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## Article

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## Research paper

# A study on the classification of China's provincial carbon emissions trading policy instruments: Taking Fujian province as an example

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## ABSTRACT

In order to reduce greenhouse gas emissions, China's provinces have issued a series of carbon emission trading policies in recent years. As China's first ecological civilization demonstration zone, Fujian Province has also promulgated an array of carbon emission trading policies. Therefore, deeply analyzing the classification of carbon emission trading policies in Fujian Province is of great reference value for other regions to formulate carbon emission trading policies. This paper first introduces the textual formulation of the carbon emission trading policies in Fujian Province, and subdivides the relevant policies into 17 types of policy instruments as per the classification criteria of mandatory, hybrid, and voluntary. Besides, it also classifies and codes the instruments involved in the Fujian provincial carbon emission trading policies using social network analysis method, with a total of 107 social network actors obtained. On this basis, the differences in the composition of various policy instruments are to be compared and analyzed. The Results show that the proportions of mandatory policy instruments, hybrid policy instruments, and voluntary policy instruments are 54.20%, 36.45%, and 9.35%, respectively. The policy instruments used by the Fujian provincial government are dominated by mandatory and hybrid policy instruments, and the voluntary policy instruments account for a relatively low proportion. Currently, what the Fujian government's carbon emissions trading policies focus on is to improve the supervision and accountability mechanism so as to form a complete carbon emission trading supervision and management system. In the process of building a carbon emissions trading market, the government of Fujian Province should strengthen policy support for talent cultivation, carbon credit evaluation system construction, and policies support for projects in finance, and reinforce the construction of voluntary certification emission reduction mechanism in a timely manner, with a view to encouraging the participation of social forces in the construction of the carbon emissions trading market.

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## 1. Introduction

In recent years, China has paid great attention to building a carbon emission trading market. In the “Twelfth Five-Year Plan”, it was clearly stated that market-based means such as carbon emission trading should be fully used to control greenhouse gas emissions. In October 2011, the National Development and Reform Commission of China issued the *Notice on Pilot Carbon Emissions Trading Project*, and approved to launch the pilot projects of carbon emission trading in seven provinces and municipalities including Beijing, Tianjin, Shanghai, Guangdong, Hubei, Shenzhen and Hebei. In December 2016, Fujian Province became China's eighth pilot region for carbon emissions trading. [Appendix](#) shows

the construction of the carbon emissions trading market in each region.

In terms of industry coverage, Fujian Province has included nine industries – ceramics, aviation, power, chemicals, and building materials, for example – into the carbon emissions trading market system. In terms of corporate access standards, Fujian Province has set the access standard of the total energy consumption amounting to more than 10,000 tons of standard coal at any year in 2013 to 2015. In terms of quota management, Fujian Province chose to adopt a free distribution method at the initial stage, and has introduced a paid distribution mechanism at an appropriate time, ultimately increasing the proportion of paid distribution step by step. As to free quota accounting, in combination with the historical emission method and baseline method, the market trading methods like open bidding and agreement transfer have been introduced, while the main participants in the market include pilot enterprises, approved organizations

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and institutions, and natural persons. With regard to the punitive measures for non-performance of settlement and payment, the government supported and introduced professional third-party verification agencies to monitor the carbon emissions of enterprises. Furthermore, to prevent enterprises from completing emission reduction tasks only by purchasing carbon credits, Fujian Province has set a limit of no more than 10% for Chinese Certified Emission Reduction (CCER) offset ratio, requiring a fine of 1 to 3 times the average market price for the non-performed part, but the penalty amount does not exceed 30,000 yuan. (As shown in [Appendix](#))

