Institutional, Technical and Financial Arrangements in China's Rural Pollution Abatement

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Abstract: *This study tracks rural waste management systems in China since 2017. Our findings are threefold: (i) Rural waste management in China is underpinned by an institutional framework of environmentally-minded laws and regulations; (ii) substantial progress has been made in livestock pollution treatment, "toilet revolution" and domestic waste management as a result of extensive public communication and state-led enforcement; (iii) environmental responsibilities are shared among the government, polluters and households. In particular, government spending has focused on areas of market failure such as waste reduction, antitoxic treatment and recycling. Moreover, our research uncovers that current waste management systems are unsustainable and must be remedied by: (i) setting aside sufficient funds for infrastructure maintenance; and (ii) increasing villagers' participation in project design and investment. Also, existing public utilities such as sewage treatment facilities should be remodeled to increase coverage for rural households who live at scattered settlements.*

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1. Introduction

Since 2018, China has implemented action plans on livestock pollution treatment, the "toilet revolution" to improve sanitary conditions, and domestic waste management as part of the rural revitalization strategy. These endeavors have yielded great results. Given the progress of the action plans, the Institute of Economics of the Chinese Academy of Social Sciences (CASS) organized a task force to survey over 20 environmental management demonstration villages in nine counties in Henan, Hubei and Zhejiang provinces and Guangxi Zhuang and Ningxia Hui autonomous regions. Fiscal subsidies greatly encouraged livestock manure treatment and investment in sanitary toilets and domestic waste treatment. For these public actions to be sustainable, however, the government should subsidize additional quasi-public services in the countryside.

2. Public Economics in Village Pollution Treatment

In the era of modern industry, the traditional recycle and reuse of rural wastes is giving way to the standardized collection, transportation and treatment of manure and domestic waste. Behind this socio-

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economic transformation, a swathe of questions needs to be answered. For instance, who is the polluter and who is the beneficiary? Should both pay? How should they pay? Which level of government should cover the costs for public goods and services in pollution control? How much should be spent and how would the funds be raised? How to balance efficiency with fairness in government investment? In addition to providing fiscal inputs, the government may intervene in pollution abatement projects through legislation, service and supervision. All these factors have been taken into account in the implementation of the Three-Year Action Plan for Improving the Rural Living Environment.[1]

Rural waste management in China is underpinned by an institutional framework of environmentally-minded laws and regulations. Under the aegis of this framework, waste management efforts are mobilized, organized and implemented by the government at all levels through the enaction of policy documents such as action plans and guidelines. In 2017, the 19th CPC National Congress adopted the "countryside revitalization strategy" and the central government released the *Three-Year Action Plan for Improving the Rural Living Environment*. Since then, the Chinese government has issued a multitude of policy documents on livestock pollution, the "toilet revolution" and domestic waste management. These documents have set out the responsibilities of competent authorities and the code of conduct for relevant institutions, enterprises, and individuals. Technical standards, management procedures, action plans and implementation and supervision measures have also been established. Competent authorities at all levels have followed a top-down approach in implementing the action plans.

The implementation of action plans started with public awareness programs as the first step for social mobilization for a better countryside. Livestock pollution control, "toilet revolution" and domestic waste management are all inspired and made possible by contemporary environmental concepts. County and township governments have communicated the concepts of actions and steps of implementation to all rural enterprises, farmers and households in their jurisdictions using simple and understandable language. They have also sent the key messages of the action plans to primary and middle schools, with the intention of having informed students influence their parents (Hengxian County Integrated Waste Treatment Project Team, 2013). Second, local governments have received technological support from research institutions, innovative businesses, and private capital in implementing each action plan. Waste management has created new businesses and jobs in the countryside in such areas as the collection and transportation of livestock manure, village sanitation and the sorting of garbage, toilet maintenance and the cleaning of septic tanks, and the management of garbage and wastewater treatment equipment. The use of rural waste management equipment has created manufacturing business opportunities.

First, central and local governments have allocated fiscal subsidies to rural waste management, forming a system of fiscal incentives that has directed funds to critical areas such as waste treatment that reduced pollution risks. Law enforcement and subsidies have incentivized and enabled enterprises, households and individuals to participate. From the treatment of livestock manure to sanitary toilets and the treatment of domestic waste, fiscal subsidies have encouraged private sector participation.

