CHINA'S LONG MARCH TO SAFE DRINKING WATER

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A China Water Risk/chinadialogue Report

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INTRO:
CHINA' S DRINKING WATER SAFETY FACES SCRUTINY IN 2015

A look at how well China is meeting ambitious goals for drinking water safety set five years ago as the government prepares its 13th Five Year Plan (2016-2020)

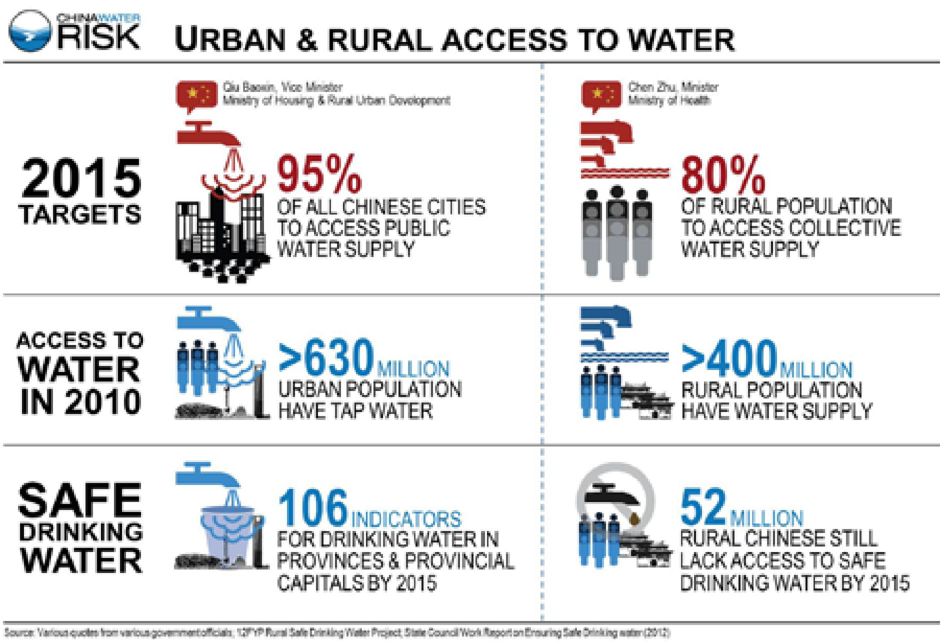
China's central government set ambitious goals to safeguard water quality in 2011, at the outset of the 12th Five Year Plan (2011-2015). Those goals targeted improvements from source-to-tap, earmarking a budget of nearly RMB 700 billion (USD112 billion) to pay for upgrades to water treatment and piping systems. The funds were spread across multiple ministries and government bodies, including the State Council, the National Development and Reform Commission ("NDRC"), the Ministry of Water Resources ("MWR"), the Ministry of Environmental Protection ("MEP"), the Ministry of Housing and Urban-Rural Development ("MOHURD") and the Ministry of Health ("MoH").

Government set ambitious goals and a RMB700 billion budget to safeguard water quality at outset of 12FYP

BIG GOALS

Separately, there was also a movement to lift and standardise varying provincial drinking water quality by introducing a new national standard. In 2007, a 'National Drinking Water Quality Standard' (GB 5749-2006) was introduced. This standard is in accordance with international standards, but since the bar was set far above the actual quality levels of China's water, it only came into full effect in July 2012. The government expects cities across China to meet this national standard by 2015.

2015 has arrived, but how far is China's government from realizing its water safety goals?



In 2010, over 600 million urban residents already enjoyed access to public water supply services, and more than 400 million rural residents had access to clean drinking water. This was primarily due to government-led improvements in water supply and safe drinking water initiatives. However, 298 million rural Chinese still lacked safe drinking water and this was to change during the 2011-2015 Plan. For urban residents, the stated public water supply penetration rate was to rise from 90% to 95%.

QUESTIONABLE QUALITY

Whilst it is clear that more people across China are enjoying access to public water supply, what is not clear is the quality of the water delivered. The mid-term evaluation of the 12th Five Year Plan (12FYP), which started in mid-2013 may hold the answers. However, the assessment report is "classified" and the full report has not yet been made available to the public.

Access & delivery increased but quality uncertain

In the wake of the anticipated 'Water Pollution Prevention and Control Action Plan', which prioritizes drinking water safety, China Water Risk and chinadialogue took a closer look at the actual status of urban and rural drinking water in China. The report finds that some urban water quality remains unreliable, while rural areas face many challenges in meeting requirements that are less stringent than those for urban areas.

Drinking water is at the end of the water supply chain. It follows that to achieve high drinking water quality requires comprehensive standards, policies and regulations to be in place governing the entire supply chain from source-to-tap. Water source protection was included in China's ambitious plan to safeguard safe drinking water in the 12FYP while targets were set for both 2015 and 2020.

High quality drinking water requires comprehensive policies and standards to govern entire supply chain from source-to-tap

For water treatment and main-pipe network management, China is locked into a 'technology-focused' path, and is looking at high-tech innovation and infrastructure investment to ensure water quality and delivery.

However, problems persist in secondary water supply, which has the greatest direct impact on tap water quality. Despite many attempts to address this, there is still no perfect solution.

MACRO-LEVEL SUCCESS

Many insiders with access to water quality data and information at ministry and department level share a common view of China's water problems.

They say that in provincial capitals and big cities in developed eastern coastal regions, water safety "essentially has no problems". In second and third-tier cities as well as medium to small towns, water safety development is "patchy", but has been improving. In rural areas, there has been rapid progress with collective water supply. Problems with the "Three Highs", namely high concentrations of fluorine, arsenic and salt found in water in some rural areas, have largely been resolved. Meanwhile, rural drinking water improvement works to stem pollution are also progressing.

In this portrait of China's drinking water safety landscape, improvements in water quality have been radiating out from the big cities to smaller cities and towns. In reality, however, information on rural areas remains limited; the rural waterscape is shrouded in fog.

Furthermore, beyond this largely positive macro-level overview of China's drinking water safety, on a local-level the real status of water safety in each city, town, county or village remains unclear. Official information disclosure on water quality is poor, and the government keeps official tests and monitoring data secret. Although water supply enterprises have been publishing their water quality test data, there is room for improvement in test frequency, the number of published indicators and public interfaces.

LOCAL CONCERNS

Against this backdrop, civil society groups have resorted to self-testing drinking water to obtain water quality data. A recent report from the China Water Safety Foundation shows that only half of the 29 big and medium-sized cities it surveyed passed the test on all 20 selected indicators from the National Drinking Water Standard; one city failed the tests on 4 indicators. These test results, together with all other civic monitoring actions, do not give a comprehensive picture of drinking water safety, but they are enough to point out the risks and challenges ahead.

