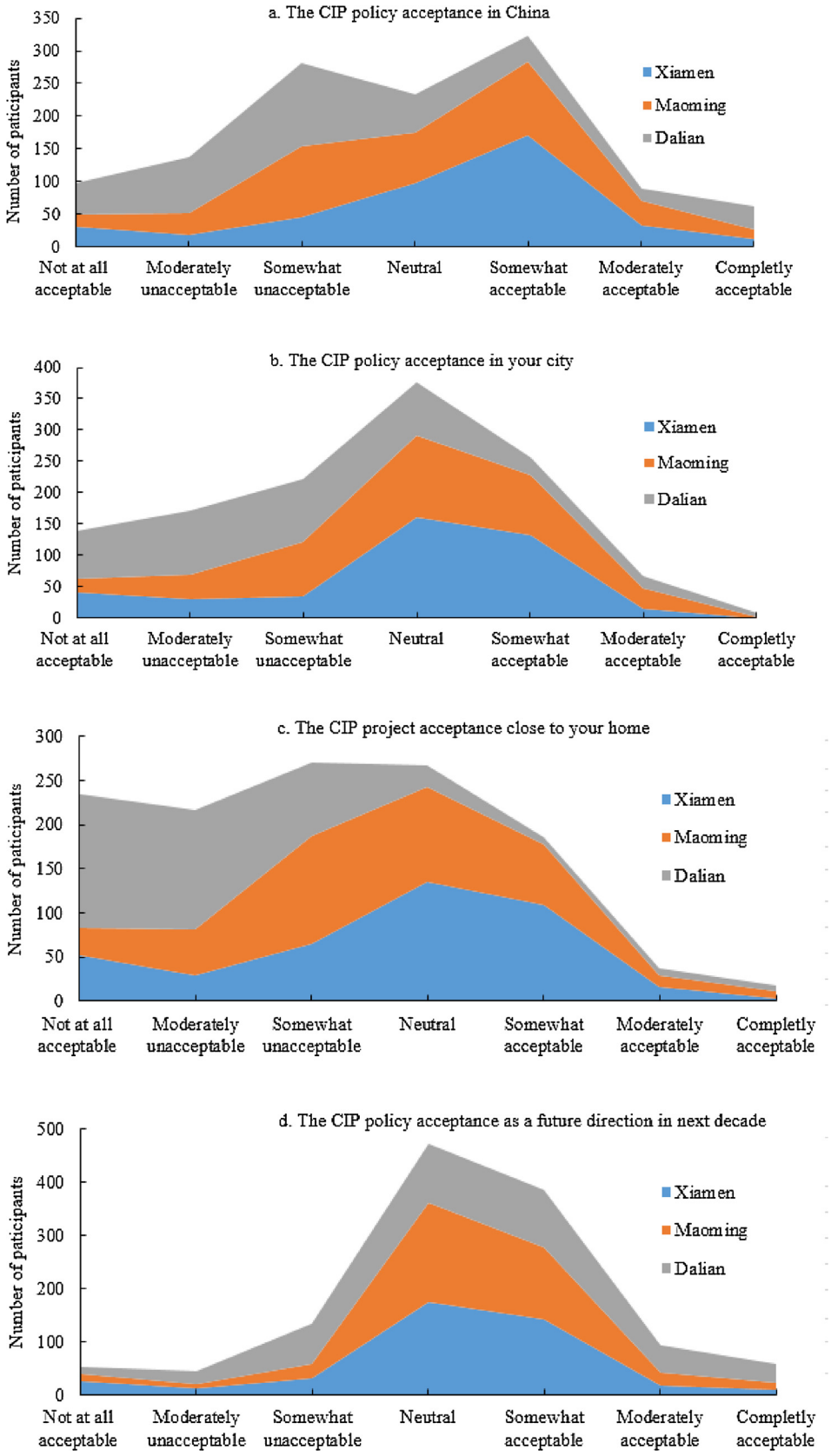

Fig. 3. (a–d) Public acceptance of the chemical industrial park policy and project in different cities (n = 1238).

