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Implementing Water Policies in China: A Policy Cycle Analysis of the Sponge City Program Using Two Case Studies

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Abstract: This study carries out an in-depth analysis of urban water policy implementation in China through a policy cycle analysis and case study of Sponge city program. The policy cycle analysis articulates discrete steps within the policy formulation and implementation process, while the case studies reflect the specific problems in water project implementation. Because of the principal–agent relation between central and local government, a "double wheel" policy cycle model is adopted to reflect the policy cycles at central level and at local level. Changde city and Zhuanghe city, two demo cities in the Sponge city program, are chosen for the analysis. The policy cycle analysis shows that the central government orders local government to implement policy without clear direction on how to attract private sector participation. The evaluation of central government did not include private sector involvement, nor the sustainability of the investments. This promotes the local government's pursuit of project construction completion objectives, without seriously considering private sector involvement and operation and maintenance (O&M) cost. The local governments do not have political motivation and experiences to attract private investments into project implementation. The case study in the two demo cities shows that local government subsidies are the main source of O&M funding currently, which is not sustainable. The water projects are not financially feasible because no sufficient revenue is generated to cover the high initial investments and O&M cost. The lack of private sector involvement makes it difficult to maintain adequate funding in O&M, leading to the unsustainability of the water projects. It is not easy to achieve private sector involvement, but it could be the key to realizing urban water resilience in a more sustainable way.

Keywords: policy cycle analysis; policy implementation; private sector involvement; sponge city program; effectiveness; sustainability

1. Introduction

Despite a long history of river management, China has only 40 years of experience with urban water management. In the 1980s, Chinese urban water policy was focused exclusively on water supply and drainage; in the 1990s, it began emphasising urban water quality. Since 2010, rapid urbanisation and the high frequency of extreme weather events have led to more serious water pollution, water scarcity and flooding problems in Chinese cities [1]. New water policies have recently been enacted to respond to these challenges and to try to build a resilient urban water management system [2]. To reach water resilient cities, the immediate response to a crisis tends to be regulation and better planning.

Introducing new rules is the first reaction. However, urban water management requires a localised and targeted response in the face of all kinds of initiatives by communities and companies to deal with the crisis. Some researchers point to the possibility of involving the relevant stakeholders during a crisis by introducing adaptive water management rather than relying on top-down governance structures because the solutions would be tailored to the local situation [3]. China is usually defined as an authoritarian state that deploys hierarchical top-down policy-making mechanisms.

What is the effectiveness of the implementation of these new water policies in China? In a hierarchical structure, the upper level issues orders to the lower level while the lower level merely executes the commands, as shown in Figure 1. In China, water policy is implemented by the local governments but formulated by the central government, which tends to design broad policies according to their ideology and conception of the problems and then orders local governments to implement these policies [4]. Research revealed that local governments' considerations and activities during the implementation process are complex and enhance the risk of implementation failure, even though the central government possesses absolute authority and power over their subordinates [5,6].

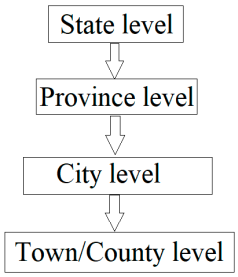

Figure 1. Hierarchy of territorial rank.

This paper takes the Sponge city program for analysis. The Sponge city program was enacted in 2014. It is currently one of the largest city programs in China, which is expected to improve urban water resilience. As China was experiencing water reform [7], only a study of the most recent water management programs can accurately reflect the current status of water policy formulation and implementation in China.

A policy cycle analysis of Sponge city policies and an empirical study of two demo cities were carried out to assess the effectiveness of policy implementation. Some key Sponge city policies have been collected from central, provincial and city governments since 2015. The policy cycle analysis helps to illustrate the lifecycle of policies, which was initially suggested by Lasswell [8] and has since been adopted by many researchers [9,10]. It helps to articulate discrete steps within the policy formulation and implementation process [11]. The empirical study focuses on the analysis of project implementation of two demo cities of the Sponge city program. Fieldwork was conducted in Changde city and Zhuanghe city separately in 2017 and 2018. The specific problems of implementing water projects is reflected in the evidence of the demo cities. Doing a policy analysis and an assessment of its implementation helps to understand the water policy formulation and implementation process in China better.