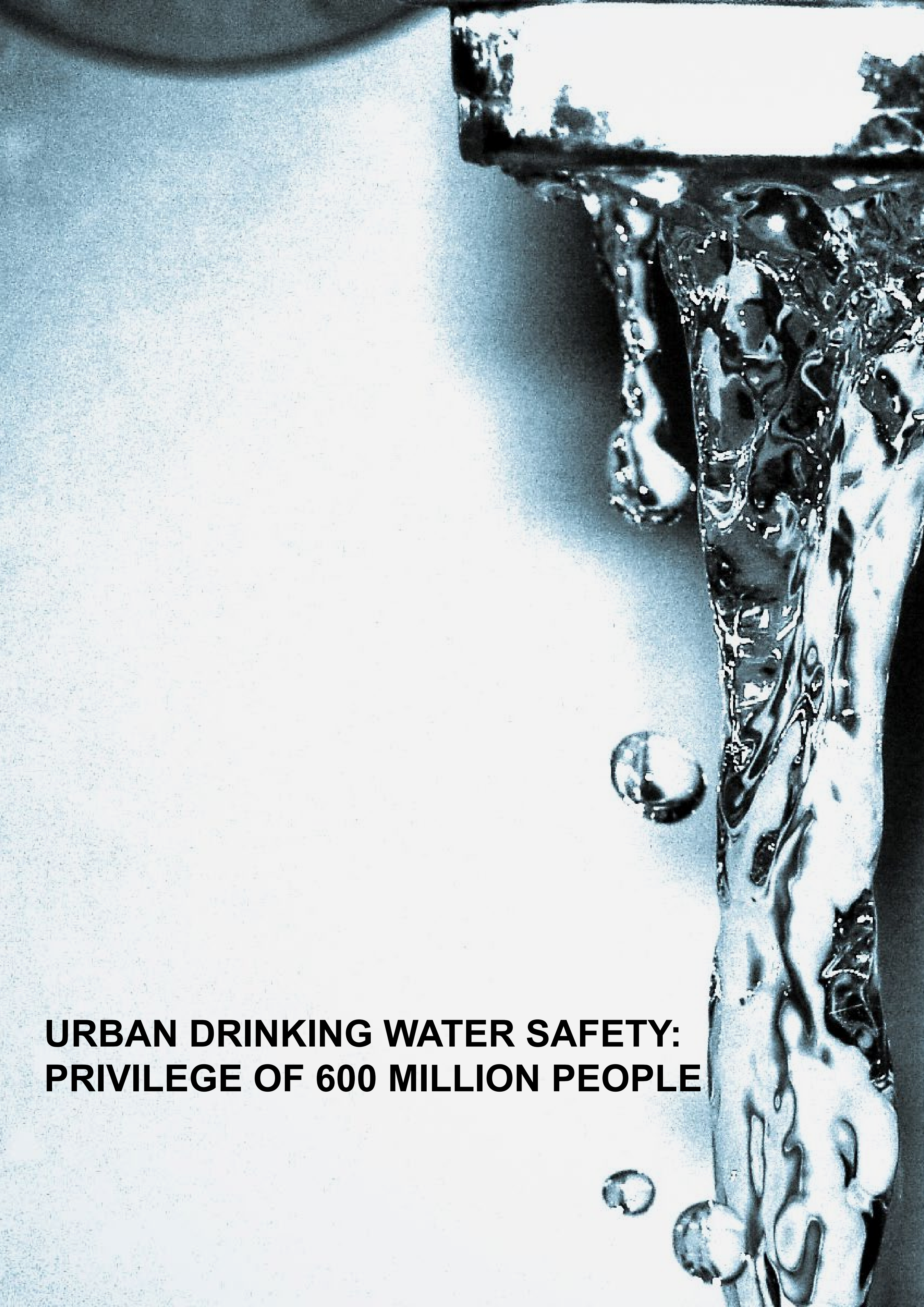
Public self-monitoring movement growing in response to lack of data

The health and environmental implications of unsafe water are already evident. In some cases, the health impacts have geological causes due to naturally occurring arsenic, fluorine and salt. But elsewhere, they result from human activity and pollution.

In recent years, Persistent Organic Pollutants (POPs), environmental hormones and other toxic organic pollutants have been detected in drinking water, causing widespread public concern. These chemicals are not yet effectively monitored, partly because not enough research has been undertaken on the health impacts when they are absorbed through drinking water.

As this report points out, many obstacles need to be addressed in China's long march to safe drinking water. China faces problems of ambiguous ownership, unclear water pricing mechanisms, immature market mechanisms and a lack of rural business models, among other issues. There are also governance challenges with dispersed and overlapping responsibilities among various departments and across ministries.

Given the current situation of "nine dragons managing water", many people are expecting to see reforms to the government's administrative systems for water management. This would mean establishing a water management and coordination mechanism across different government bodies. A drinking water monitoring system at both national and local levels is clearly required, as are a water quality technology framework from source-to-tap; supervision and early warning systems; and integrated watershed management. This report hopes these needs will be addressed in the coming 'Water Pollution Prevention and Control Action Plan'.



URBAN DRINKING WATER SAFETY: PRIVILEGE OF 600 MILLION PEOPLE

PART I:
URBAN DRINKING WATER SAFETY: PRIVILEGE OF 600 MILLION PEOPLE

On 14 June 2012, the MOHURD and the NDRC jointly issued, '12FYP National Urban Water Supply Infrastructure Retrofitting & Construction & 2020 Targets'. The plan states that during the 12FYP, China will invest RMB410 billion into urban water supply to achieve the long-term goal of a stable standard of drinking water in urban areas by 2020.

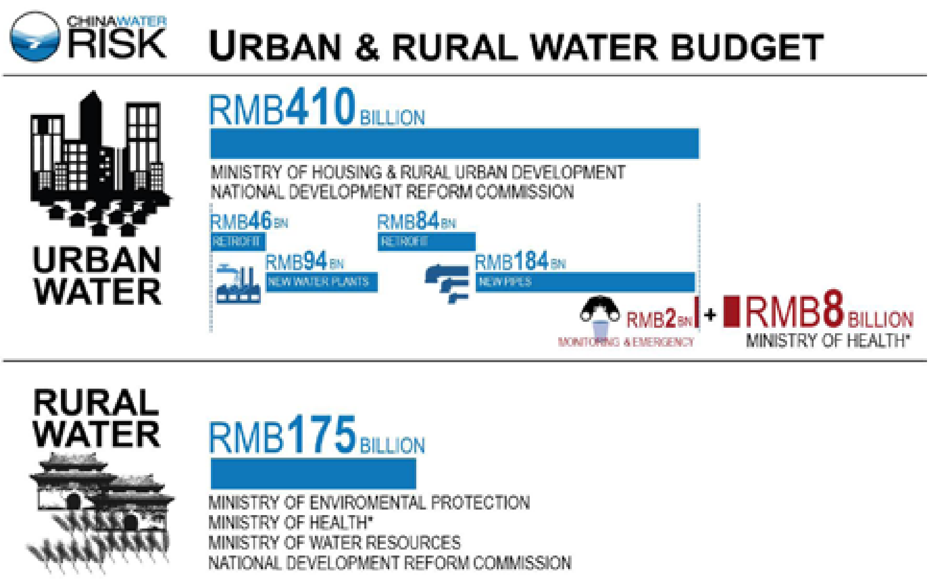
In theory, if water reaches this standard then Chinese urban residents can simply turn on the tap and drink the water directly without having to boil or disinfect it first, as is now common practice.

In 2007, the MoH and the Standardization Administration of P.R. China released the latest 'National Drinking Water Quality Standard' (GB 5749-2006). Compared with the old version issued in 1985, the new standard saw a substantial increase in the number of indicators/parameters, jumping from 35 to 106. The original limits of some existing indicators were also raised. This revision, which had been delayed for 20 years, is now not only China's most stringent water quality standard, but also makes it one of the strictest drinking water quality standards globally.

New national standard introduced

Still, given the complexity of the drinking water situation in China, the new national standard was not immediately enforced after it was issued. The time frame for enforcement was extended to 1 July 2012, providing a transition period for upgrades to meet this new standard.[1] The government expects cities across China to meet this national standard by 2015.[2]

It was in this context that the aforementioned RMB 410 billion investment plan was introduced. The public draft of this plan shows the expected allocation of the RMB410 billion total investment: RMB46.5 billion for the upgrading of existing water plants, RMB83.5 billion for network transformation, RMB94 billion for new water plants, RMB 184.3 billion for new pipe network, RMB1.5 billion for water evaluation regulatory capacity building, and RMB200 million for emergency capability of water supply.[3]



Source: National Urban Drinking Water Source Environmental Protection Plan (2008-2020), 12FYP National Urban Water Supply Infrastructure Retrofitting & Construction & 2020 Targets, National Plan to Ensure Urban Drinking Water Safety (2011-2020), National Groundwater Pollution Prevention & Control Plan (2011-2020), 12FYP Rural Safe Drinking Water Project.
*Since the issuance of the above, the Ministry of Health was integrated into the National Health & Family Planning Commission in 2013

This was the Chinese government's largest-ever investment for one single public service. However, some scholars have pointed out that the investment mainly focuses on water and pipe network retrofitting rather than management systems improvement and is unlikely to guarantee success.

On 30 July 2014, the international scientific journal 'Nature' magazine published an article entitled 'A sustainable plan for China's drinking water'.[4] The article points out that as a developing country, infrastructure-focused solutions to ensure drinking water safety are unsuitable for China. Instead, water sources protection and clean-up as well as the development of water recycling would be more effective.

