

Article

# Multilevel Environmental Governance: Vertical and Horizontal Influences in Local Policy Networks

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**Abstract:** In the context of multilevel governance, collaboration among governmental and non-governmental entities across different levels of government is increasingly popular in China's environmental governance. Policy actors are engaged in two types of collaboration with other local governments: horizontal and vertical collaboration. Policy actors participate in horizontal collaboration when they work with entities at the same level, and in vertical collaboration when working with governments at different levels. This study examines multilevel environmental governance in China by studying how the decisions of policy actors to participate in local water governance networks are influenced by vertical pressures from higher level government and horizontal influences from other policy actors at the same level. We approach the research questions in the empirical context of local water governance in Dongguan city of Guangdong Province. With survey data collected from 31 municipal departments, 32 town governments, nine water-related private businesses and five NGOs, we tested the hypotheses with Ordinary Least Squares (OLS) regressions. The results indicate that vertical pressure and horizontal brokerage are both drivers for participation in the local water governance network.

**Keywords:** multilevel governance; environmental governance; policy network; governance network; water governance

## 1. Introduction

With the recent trend to decentralize the governance of the environment and natural resources and the expansion of local governments' administrative capacity, multiple levels of governments are actively involved in environmental governance in China, and are entering a new age of multilevel environmental governance. Different from the traditional model of top-down environmental policy implementation, recent practices in China's local environmental governance feature a more integrated model of collaborative governance, in which central, provincial, municipal, county and township governments are involved in a complex governance network, resonating the trend for multilevel governance (MLG) in Europe [1] and the USA [2], and other policy areas in China [3,4].

In the context of MLG, policy actors at the local level face a more complicated institutional environment compared with that of traditional bureaucracy. Under MLG, environmental policy actors not only have to respond to the policies and rules made by their immediate superior, but they are

also influenced by policies and the intentions of higher level authorities and horizontal partners. Environmental policy actors are also driven by their local conditions, for instance, environmental stress, economic development conditions, and industrial development needs. While the MLG is an emerging trend in the practice of environmental governance in China, few studies have examined why local policy actors participate in environmental governance, and whether vertical pressures or horizontal brokerage play a role in facilitating MLG.

In this study, we examine multilevel environmental governance in China by studying how the decisions of policy actors to participate in local water governance network are influenced by the vertical pressures from higher level government and horizontal brokerage with other policy actors. The research questions for this study are: who are involved in the multilevel governance of local water resources? What drives policy actors' participation in the local water governance network? Are policy actors' decision to join the local water governance policy network influenced by pressure from higher level government or motivation to work with other partners?

We approach the research questions in the empirical context of local water governance in Dongguan City, Guangdong Province. We hypothesize that policy actors experiencing stronger pressure from their higher level organizations are more likely to be active in the water governance network. We also hypothesize that policy actors with stronger motivation to coordinate with other organizations are more likely to be active in the governance network. With survey data collected from 31 municipal departments, 32 town governments, 9 water-related private businesses and 5 NGOs, we tested the hypotheses with Ordinary Least Squares (OLS) regressions.

The rest of the paper is organized as follows. In the next section, we present a review of the literature on MLG and environmental governance. We then direct our attention to the study site of this paper, the Dongguan water governance network. Then, a set of research hypotheses is presented to explore the impact of vertical and horizontal influence on MLG. We then demonstrate our research design and data collection procedures, accompanied by a descriptive analysis of the local water governance network. An OLS regression is then estimated to test the hypotheses. The paper concludes with a discussion of the results, along with theoretical and practical implications.

## 2. Multilevel Environmental Governance in China

### 2.1. Multilevel Governance: Theoretical Construct and Chinese Context

With the development of advanced industrialized democracies and increasing influence of private sectors in policymaking, scholars have realized that governance across different tiers of jurisdictions is more effective than policy monopoly from the central government [5–10]. Governance covers multiple scales, leading to policy externalities across levels. Scholars argued that governance should be multilevel to internalize cross-level externalities [7]. Through addressing policy externalities in the governance process, policy synergy can be facilitated [11,12] and inter-jurisdictional competition will be enhanced [13], which thereby promote innovation and experimentation [14].