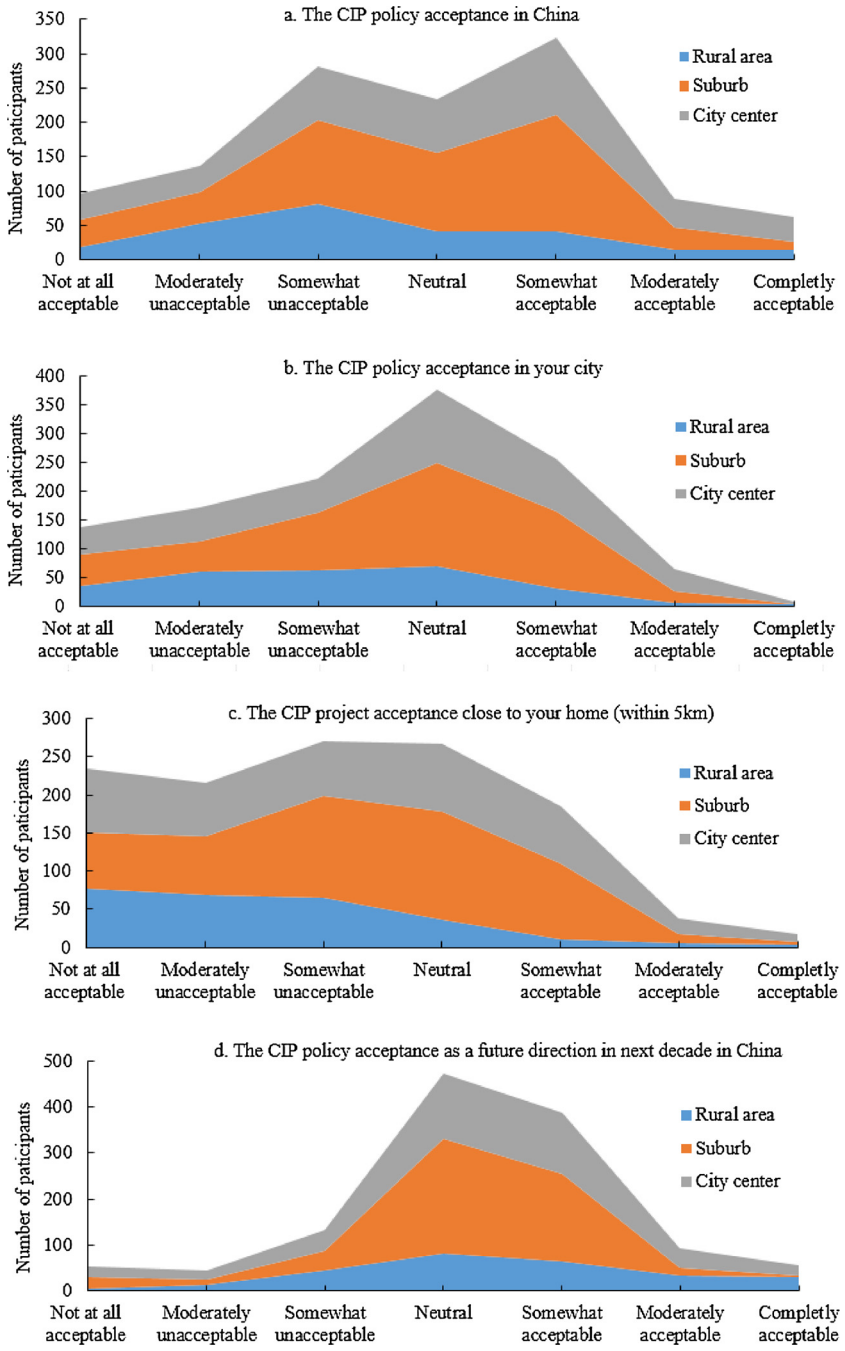

Fig. 4. (a–d) Public acceptance of the chemical industrial park policy and project in different groups living in various places of the city (n = 1238).

acceptance of a city level CIP policy. The CIP policy would be accepted as a future policy direction by approximate 36%–59% of the respondents. The results indicated the typical NIMBY effect.