Some scholars think China is on the wrong path to drinking water safety

The authors, Professor Tao Tao and Associate Professor Xin Kunlun, both from the College of Environmental Sciences and Engineering of Tongji University, warned that China should not follow the technology-focused path of developed countries. Yet, the overall aim of safe drinking water from taps means China has focused on treatment technologies and pipeline upgrading. However, this will result in large volumes of high-quality treated water being wasted in toilet flushing and cleaning.

The Nature article also points out that China will remain a developing country up to 2050 and meanwhile, urban expansion will outpace the improvements in water supply systems. Thus, the approach adopted by China will not only use up vast amounts of energy, but also will be expensive and consume quantities of chemicals.

Unfortunately, after the release of data from two urban water quality surveys by the MOHURD and MoH in 2012, these two ministries have not disclosed any new information about China's urban water quality. Now, eight years after the new standard was released, it remains unclear whether water quality has improved or not. The effectiveness of the huge investment made by the Chinese government is also under wraps.

Although public discussions around drinking water safety have slowly died down, the Chinese people are still concerned about water quality. On 1 December 2014, Xylem (an American water technology provider) and H2O-China (a Chinese water platform) jointly issued the '2014 Value of Water Index: China'. The report states that among 2,000 consumers and industry experts from cities such as Beijing, Guangzhou, Taiyuan and Changsha, over 70% were concerned about drinking water safety and related health impacts.[5]

The reality is that water supply, as a public service provided by the government, is not equally provided in China, where a decade of rapid urbanization has resulted in hundreds of millions of farmers moving into cities, but there are still about 700 million people living in rural areas[6]. The huge investment in urban water supply of course only targets urban residents, which account for 54% of the total population. Even in urban areas, public water services cover about 91% of residents, so there are still around 70 million urban dwellers without access to adequate water supply services[7].

Investment in urban water supply only targets 54% of total population; still ~70 million urban residents without access

WATER SOURCES: DRINKING CONTAMINATED WATER?

> No matter urban or rural, water sources are threatened by pollution. In reality, water source standards and regulations are often ignored and water companies have no choice but to use contaminated water.

China produces almost 70 billion tonnes of wastewater annually (excluding agricultural wastewater)[8]. As 'the world's factory', China is one of the highest consumers and emitters of many heavy metals, compounds and other industrial raw materials. Survey data in recent years show that toxic organic pollutants can be found in China's major rivers, lakes and other bodies of water. On the Yangtze and Songhua rivers basin alone, 107 kinds of toxic and hazardous organic pollutants were detected[9]. The goal of ensuring drinking water safety in China must overcome a huge challenge: To treat one of the world's most complex water sources to a level that complies with one of the world's strictest drinking water quality standards.

As the unit in charge of urban water supply, the MOHURD is not afraid of being embarrassed. A senior expert in the field of water supply and drainage revealed to China Water Risk/ chinadialogue that the Vice Minister of MOHURD, Mr. Qiu Baoxing has said that improving China's drinking water quality is actually a fight against environmental pollution. But, if water sources cannot be well managed for the time being, he was reported to have said that China at least needs to ensure that people can have drinking water that meets the established standards flowing from the taps.

Looking at water sources quality survey results released by the MEP, it would appear as though the quality of urban water sources is improving steadily. In 2011, a survey carried out by the MEP about the centralized drinking water sources of prefecture-level cities and above showed that water sources accounting for 11.4% of supply failed the water quality test. By the first half of 2014, this figure had gone down to 3.8%. A closer look at MEP's data regarding different types of water sources shows that 94.3% of surface water sources meet requirements, with the main exceptions being excessive levels of phosphorus, ammonia and manganese. Of underground water sources, however, only 87.6% were reported to meet requirements. The main challenges there were iron, manganese and ammonia.[10]

If for the moment we don't consider both the scope of the investigation and the statistical differences from inconsistencies between statistical and evaluation criteria, then drinking water quality in towns and cities over the past few years has undoubtedly seen a significant improvement. However, a key question needs to be addressed: How exactly is a water source considered to 'meet standard'?

China has never issued a specific 'Drinking Water *Source* Quality Standard'. Water source quality is managed by the 'Surface Water Environmental Quality Standard' (GB 3838-2002) or 'Groundwater Quality Standard' (GB/T 14848-93), depending on the type of source. The 'National Drinking Water Quality Standard' only makes reference to relevant provisions in these two existing environmental quality standards of surface water and groundwater.

Some industry experts believe that the fact there is no clear standard to measure water source quality, makes the conclusion of a water source 'meeting standard' actually very ambiguous. This means that, although it looks like the water source quality compliance rate has been rising, it's actually totally useless to understand the actual situation of water source quality because there are no standards.

If we take surface water sources as an example, according to the MEP's 'Management Measures for Pollution Prevention and Control in Drinking Water Source Protection Zones', certain areas near to sources of drinking water are designated as Class I drinking water source protection zones. Here, the water must reach the Class II requirement as per the Surface Water Environmental Quality Standard. Outside the Class I zone, there are Class II protection zones, where the water quality of surface water should at least meet Class III surface water environmental standards.[11]

According to 'Surface Water Environmental Quality Standard' (GB3838-2002), surface water quality is divided into a total of five Classes (I-V), with Class I being the best. Compared to Class III water, Class II water requirements of permanganate, chemical oxygen demand (COD), ammonia, mercury, lead, cyanide, volatile phenol, petroleum and other more stringent toxicological indicators mean better water quality. As a centralized water source, surface water quality needs to meet the requirements of 80 toxicological indicators.

In January 2015 during a telephone conversation between a staff member of the Drinking Water Office of the MEP and China Water Risk / chinadialogue, the officer candidly said:"In reality, some drinking water sources can only meet Class III water quality requirements".

"China does not have many water bodies at Class II level", according to Wang Zhansheng, a professor with the Department of Environment Science and Engineering at Tsinghua University. "If the requirements of Class II are followed strictly, then probably only up to one-half of surface water sources can meet the Class II level".

At the planning level, the central government has announced a series of plans and measures to tackle the water source problem. Already back in 2010, the MEP in conjunction with NDRC, MOHURD, MWR and MoH jointly issued China's first drinking water sources environmental protection plan: 'National Urban Drinking Water Source Environmental Protection Plan (2008-2020)'. This was intended to mobilize RMB58 billion with the intention of solving the substandard polluted water source quality.

Additionally, the 'National Groundwater Pollution Prevention & Control Plan (2011-2020)' aims to invest a total of RMB34.66 billion. The main goals of this investment are to conduct and develop investigations of groundwater pollution, to do work related to the prevention of groundwater pollution and to remedy environmental safety issues related to using groundwater as drinking water. The 'National Plan to Ensure Urban Drinking Water Safety (2011-2020)' led by the MoH and the '12FYP National Urban Water Supply Infrastructure Retrofitting & Construction & 2020 Targets' led by the MOHURD also clearly focus on work to strengthen the protection of drinking water sources.

It is also worth noting that although various ministries have plans that are in some way related to the protection of drinking water sources, at the moment the main regulatory responsibility still falls on the head of the MEP and the MWR. When we look at each of the ministries in turn, it's clear that the MEP's ability to invest is considerably less, and thus this government organ mainly performs surveillance functions. Work related to water protection projects, reservoirs and water diversion project construction is mainly carried out by the MWR.

Take the South-to-North Water Transfer Project (SNWTP) as an example. After water is diverted from the South to Beijing, the water is allocated by the head office of the SNWTP Eastern Route company. After the allocated water reaches the reservoir, it is then transported to the water company. "During the water transferral, there are issues related to transfer and also ownership", said Mr. Xue Tao, the deputy director of the Water Industry Policy Research Centre of Tsinghua University.

"[If] there are problems with the water source, is it the responsibility of the MEP for its bad management or the MWR's poor planning? It is clearly not the responsibility of one single government body. The reality is more complex", said Mr. Xue Tao.