As a response to technological and institutional progress, collaborative actions across multiple levels of governments and various types of organizations have been a common phenomenon, the terminology of which is named multilevel governance [1,15]. MLG broke the borders of traditional administrative jurisdictions, and changed political structures and processes in response to the interdependent relationships in social development and political decision-making [16]. According to "The White Paper on Multi-level Governance" of the Committee of the Regions, in the context of the European Union, multilevel governance refers to collaborative actions taken by the EU, the member states, and local and regional authorities, which involves actors at different tiers of government to share governance responsibilities [17]. Under MLG, governance at different levels is mutually interactive, but is independent vertically or horizontally, which is different from the traditional bureaucratic hierarchy [18,19].

One of the key objectives of multilevel governance is to ensure the balance and collaboration between local, regional, and national governments and other authorities [20]. Scholars defined two types of multilevel governance [7]. Type I governance is federalism and intergovernmental relations, which refers to power sharing among a limited number of non-overlapping governmental agencies at limited levels. On the contrary, Type II governance is more complex and fluid, and encompasses vast numbers of overlapping jurisdictions, diverse territorial scales, and specific functions. From the perspective of private actors, the study pointed out that Type I governance, which sets the division of power hierarchically, corresponds to highly institutionalized private actors and associations [21]; Type II governance corresponds to less institutionalized but more fragmented private actors. The study indicates that organized interest groups have become increasingly influential as they have linked different levels of governance and offer expertise to solve policy problems. From the perspective of management of public-nonprofit partnerships (PNPs), there has been increasing numbers of external actors who participate in providing social services through establishing collaborative relationships with government, and intergovernmental relations show a huge influence on shaping these relationships [22].

China has also joined the global trend in multilevel governance. Unprecedented challenges, like marketization, globalization and social restructuring, have fundamentally influenced China's governance transition. MLG has emerged in China as a new way to deal with public service delivery, technological innovation, liberalization and facilitation of trade and investment, population migration, and environmental protection [23]. MLG in China is a bidirectional and simultaneous process of privatization and publicization [24], participating actors from different sectors are engaged in a win-win game. Such a collaborative governance process not only features horizontal inter-governmental relations, but also demonstrates horizontal government-society relations in China [3]. For example, nonprofit organizations actively participated in disaster relief after the Sichuan Great Earthquake, and in the environmental movement against the construction of the Nu River Dam. All these sent signals that external actors have widely participated in public affairs and that the intergovernmental system has become flatter and more cooperative [3,4].

MLG is also new to China, thus, there may be several obstacles to China's road toward MLG, such as transitional social and economic structures, an entrenched governing culture, and external actors' ineffective influence on public processes [3]. There are many unresolved theoretical and empirical questions on MLG in China, this paper contributes to the extant literature on MLG by examining who participates in MLG and whether traditional hierarchy still plays a role in MLG, in the context of the Dongguan water policy network.

## 2.2. Environmental Governance and MLG

In the globalization process, the interdependence of environmental resources has been an emerging trend [25]. More and more countries, regions and local governments choose to utilize collaborative approaches to address environmental problems. Instead of relying solely on regulatory policy tools, policy actors have engaged in the process of environmental governance, which involves a diverse set of policy actors and multiple levels of governance to address environmental problems. The concept of environmental governance is thus compatible with the theme of MLG. A study advocated that environmental governance is targeted at solving conflicts over environmental resources [25]. Another research argued that the goal of environmental governance is to analyze the interactions among the participants involved in collective environmental problems [26]. Environmental issues are not restricted by region, thus governments at one level can no longer be isolated from governments at other levels [27]. A scholar suggested that multilevel governance is needed to deal with environmental challenges [28]. Therefore, environmental governance required multilevel interactions among various actors in dealing with complicated environmental governance issues and achieving sustainable development.