As China's first ecological civilization demonstration zone and the 8th carbon emission trading pilot area, Fujian Province has issued an array of policy documents like *Implementation Plan of Fujian Province Carbon Emissions Trading Market Construction and Interim Measures for Fujian Province Carbon Emissions Trading Management*, which are involved in a number of policy instruments. Therefore, its policy practices are of important enlightening significance and great reference value for other regions of China. However, as of now, although there have been some studies focusing on the topic of China's provincial carbon emissions trading, most of them aim at the necessity of establishing China's carbon emission trading market ([Zhu et al., 2016](#); [Department of Eco-Environmental Response to Climate Change, 2018](#); [Jinqi, 2018](#); [Shuang, 2014](#)), the quota design of carbon emission permit ([Jotzo and Löschel, 2014](#); [Zhaoxia and Shian, 2018](#); [Mengshu, 2011](#); [Fan, 2018](#); [Kehui, 2015](#); [Li and Fengqiao, 2016](#); [Rui, 2016](#)), or the institutional design of China's carbon emission trading market ([Xiaotao and Xue, 2010](#); [Bowen, 2018](#); [Haiyun and Tao, 2013](#); [Li et al., 2012](#); [Lei and Yongqiang, 2019](#)) and the problems existing therein ([Jiemin, 2013](#); [Xiaoling and Chuiming, 2018](#); [Chao et al., 2016](#); [Xingyan, 2016](#); [Zhongyu and Zhixiong, 2018](#)), with few getting engaged in China's provincial carbon emission trading policy instruments. In view of the above, this paper, taking Fujian Province as an example, explores its use of carbon emission trading policy instruments, and strives to comparatively analyze the differences in the composition of various policy instruments involved in the carbon emission trading policies of Fujian Province on the basis of classifying policy instruments into the three types of mandatory, hybrid, and voluntary.

## 2. Methods and data

### 2.1. Methods

This paper carries out text mining and comparative analysis of Fujian carbon emission trading policy documents using social network analysis (SNA) method. SNA defines social structure and relationships as a network that quantifies the relations between actors in the social network, focusing more on finding the relations between actors and exploring the influence of the relationship on the whole network ([Borgatti, 2003](#); [Peng et al., 2015](#); [Qinghua and Liang, 2008](#)). Therefore, it is a relatively mature quantitative analysis method for public management issues, and has enjoyed a broad application prospect in the field of public management and policy analysis ([Aggarwal, 2011](#); [Ahmadi et al., 2019](#); [Borgatti et al., 2009](#); [Sandström and Carlsson, 2008](#); [Weihua, 2015a,b](#)). In SNA, a social network is a collection of multiple points (social network actors) and connections between the actors (the relations between actors). As a result, it has been widely used in a large number of literature, in which the text content of public policies are studied with tool software such as UCINET ([Yi et al., 2018](#); [Hailin and Cuihong, 2018](#); [Lewis, 2006](#)). The general practice is first to sort out the relevant policy documents to spot the policy instruments to be viewed as the actors in the social network after coding, and then to map the

policy instruments spotted with the Netdraw tool provided by Ucinet software and based on the SNA method.

UCINET has the NetDraw function, which can visualize data, as shown in [Fig. 3](#). After continuous upgrade and update from Basic language, Dos program to Windows system, it was upgraded to version 6.0 in 2002 and has been undergoing continuous upgrade. With the help of UCINET software, this paper teases out the policy instruments involved in the carbon emission trading policy documents of Fujian Province that are taken as social network actors and mapped, and analyzes the classification characteristics of the policy instruments on the basis of the mapping.

### 2.2. Data

This paper collects and sorts the 17 policy documents followed by the carbon emissions trading activities in Fujian Province since 2015, which are taken as the analysis samples of the policy texts. Based on the existing classification criteria of policy instruments ([Rochefort, 1997](#)), the carbon emission trading policy instruments of Fujian Province are divided into three categories, namely mandatory, hybrid and voluntary according to the strength of government administrative intervention. Among them, the mandatory policy instruments can be subdivided into 8 categories, including access mechanism construction, information reporting and verification, quota allocation and management, trading platform operation and maintenance, contract performance and settlement, carbon credit evaluation, supervision and accountability, and information disclosure. The hybrid policy instruments can be subdivided into 7 categories, including flexible quota adjustment mechanism construction, enrichment of carbon financial products and investment and financing channels, financial subsidies, increase of financial support, publicity and education training, priority to the application of financial fund support projects, and professional talent training. The voluntary policy instruments can be subdivided into 2 categories, namely construction of voluntary certification emission reduction mechanism and encouragement to social force participation. (As shown in [Tables 1 and 2](#))

Among the 17 policy documents collected, there are only Policy documents 3 and 4 covering all the policy instruments, and the remaining 15 policy texts cover different policy instruments. This suggests that the policies issued by the government have different priorities in the use of the policy instruments. For example, Policy documents 1 covers seven policy instruments, of which hybrid policy instruments occupy a relatively high proportion, indicating that in Policy documents 1, the government prefers to use hybrid policy instruments to strengthen carbon emissions trading management. (As shown in [Table 2](#))

The policy instruments involved in the selected 17 policy documents ranked as per the time of issuance can be coded into 107 actors in the social network, and the coding follows the principle of "actor serial number + policy file code + policy instrument number" (as shown in [Table 3](#)). Take the actor coded "1A(7)" in [Table 3](#) as an example, where 1 indicates the actor serial number, A is the code of the policy file involving the actor (see [Table 2](#) for details), and (7) stands for that the actor gets involved in the No.7 policy instrument (see [Table 1](#) for the policy instrument number).