2. Theoretical Section

Policy makers and implementers are the major stakeholders in a policy cycle. The policy makers can be taken as the "principal", those who make the decisions and delegate the tasks to be carried out by the implementers. The implementers are the "agents" responsible for carrying out these tasks on the principals' behalf.

According to principal–agent theory, policy implementation failure can occur when the interests of the principal and agent are inconsistent [12,13]. The principal makes decisions and delegates tasks to the implementers, while the policy implementers as "agents" are responsible for carrying out the tasks on the principal's behalf, although they may not have the same knowledge and interests. If the agents have different interests than the principal, they can deviate from the principal's preferences and pursue their own interests, for example when information is asymmetric. Consequently, policy implementation failure may happen. To solve the problem and increase the chances of policy success, the principal needs to offer attractive benefits sufficient to incentivise the agent to accomplish the policy goals [14]. Moreover, a strict supervision system should be established to ensure that the principal controls the agent's behaviour and to reduce asymmetric information.

China's top-down political system invests more power in the higher level of government than in lower-level government, and many polices are made at the top for the bottom. The relation between higher-level government and subordinate government can be studied according to the model of "principal" and "agent". We will focus on exploring how principals and agents influence the implementation of water policies and determine the outcome.

3. Double Wheel Policy Cycle Analysis

In order to better understand the water governance mechanism in reality, this study develops a "double wheel" policy cycle model based on the traditional "one wheel" policy cycle model, although the latter is mainly used in water policy research [15]. The traditional policy cycle consists of four parts: problem identification, policy formulation, policy implementation and evaluation [16,17]. However, because of the regional diversity in China, the central government usually decentralize parts of decision-making power to the local government to make policies better adapted to the local situation. Therefore, the problem definition process occurs at the local government level in fact, and policy adjustment is allowed and encouraged by the centre. This subtle trait cannot be reflected in the classical policy cycle model. This paper argues that the policy cycle of water governance has a "double wheel" structure, which means the policy cycle occurs at the levels of both the central government and local governments. The policy cycle of the central government consists of three parts (problem identification, policy formulation and evaluation), while the policy cycle of the local government focuses on problem identification and policy adjustment, policy implementation and policy evaluation.

The communication between the two cycles occurs through the process of "policy order sending" and "feedback returning", as shown in Figure 2. After the central government completes policy formulation, it will send a policy order to the local government. Then the local government starts the policy adjustment in terms of its own situation. After project implementation and evaluation, the local government returns its feedback to the central government. Subsequently, the central government makes an evaluation according to the feedback. The "double wheel" policy cycle model is a uniquely appropriate model for illustrating the process of urban water policy in China.

Notably, the local government in this study refer to both city level and provincial level governments. The water policies issued by the central government are usually implemented from the upper level to the lower level. The provincial government takes responsibility for adjusting central policies according to the local conditions and clarifies these policies. Furthermore, it conducts and supervises the city level government's implementation. In other words, the provincial government plays a dual role in the program as the agent of the central government and the principal of city level governments [18].

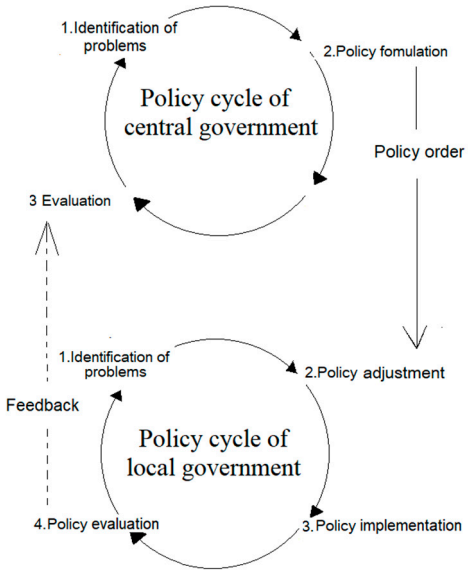

Figure 2. The "double wheel" of the policy cycle.