4.3. Public perceptions of the decision-making of CIP policy and project

We invited the respondents to present their attitudes towards and perceptions on decision-making of CIP policy/project. The aspects included their knowledge of CIP policy/project, environmental values, trust in policy-makers, perceived risk of CIP, benefits and side impacts of CIP, the distributive justice of benefits and side impacts among the governments, the chemical companies, and the local people, procedural justice, information disclosure, and public participation in the CIP policy/project. The scales ranged from 1 to 7. Results showed that the average scores of these ten aspects were between 3.23 and 4.57 (Table 3). The highest score was side impacts of the CIP policy/project. Information disclosure of and public participation in the CIP policy/project got the lowest scores.

Public knowledge were about the current development of CIP policy/project, its positive and negative impacts, organizational agencies, and implementation. Environmental value covered items such as care for environment, respect for the earth, harmony with nature. Average scores of public knowledge of CIP policy/project and environmental values were 3.66 and 4.08, respectively (Table 3). More than 38% of the respondents thought that they were high knowledgeable of CIP policy/project. Almost 52% of the respondents declared that they had very high environmental values. Did local residents trust in the decision-makers of CIP policy/project? The specific question raised was: “To what extent do you trust in the decision-makers of CIP policy/project?” The scale ranged from 1 (very little) to 7 (a lot). Results