## 3. Results and discussions

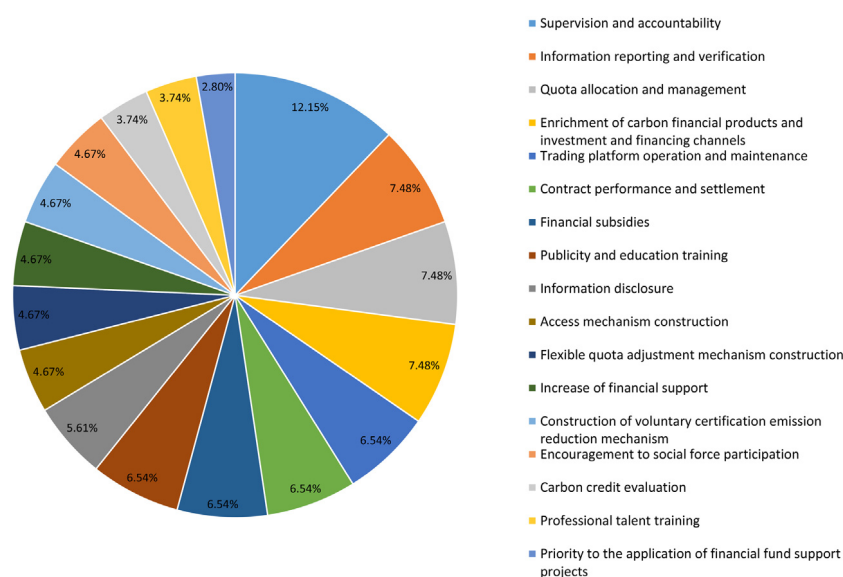
### 3.1. Results

The 107 social network actors (see [Table 3](#)) formed as per the classification of policy instruments can form a relationship matrix of the actors in the Fujian Carbon Emissions Trading Policy Instrument Network (if two actors belong to the same category of policy

**Table 1**  
Policy instruments for Fujian carbon emission trading system.

Category	Strength of government administrative intervention	Number & name
Mandatory	Strong	(1) Access mechanism construction; (2) information reporting and verification; (3) quota allocation and management; (4) trading platform operation and maintenance; (5) contract performance and settlement; (6) carbon credit evaluation; (7) supervision and accountability; (8) information disclosure
Hybrid	Medium	(9) Flexible quota adjustment mechanism construction; (10) enrichment of carbon financial products and investment and financing channels; (11) financial subsidies; (12) increase of financial support; (13) publicity and education training; (14) priority to the application of financial fund support projects; (15) professional talent training
Voluntary	Weak	(16) Construction of voluntary certification emission reduction mechanism; (17) encouragement to social force participation

Notes: “Hybrid–financial subsidies” represents the financial subsidy instrument in the hybrid policy category; “Mandatory–supervision and accountability” represents the monitoring and accountability instrument in the mandatory policy category.



**Fig. 1.** Proportion of social network actors contained by different carbon emissions trading policy instruments.

instrument, it is to be marked as “1” in the corresponding position of the relationship matrix; or otherwise it is “0”). The matrix is imported into the social network method analysis tool UCINET6.0, so that the social network map of various policy instruments can be drawn (see Fig. 3). There are 17 maps drawn in total. The number of social network actors included in each of the 17 policy instrument networks is shown in Table 4, and they can be ranked from high to low as per their proportion, namely: mandatory–supervision and accountability, mandatory–information reporting and verification, mandatory–quota allocation and management, hybrid–enrichment of carbon financial products and investment and financing channels, mandatory–trading platform operation and maintenance, mandatory–contract performance and settlement, hybrid–financial subsidies, hybrid–publicity education and training, mandatory–information disclosure, mandatory–access mechanism construction, hybrid–flexible quota adjustment mechanism construction, hybrid–increase of financial support, voluntary–construction of voluntary certification emission reduction mechanism, voluntary–encouragement to social force participation, mandatory–carbon credit evaluation, hybrid–professional talent training, and hybrid–priority to the application of financial fund support projects. The number of social network actors covered is 13, 8, 8, 8, 7, 7, 7, 7, 6, 5, 5, 5,