3.1. Policy Cycle Analysis at the Central Level

City flooding results in substantial economic losses, threatens human life and impedes agricultural and industrial production [19–21]. To improve water resilience in Chinese cities, the Sponge city program became part of the political agenda in 2013. The central government considers this an urgent problem that must be solved. The State Council first published the guidelines of the Sponge city program in 2013. According to the guidelines, 70% of rainwater should be absorbed or used locally in "Sponge City". Based on the State Council's guidelines, the Sponge city policy was jointly formulated and published by the Ministry of Housing and Urban-Rural Development (MHURD), the Ministry of Finance and the Ministry of Water Resources in 2014.

There is not a specific assessment policy for the financial and institutional sustainability of the projects in the assessment (see Table 1). MHURD, being the only institution involved in the Sponge city program evaluation, published the "Assessment Indicators for the Sponge City Construction Activities" in 2015. The assessment criteria mostly emphasise construction features and effects presented quantitatively. In general, the evaluation procedure is performed according to feedback reports provided by local governments or through a number of visits to demo projects. As the construction activities are the main indicator used to assess Sponge city policy implementation, the evaluation of the central government is incomplete and not effective in assessing the effects of water policies and correcting these problems in the next policy cycle. Financial problems, institutional issues and project sustainability are not reflected in the evaluation at all.

Table 1. Assessment Indicators for the Sponge City Construction Activities.

Item	Criteria	Assessment Method
Water ecology	Volume capture ratio of annual rainfall Ecology shoreline Groundwater table level Urban heat island effect	Quantitative
Water environment	Water quality Non-point source pollution controlling	Quantitative

Table 1. *Cont.*

Item	Criteria	Assessment Method
Water recycling	Wastewater reuse rate Rainwater reuse rate Pipe leakage rate	Quantitative
Water security	Flood prevention Drinking water safety	Quantitative
Institutional establishment	Project planning and construction regulations Financing system establishment Punishment and reward	Qualitative

3.2. Policy Cycle Analysis at the Local Level

Local governments must first grasp the nature and scope of their own problems in terms of economic and social development and environmental issues. Each city has its own unique problems. Local governments make policy adjustments in line with policy orders received from the central government. The study takes the Guangdong province as an example to illuminate the policy adjustment of local governments. Guangdong Province is located in the eastern coastal region, the most developed area in China.

After the Sponge city program was announced by the central government, the Guangdong province published its Sponge city policy in 2017 to conduct and supervise the policy implementation (see Table 2). Table 2 is indeed a supplement to Table 1, which is also concerned with water ecology, water environment, water recycling, water security and institutional establishment. Table 2 operationalizes the criteria of Table 1 and shows that local governments strictly follow the standards required by the central government. However, the requirement under the institutional establishment section remains vague and unclear although relatively high standards are set for each indicator. The financial and institutional issues are mentioned in the Guangdong policy's adjustment, without giving precise objectives.

Table 2. Sponge city policy implementation criteria for Guangdong Province.

Item	Criteria
Water ecology	Volume capture ratio of annual rainfall should be higher than 60%. The city's ecological shoreline should be restored. Waterbody percentage should not be less than 6%.
Water environment	The water quality of demonstration cities' lakes and channels should improve overall. Non-point source pollution regulation should be made to prevent lake and channel pollution.
Water recycling	Wastewater reuse rate should be higher than 15%. Rainwater harvesting and reuse rate should be higher than 3%.
Water security	The flood prevention capacity should be increased. Guangzhou and Shenzhen should be able to cope with a storm occurring once every 50 years; other cities should be able to cope with a storm occurring once every 30 years; counties should be able to cope with a storm occurring once every 20 years.
Institutional establishment	Making project planning and construction regulations; setting technological standards; establishing a financial system for projects, such as public-private partnership designing assessment methods.

Local governments are responsible for project implementation. Each project has to follow technological regulations while elaborating the technological designs to conform to its specific circumstances. The policy of the Sponge city program has stipulated clear technological regulations. The financial consequences of a project are normally planned by city governments. Only the initial investment planning is assured, whereas additional operation and maintenance (O&M) capital is always neglected in the plan. There are three scenarios by which initial investment is secured: (1) partly paid by central government and partly paid by city government; (2) all paid by city government and (3) partly paid by central government, partly paid by city government and partly paid by private sector. The third scenario involving private capital is strongly encouraged by central government [22]. However, in practice, the third scenario is rarely adopted by city governments.