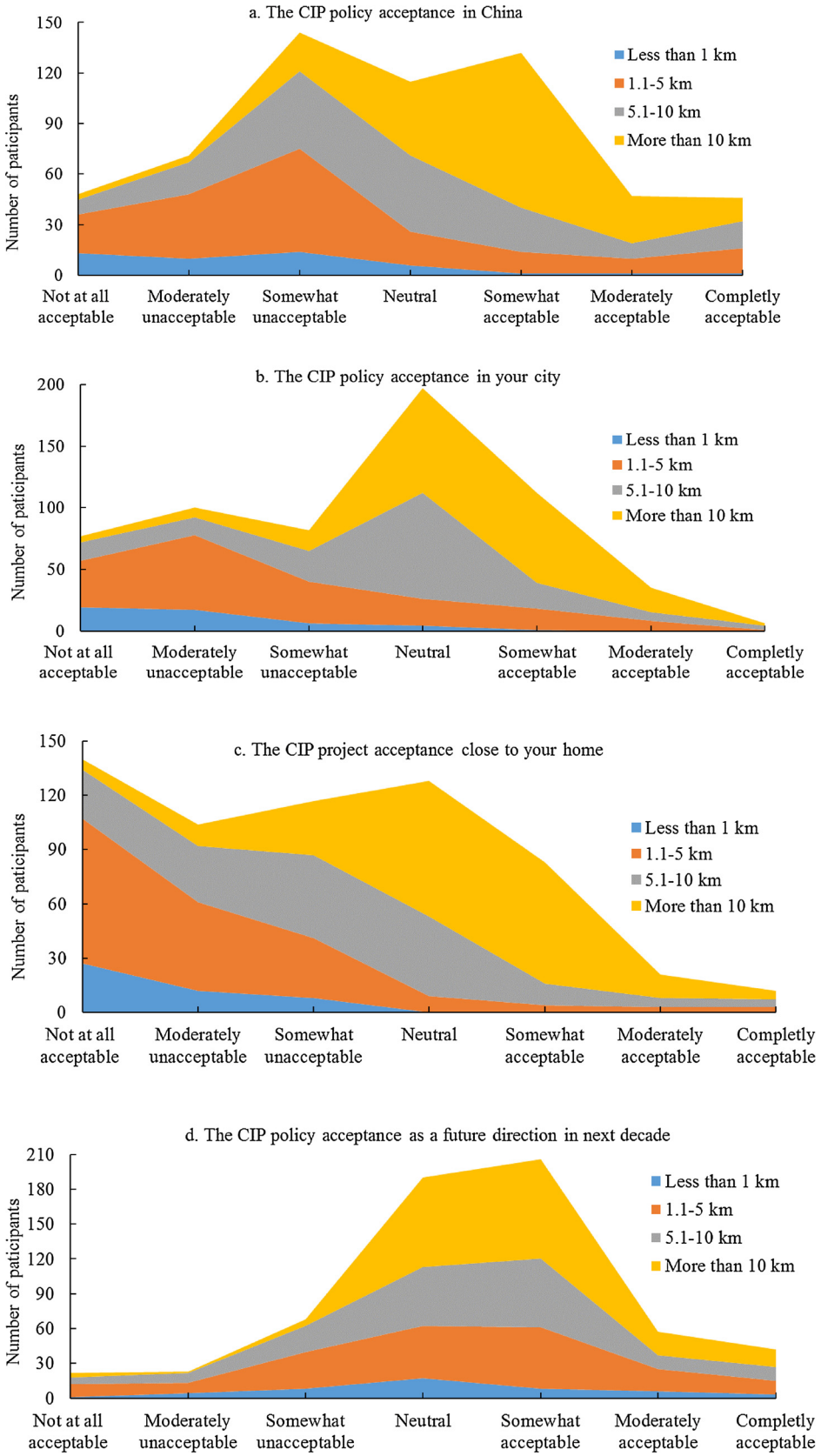

Fig. 5. (a–d) Public acceptance of the chemical industrial park policy and project in groups with different distances to the CIP (n = 609).

Table 3
Mean scores, standard deviations for different variables with a 7-point scaling.

Items	Knowledge	Environmental values	Trust in policy-makers	Perceived risk	Procedural justice (fairness)
Mean scores	3.66	4.08	3.36	4.56	3.33
SD	1.15	0.88	1.49	1.08	1.34

Items	Information disclosure	Public participation	Benifits	Side impacts	Distributive justice
Mean scores	3.23	3.23	4.12	4.57	3.90
SD	1.29	1.41	1.36	1.63	1.39

Table 4
Hierarchical multiple regression analysis on public acceptance of chemical industrial park policy and project.

Predictors	Acceptance of national policy		Acceptance of local policy		Acceptance of project	
	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	0.15***		0.24***		0.34***	
Gender		−0.08*		−0.05		−0.04
Age		−0.02		−0.10*		−0.07*
Education		−0.12*		−0.09*		−0.06
Income		0.14**		−0.10*		−0.11**
Distance to a CIP		0.09*		0.11**		0.18***
Step 2	0.26***		0.45***		0.50***	
Knowledge		0.02		0.03		−0.09*
Environmental value		0.11*		0.09*		0.08*
Trust level		−0.06		0.14**		0.17***
Peceived risk		−0.15**		−0.22***		−0.25***
Step 3	0.38***		0.52***		0.57***	
Procedural justice		0.26***		0.09*		0.23***
Information disclosure		0.02		0.07		0.10*
Public participation		0.03		0.002		0.16**
Step 4	0.51***		0.60***		0.63***	
Side impacts		−0.05		−0.13**		−0.17***
Benifits		0.09*		0.11*		0.16***
Distribution justice		0.07*		0.15***		0.18***
Total R^2	1.30***		1.81***		2.04***	
Adj R^2	130***		1.81***		2.04***	
n	1238		1236		1238	

Note: ΔR^2 means R square change. β is a medium effect size.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

showed that average score of the respondents' trust in decision-makers of CIP policy/project was 3.36. Nearly 28% of the respondents indicated that the decision-makers of CIP policy/project were very trustworthy. At same time, over 31% of the respondents considered the decision-makers of CIP policy/project were very little trustworthy. For the perceived risk, average score was 4.56 that was ranked the second highest level. More than half (51%) of the respondents considered the CIP had very high and high risk for local environment and human health.