For multilevel environmental governance, a study stressed that environmental governance should ensure transparency, accountability, and public participation during the process of decision-making [29]. Sharing decision-making power allows more actors to get involved in resolving environmental

problems [30]. Some have found that indigenous people with localized knowledge are able to offer more effective recommendations to enhance environmental governance [30–33]. For example, studies have highlighted the principles of enhancing indigenous participation in water planning, including diversity of interests and local knowledge [33]. It is recommended that scholars build strong relationships between indigenous people and other participants in the environmental governance process [34]. Recognizing the importance of stakeholder participation in MLG in general and environmental governance specifically, there still exists a participation gap in environmental governance. It is important to promote trust among stakeholders, to involve multilevel actors and to cultivate their self-initiative and awareness in environmental participation [27].

Based on the above literature review, environmental governance is moving towards multilevel participation globally, but few studies have examined multilevel environmental governance in the Chinese context. As a country featuring a strong central government and an administrative habit of imposing top-down mandates, environmental governance in China is slowly engaging in diversified participation and collaborative partnerships. This paper aims at examining local environmental governance in the context of China, with the goal to analyze how the decisions of policy actors to participate in local water governance network are influenced by the vertical pressures from the higher level of government and horizontal influences from other policy actors.

### 3. China's Local Environmental Policy Network: The Case of the Dongguan Water Network

Dongguan is a prefecture-level city located in the Pearl River Delta, Guangdong province, China. Dongguan enjoys great geographic advantages, as it borders the capital city of Guangzhou to the North, Huizhou to the northeast, Shenzhen to the south, and Hong Kong to the southeast, which are all mega cities. In the past few decades, Dongguan has developed rapidly and become one of the biggest manufacturing hubs in the world. The largest industrial sector in Dongguan is manufacturing industries for electronics and communication equipment, attracting many international organizations to establish factories in Dongguan, including Samsung, Nokia, Coca-Cola and Nestlé. It is the fifth largest city in terms of total volume of export in China, ranking only behind Beijing, Shenzhen, Shanghai and Suzhou. Following China's Belt and Road initiative, the city government is progressive in seeking more foreign investment and economic development opportunities. In 2015, about 4.55% of China's export GDP was contributed by Dongguan.

Dongguan belongs to the Pearl River basin and is located in the lower stream of the Dongjiang River. With its geographic proximity and abundant water resources, the Dong-Shen water supply project was implemented to supply water for Hong Kong. With three large-scale reconstructions and over 7.6 billion RMB Yuan investment, the annual supply capacity has reached 1.1 billion cubic meters, with a cumulative supply of around 22.8 billion cubic meters in the past five decades, accounting for more than 70% of the annual water consumption in Hong Kong. However, because of its rapid development in manufacturing industries, Dongguan has encountered enormous challenges in its water governance, for example, the shortage of water resources, water pollution, and unbalanced water demand and water supply. Apparently, its traditional development pattern can no longer sustain the ecological cost imposed by economic development, exposing intense conflicts between economic development and environmental protection.

Recently, China's central government has stressed the need for coordinated development between the regional economy and environmental protection. As a response, the city government of Dongguan has made a strong commitment to environmental protection and water ecological restoration, and has become the first of 45 pilot cities for developing the *Aquatic Ecologically Friendly City* in China. In 2010, Dongguan set up the new Water Affairs Bureau, which took charge over overall water-related affairs in Dongguan. Under the leadership of WAB, Dongguan has implemented integrated management of water-related affairs across levels of governments and across regions. A multilevel water governance network has emerged as a recent development of such reform.