5, 5, 4, 4, 3, respectively, and the proportion accounted for in the total social network actors is 12.15%, 7.48%, 7.48%, 7.48%, 6.54%, 6.54%, 6.54%, 6.54%, 5.61%, 4.67%, 4.67%, 4.67%, 4.67%, 4.67%, 3.74%, 3.74%, 2.80%, respectively (see Fig. 1). Fig. 3 is a visual representation of the number of social network actors involved in the 17 policy instrument networks.

Among the 17 policy instruments, mandatory–supervision and accountability is the most frequently used, while hybrid–priority to the application of financial fund support projects is the lowest frequently used, with the use frequency of the former significantly higher than other policy instruments. As can be seen from Fig. 2, among the 107 actors, the proportions of mandatory, hybrid, and voluntary policy instruments are 54.20%, 36.45%, and 9.35%, respectively. As shown in Fig. 3, compared with voluntary policy instruments like construction of voluntary certification emission reduction mechanism and encouragement to social force participation, mandatory policy instruments like supervision and accountability, information reporting and verification, quota allocation and management, trading platform operation and maintenance, and contract performance and settlement see more intensive sub-network maps. The reasons may be ascribed to the short construction time of Fujian’s carbon emission trading market, needing-to-be-standardized operation

**Table 2**  
Fujian province carbon emissions trading policy documents.

No.	Document name	Issue time	Instruments involved	Document code
1	<i>Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating the Construction of Ecological Civilization</i>	April 25, 2015	(7)(10)(11)(12)(13)(16)(17)	A
2	<i>Notice of the General Office of the National Development and Reform Commission on 'The Internet Plus Green Ecology Three-Year Action Implementation Plan</i>	January 11, 2016	(7)(13)	B
3	<i>Interim Measures for the Management of Carbon Emissions Trading in Fujian Province</i>	September 22, 2016	(1–17)	C
4	<i>Notice of the Fujian Provincial People's Government on the Implementation Plan for the Construction of Carbon Emission Trading Market in Fujian Province</i>	September 26, 2016	(1–17)	D
5	<i>Notice on the 'Measures for the Management of Carbon Emissions Offset in Fujian Province (Trial)'</i>	November 28, 2016	(3)(5)	E
6	<i>Notice of Fujian Provincial Bureau of Quality and Technical Supervision and Fujian Provincial Development and Reform Commission, on the 'Measures for the management of the Third-party Verification Organization Concerning Carbon Emissions Trading in Fujian Province (Trial)'</i>	November 28, 2016	(2)(3)(5)(7)	F
7	<i>Notice of Fujian Provincial Development and Reform Commission and Fujian Provincial Department of Finance on the 'Implementation Rules for the Regulation of the Carbon Emission Trading Market in Fujian Province (Trial)'</i>	November 30, 2016	(4)(9)	G
8	<i>Notice of Fujian Provincial Development and Reform Commission and Fujian Provincial Bureau of Statistics on the 'Measures for the Management of Greenhouse Gas Emission Reports of Key Enterprises and Public Institutions in Fujian Province (Trial)'</i>	November 30, 2016	(2)(3)(7)(8)	H
9	<i>Notice on the 'Implementation Rules for the Management of Credit Information in the Carbon Emission Trading Market of Fujian Province (Trial)'</i>	November 30, 2016	(2)(6)(7)(8)(17)	I
10	<i>Notice of the Fujian Provincial Development and Reform Commission on the 'Implementation Rules for the Management of Carbon Emission Quotas in Fujian Province (Trial)'</i>	December 2, 2016	(1)(2)(3)(4)(5)(7)	J
11	<i>Notice on Further Promoting Forestry Ecological Construction by Developmental and Policy Finance</i>	January 20, 2017	(7)(10)(11)(12)(13)(14)	K
12	<i>Notice of the Fujian Provincial People's Government on the Work Plan for Controlling Greenhouse Gas Emissions in the 13th Five-Year Plan of Fujian Province</i>	January 26, 2017	(1–12)(15)(17)	L
13	<i>Notice of the General Office of the Fujian Provincial People's Government on the Pilot Program for Forestry Carbon Sink Trading in Fujian Province</i>	May 17, 2017	(10)(11)(13)(15)(16)	M
14	<i>Opinions of Fujian Provincial People's Government on Promoting the Construction of National Ecological Civilization Experimental Zone (Fujian) by Playing the Role of Price Mechanism</i>	May 26, 2017	(4)(7)	N
15	<i>Notice on 'Issuing the Measures for the Member Management of the Carbon Emission Business of Haixia Equity Exchange Center (Revised in 2017)'</i>	December 4, 2017	(7)(16)	P
16	<i>Notice of the National Development and Reform Commission on the 'National Carbon Emissions Trading Market Construction Plan (Power Generation Industry)'</i>	December 18, 2017	(1)(2)(3)(4)(5)(7)(8)(9)(10)(13)	Q