In order to measure participants' perceived procedural justice of CIP policy/project, we asked three general questions: "How unfair/fair was the decision-making process of the CIP policy/project?" "To what extent did you participate in the decision-making process of the CIP policy/project?", "How open was the decision-making process of the CIP policy/project?" The scale ranged from 1 (very unfair/not at all participation/not at all open) to 7 (very fair/very high degree participatory/completely open). The mean values were presented in Table 3. Results showed that more than 50% of the respondents considered the decision-making process of CIP policy/project to be unfair (54%). Only one-fifth of the respondents thought the process was fair (20%). Nearly 82% of the residents in the survey have not participated in the decision-making process of CIP policy/project. Approximate 57% of the respondents criticized the non-transparency of information on planning, environmental impact assessment, environmental pollution, side impacts, accidents, operation and management of CIP. Only 17% of the respondents thought this information being transparency and public available. Other people are neutral about the transparency of information. In general, the respondents where not satisfied with the level of public participation and information disclosure.

The participants were asked their opinions on the expected benefits (such as economic development and employment), side impacts (such as safety and environmental accident, pollutant emissions, human health impacts), and distribution of these benefits and side impacts of CIP policy among the national, local, and project levels. The scale was from 1 (very low/unequal completely) to 7 (very high/equal completely). Average scores were 4.12, 4.57, and 3.90 (Table 3). More than 46% of the residents agreed that CIP policy/project would benefit them to some degree. However, over 56% of the respondents cared about the side impacts of CIP policy/project. About 22% of the respondents thought that the distribution of benefits and side impacts was equal among the governments, the chemical companies, and the local residents while almost 61% of the respondents did not think so. If the CIP strategy fits in with the perceptions and expectations of governments, companies, citizens and NGOs in terms of environmental and socio-ethical sustainability, there are opportunities for the development and implementation of CIP policies/projects. Important aspect in this regard was the balance between benefits and side impacts.

4.4. Factors associated to public acceptance

Hierarchical multiple regression analyses were carried out to explore what variables were key factors for explaining public acceptance of CIP at the national and city level policy, and project. A hierarchical procedure was applied to make sure that effects of socio-demographic characteristics and distance to CIP reported in Table 2 (step 1) were the same for the rest of the analyses. In order to comply with the precondition of hierarchical multiple regression analysis, we divided the education level into lower education level (high middle school and below) and higher education level (college and above). The income level was also separated into lower level (less than 200,000 RMB) and higher level (more than 200,000 RMB). In the second step (step 2), variables such as knowledge, the environmental value, trust, and the perceived risk were included. In the third step (step 3) procedural justice, information, and public participation variables were entered. Last step (step 4) added side effects, benefits, and distributive justice (equal- or non-equal distribution of the national, local/collective and individual outcomes). The second and third hierarchical regression analyses were used to explain acceptance of local CIP policy and CIP project with variables measured in Table 3, respectively. Differences were only indicated when found to be significant.

The results showed that income, distance to a CIP (e.g. within 5 km), environmental value, the perceived risk, procedural justice, benefits, and distributive justice were the most important factors influencing the acceptance of the national CIP policy, local CIP policy, and CIP project (Table 4). Otherwise, public acceptance of the national CIP policy significantly related to the local respondents' gender and education levels. Public acceptance of the local CIP policy significantly associated to age and education of the local respondents, trust in the decision-makers of CIP policy, and side impacts of CIP policy. Public acceptance of the CIP project significantly associated to age of the local respondents, trust in the decision-makers of CIP project, information disclosure, public participation, and side impacts of CIP project.