In addition to the central government, local governments have adopted specific evaluations of the Sponge cities' projects. Table 3 presents Guangdong province standards for the assessment of projects as an example. The assessment method used for each criterion includes paper reporting, expert evaluation and random surveys (see Table 3). Expert evaluation can be potentially risky, since experts' judgement on a fact is always subjective. Random surveys measuring public participation and satisfaction tend not to be very precise. Because of the agent–principal relation between central and local governments, provincial government feels pressured to submit good results to the central government in order to be recognised for its political achievement [23]. Hence the non-standardised nature of the expert evaluation and random survey evaluation methods may provide an opportunity for a provincial government to manipulate evaluation results for its own benefit. Moreover, although public participation and satisfaction are taken as evaluation criteria, usually the citizens living in proximity to the project do not actually know about the Sponge city project [24].

Table 3. Assessment of the Sponge cities' projects of Guangdong Province.

Item	Requirement	Assessment Method
Working status	1. Are there specific Sponge city working groups and offices? 2. Are there regular meetings and monthly reports? 3. Are there construction policies and requirements? 4. Is there technological direction on O&M? 5. Is there a specific financing mode or not?	Paper reporting
Planning	1. Identifying current water problems. 2. Clear construction objectives on water ecology, water environment and water recycling. 3. Whether the measurement is feasible?	Experts' evaluation
Coordination	1. Coordinating city water systems, including water supply, wastewater treatment and flood prevention. 2. Examining whether parks, green spaces and transportation planning in the Sponge city program are harmonious.	Experts' evaluation
Public participation	1. Is there regular engineer training? 2. Are there advertisement campaigns? 3. Is there public education?	Paper reporting and random survey

Table 3. *Cont.*

Item	Requirement	Assessment Method
Construction progress	1. Is the construction of programs well organised? Is it making progress? 2. Are the city floods and black odorous water effectively treated? 3. Does the project construction follow the design?	Experts' evaluation
Public satisfaction	1. Reducing waterlogging. 2. Improving water quality. 3. Reducing the negative effects of urban heat islands.	Random survey

4. Empirical Evidence on Project Implementation

Currently, there are a total of 30 demonstration cities in the Sponge city program: 16 demonstration cities were selected in 2015, and 14 more demonstration cities (including Beijing, Tianjin, Shanghai and Shenzhen) were added in 2016. This study takes two demo cities for the empirical analysis, which are Changde city and Zhuanghe City.

The empirical analysis focuses on the project implementation. Figure 3 visualises the implementation of the Sponge city project and includes project planning and construction as well as project O&M. It is not difficult to obtain technological support from relevant water planning and design institutes, which are generally state-owned enterprises. Currently, the technology needed for each project, such as building a wetland or rainwater harvesting installations, is quite well developed in China [7]. Therefore, technological design and building the infrastructure are not challenges to the city government.

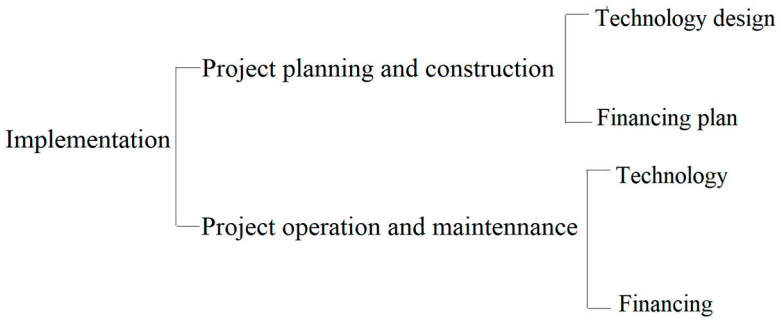

Figure 3. Visualising the implementation of a project.

4.1. Changde City

Changde city is located in the northern Hunan province. The city was congested with polluted and smelly rivers, channels and lakes, and parts of some of channels were completely blocked by solid waste [15,16]. Moreover, Changde frequently suffers from serious flooding events, which occur approximately one time every four years. The local government realized the water problems were threatening the city's economic and social development. Due to its serious problems in the water environment and the local governments' strong desire for water environment improvements, Changde has been carrying out rainwater harvesting projects and water environment improvement since 2008. In 2015, Changde was selected as one of the demo cities of the Sponge city program.