Xue Tao,
Deputy Director of the Water Industry Policy Research Centre at Tsinghua University

"[If] there are problems with the water source… It is clearly not the responsibility of one single government body. The reality is more complex"

Some scholars have pointed out that the management of water sources should build upon what could have been improved upstream. The Ministry of Agriculture (MoA) and the MoH should also bear the appropriate regulatory responsibility. This line of thinking is not without basis.

China is one of the world's biggest users of pesticides and fertilizers. Indeed, the amount of pesticides used per unit of arable land is three times the world average with comparatively low efficiency. A spokesperson of the MoA said that only about 30% of the applied pesticides reach the target agriculture, while the remaining 70% are released into the environment.[12] This means that the vast majority of pesticides and fertilizers end up flowing into soil and bodies of water. After large volumes of nitrogen and phosphorus enter surface water, lakes, rivers and reservoirs, the consequences are not just 'eutrophication' or 'algae outbreak'.

Under certain conditions algae will release algal toxins into the water. These toxic substances can be very difficult to remove and can be a leading risk factor in causing liver cancer, as well as hepatitis. Aflatoxin, which also can cause cancer, can be present as well.[13] In the eastern coastal areas such as Qidong city in Jiangsu province, Tongan city in Fujian province, Shunde city in Guangdong province, and Fusui city in Guangxi province, there is a high prevalence of liver cancer, which is confirmed to be linked to drinking water contaminated with microcystin and other toxins.[14]

Another water challenge in China is the prevalence of antibiotics in surface water. Normally Illegal discharges from the livestock and pharmaceutical industries are blamed for this. But a researcher with the National Institute of Environmental Health and Related Product at the Chinese Center for Disease Control and Prevention asked China Water Risk/ chinadialogue, "Is there any connection to the abuse of antibiotics? If there is, then shouldn't the MoH stand up and take some responsibility?"

Antibiotics in surface water is a challenge but related data is usually a "state secret"

In order to obtain more information about the latest efforts to protect urban water sources, China Water Risk/ chinadialogue requested that the MEP publish results from the mid-term evaluation of the 'National Urban Drinking Water Source Environmental Protection Plan (2008-2020)'. A ministry staff responded in a phone call that the mid-term evaluation was conducted by the Chinese Academy of Environmental Sciences, but the results were classified as 'state secret'. The results are not available to the public and are instead only used for reference during the government decision-making process.

WATERWORKS: A HEAVY BURDEN

Waterworks are in an awkward position in the middle of the water supply chain. Water from substandard sources makes the treatment process more difficult. Conventional water treatment processes are insufficient to remove some of the more complex elements found in China's water.
There is an advanced treatment process that is better equipped to do this but investment costs are too high.
At present, only 5% of urban water goes through the advanced treatment process – ideally this figure should be 20%.

In the debate surrounding water treatment, New York City is often used as a case study. But the comparison is not a good one since New York City is mainly supplied with relatively clean spring water and rainwater collected in reservoirs and controlled lakes.[15] Additionally, there is not much heavy industry near the drinking water sources and consequently the city's water doesn't require advanced treatment. Conventional treatment processes are sufficient.

Most Chinese cities, by contrast, do not have a generous supply of high-quality water sources. In reality, the choices facing the vast majority of Chinese water supply companies are not whether water sources should be treated, but instead how much money should be spent to do so and how complex the treatment process should be in order to get the water quality up to standard.

Water supply companies are stuck in the middle of the supply chain with water arriving at substandard quality on the one side, and high pressure to reach tough new national standards on the other.

Water supply companies are stuck in the middle

A spokesperson from a low-level water supply company told Caixin 'Century Weekly' magazine: "Any company that does not get "qualified raw materials" can suspend production - but not waterworks. Instead waterworks have to operate 24 hours a day to supply drinking water that meets the standard".[16]

Mr. Fu Tao, the director of the Water Industry Policy Research Centre at Tsinghua University, believes that the conventional three-stage water treatment process has been unable to respond effectively to the changed water sources. Water treatment and production process as well as management and maintenance all need to be modified appropriately by water supply companies. Compared to big cities, small and medium-sized cities face bigger challenges in this regard.

The conventional process consists of a three-stage treatment including: sedimentation, filtration and disinfection. This century-old process works well with qualified water sources but is limited in its ability to purify water from complex water sources. It is almost useless in removing heavy metals and toxicological substances. Advanced treatment is based on the principles of the conventional process with the addition of ozone activated carbon and membrane treatment technologies. These are used to remove complex organic and inorganic contaminants.

Fu Tao has said, "Water is not as difficult to treat as air is. As long are we are willing to invest, it is technologically possible to do it. Water source is easy to analyze and relatively stable and relevant technologies can also be adjusted. Regarding the complex water sources such as Class III water, an additional fifty cents of treatment cost (per tonne of water) is enough to process the water".

Fu Tao,
Director of the Water Industry Policy Research Centre
at Tsinghua University

"Water is not as difficult to treat as air is. As long are we are willing to invest, it is technologically possible to do it."

The consensus within the Chinese water industry is that as long as water sources meet the Class II criteria, they will meet the basic national quality standards - even if water only goes through the century-old traditional treatment process. However, in the current situation whereby three different types of water source are being used, only water that has gone through pre-treatment and the advanced treatment process can be ensured to meet factory-produced water quality standards.

So what role can water treatment play? Desalination and water recycling technologies are often pointed to as possible solutions. According to Fu Tao, the base cost of recycling wastewater into drinking water is only RMB2 per tonne of water and processing seawater into highly pure water is only RMB4 per tonne of water. "The crux of the problem is in how much the waterworks are willing to invest", he said.

From this perspective, it is not hard to see why China wants to embark on the 'technology-focused' path previously trodden by developed countries, instead of focusing more on water source protection and pollution control.

In the '12FYP National Urban Water Supply Infrastructure Retrofitting & Construction & 2020 Targets' released by the MOHURD, investments are directed towards infrastructure. For water supply companies, 'waterworks retrofitting' and 'emergency capacity building' all refer to upgrading to advance treatment capability.

In 2012, when the new national standards were to be enforced, only 2% of China's water supply companies had the facilities to carry out advanced water treatment. During an interview with China Water Risk/ chinadialogue, the director of the Safe Drinking Water Institute of Tsinghua University, Mr. Liu Wenjun, revealed that, as of early 2015 only about 5% of waterworks have the facilities for advanced water treatment. In Jiangsu province, the provincial government has been planning to promote 'ozone-activated carbon' technology across the province.

As we can see, the penetration rate of advanced water treatment has increased from 2% to 5%, but that is still far from the actual demand. Song Lan, the chief engineer at the Urban Water Quality Monitoring Centre of the MOHURD, estimates that at least 20-30% of waterworks in China need to adopt advanced treatment processes as soon as possible.[17]

Penetration rate of advanced water treatment now 5% but should be at least 20-30%

However, Liu Wenjun says that not all waterworks need to have advanced treatment to guarantee good water quality. Instead, different waterworks should choose the technology relevant to the circumstance.

Regarding the cost of constructing advanced water treatment facilities and the differing scales of water treatment, the upgrades could cost anywhere from millions to hundreds of millions of yuan. According to Mr. Liu Baohong, the Secretary-General of the China Water Supply Service Promotion Alliance, funding for the construction of advanced water treatment facilities should be partly provided by the government and partly provided by the private sector, with the remainder being borne within the cost of water itself.

China Water Risk/ chinadialogue learned that during the planning stages of the Guogongzhuang waterworks, the Beijing municipal government was hesitant to include the membrane treatment process in part because of the cost. Investment in this process alone would amount to several hundred million yuan. This process is also not actually required to achieve the water quality standard, representing something more akin to the 'icing on the cake', said Liu Wenjun. However, considering the potential public health investment reduction due to improved water quality, it was finally decided that the membrane treatment should be included.