Second, the fiscal subsidy system for waste management works well with previous policy incentives for industrial development. For instance, subsidies were given to large livestock farms and counties on a priority basis to encourage livestock pollution treatment and manure recycling. According to the Ministry of Agriculture and Rural Affairs, by the end of 2017, large livestock farms accounted for 58% of livestock farming in China, and 65% and 64% of large livestock farms had adopted manure treatment facilities and recycled livestock manure, respectively.

Third, fiscal resources have been focused on the supply of public goods and quasi-public goods, as well as blind spots in the waste recycling market. Investments in centralized solid waste treatment and

[1] See the report of Xinhua News Agency on February 5, 2018: *Three-Year Action Plan for Improving Rural Living Environment* released by the General Office of the CPC Central Committee and the State Council General Office. Downloaded from http://www.gov.cn/zhengce/2018-02/05/content_5264056.htm on June 18, 2019.

sewage systems help align the supply of sewage and solid waste services with public expectations and conserve resources. Another priority is waste recycling, with subsidies for the construction of biogas digesters and waste-to-energy power plants. In areas where market mechanisms fail, fiscal subsidies have incentivized service supply from the private sector. Given the existence of a well-functioning market for recyclable domestic waste, local governments have invested in the collection, transportation and treatment of non-recyclable waste. Although livestock farmers trade dry manure between themselves, they are not willing to trade liquid manure and waste as the storage, transportation and fermentation is costly. In Zhejiang Province, local governments have shared the costs of investment in storage and transportation equipment and daily transportation, introduced a professional service company, and created a market for manure and wastewater collection and transportation.

Fourth, fiscal funds have been used to increase the supply and consumption of merit goods for public benefit. For instance, upgrading rural private toilets into modern sanitary toilets is good for people's health and helps improve sanitation at home and in the external environment. Similarly, the construction of drinking water facilities and kitchen renovations achieve similar effects. For this reason, local governments have set aside fiscal resources to improve water, kitchen and toilet facilities for village communities and households, creating a safety net for low-income individuals and groups to contribute to the establishment of a more sanitary living environment and safer drinking water.

3. Institutional and Technical Requirements for Waste Management

The reality is that fiscal incentives alone are not enough for rural waste management to become sustainable. The government should establish procedures by which villagers could participate in decision-making (Bekchanov *et al*., 2018). Public participation is essential if projects are to fit local conditions and needs while avoiding inefficiency and ineffectiveness. The importance of public participation is demonstrated in sanitary toilet and waste treatment facilities that residents were happy to use and took the initiative to maintain. Some facilities were underused or discarded because they did not fit local conditions. For instance, flush toilets in regions where water was scarce or with frigid winters were rarely used. Another reason for non-use is the high cost of use. In some cases, county-level centralized waste treatment sites are distant from cash-strapped fringe townships, forcing the townships to landfill wastes locally without treatment.

Some facilities were not equipped with maintenance systems or professional managers. In villages where most of the residents were elderly and physically weak persons, and women and children, newly-built public toilets quickly became dilapidated without regular cleaning and maintenance. Some oligodynamic sewage treatment facilities were left idle due to the lack of operation and maintenance. Rural waste management can be sustainable only when convenient and cost-efficient waste disposal systems are in place and they are properly maintained by villagers, self-governing village organizations and local governments.

Any treatment technology, if it is too costly to be widely applied, increases the potential for the application of technical or institutional innovations. For instance, rural domestic sewage is often mixed with chemical residuals and must be purified to reduce the risk of polluting the environment. Yet scattered, village-based sewage purification technology is too expensive to be widely applied. As a solution although already implemented in developed counties or cities, the extension of urban sewage pipelines to the surrounding countryside hardly reaches village households at the fringe of jurisdictions. Less-developed counties cry out for economical and easy-to-operate sewage purification systems for their scattered populations. This gap needs to be filled by government-led technological innovation.