There are eight water projects constructed along Changde's main river, the Chuanzi River, which branches off the Yangzi River. Each project consists of rainwater harvesting plants and ecological purification ponds. The total initial investment for all of the projects is approximately CNY 312 million. Only 10% of the initial investment is subsidized by the central government and the remaining amount

is contributed by the local government. It is expected that 50% of the initial cost could be funded by the private investor. However, Changde's government has no clear plan and scheme to attract private capital.

The O&M costs were solely related to paying salaries because no machines or chemicals are required to operate the project. There are about 170 workers employed for the projects, and the total O&M cost per year is around CNY 10.56 million. All of the projects have been operated by a state-owned enterprise, which belongs to the municipality. In order to cover the O&M cost, the government is developing tourism in the form of cruises on the Chuanzi River. Table 4 shows the financial evaluation results of Changde's Sponge city projects, of which the calculation in detail refers to Liang's study [25]. It reflects that the income of tourism can cover the O&M cost. However, if the initial investment is included in the evaluation, the project is not financially feasible. The initial investment cost is much higher than the O&M cost. The lack of financial feasibility results in limited interest for private funding in the program and means the water projects are not sustainable in the long term. If the initial investment were completely subsidized by the central government, the private sector would be incentivized to manage the water projects. However, it seems unrealistic to require the central government to provide all initial investments. Currently, Changde is primarily interested in construction and management, while it has limited interest in the financial feasibility of the water projects.

Table 4. Financial Analysis of Changde's Sponge city projects (base on 10 years evaluation).

Project No.		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Financial cost	Initial investment (million Yuan)	117	23.4	27	27	27	23.4	18	18
	O&M cost (million Yuan)	9.7	8	9.7	9.7	9.7	8	8	8
Financial benefits	Tourism (million Yuan)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Ratio of financial benefits to cost		0.09	0.37	0.32	0.32	0.32	0.37	0.45	0.45

Sourced [25].

4.2. Zhuanghe City

Zhuanghe city is located in the northeast of Liaoning province, next to the East China Sea. It has plenty of water resources, including 365 rivers and 45 reservoirs. Zhuanghe was officially chosen by the central government as a demo city in 2016. In order to ensure the construction of the projects, the Zhuanghe government established a ''leading group'' drawing from different local government departments. The government leaders took the role of leading this group through the Financial bureau, the Construction bureau, the Development and Reform bureau, and the Environmental Protection bureau. Zhuanghe has started many construction projects, such as building an underground reservoir of 300 m^3, improving drainage in different ways, building a wetland, planting grass around houses and so on.

According to central government policies, local government is supposed to pay 40% of the cost, while 10% percent comes from central government, and 50% should come from the private sector. Currently, Zhuanghe city obtains around CNY 1.2 billion for a three-year period from the central government, and the local government has to pay the rest of the cost. So far, Zhuanghe city has spent CNY 3.8 billion on the program in total. However, there is no contribution by the private sector except that some construction work has been tendered to some state-owned companies.

Like other demo projects, the O&M of Zhuanghe's projects depends on the local government's subsidies. Given their environmental nature, the projects in Zhuanghe do not generate any revenue. O&M expenditures are fully dependent on subsidies. Whether the subsidies of the city government can be sustained depends heavily on the budget of the city government. Private companies interviewed in

Zhuanghe said that this kind of project is usually not profitable, and it is hard for them to get through the bidding process, which state-owned companies tend to win. Moreover, the city moves from one government financed project to another, without bothering too much about the sustainability of their investments after the end of the projects.

5. Discussion

The double wheel policy cycle analysis is a good framework for understanding the problems of implementing policies in China. The policy cycle analysis at both central and local government levels has been extracted and presented in Table 5. It indicates that O&M financing issues are not emphasised sufficiently. Construction and O&M are key elements for implementing water policy. During the processes of policy formulation, the central government provides a brief policy on construction and O&M. The local government implements the policy by issuing detailed construction and O&M directions while offering a vague O&M financing plan. Neither central government nor local government provides the O&M financing plan in detail.

Table 5. Extraction of the policy analysis.