#### 4. Vertical and Horizontal Influences in the Multilevel Environmental Governance

China's road toward MLG arouses stimulating questions due to its transitional regime and entrenched governing culture and practices [3]. In China's multilevel environmental governance, traditional bureaucracy is still relevant and plays a critical role. As China features a very powerful central government, the involvement of central and provincial governments in local environmental governance will inevitably present a coercive influence on local policy actors [35]. This means that local policy actors' decision to participate in the governance network will be heavily influenced by the hierarchical nature of the administrative bureaucracy [36]. For governmental actors, the pressures come from higher level governments' policies and mandates [37]. For nonprofit and business actors, the vertical pressures come from any government authorities who can regulate market interactions, incentivize actions and punish non-cooperative behaviors from these non-governmental actors [38,39]. We expect that policy actors receiving strong vertical pressure are more likely to be active in the network. For governmental actors, this is obvious, as the top-down relationship defines the traditional hierarchy. For non-governmental actors, vertical pressure could also be highly influential, as many businesses and nonprofits are dependent on government policies and funding for survival. In this sense, we approach the concept of "vertical pressure" from the regulatory governance perspective, in which all entities are subject to regulatory influence from the government [40]. Businesses and NGOs are regulated and governed by governmental entities, and lower level governments are regulated by higher level governments. Therefore, governments, businesses and NGOs could all subject to regulatory pressures from government entities. Such pressure is termed "vertical pressure" in this study.

**Vertical pressure hypothesis:** Policy actors experiencing stronger vertical pressure are more likely to be active in the policy network.

The concept of MLG necessitates the involvement of policy actors from diverse backgrounds, including but not limited to governments, NGOs, businesses and universities [3]. The success of MLG calls for partnership and coordination in the governance process. Policy actors with externally oriented strategies, who are ready to work with their partnering organizations, are more likely to be active and influential in the local environmental network. As shown in the study of environmental policy network in the U.S., policy actors with high bridging social capital tend to bring in novel information and glue the network together [41,42]. Thus, we expect policy actors' activity in the local environmental governance network to be driven by their motivation to work with other actors. One indicator of such motivation to work with other actors is demonstrated by policy actors' own strategic goals. The goal setting process within the organization can direct organizations in attaining the expected performance outcomes [43]. If the policy actor has a goal to participate in the policy network and work with other actors, it is more likely that the policy actor will be more active than other actors without such a goal.

**Horizontal brokerage hypothesis:** Policy actors will be more active in the policy network when motivated by their organizational goals to coordinate with other organizations.

#### 5. Data Collection

In order to empirically examine multilevel environmental governance in China, this article resorted to a mixed method research design [44]. We used both interviews and surveys to gather network data in Dongguan city, China. The reasons that we resorted to such mixed method research design was that either interview or survey alone was sufficient to come to comprehensive understanding of the local network conditions. These two methods are mutually enhancing in that we use interviews to explore critical issues facing local policy actors and define the boundary of local networks. We use the survey method to collect data on networks and independent variables.

For the interview process, we selected 12 interviewees, including 6 department managers from Dongguan Water Affairs Bureau, 3 executives from Dongguan Water Investment Organization, 1 officer from Dongguan Environmental Protection Bureau and 2 officers from township level government. For the survey process, we used a sample size of 31 municipal departments, 32 town governments, 9 water-related businesses and 5 environmental NGOs.

### *5.1. Interview*

To understand how government departments deal with water governance affairs, we designed customized interview questions. As Water Affairs Bureau (WAB) is the leading department of water governance, we interviewed six different functional WAB offices, including the Water Ecological Office, Policy and Regulation Office, Water Resource Management Office, Water Pollution Control Office, Communications Office and General Affairs Office. We focused on the cooperation among these offices, and their inter-departmental relationships with other municipal departments and town departments. We also invited the Dongguan Water Investment Organization and Environmental Protection Bureau to join the interviews, regarding their responsibilities in water governance and cooperative relationships with other departments. Besides, we selected two townships with different watershed locations and water governance performance: Houjie and Machong, as our interviewees. The former is located on the upstream of the Dongjiang River with relatively good performance in water governance, while the latter is located on the downstream and is ineffectively dealing with its water affairs. In the interview process, the interviewees helped us identify the boundaries of the local water governance network, which we used as the research targets in the survey implementation.