Treatment facilities for rural domestic waste also require economies of scale to be financially sustainable. The question is what is the appropriate technology and scale of operation for domestic waste management? To answer this question, we need to conduct an assessment of the method of low-

cost waste collection and transportation. According to existing studies, transportation accounts for around 50% of the total operational cost of centralized waste treatment; biodegradable waste normally accounts for 50% of domestic waste in villages and towns, and this ratio is close to 80% in some villages (He *et al*., 2010; 2014). Our research team observed in an administrative village with successful waste sorting practices that farmer households or village cleaners put compostable waste (biodegradable organic waste) into a biogas digester and cleaners further sorted and transported non-compostable waste; while recyclable wastes were sold to collectors, non-recyclable wastes were delivered to treatment centers shared by a few townships. While hazardous waste was stored locally for transportation to the county-level waste treatment plant, non-hazardous waste was put into an incinerator with heat cracking technology (with a daily capacity of 10~30 tons). Not only did this approach reduce dioxin emissions from waste incineration, but the final product could be used as a cement additive. Shared waste treatment facilities have made economies of scale possible for scattered villages. Cost-effective waste sorting and treatment in villages have rendered this approach financially sustainable. Compared with urban neighborhoods, village waste sorting offers more economic and social cost advantages.

It should be noted, however, that most villages recommended by the local governments for our field studies are demonstration villages. Since the launch of the "new countryside campaign," these villages have received fiscal support for infrastructure and public services. According to officials from a township government in Ningxia, a village must meet three criteria to qualify as a demonstration village: First, it should have a large population with at least 2/3 of villagers living in the village for more than half a year in the recent year; second, the locations of households should be concentrated; third, village Party branches and village committees should be competent. Without a doubt, these criteria are intended to maximize the effectiveness of public investment. A large permanent population means a lower infrastructure and public services cost per head. A high concentration of households will economize public investment and facility operation and maintenance costs. The competence of village Party branches and village committees provides an essential organizational assurance for project implementation and sustainable operation.

The question is how could villages that cannot meet these criteria replicate the waste management practices of demonstration villages? A simple answer is to create the conditions, which cannot be accomplished overnight. It takes time for rural waste management to develop from scratch. All the surveyed counties and cities have consolidated villages and townships many times to save administrative costs, but the concentration of the permanent village population did not increase at the same pace. In hollowed out villages where most residents have left for cities, remaining villagers would trade their housing plots only for much more favorable land contracts or resettlement compensation. Of course, better public services and new village planning would help attract households. From this perspective, some villages will inevitably disappear as populations migrate elsewhere. In this context, local governments should introduce appropriate technical solutions and management practices for waste management according to the scattered locations of village households. Efforts should also be made to encourage villagers to participate in public affairs and to identify and train emerging village leaders to enhance village self-governance.

The current status of village affairs in the demonstration villages indicates a rapid expansion of public services and quasi-public services in the countryside in recent years. Payments from villagers and village public financial expenditures may cover only part of the costs. Without fiscal subsidies, service supply systems could fail. As mentioned by two village Party secretaries in Yueqing County of Zhejiang Province, it took less than 100,000 yuan to run village affairs, but with additional public services - not least environmental management, the cost increased tenfold. To make up for the funding gaps, they asked for donations from entrepreneurs who returned home during lunar New Year festivals. For cash-strapped villages, regular fiscal subsidies are necessary to run new quasi-public services. More importantly, villagers and village economic organizations should be given greater autonomy in crop farming and

more construction land quotas for non-farming activities to generate more income. Policymakers should create such conditions for villages to earn more income to fund community services.

4. Concluding Remarks: Fiscal Support Needed to Run Public Services in Villages

Since 2014, rural environmental management funds have, as a separate item, accounted for around 0.03% of the national general public budget, as shown in Table 1. The Chinese government earmarked a slew of special funds for improving the rural living environment in 2018 under the Three-Year Action Plan. Since 2019, the central government has devoted some 10 billion yuan to improving the rural living environment in central and western regions, including rural fecal treatment and recycling and rewards to high-performing counties.[2]

Yet most funds are special public investment, leaving maintenance underfunded. According to previous experience, the lack of maintenance for rural roads and drinking facilities leads to recurring traffic problems and water shortages due to equipment wear and tear. Given the missing data about special subsidies for public facilities at the community level, we use data from Table 2 to roughly explain the degree of county (city) government fiscal support to public and quasi-public services in local communities. From 2016 to 2018, government spending on urban and rural community affairs accounted for 3% to 9% of total fiscal spending in the four surveyed counties (cities). Such data makes no distinction between urban and rural areas and detailed items, but it reflects the level of fiscal subsidies for utilities maintenance. Hence, it provides a reference for subsequent fiscal policymaking for the

Table 1: Special Funds for Improving the Rural Environment as Part of the National General Public Budget Expenditure, 2014-2018