But not every waterworks is as fortunate as Guogongzhuang to obtain the financial support of local governments to carry out such retrofitting. The reality facing China's water industry is that water supply companies are facing large financial losses; funds from the central government are limited; local government support differs across the country and there are many difficulties facing water price reform. Until the end of 2011, 31% of public water supply companies faced loss and their debt ratio was higher than 50%.[18]

Mixed views on who should bear costs;
Limited government funds and
31% public supply companies face loss

According to the '12FYP National Urban Water Supply Infrastructure Retrofitting & Construction & 2020 Targets', China plans to encourage financing through multiple channels. This includes local financial capital investments, water price adjustment, private investments and central government subsidies and investments.

Some academics believe that advanced water treatment costs should be covered by government rather than by businesses or private individuals. The thinking behind this view is that water pollution problems have been caused by economic development and since this has been carried out by and brought benefits to the government, they should be the ones to pay. Liu Wenjun emphasizes that "water is a basic human need; it's not an optional requirement".

Liu Wenjun,
Director of the Safe Drinking Water Institute of Tsinghua University

*"water is a basic human need;
it's not an optional requirement"*

Other scholars think that the price of water should be increased so that consumers bear the costs. This would help to improve the current bleak financial situation of water supply businesses. Only in this way can the vicious cycle of low cost, low quality water be broken and instead replaced with a positive, sustainable cycle of improved water services.

INTO THE HOME: SECONDARY POLLUTION IS YET TO BE SOLVED

Secondary pollution caused by the pipe network and secondary water supply is the biggest reason why water in homes is not up to standard. Excessive levels of bacteria, chlorine and turbidity brought into the water by secondary pollution are the main reasons why Chinese water can't be used directly from the tap. MOHURD has put substantial investments into retrofitting the pipe network but unclear ownership is disrupting proceedings. Sanitation standards of the secondary water supply lag far behind where they should be.

Even if water produced by water supply companies reaches the 'National Drinking Water Quality Standard', this doesn't mean that residents will be able to drink straight from the tap. The reason for this is the secondary pollution that contaminates water during transmission through the pipe network.

National census data from 2011 published by the MOHURD shows that water from waterworks has a standard compliance rate of 83%, whereas the tap water standard compliance rate is only 79.6%.

Liu Wenjun told China Water Risk/ chinadialogue that the substandard drinking water mainly lies at the end of supply chain, not when it leaves the water treatment plant. Rather, he said, the main reasons tap water fails quality tests are an excess of bacteria, chlorine and turbidity. These are related to the pipe network and the secondary water supply. "These three factors are directly responsible for the fact that people can't drink China's water directly from the tap", he said.

Discoloured water, excess bacteria, chlorine & turbidity are why people don't drink from the tap

Recent studies have shown that the distribution pipes in the water supply system as well as the household water supply network and secondary water supply units are the parts of the system that represent the worst water quality deterioration. These are key areas that need to be targeted in order to protect water quality and safety. Transmission and distribution pipes, pipe network scale and structure and the operation and maintenance of the pipe network all have an impact on the quality of water.[19]

In 2008, when Beijing was using emergency water resources from Hebei province, the tap water in some areas was yellow in colour. This meant the local government had to look for solutions, including exempting water charges and bringing in water by tankers.

According to a group of experts, the cause of the yellow water was secondary pollution created by the pipe network. The reason was identified as the difference in the water composition of the Hebei Huangbizhuang reservoir water and the regular water supply. The Hebei reservoir water was found to have much higher concentrations of sulphate and chlorine. The lower alkaline level of the water increased its corrosiveness, messing up the pH balance of the pipe lining in the pipe network. This damaged the pipes' protective lining and caused a layer of rust to be released into the water, creating the 'yellow water' that came out of the taps.

An event on this scale is not common in China. But there have been various instances nationwide where tap water turned yellow, white, murky, smelled like bleach, presented as oily, or even contained moss or red worms. In all cases, the reasons could mostly be traced back to the pipe network and 'secondary pollution' from the secondary water supply network, observers have said.

According to the '12FYP National Urban Water Supply Infrastructure Retrofitting & Construction & 2020 Targets', many of the pipelines in China have been in service for over 50 years and are made from antiquated materials. Thus, water coming from the pipe network is of lower quality than water straight from the waterworks.

Beyond quality issues, there are problems that relate to pipeline leakages. Burst pipes are a common occurrence, sometimes affecting the water supply across whole cities. Secondary water supply facilities are mainly roof tanks and underground cisterns where sanitation is bad. Secondary pollution is a real risk and is seriously affecting the urban water supply.

During the 12FYP period, the MOHURD required that pipes in use for over 50 years and made out of gray cast iron, asbestos or concrete be replaced. This came to a total of 92,300 kilometres of pipe, equivalent to circling the earth more than twice. In addition, the MOHURD wanted to renovate some of the secondary water supply facilities with high risk potential, affecting 13.9 million urban residents.

Pipes still leaking; During 12FYP 92,300 km to be replaced – enough to circle the earth twice

"Of the RMB410 billion total investment, 60% is going towards the retrofitting of the pipe network", a water industry expert told China Water Risk/ chinadialogue. However, because the specific use of funds laid out in the 12FYP and the proportion of financing from various channels is unknown, it's difficult to accurately analyze the funding of the pipe network retrofitting.

Xue Tao said that, historically urban water pipe network construction was funded through several channels. For some poor areas, central government funding helped, while for other regions it was supported by local government investment. In some areas, the construction was solely financed by water companies; while in some older districts, the cost of the main pipeline network was included in the land development fee. In light of unresolved ownership and liability disputes, promoting the retrofitting of the pipe network will meet with some difficulties.

Secondary water supply is also controversial for other reasons. In many parts of China, water supply companies can only directly supply water to users up to a certain floor in a building. Residents living on higher floors often must use secondary water supplies from residential tanks, compression devices and other water storage methods.

Unlike the pipe network, the secondary water supply is regulated by the MoH, generally through local Disease Control Centres. In 1997 the MoH put forward the 'Secondary Water Supply Hygiene Standard'. The proposed standard outlined that water provided by secondary water supply facilities should not have sensory properties that adversely affect people; should not contain toxic and hazardous substances harmful to human health; and should not cause intestinal infectious diseases or epidemics.

But, in practice, it is not uncommon for secondary water supply tanks to be infested with cockroaches and rodents, and they are also sometimes covered with moss. As the 1985 version of the 'National Drinking Water Quality Standard' referred to is no longer in effect, the clauses it contained regarding secondary water supply are no longer in effect. Thus, there is an urgent need to update the "Secondary Water Supply Hygiene Standard" to include these "lost clauses" to improve secondary water supply quality.

STANDARDS: HOW CLEAN DOES WATER NEED TO BE, TO BE 'SAFE'?

The 'National Drinking Water Quality Standard', deemed the most stringent standard ever, lacked basic research into both environmental health risks and cost-benefit analysis. This means that the standard overestimated what China could realistically achieve.

In recent years, there have been a lot of discussions surrounding drinking water safety, but all conversation gets stuck on the topic of the 'National Drinking Water Quality Standard'. Meeting the standard has become the yardstick by which the government evaluates and guarantees drinking water safety. Public expectations have already risen to expect water quality to meet all the 106 indicators with which drinking water needs to comply. At the same time, the public and the media have also started to express concern about additional toxic substances not included in the standard.

In academic and industrial circles, a reasonable level of doubt about the 106 indicators persists. During interviews with China Water Risk/ chinadialogue, many scholars questioned China's new national standard. For example, some indicators they felt were too harsh whereas others were considered too lenient, meaning that adhering to the standard could still result in risk to human health. But in reality, 106 indicators are already simply too many to cover, particularly as some are just listed, with no matching technologically feasible standards.

Some scholars have said that because China's water sources, water treatment processes, pipe networks and secondary water supplies are far from satisfactory, it's hard to guarantee water standards will be met. This is particularly true given the context that waterworks find it hard consistently to reach standards. Thus realistically, it's very difficult to enforce and achieve national standards.

Public expectations to meet all 106 indicators are high

Another criticism of the new national standards is that the 'National Drinking Water Quality Standard' lacks both supporting technical guidelines and an input-output efficiency evaluation. Liu Wenjun holds this view. He told China Water Risk/ chinadialogue that when assessing the limitations of each indicator, the evaluation should include a calculation of the funds needed to achieve the target as well as the health risks involved.