We learned from the interviewees that water policy making in Dongguan is not solely determined by the city government, instead, all policy actors interviewed indicated that they actively participated in influencing the policy formulation, and especially the implementation process. They mentioned the mandates imposed from higher level government, which creates tremendous pressure to ensure the accomplishment of the policy goals in water governance. However, at the same time, they thought that their actions to engage in water governance were not solely based on external pressures, and that they did take initiatives to actively seek effective governance outcomes. The results provide preliminary confirmation of the research hypotheses, but it should be acknowledged that such responses were likely driven by their motivation to impress the interviewers that they not only adhered to the mandates from central government, but also that they were actively doing their job. Nevertheless, a cross validation to compare the responses from different types of actors revealed that their stories were consistent. The biases in the responses were reasonable and should not affect the validity of the interview.

### *5.2. Network Boundary and Survey Administration*

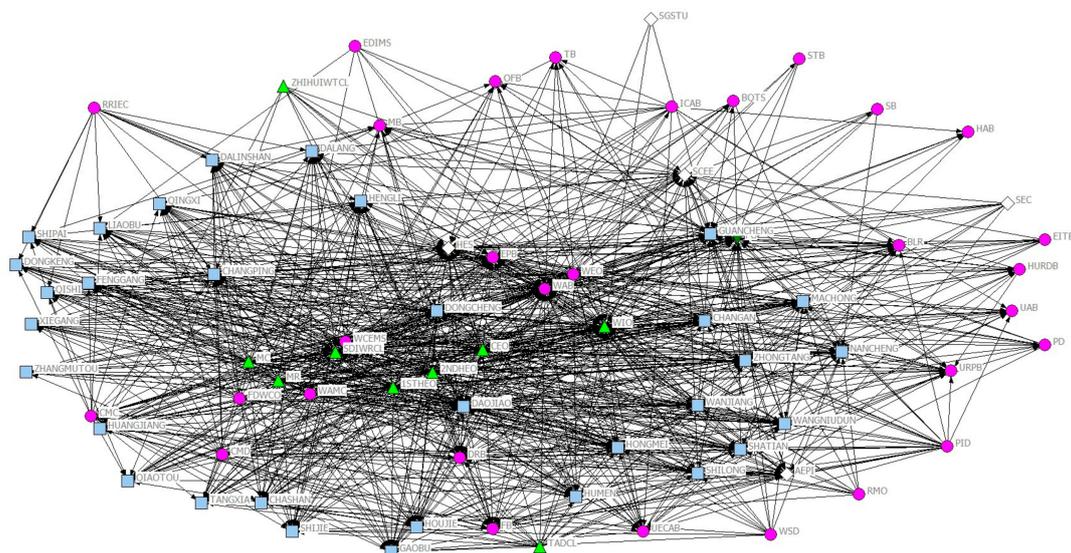
In order to determine the boundaries of the local water governance network in Dongguan, we consulted several key informants in the local water governance network, including the managers and engineers of the Dongguan Hydraulic Engineering Society, and the managers of the Dongguan Environmental Protection Bureau and Water Affairs Bureau. We communicated and confirmed multiple times with local actors to ensure no significant actors were left out of the network boundary.

We designed a questionnaire to investigate multilevel water governance in Dongguan, with 20 questions covering the governing objectives, procedures and effectiveness. Survey questionnaires were sent to directors and managers in 31 municipal departments, 32 town governments, 9 water-related businesses and 5 environmental NGOs that were identified as key policy actors in the interview process. We used both an online survey and paper survey, which were issued via email, Wechat (a social networking app), Tencent QQ and regular mail. After several rounds of effort, almost all targeted local actors responded to the survey. The surprisingly high response rate was a result of multiple factors. First, the survey was administered on behalf of the Dongguan Hydraulic Engineering Society to provide us a more convenient communication platform and ensure a high response rate. Second, persistent effort was made by our research team, with one graduate student nudging each respondent every few

days for over three months. We also contacted local MPA alumni who were well-connected locally to facilitate responses from survey respondents. Third, we also reminded them twice a week through either telephone calls or Wechat messages, and offered the opportunity to answer the questionnaire via telephone.