	Special funds for improving the rural environment (100 million yuan)	National general public budget expenditures (100 million yuan)	Percentage
Final account in 2014	58.84	151,785.56	0.0388
Final account in 2016	59.93	187,755.21	0.0319
Final account in 2017	59.85	203,085.49	0.0295
Final account in 2018	59.84	220,904.13	0.0271

*Data was downloaded from the webpages of the Ministry of Finance on July 29, 2019. Specifically, data for rural environmental improvement funds are from the following sources:

2014: http://yss.mof.gov.cn/2014czys/201507/t20150709_1269837.html (Project name: "Rural environmental protection fund")

2016: http://yss.mof.gov.cn/2017zyys/201703/t20170324_2565746.html

2017: http://yss.mof.gov.cn/qgczjs/201807/t20180712_2959754.html

2018: http://yss.mof.gov.cn/2018czjs/201907/t20190718_3303311.html

National general public budget expenditure data are from the following sources:

2014: http://yss.mof.gov.cn/2014czys/201507/t20150709_1269855.html

2016: http://yss.mof.gov.cn/2016js/201707/t20170713_2648981.html

2017: http://yss.mof.gov.cn/qgczjs/201807/t20180712_2959592.html

2018: http://yss.mof.gov.cn/2018czjs/201907/t20190718_3303195.html

[2] See the update of the Ministry of Agriculture and Rural Affairs: *Steady Progress Made in Improving Rural Living Environment,* downloaded on August 11, 2019 from http://www.shsys.moa.gov.cn/gzdt/201907/t20190712_6320789.htm.

Three-Year Action Plan.

Amid the novel coronavirus (COVID-19) pandemic, China has been under great pressure to shore up the economy, create jobs, and protect livelihoods. Despite these priorities, China should continue to maintain public investment in rural pollution abatement. Otherwise, the hard-won progress could be lost. To fight COVID-19, the countryside needs resources to improve public health and the environment.

As the pandemic persists, China should, in parallel with emergency measures, strive to narrow regional, urban-rural and wealth gaps in the long run. Over the past four decades, substantial improvements have been made in rural infrastructure. Yet access to public services remains unequal

Table 2: Government Spending on Rural and Urban Community Affairs in Surveyed Counties (cities), 2016-2018*

Survey site and year	Total fiscal revenue	Total fiscal spending	Spending on urban and rural community affairs and percentage in total fiscal spending		Registered permenant population	Per capita fiscal revenue
	In 100 million yuan	In 100 million yuan	In 100 million yuan	%	In 10,000 people	Yuan/person
Hengxian County, Guangxi						
2016	50.84	50.84	1.85	3.64		
2017	45.55	44.69	1.39	3.11	127.46	3,574
2018	50.15	49.89	1.88	3.77		
Beiliu City, Guangxi						
2016	53.96	53.96	2.18	4.04	151.5	3,562
2017	55.72	55.72	2.26	4.06		
2018	58.16	58.16	1.41	2.42		
Yueqing City, Zhejiang						
2016	102.56	102.56	3.03	2.95		
2017	113.1	113.1	3.1	2.74	130.89	8,641
2018	147.4	147.4	13.2	8.96		
Pingluo County, Ningxia						
2016	16.11	16.11	0.53	3.29	28.92	5,571
2017	18.09	18.09	0.53	2.93		
2018	20.69	20.69	1.2	5.80		

* Notes: Spending on urban and rural community affairs is government spending on a range of community affairs, including urban and rural community administration, public facilities, environment and sanitation, as well as market management and supervision. Fiscal income and spending data are from the fiscal budget drafts published on local government websites. Total population is year-end registered permenant population. Population data for Hengxian County of Guangxi and Yueqing County of Zhejiang are from the local Statistical Communique on National Economic and Social Development. Population data for Beiliu City of Guangxi and Pingluo Cuonty County of Ningxia are from *Guangxi Statistical Yearbook 2018* and *Ningxia Statistical Yearbook 2018*.

across the country. China should invest more in rural public services to curb pollution and improve public health, and empower less developed regions and vulnerable groups to cope with health and economic crises, escape poverty, and increase social cohesion.

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[2] He, Pinjing, Chunyan Zhang, and Na Yang *et al*. 2010. "Rural Domestic Waste Treatment in China: Current Status and Technical Pathways." *Journal of Agro-Environment Science*, 29 (11):2049-2054.

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