He outlined the example of Bozhou in Anhui province. Due to excessive sodium levels in tap water, the local government was questioned by higher government authorities. Large investments had to be made to retrofit the waterworks with reverse osmosis equipment.

"Sodium itself is not very toxic and does not represent a big threat to human health. Then is it worthwhile to invest this money in order to meet the standard? It's not easy to judge", asked Liu Wenjun.

In addition to funding challenges, achieving drinking water quality standards and increasing the capacity for advanced treatment increases the energy consumption of water supply companies. That is inconsistent with China's current energy consumption reduction policies.

By the end of the 12FYP, all waterworks across Jiangsu province are planned to be equipped with ozone activated carbon advanced treatment facilities. In the Nature article, Professor

Tao Tao from Tongji University estimated the potential carbon emissions this initiative could produce. If a quarter of the water supply went through the treatment process, carbon emissions would rise by 28%, she was quoted as estimating.

In the current situation where the existing standards are not yet widely and consistently met, toxic substances other than the 106 indicators included in the new national standard are regularly detected. These include antibiotics, environmental hormones, persistent organic compounds (POPs), perfluorinated organic compounds and polycyclic aromatic hydrocarbons (PAHs). Of these, POPs and PAHs have been clearly classified as hazardous substances. Public health concerns have sparked the calls for higher water quality standards, particularly an expansion in the detection and monitoring of toxic and hazardous substances.

Toxic substances outside of the 106 indicators are regularly detected

In December 2014, China's national television CCTV reported that Nanjing's tap water contained amoxicillin. This and other antibiotics were detected in the Huangpu River.[20] In April 2014, the magazine 'Science China' published a review showing that 158 kinds of pharmaceuticals and other personal care products were found in China's rivers, lakes and other natural water bodies. These included 68 kinds of antibiotics.[21] In 2014, the environmental organization Greenpeace conducted tests along the Yangtze River Basin. Greenpeace found the environmental hormones, perfluorooctanoate (PFOA) and bisphenol A, in the drinking water sources of Chongqing, Wuhan and Nanjing City.[22] These contaminants might come from industrial discharge, agricultural runoff or municipal discharge.

According to a U.S. Environmental Protection Agency report, existing detection technology has found 2,221 types of organic compounds in U.S. water sources, with 756 types found in drinking water. Of these, 20 are carcinogenic, 23 are suspected carcinogens, 18 kinds are tumour-promoting compounds and 56 are mutation-promoting compounds.

The situation in China may be equally, if not more complex but this kind of analysis is limited by detection technology and lack of funding. Therefore, we have not yet seen such exhaustive analysis of natural water bodies and drinking water from Chinese government or academic institutions. Regarding the monitoring of water source quality, the capacity and capability also vary among different areas, subject to funding.

Some research institutions such as the South China Institute of Environmental Sciences, have established a 'Water Source Risk Control System' on the Pearl River Basin. The deputy director, Xuzhen Cheng, revealed that beyond the106 regular indicators they are also monitoring 202 additional indicators that are not required by the standard, including heavy metals, antibiotics, environmental hormones and pesticides. This dynamic monitoring system can help companies that currently emit biologically toxic substances to improve their practices and can be of use in future water quality risk management.

When faced with the controversy surrounding the 'National Drinking Water Quality Standard', a researcher involved in drafting the standard said that after the implementation of the new national health standards, the MoH and the MOHURD jointly carried out water quality tests in more than 1,800 waterworks. During these tests, only two out of the 106 indicators could not be detected. According to the researcher, the results back up the rationality of the new drinking water quality standard, as "it has caught the main problems" of the drinking water.

New drinking water quality standard "caught the main problems" but lacks "domestic tailoring"

As for public concern related to antibiotics and environmental hormones, a researcher involved in the drafting of the 'National Drinking Water Quality Standard' said he believed that, "it is currently difficult to set limits for antibiotics and contraceptives. They are not the same as endocrine-disrupting substances and POPs. We still have no conclusion on which to say to what extent and in what way they can affect human health".

In fact, these doubts can all be traced back to one source. Although the new national standard drew on water quality standards publicized by the WHO, the EU and Japan, there is a lack of support for basic domestic research. In particular, the standard lacked a toxicological study of all indicators and an environmental health risk assessment.

The director of the Water Industry Policy Research Centre, Mr. Fu Tao, pointed out that, "If China wants to become a big power, it must be responsible for its people." China should research the relationship between water and health, as well as the different impacts that each pollutant can have on the human body. For example, in light of the rare earth pollution issue, which is a problem unique to China, research should be conducted regarding the impact of chemical compounds from the refining process.

The reality is that domestic research into interactions between environmental challenges and human health started late, has insufficient funding and also faces political constraints. An environment and health researcher who started work in the 1980s said that many studies related to environment and health damage cannot be carried out in China. Take the high incidence of skin cancer in the arsenic-contaminated area in Shimen of Hunan province, for example. Good research could help improve our understanding of both the toxicology of arsenic as well as the pathogenesis of cancer. However, this research was not approved.

One of the drafters of the 'National Drinking Water Quality Standard', a researcher from the Chinese Centre for Disease Prevention and Control (CDC) E Xueli, spoke frankly to China Water Risk/chinadialogue, saying that, "In the public health system, drinking water standards have never had comprehensive support. Investment and research were lacking. As such, standard drafting had to rely on studies and information from other countries".

A researcher involved in the drafting of
the 'National Drinking Water Quality Standard'

"In the public health system, drinking water standards have never had comprehensive support. Investment and research were lacking."

The researcher told us that the CDC Control was informed in 2005 about the revision of the drinking water quality standards and the target of releasing the new version in late 2006. The revision of the old standard, including testing standards, only received RMB400,000 of funding, he said.

From August to October 2010, three years after the release of the new national standard, the Chinese Academy of Urban Planning and Design, together with the Urban Water Quality Test Center of the MOHURD jointly conducted a nationwide survey to test urban drinking water quality. Of the 284 waterworks that were tested, 51 didn't meet the standard and the overall pass rate was 82.4%. In Hubei, Hunan, Henan, Heilongjiang and Jilin there were also cases where the raw water was fine; however, the water from waterworks was found to be substandard.

51/284 tested waterworks in 2010 did not meet new national standard

Until now, seven years after the enforcement of the new national standard, no new survey results have been released. Meanwhile, the MOHURD and the MoH also have not published any additional national drinking water quality monitoring data.

The chief engineer of the Urban Water Quality Test Center of the MOHURD, Mr. Song Lanhe, told China Water Risk/ chinadialogue that according to the requirements of the Standardization Administration, there should be an evaluation of a national standard every five years in order to determine whether any modification is necessary.

Though Liu Wenjun said that the preliminary work to revise standards has started, a resource from the CDC, which is responsible for the revision of the drinking water quality standard, said the institute has not yet received any order to start relevant tasks.

“The existing standard is still more strict than the actual context”, said a researcher involved in the drafting of the 'National Drinking Water Quality Standard'. The researcher said he believed that while Chinese environmental standards, emission standards and drinking water quality standards are aligned with those in the US, the state of the environment is not. “The environment in China is probably comparable to that of the US 30-40 years ago”, he said. And while China is gradually improving its environment to meet the national standards, revision of standards will not begin, he said.

WATER QUALITY: WHAT’S THE TRUTH?

The public is concerned about water quality. However, the water quality information channels are still poor and the government keeps official tests and monitoring data secret. The public has had to seek private tests for answers and these have exposed problems with water quality.

China Water Risk/ chinadialogue learned that during the middle of 2013, the MEP, MOHURD and MWR launched an evaluation of the implementation status of the 12FYP drinking water safety targets. An important objective of this evaluation was to figure out the gap between targets and performance in order to guide the works during the second half of the 12FYP. Meanwhile, the results were also to be used to determine the targets for the 13FYP, currently in drafting.

Unfortunately, as mentioned earlier, these results were classified as ‘state secret’ and not made available to the public. This will be discussed at greater length later.

Nevertheless, several industry experts with connections to relevant ministries said that from 2012 until now, with so much invested, there surely are some improvements and generally, the improvements are significant.