(continued on next page)

standards, and stronger binding effectiveness of mandatory and hybrid policy instruments than voluntary ones, for mandatory

and hybrid policy instruments can play a more intense normative role in the construction of the carbon emissions trading market.

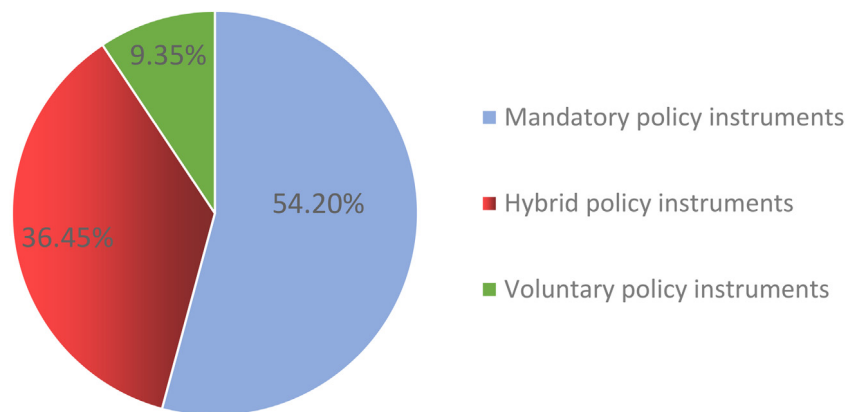
**Table 2** (continued).

No.	Document name	Issue time	Instruments involved	Document code
17	<i>Notice of the National Development and Reform Commission on the 'Work Plan for Ecological Poverty Alleviation'</i>	January 18, 2018	(10)(11)	R

Data Sources: 1. Chinese government website: <http://www.gov.cn>;  
 2. National Development and Reform Commission of the People's Republic of China: <http://www.ndrc.gov.cn>  
 3. Fujian Provincial People's Government: <http://www.fujian.gov.cn>;  
 4. Fujian Provincial Development and Reform Commission Committee: <http://fgw.fujian.gov.cn>;  
 5. Haixia Equity Exchange: <http://carbon.hxee.com.cn/dfgf/index.htm>.

**Table 3**  
Codes of social network actors of the carbon emissions trading policy instruments.

The codes of 107 social network actors	
1A (7) 、 2A (10) 、 3A (11) 、 4A (12) 、 5A (13) 、 6A (16) 、 7A (17) 、 8B (7) 、 9B (13) 、 10C (1) 、 11C (2) 、 12C (3) 、 13C (4) 、 14C (5) 、 15C (6) 、 16C (7) 、 17C (8) 、 18C (9) 、 19C (10) 、 20C (11) 、 21C (12) 、 22C (13) 、 23C (14) 、 24C (15) 、 25C (16) 、 26C (17) 、 27D (1) 、 28D (2) 、 29D (3) 、 30D (4) 、 31D (5) 、 32D (6) 、 33D (7) 、 34D (8) 、 35D (9) 、 36D (10) 、 37D (11) 、 38D (12) 、 39D (13) 、 40D (14) 、 41D (15) 、 42D (16) 、 43D (17) 、 44E (3) 、 45E (5) 、 46F (2) 、 47F (3) 、 48F (5) 、 49F (7) 、 50G (4) 、 51G (9) 、 52H (2) 、 53H (3) 、 54H (7) 、 55H (8) 、 56I (2) 、 57I (6) 、 58I (7) 、 59I (8) 、 60I (17) 、 61J (1) 、 62J (2) 、 63J (3) 、 64J (4) 、 65J (5) 、 66J (7) 、 67K (7) 、 68K (10) 、 69K (11) 、 70K (12) 、 71K (13) 、 72K (14) 、 73L (1) 、 74L (2) 、 75L (3) 、 76L (4) 、 77L (5) 、 78L (6) 、 79L (7) 、 80L (8) 、 81L (9) 、 82L (10) 、 83L (11) 、 84L (12) 、 85L (15) 、 86L (17) 、 87M (10) 、 88M (11) 、 89M (13) 、 90M (15) 、 91M (16) 、 92N (4) 、 93N (7) 、 94P (7) 、 95P (16) 、 96Q (1) 、 97Q (2) 、 98Q (3) 、 99Q (4) 、 100Q (5) 、 101Q (7) 、 102Q (8) 、 103Q (9) 、 104Q (10) 、 105Q (13) 、 106R (10) 、 107R (11) .	