### 5.3. Network Visualization

With the network data collected, we constructed a network diagram with UCINET, as shown in Figure 1. For a network with a size of 77 network actors, the density of the network (0.26) demonstrates that the policy actors are very active in working with their partners. We can also observe that each type of policy actor has representation at the core of the network. For example, city agencies, such as the Water Affairs Bureau and Environmental Protection Bureau are both located at the center. An NGO, the Dongguan Hydraulic Engineering Society, multiple businesses (Water Investment Organization), and towns (Houjie Town and Machong Town) are also part of the core policy network. This provides strong evidence that the Dongguan Water Governance Network features opportunities for widespread participation from multiple sectors of society, and is not a fully government-centered network.



**Figure 1.** Network diagram of the Dongguan Water Policy Network (UCINET). Circle: City department; Square: Town governments; Triangle: Businesses; Diamond: NGOs.

### 5.4. Network Statistics

We calculated the E-I index [45], which measures a network's tendency toward homophily based on a given attribute of the nodes (i.e., the organizational types of actors). The index is calculated as follows:

$$E - I \text{ Index} = \frac{EL - IL}{EL + IL} \quad (1)$$

where *EL* represents "external" links, or the number of links between nodes which are of a different organizational type, and *IL* represents the "internal" links, or the number of links between nodes who share the same organizational type. The index ranges from  $-1$  (complete homophily, in which all links are internal and thus complete insularity exists) to  $1$  (complete heterophily, in which all links are external and thus no insularity exists).

As shown in Table 1, the E-I indexes for the policy actors in the Dongguan water policy network are presented. We can observe from the table that city government has the most links in the policy network, with a total number of 693 partnership links, 41% of which are from/to other city departments. The town departments have even higher activities (850 links) and are more heterophily than city departments, as demonstrated with an E-I index of 0.539. Businesses and NGOs also show very

high activity level, and very strong tendency to work with policy actors that belong to different actor categories. The actors from the private sector have the highest E-I index, indicating their strong tendency to work with a diverse group of policy actors.

**Table 1.** E-I Index of the Dongguan water policy network by types of policy actor.

	Internal	External	Total	E-I
City Agencies	204	489	693	0.411
Town Governments	196	654	850	0.539
Businesses	22	323	345	0.872
NGOs	10	114	124	0.839

## 6. Research Design

In this study, we proposed two hypotheses on the impact of vertical influence and horizontal brokerage on network activities. To test the hypotheses, we ran an OLS regression analysis. The dependent variable of this study is the level of activity of each policy activity in the Dongguan water policy network, as measured by the degree centrality for each policy actor. Degree centrality measures the number of relationships each actor develops, which reflects both the general interest in network activities and the resultant connectedness of the network [42]. As we have collected network data for 77 city agencies, town governments, businesses and NGOs, our sample size is thus 77.

The independent and control variables were also collected from the Dongguan water network survey. The descriptive statistics are shown in Table 2. The first independent variable we include is vertical pressure. We measured the vertical pressure of each policy actor as the number of designated water-related activities from the City Government of Dongguan. The City Government designates water-related functional areas to a list of city agencies and towns, and also mentions the names of businesses and NGOs. The more frequent an organization is called upon to perform a water-related function, the more pressure it receives from the city government. As shown in the descriptive statistics, on average, a policy actor is designated to 11 water-related functions, with some actors only required to participate in one activity, and the WAB is encouraged to participate in all 34 activities. For the government actors, vertical pressure comes from higher level government. For the NGOs, vertical pressure could come from any government actors, who can potentially regulate their behaviors and provide funding sources. In practice, NGOs and businesses have been called upon by city government to perform certain responsibilities in the water governance, as if they were in the administrative hierarchy.