Table 4 showed that the socio-demographic variables and background questions contributed significantly to the model at the first step in all three scenarios (the national and local CIP policy, and CIP project). They explained 15%, 24%, and 34% of the variance in the public acceptance variable for three scenarios. This supported our first hypothesis: There has been a positive relationship between public acceptance and demographic characteristics of the interviewees (gender, age, education, occupation, income, and place of residence) for CIP policy. Men were more acceptable of the national CIP policy than women were, but gender had no significant influence on city level and project. Older respondents were more negative about the city level policy and project (negative beta-value). A higher educational level is associated with a more negative attitude towards the national and local policy. Respondents with higher income also were less likely to accept the CIP project nearby their home. Particularly, further distance to a CIP project was associated with more positive acceptance (positive beta-value). The other socio-demographics to some degree contributed to the model. However, the low β-values suggested that they had no strong influence. The results partly confirm the Hypothesis 1.

In the second step, we added variables e.g. public knowledge, environmental values of local residents, trust in decision-makers, and the perceived risk of CIP to the model. There were improved by an additional 11–21% explained variance in the acceptance of the CIP policy and project. Higher levels of the perceived risks of CIP were associated more negative acceptance of the national CIP policy, the local CIP policy and CIP project. More knowledge of the respondents associated with their more negative acceptance of CIP project. People with strong environmental values had significant positive acceptance of the national CIP policy, city level CIP policy, and CIP project. Respondents with higher trust levels in the decision-makers were with significant positive acceptance of local CIP policy and project.

In the third step, decision-making process related factors such as procedural justice, information, and public participation variables were entered. Through adding to the explained variance by 38–57%, they contributed largely to the model. Procedural fairness was the most important contributor for all scenarios. Acceptance levels were more positive when the respondents perceived the decision-making procedures as fair. Acceptance were more positive when people had access to more information and more participation for the CIP project. Further, the low β-values for some variables showed only marginal contribution to the explanation of variance in public acceptance of CIP policy.

In the last step, side impacts, benefits, and distributive justice variables were added to the model. They explained variance by 49–63% and contributed largely to the model. Perceived side impacts are associated more negative acceptance of local policy and project. Benefits and distribution justice were the most important contributors for all scenarios (the national CIP policy, local CIP policy, and CIP project). The more benefits were expected or perceived the more positive acceptance to the CIP policies and project were. Whereas the more equally of benefits and side impacts distributed among nation, collective, and individual, the more significantly positive acceptance was (positive beta-value in Table 4; confirming Hypothesis 2). In the model, other variables also contributed to the model, though in different degrees. However, it assumed that these effects were the result of the large sample size in terms of the low beta values. Hence, the impacts of these factors on public acceptance of CIP were negligible.

5. Conclusions

There was limited reference to public views of chemistry and chemical industrial policy in the literature, but a great deal of the literature focusses on the public's view of chemicals. This could be linked to chemistry's lack of public or media profile (Levinson, 1998). There is an underlying assumption in the literature that the public's views about chemistry are connected to those about chemicals and the chemical industry – and that chemistry is likely to suffer from these negative associations. According to a TNS BMRB survey on 2104 UK adults over 16 years old (TNS BMRB, 2015), we see that there is neutrality (51% of the respondents) and relatively low interest/engagement (43% giving a low score 1–3, one being not at all engaged and ten being very engaged) in chemistry currently. Yet at the same time people are generally positive about its impacts. On the whole, the UK public recognizes the societal value of chemistry, with six in ten (59%) agreeing that the benefits of chemistry outweigh any harmful effects. Three quarters (75%) stated that they felt chemistry had a positive impact on well-being. The majority of people (55%) do not feel informed about chemistry in their everyday lives, while four in ten feel informed (41%).