**Fig. 2.** Proportion of different types of carbon emissions trading policy instruments.

In the process of using policy instruments, the government pays more attention to the comprehensive supervision of the carbon emission trading market, so as to ensure the rational allocation of carbon emission quotas. It is worth noting that carbon credit evaluation, priority to the application of financial fund support projects, and training of professional talents are important links in the construction of carbon emission trading market, which is of great significance for promoting the development of carbon emission trading market in Fujian Province, but these three policy instruments involve a small number of social network actors, and thereby need to be improved.

### 3.2. Discussions

It can be discovered that mandatory—supervision and accountability instrument is the most frequently used among the 17 policy instruments. Why is the government so keen to promote the development of the carbon emission trading market through the supervision of accountability instrument during the construction of the carbon emission trading market in Fujian Province? This is mainly because the use of supervision and accountability instrument can form a powerful deterrent in the construction of the carbon emission trading market. Meanwhile, it can make the implementers of policy instruments more self-binding and ensure that the market transactions are conducted fairly.

Mandatory and hybrid instruments account for 90.35% of the total number of policy instruments used. This strongly reflects the



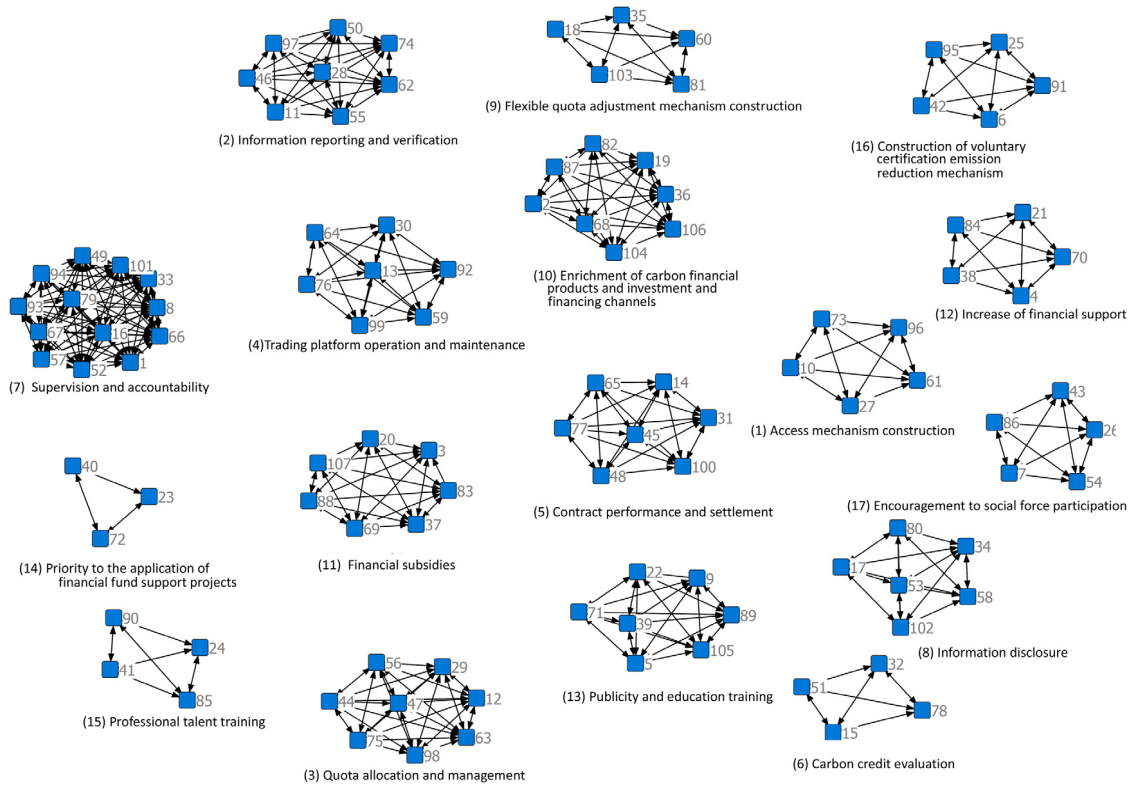


Fig. 3. Policy network map of Fujian provincial carbon emission trading system.

Table 4  
Number of social network actors contained in the carbon emissions trading policy instruments.

Region	Number of social network actors contained in the policy instruments																
	Mandatory					Hybrid							Voluntary				