**Table 2.** Descriptive statistics.

Variables	Mean	SD	Min	Max
Degree Centralities	26.56	14.28	3	76
Vertical pressure	10.57	8.78	1	34
Horizontal brokerage	0.73	0.45	0	1
Conflict	0.44	0.50	0	1
Trust	0.04	0.19	0	1
Non-Government actors	0.18	0.39	0	1
Fairness of Rules	0.16	0.37	0	1
Scientific uncertainty	0.30	0.46	0	1
Organizational homophily	0.43	0.50	0	1

The second independent variable is horizontal brokerage, as measured by the answer to the survey question, “My organization participates in the local water governance network, because it is consistent with the organizational goals to work with other organizations”. Seventy three percent of policy actors agreed that network participation is consistent with their organizational goal.

A set of control variables was also included in the regression model. These variables measure the perceived conflict among organizations, perceived trust among organizations, perceived fairness of the

participatory process, perceived scientific uncertainty and organizational homophily. They were all measured by Likert scale, which ranged from 1 (lowest degree) to 7 (highest degree). A binary variable indicating whether the policy actor was a non-governmental actor was also included.

## 7. Results

Table 3 shows the results of a regression analysis modeling the network activity of local policy actors in the multilevel water governance. The adjusted R-squared for this model is 0.32, a relatively good model fit. Various diagnostics were performed to test the assumptions of regression models. The variance inflation factor (VIF) was calculated for each variable, and all of the VIF values were smaller than 5. No obvious outliers were observed in the diagnostic plots.

**Table 3.** Ordinary least squares regression analysis (dependent variable: network activity of each policy actor as measured by degree centrality).

Variables	Coefficient	SE
Vertical pressure	0.48 **	0.19
Horizontal brokerage	8.39 **	3.59
Conflict	3.33	3.07
Trust	9.15	8.35
Non-Government actors	9.84 **	4.10
Fairness of Rules	−3.74	4.39
Scientific uncertainty	0.96	3.55
Organizational homophily	−0.35	3.48
Constant	22.82	3.80
N	77	
Adjusted R-squared	0.32	

\*\*  $p < 0.05$ , two tailed test.

The hypotheses we intended to test in this study center around the impact of vertical pressure and horizontal brokerage on the level of collaborative activities in the local water policy network. The first result to note is the positive and statistically significant coefficient on vertical pressure, consistent with our hypothesis that vertical pressure pushes policy actors to engage in local policy networks. The size of the coefficient means that for every additional administrative designation into a specific water-related functional area, the policy actor will become more active in multilevel environmental governance by adding 0.5 link in the network.

The second hypothesis we tested is whether policy actors engage in multilevel environmental governance because they are driven by organizational goals to coordinate with other actors in the network. The result shows that the coefficient for horizontal brokerage is positive and statistically significant, significant at 0.05 level, lending strong support for the horizontal brokerage hypothesis. The size of the coefficient means that policy actors with an organizational goal to engage in water governance will, on average, have eight more partners than those actors without a goal.

For the control variables, we found no statistical significance for perceived trust, conflict, fairness of the rules and scientific uncertainty. The coefficient for non-government actors is positive and statistically significant. This means that on average, non-governmental policy actors have 10 more partners than city agencies and town government. It shows strong evidence that the multilevel governance in the Dongguan water network features active and diverse participation from non-governmental sectors. This also shows diverging influence among government actors, with some key actors, including the WAB and EPB, playing central roles, and more governmental organizations playing supporting roles.

## 8. Discussion

This study aims at addressing the motivations of local policy actors in their participation in multilevel environmental governance. We specifically differentiate two different motivational drivers

of network participation: vertical pressure and horizontal brokerage. We specially ask these questions: are local policy actors' decision to participate still heavily influenced by the top-down administrative directives from their higher level government? That is, are they forced to participate in multilevel environmental governance? Or are they more driven by organizational goals to coordinate activities and achieve the collective good?