In fact, since 2004, the MOHURD has started to conduct an annual examination of urban water quality, including inter-regional crosscheck. The examination includes sample surveys of the water quality and emergency response systems.[23] Apart from the two-year data disclosed by the MOHURD-Water Quality Centre in

2012, these survey results have not been made public. With regard to rural drinking water safety, information made public is even rarer.

So what does it mean if water isn't up to standard? It means risks, we believe.

When water quality meets standards, it means that the exposure to health risks from drinking the water is within a manageable range. According to standard-setters, this 'manageable range' has a specific meaning. If we take cancer risks as an example, it means that if everyone drinks 2 litres of tap water per day, over 70 years only 1 in 100,000 people will get cancer solely from drinking the water.

If standards are met,
exposure to health risks are manageable

Despite the controversy around the specific indicators of the 'National Drinking Water Quality Standard', this still relates to the quality of tap water, which is inextricably linked to everyone.

In terms of different uses of water, studies show that the main ways for water-borne contaminants to enter the human body are through drinking, breathing and the skin. Each of these three channels accounts for roughly 1/3 of water-borne contaminants intake. About 30% of the contaminants found in water enter the body through drinking, while the other 70% is taken in through bathing, eating and other family hygiene channels.

So who is testing the quality of our water and mitigating risk?

This question isn't hard to answer. At the water source end of the supply chain, the MWR and the MEP both carry out tests and monitoring. In the water pipelines of the supply chain, the MOHURD and the MoH are in charge of testing the water. During the water supply process, the MOHURD tests water coming out of the waterworks. As the supplier of tap water, the waterworks should also test the quality of both water into and leaving plants.

A much-harder-to-answer question associated with water quality is: Who is publishing the testing data?

As seen from public documents, responsible departments all publish data related to a number of key indicators. For drinking water sources, the MEP publishes national quality status in its monthly, quarterly, half-yearly and annual environmental reports. The MWR also publishes data related to the water quality of major rivers, lakes and reservoirs in their annual report. Some of these also represent drinking water sources.

For water supply, in recent years increasingly water service companies have regularly published water quality data on their official websites or in local media. In the past, such reports often simply stated '100% meeting standards', whereas now water quality test reports of 42 or even 106 indicators are included.

However, from published data, can we really know the actual quality of the urban drinking water? Our answer is: Hardly.

It has been more than seven years since enforcement of the new national standard was in effect, but the question of drinking water quality still hangs in the air and remains unknown.

Back in May 2012, two months before the new national standards came into force, Caixin's 'Century Weekly' magazine reported that the tap water in nearly 50% of China's provincial capitals did not meet the new standard.[24] That was the first time Chinese media disclosed such information.

This news was confirmed by data published by the MOHURD on national water quality later in 2012. As shown in official results, the MOHURD-Water Quality Centre tested water quality from 4457 urban waterworks in 2009 - the pass rate for water from the waterworks was 58.2%. In 2011, another random sampling survey was done and the pass rate rose to 83%. In addition, the pass rate for water quality at the user end at the city and county level was 79.6%.[25]

24.8% increase in MOHURD waterworks pass rate from 2009-2011 raise doubts

However, the increase in water quality from 58.2% in 2009 to 83% in 2011 raised some doubts. Among the skeptics was one report from the national media, 'People's Daily', which questioned the credibility of the test results.[26] In the meantime, a public movement of self-testing tap water quality was started. The water quality in some provinces confirmed as meeting the standard, according to government data, was soon found less perfect in private tests. In cities such as Beijing, Shanghai, Guangzhou and Nanjing, there were numerous cases of people testing water quality on their own due to distrust of official results. Civil society organizations continu to urge local water supply companies to disclose water quality information but to no avail.

2012 was the first and last time the MOHURD published the national tap water quality census data. According to Du Ying, the Deputy Director of NDRC, since 2004 the MOHURD has been conducting annual monitoring of urban water quality, including inter-regional crosscheck and checking local emergency response systems based on random sampling.[27]

The MoH, another ministry monitoring urban water quality, has been even less open about results. In December 2012, the MoH published only once the results of a Chinese urban drinking water quality census. These results came at the 2012 MoH Health Inspection Work conference. The pass rate was cited as 83%. After this, no more information was made public.

In early May 2013, a Nanjing-based NGO called 'Nanjing Tianxiagong (justice for all)' applied to the health departments in 77 cities to disclose tap water quality monitoring data. Of the 57 cities that responded, only 17 provided relevant information and 10 cities replied saying that they couldn't release the information.

In January 2015, China Water Risk/ chinadialogue applied to the National Health and Family Planning Commission ("NHFPC") to publish information related to the 2014 rural drinking water monitoring tests and was told the information was temporarily unavailable for disclosure. The NHFPC was created in 2013 by merging the MoH and the National Population and Family Planning Commission.

Water testing by individuals or civil environmental protection groups, however, hopefully will help reveal the truth related to water quality. Since August 2013, the Shuguang Environmental Charity Development Center in Changsha, Hunan province has collected 166 drinking water samples in three cities (Changsha, Xiangtan and Zhuzhou) using an automatic water quality-testing vehicle. The results showed that the water quality in Changsha and Xiangtan was up to standard. However, of the 40 samples taken in Zhuzhou city, 8 contained permanganate levels 2-3 times higher than regulation and 1 sample contained arsenic at twice the regulation levels.

From November 2014 to January 2015, the China Water Safety Foundation carried out water quality sample testing in 29 large and medium cities across the country. All 89 water samples were taken from the end-source that people use in their daily lives (tap water). This project tested 10 sensory and chemical indicators, 7 toxicological indicators, 2 microbial indicators and 1 organic indicator. The testing standard was the new national standard.

Results showed that of the 29 cities included in the survey, only Beijing, Shanghai, Tianjin, Hangzhou, Shenzhen and 10 other cities passed all 20 indicators, making up 52% of the total city sample. Whereas Jinan, Changchun, Zhengzhou, Guangzhou, Xiamen, Chongqing and 8 other cities had substandard results for one or more indicators, accounting for 48% of the total urban sample. Within this group, Changchun city failed in the tests of 4 indicators, with excess levels of total residual chlorine, fluoride, turbidity and arsenic.[28]

CHINA WATER SAFETY FOUNDATION - 29 CHINESE CITIES WATER QUALITY REPORT

Test indicators: total residual chlorine, pH levels, turbidity, total hardness, chloride, sulphate, oxygen consumption (COD_{Mn}), copper, iron, TDS (total dissolved solids), nitrate, fluoride, lead, cadmium, chromium, mercury, arsenic, total bacteria count, total coliforms, TOC (total organic carbon)

Testing standards: 'National Drinking Water Quality Standard' (GB5749-2006)

CITIES THAT PASSED ALL 20 INDICATORS	CITIES THAT FAILED ONE OR MORE INDICATORS
Beijing, Shanghai, Tianjin, Hangzhou, Shenzhen, Hefei, Kunming, Urumqi, Shenyang, Dalian, Qingdao, Ningbo, Suzhou, Hengyang and Shaoyang	Jinan, Changchun, Zhengzhou, Guangzhou, Loudi, Chengzhou, Xi'an, Xiamen, Chongqing, Yinchuan, Harbin, Wuhan, Nanjing and Wuxi

In fact, the MoH led the development and issuing of the 'National Drinking Water Quality Standard". Not only does the MoH have the responsibility to test and monitor the quality of the water supply, the ministry also is responsible for testing and monitoring the quality during public emergencies. Every year, the MoH publishes the national drinking water quality monitoring data in the 'China Health Statistics Yearbook.'

China Water Risk/ chinadialogue consulted the 'China Health Statistics Yearbook (2013)' and found that in 2012, regular monitoring of drinking water quality showed good standard compliance levels. Furthermore, quality supervision compliance rates reached 99.78% and quality monitoring pass rates were 92.3%. These sets of data are higher than the water quality pass rates previously issued by the MOHURD (79.6%) and the MoH (83%).

The uncomfortable truth is that because water supply is a public service, waterworks will continue to supply water whether the water quality meets the standard or not. Only in cases of major incidents will waterworks choose to stop supplying water. This, of course, is not an easy decision for a waterworks to make.