	Access permission mechanism	Information reporting and verification	Quota allocation and management	Trading platform operation and maintenance	Contract performance and settlement	Carbon credit evaluation	Supervision and accountability	Information disclosure	Flexible quota adjustment mechanism construction	Enrichment of carbon financial products and investment and financing channels	Financial subsidies	Increase of financial support	Publicity and education training	Priority to the application of financial fund support projects	Professional talent training	Construction of voluntary certification emission reduction mechanism	Encouragement to social force participation
Fujian	5	8	8	7	7	4	13	6	5	8	7	5	7	3	4	5	5

Notes: “Hybrid—financial subsidies” represents the financial subsidy instrument in the hybrid policy category; “Mandatory—supervision and accountability” represents the monitoring and accountability instrument in the mandatory policy category.

government’s preference on use of the 17 policy instruments in Fujian Province. But whether the government is excessively involved in the development of the carbon emission trading market is still worth further discussion.

This paper uses three types of policy classification methods including mandatory, hybrid and voluntary in the classification of carbon emission trading policy instruments in Fujian Province, but in fact, other policy instruments classifications can be considered for provincial carbon emission trading policy instruments. In addition, this paper uses social network analysis to study policy texts and policy instruments, but other methods, such as qualitative analysis, can also be applied to this study.

#### 4. Conclusions

In the construction of the carbon emission trading market in Fujian Province, compulsory, hybrid and voluntary policy instruments were comprehensively utilized, but there were significant differences in the component ratio of the policy instruments. In the process of using policy instruments to promote the development of the carbon emission trading market, Fujian government tended to use mandatory and hybrid policy instruments rather than voluntary ones. Therefore, perfecting the supervision and accountability mechanism to form a complete carbon emission trading supervision and management system is the focus of the current Fujian government’s carbon emissions trading policy. In