		Construction	**O&M Technology**	**O&M Financing**
Policy formulation	Central government	Brief	Brief	Brief
	Local government	Detailed	Detailed	Brief
Evaluation standards	Central government	Brief	Brief	Brief
	Local government	Detailed	Detailed	Brief
Policy implementation	Local government	Executed smoothly	Limited difficulty	Unsustainable capital

Since there is no clear policy instruction, the O&M funding of nearly all Sponge city projects is provided by city governments at present. Both the case of Changde and Zhuanghe show there is not any financial support for the project's O&M cost from the central government, and little private capital is involved in the project. As there are no other financing sources, subsidies provided by city governments become the only source of O&M financing. Indeed, subsidies for water projects are not prioritised by city governments. One reason why they are reluctant to provide money for O&M is that O&M demands continuous expenditures, and yet the effects of the projects are not known until unexpected heavy rainfall occurs. Moreover, in Chinese politics, the local leadership rotation system (the local leadership rotation system refers to how local leaders are arranged to be the governors in one place for about 1–3 years, and then assigned to other places as governors. This system aims at improving the local leaders' management abilities in different contexts on the one hand, and preventing a leader cultivating their local coalition powers on the other hand) means that leaders often do not stay in one place for long, as local leaders routinely cross administrative boundaries, which means that city governors tend to only care about short-term performance rather than prioritising the long-term benefits of local development. Subsidies for the O&M of water projects are often cancelled to offset budget deficiencies of city governments. Thus, complete dependency on city government subsidies for O&M is not sustainable.

The central government sent policy orders to local government without clear direction on how to attract private capital, although it greatly expects the private sector to act as the primary financial source for construction as well as for O&M. Private sector involvement is regarded as a more feasible approach to sustain O&M [26,27]. In fact, the central government hopes that local governments will find solutions according to their situations, while local governments have no experience and plans on incorporating private capital and corporations into projects. The increased cost of communications and trust with private corporations all compel city governments to prefer familiar state-owned enterprises

over private corporations. Moreover, the principal–agent relationship between central and local government determines that evaluation is designed to assure that the agent does not disobey the principal's orders. Since the O&M financing issue is not emphasized in the evaluation of central government, local government places no stress on private sector involvement.

The problem in water policy governance is that the feedback generated in the policy cycle of the central government is different given the indicators used with the feedback generated in the local government policy cycle. There is no link between the feedback given in the second, local government cycle, and in the first cycle. The local governments return the feedback to the central government through the evaluation report. The evaluation criteria of central government simply survey all the actions of local government and further emphasize construction. Actually, the second cycle would provide information on the problems of involving the private sector and finding the money for O&M to the central government, which is currently not interested in these indicators and not receiving this information.

6. Conclusions

This study carried out an in-depth analysis of urban water policy implementation in China through policy cycle analysis and case studies of two Sponge program cities, Changde city and Zhuanghe city. The Sponge city program was chosen for analysis because it is the most recent and a large-scale water project in China. The policy cycle analysis assesses the policy formulation and implementation process, while the case study illustrates the problems in project implementation.

The policy cycle analysis of the Sponge city program shows that the central government sent policy orders to local government without clear direction on how to attract private capital, meanwhile specific O&M financing plans are not assessed in policy evaluation procedures. Central government evaluation only assesses whether local governments have implemented central policy requirements, resulting in an emphasis on short-term goals while project sustainability is neglected.

The empirical analysis of Changde and Zhuanghe shows that local government subsidies are the main source of O&M funding currently, but this is not sustainable. The initial investment of the projects could not be recovered at all because there is less or no revenues from the projects. Therefore, the Sponge city projects are not financially feasible. The limited private sector involvement in managing the water projects makes it difficult to maintain adequate funding in O&M. Meanwhile, the local governments do not have sufficient political motivation to attract private investments into project implementation. Limited private capital involvement in the project resulting in unsustainable O&M funding throws the sustainability of water projects into jeopardy.

In many cities urban water resilience is high on the political agenda. From a governance point of view, the potential victims may be involved in urban management in resilient cities, while in the Sponge city concept the idea is mainly to involve the private sector [28]. However, this has not happened most of the time in China. Private involvement in water projects increases the chances of additional investments, profitable projects, cost recovery and financial sustainability. Private sector involvement is not easy to achieve, but it could be the key to realizing Chinese urban water resilience in a more financially and institutionally sustainable way.

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