As shown in the above results, we found empirical support for both the impact of vertical influence and horizontal brokerage. This means that although China's local environmental governance is still facing challenges from the traditional administrative hierarchy [3], it presents some features of multilevel governance. Facing the tremendous administrative pressure from the city government, the city agencies, town governments and other NGOs actors are somehow forced into action in the policy network, and demonstrated features of a managed network [46]. This means that in the multilevel water governance in Dongguan, local policy actors are not enjoying equal status with their superiors. At the same time, we also observed the self-organizing element in the multilevel governance network, in that many policy actors have set goals to participate actively in the policy network and that these goals are working to predict network activities.

The influence of central government in the MLG in China also echoes the findings on the increasing role of national governments compared to state and local governments in the U.S., and the dominance of the EU over national governments in policy-making and implementation [47,48]. Enhancing the relative influence of lower level government and empowering non-government actors seem to be a universal problem facing countries across different political contexts.

The results of the regression analysis provide strong support for the influence of horizontal brokerage in motivating the participation of policy actors in multilevel governance. We can conclude that a bottom-up organization-driven process is in place to provide a solid basis for self-organizing multilevel governance. Obviously, the local policy actors are both under pressure from higher level government, and at the same time are willing to commit to working with their partners in multilevel collaborative water governance. The internalization of the externally imposed pressures helps to ensure the long-term sustainability of the MLG.

It was also observed that non-governmental actors tend to be more active than governmental actors in the network. This shows that the non-governmental actors are playing increasingly important roles in multilevel environmental governance in China. The transition from government-centered service delivery to a more inclusive governance model is evident in the governance of water affairs in Dongguan. Being entrepreneurial and flexible, the roles of businesses and non-profits supplement that of the government actors, who are typically rigid in policy implementation.

The significance of horizontal brokerage also reflects the maturation of the multilevel environmental governance in the Chinese context. A successful MLG requires continuous coordination of activities among policy actors [49]. The finding is also reflected in the interviews, in which a few local policy makers expressed the need for strong horizontal information sharing and joint projects to collectively solve the local water issues.

Another interesting finding is the insignificance of trust in the regression analysis. This is consistent with the descriptive statistics, which show that only 4% of policy actors report high trust in other organizations in the collaboration. This is consistent with the overall finding in this study that vertical pressure from higher level government dominates the formation and activities of the local water governance network. In order to enhance the self-organizing capacity of local policy actors, trust building is needed to enhance the bonding social capital among policy actors.

## 9. Conclusions

Multilevel environmental governance is increasingly important both as an academic focus and policy practice. With many local governments, businesses, and NGOs actively engaging in multilevel governance, the governance of water affairs is no longer an issue only for higher level governments. The critical questions we ask in this study center around who participate in local water governance,

and what drives their activities in the multilevel policy network. With a research design that allowed us to collect data on the actors in the local water policy network, we were able to study whether vertical pressure or horizontal brokerage affects network activities in MLG. The results provide support for the roles of vertical pressure and horizontal brokerage in driving participation in multilevel network governance.

This study highlights the challenges faced by local policy actors in addressing the pressures from higher level governments in MLG. Bureaucratic hierarchy is not always consistent with the logic of MLG, but it seems that the local water governance is still heavily influenced by the policy determination of the provincial and city governments. On the other hand, we also see very strong signals that local policy actors are increasingly capable of engaging in MLG, as evidenced by high network density and the significance of organizational goals in affecting their decisions to engage with other actors. It shows that the transition from traditional hierarchy to a more collaborative governance approach is making substantial progress in the Chinese context. Utilizing network analysis and OLS regression, this study presents a first step in understanding China's multilevel environmental governance.

While this study focuses on water governance in the City of Dongguan in Guangdong Province, we believe that the policy implications go beyond Dongguan and Guangdong as the multilevel nature of water governance is a general issue for governments in China. Other cities and provinces in China will likely see a similar effect of vertical pressure from central government in multilevel governance, as it is highly constrained by the authoritarian political institutions in China. Future studies are needed to address the multilevel nature of policy designs, and their impact on the local ecology of policy games played by the policy actors.

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