**Table A.1**  
Overview of the Construction of Pilot Areas for Carbon Emissions Trading in China.

Pilot Areas	Beijing	Tianjin	Shanghai	Shenzhen	Chongqing	Guangdong	Hubei	Fujian
Run-up time	November 28, 2013	December 26, 2013	November 26, 2013	June 18, 2013	June 19, 2014	December 19, 2013	April 2, 2016	December 22, 2016
Trading platform	Beijing environment exchange	Tianjin climate exchange	Shanghai environment and energy exchange	Shenzhen emissions exchange	Chongqing Carbon emissions trading center	Guangzhou emissions exchange	Hubei emission exchange	Fujian Haixia Exchange
Industries covered	6 major industries (e.g., steel, chemical engineering, and large-scale construction)	6 major industries (e.g., steel, electric power, and civil construction)	10 major industries (e.g., building materials, papermaking, and finance)	4 major industries (electricity, water, construction, and manufacturing)	Industries like power, metallurgy, chemical engineering, and building materials	6 major industries (e.g., power, cement, and steel)	8 major industries (cement, electricity, and papermaking)	9 industries (e.g., ceramics, aviation, power, chemical engineering, and building materials)
Access standard	10,000 tons and above of total carbon dioxide emissions	20,000 tons or above of carbon dioxide emissions from industries and civil construction	10,000 tons or above of industrial carbon dioxide emissions, 10,000 tons or above of non-industrial carbon dioxide emissions	5,000 tons or above of carbon dioxide emissions; an area of 10,000 M <sup>2</sup> or above for public and office buildings	10,000 tons and above of total carbon dioxide emissions	10,000 tons of industrial carbon dioxide emissions, or 5,000 tons of non-industrial carbon dioxide emissions	Annual comprehensive energy consumption reaching 60,000 tons of standard coal	Total energy consumption in any year from 2013 to 2015 reaching 10,000 tons of standard coal
Quota distribution	Free quotas allocated every year, with a small number reserved for auction.	Dominated by the free and supplemented by the paid	One-time free allocation of 2013–2015 carbon emission quotas for enterprises from	Combination of paid and unpaid, with the quotas for new entrant quotas reserved	Free allocation (Combination of government total control and corporate competition )	Combination of paid and unpaid, with the quotas for new entrants reserved	Free allocation, with 3% reserved for carbon trading market regulation and 15% as quotas for new entrants	Initially adopting a free distribution method, and introducing a paid distribution mechanism in a timely manner to gradually increase the proportion of paid quotas.
Free quota determination methods	Historical emission method & baseline method			Baseline method	Enterprise independent declaration	Historical emission method & baseline method		
Trading methods	Public trading, agreement transfers, etc.	Network spots, agreement and auction trading, etc.	Listing transactions and agreement transfers	E-auctions, click-through pricing, large-scale transactions, agreement transfers, etc.	Open bidding, agreement transfers, etc.	Listing bidding, single bidding, agreement transfers, etc.	E-bidding, network matching	Open bidding, agreement transfers, etc.
Market participants	Pilot enterprises, approved organizations and institutions, natural persons							
Punitive measures for non-performance of settlement	It is allowed to offset no more than 5% of CCCE and local emission reduction credits, and a fine of 3–5 times the average market price is to be imposed against the non-performed part.	It is allowed to offset no more than 5% of CCCE; in the case of non-performance, the qualification of applying for relevant support policies will be canceled.	It is allowed to offset no more than 5% of CCCE; in the case of non-performance, the enterprises are to be ordered to pay for the originally free quotas, with a fine of 50,000–100,000 yuan.	It is allowed to offset no more than 5% of CCCE, and the number of the non-performed part will be deducted from the quota next year, with a fine of 3 times the average market price imposed.	It is allowed to offset no more than 8% of CCCE; in the case of non-performance, a fine of 3 times the average market price is to be imposed, and the qualification of applying for excellence selection and financial subsidies to be canceled.	It is allowed to offset no more than 10% of CCCE; in the case of non-performance, 2 times the number of the non-performed part is to be deducted from the quota next year, with a fine of 50,000 yuan imposed.	It is allowed to offset no more than 10% of CCCE, and a fine of 1–3 times the average market price is to be imposed against the non-performed part, with an upper limit of 150,000 yuan and 2 times deduction from the quota next year.	It is allowed to offset no more than 10% of CCCE, and a fine of 1–3 times the average market price is to be imposed against the non-performed part, with an upper limit of 30,000 yuan and 2 times deduction from the quota next year.

the process of building a carbon emission trading market, Fujian government should increase policy support for talent cultivation, strengthen the training of relevant professionals engaged in carbon emissions trading, and support and encourage the

wide-ranging cross-system, interdisciplinary, cross-sectoral and inter-regional cooperation and exchanges among universities, research institutes, enterprises in the industry, and government



departments, in an attempt to cultivate a batch of professionals who are capable of and interested in devotion to this field, accelerate carbon credit evaluation system construction, uplift financial and policy support, and strengthen the construction of voluntary certification emission reduction mechanism in a timely manner, with a view to encouraging social forces to actively participate in the construction of carbon emissions trading market.

The result of this paper shows that the policy instruments with binding nature are widely used in the construction of the carbon emission trading market in Fujian Province. It is mainly due to the fact that the carbon emission trading market in Fujian Province is still in the primary construction stage. Although the use of compulsory and hybrid policy instruments is positive for promoting market development, attention should also be paid to prevent the risks of excessive interventions in the development of the carbon emission trading market. The development of the carbon emission trading market in Fujian Province needs to be realized through the comprehensive use of various policy instruments.

### Abbreviations

CCER: Chinese Certified Emission Reduction

SNA: Social Network Analysis

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Authors' contributions

YLD provided literature reviews and some quantitative analyses. GD guided the project with direction and ideas. SSL analyzed the data and edited the manuscript.

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### Appendix

See [Table A.1](#)

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