This study's aim is to understand what drives the level of public acceptance of China's chemical industrial policy and project. This was examined in a survey with 1238 Chinese residents of different age and income groups, in Dalian, Xiamen, and Maoming city. We were especially interested in the overall public acceptance for the transition towards CIP, the difference between acceptance of national CIP policy versus its local and project level, and the related factors driving overall acceptance or rejection. Through this study, we have identified some factors that help explain public acceptance for different levels of CIP policy and project. The overall finding was that respondents were more positive toward the national and future policy, but more negative about the local CIP policy and project nearby their homes. Respondents in Dalian were less likely to accept CIP policy and project compared to people in Xiamen and Maoming. The further people were away from a CIP project, the more likely they were to accept CIP policy and related project. We could therefore conclude that, most of the public approved the chemical industrial transition pursued by the national government as long as it was not implemented close to their homes. The decision-making process of CIP policy was considered not very inclusive, characterized by a lack of transparency and low levels of public participation. The distribution of side impacts and benefits was unequal as well.

We tried to answer the question: what are the determinant(s) for explaining the overall public acceptance? The results showed that income, distance to a CIP (within 5 km), environmental value, the perceived risks, procedural justice, benefits, and distributive justice were the most important factors influencing the acceptance of the national CIP policy, local CIP policy, and CIP project. In the model, other variables also contributed to the model, though in different degrees. Relatively small amounts of variance of the national CIP policy were explained by socio-demographics of the respondents in the first step of the model. A large part of the variance in public acceptance toward the CIP project was explained by socio-demographics in the first step and public perceptive variables including knowledge, the environmental value, trust in the decision-makers, and the perceived risks of CIP in the second step. Results indicated that socio-demographics and public perceptive variables were the most important factors that influence acceptance of a CIP project. The mid-level of variance of the local CIP policy was explained in the model. Our results had some similarities to another study in three cities, Jiangsu Province (Huang et al., 2013). Based on 1190 valid questionnaires, four factors could influence public acceptance of the chemical industry risk: the public perception of their personal knowledge, the perceived effect of accidents, the perceived benefit, and trust in the government's risk management abilities.

Based on above results, we would suggest that the public's views and interests can and should not be ignored at planning to implement a CIP policy or project. For the decision-making process of CIP policy and project, the decision-makers must ensure its procedural justice, distributive justice, and benefits. The decision-makers should make decision complying with the national legal procedures, but not decide based only on individual hobby and experience of managers. The latter would be to fail as soon as beginning such as PX project in Xiamen. In design of a policy/project, direct and indirect benefits to local people should be considered and analyzed carefully. We would advise against conceptualizing public acceptance too narrowly in terms of simple trade-offs between potentially competing costs and benefits. Distance of CIP project to the residents' homes was the most concern of the public. In the national and local industrial plans, urban plans, and environmental plans, the CIPs layout and sites had to be designed based on the geographical situation and public acceptability. For example, it was better to select at least five kilometers between a CIP project and nearby communities. The environmental value was rarely studied in China. Based on our results, it was an important factor affecting public acceptance. The decision makers should be aware of this problem and worked with educational and other agencies together to increase public environmental values. In terms of the high-perceived risks of CIP on the environment and human health, the integrated and effective risk emergency & management system is a priority for the governments and the chemical companies. Overall, the decision-makers needed also consider specific factors at the different levels of the national CIP policy, local CIP policy, and CIP project. There was no fit-for-all approach to the decision-making of CIP policy/project. However, our identified factors provided a strong basis for anticipating and understanding likely public acceptability and should be considered alongside other more technical and conditional elements of industrial policy change.

Therefore, the question arises whether a lack of local residents' acceptance may evolve into a 'deal-breaker'. The answer to this question may very context-specific. In the future, case study should be conducted in-depth for individual project where a 'deal-breaker' despite a high degree of public acceptance on a national level. All in all, understanding public acceptance in our study is a critical first step towards including social dimensions in the analysis of decision making around such a complex issue.

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