No matter the quality, water supply will continue except for major incidents

On 30 October 2014, the MEP commented on several incidents of 'excessive emergency response or unnecessary suspension of water uptake and supply'.[29] From May to August 2014, waterworks in Taizhou (Jiangsu), Tonglu (Zhejiang) and Yibin (Sichuan) were named by the MEP because they suspended water supply due to unpleasant smells from water sources or chemicals (like tetrachloroethane) being dumped into rivers. The MEP criticized that, "not only has this been a huge inconvenience to people trying to get on with their daily lives, but it has also triggered mass panic and has affected social stability".

These accidents aside, very rarely does producing substandard water lead to serious punishment of waterworks. Of course this isn't to say that no punitive measures exist. There are a number of sanctions for waterworks that cause water supply accidents including: administrative penalties, fines and even the revoking of licenses. However, in case of water quality not meeting standards, it is not entirely clear who should be punished and what the punishment should be.

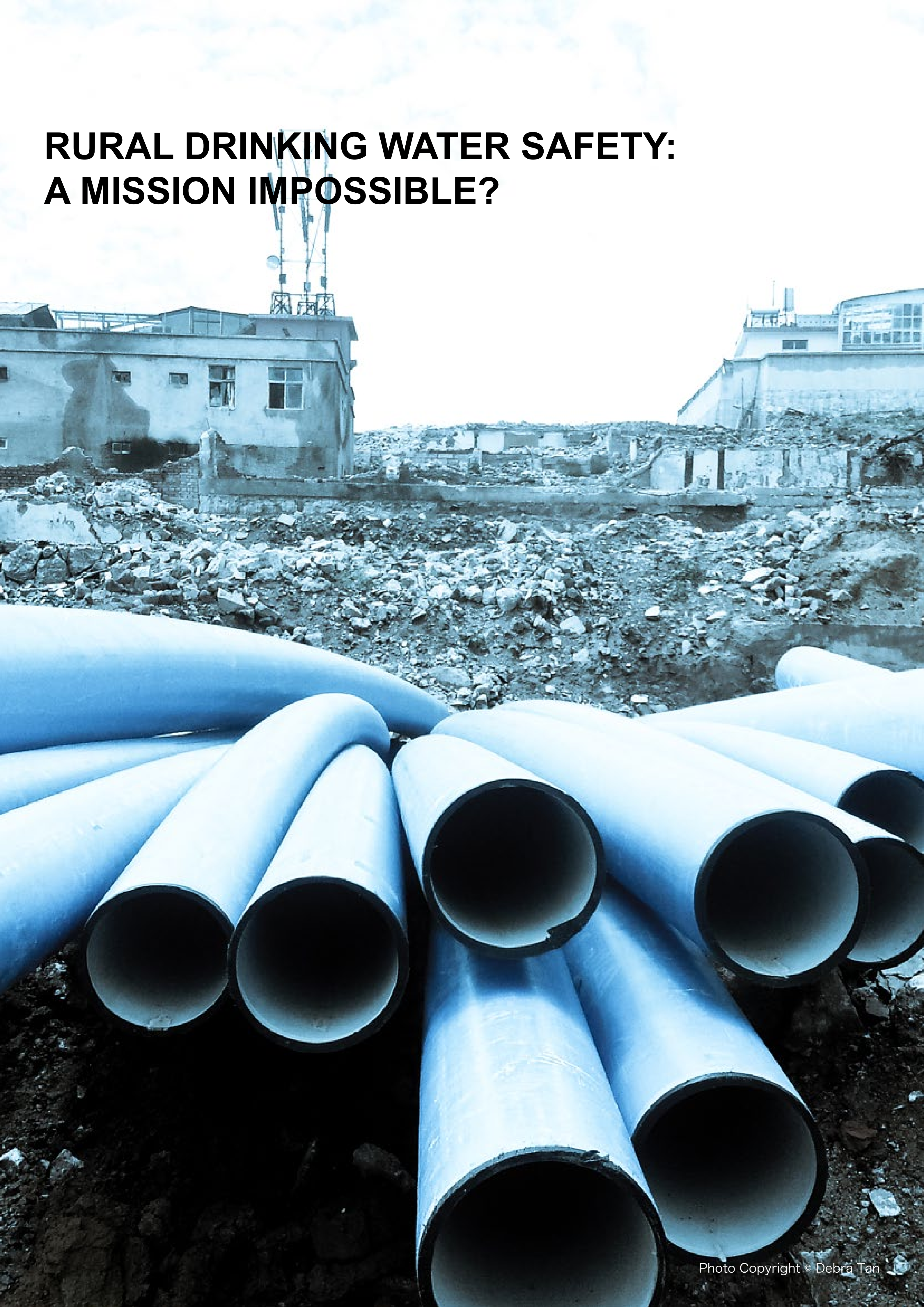
As the body in charge of monitoring drinking water quality, the MoH punished 357 cases under the charge 'drinking water not up to hygiene standards' in 2012 alone. The problems were mainly found in the collective/centralized water supply, which accounted for 91.6% of the cases.[30] The ratio between these punishments and the number of regular drinking water quality supervision and monitoring samples that weren't up to standard was 1:10. In other words, statistically for every 10 samples of substandard water found by the MoH, only one of them faced penalty.

MoH punishes 1 in 10
for substandard monitoring samples

A source involved in the drafting of the new national standards told China Water Risk/ chinadialogue that the new national standard, as a national regulation, should be enforced. However, since the day it was introduced, the standard hasn't been strictly enforced.

"If standards were strictly enforced, then failing in just one indicator would lead to stopping water production and would disrupt the water supply. But stopping water production would lead to societal chaos". The source said he believed that drinking water was a public service product and shouldn't be subject to the same standards as water that can be bought on the market.

RURAL DRINKING WATER SAFETY: A MISSION IMPOSSIBLE?



PART II:
RURAL DRINKING WATER SAFETY: A MISSION IMPOSSIBLE?

The Chinese government suggested that the problem of rural drinking water safety would be 'completely solved' by the end of 2015. Experts say that this is 'a mission impossible'. As of 2015, rural drinking water safety remains an issue for more than 50 million people.

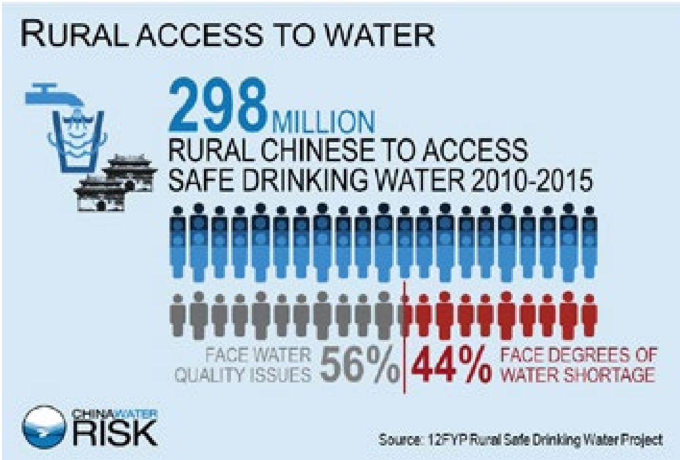
On 24 November 2014, Premier Li Keqiang visited the MWR. His first stop was the Rural Water Division to follow up on the progress of rural drinking water safety projects and plans. According to the 12FYP, the Chinese government planned to "completely solve rural drinking water safety issues".

During his visit, Premier Li Keqiang stressed that, "It is the government's responsibility to make sure all rural residents have access to clean water, and to provide the basic living condition for the masses".

Compared with the demands of urban residents for higher water quality, the rural population faces drinking water safety issues that are even more urgent. Firstly, there is the issue of having water at all, and then there is the issue of having enough basic, clean, accessible and affordable drinking water.

By the end of 2010, there were still over 400 million rural people taking water directly from water sources with either no facilities, or with only very simple water supply dispersal systems. This accounts for 42% of the rural population. Among them, 85.72 million people have no water supply facilities at all and get their water directly from rivers, streams and ponds.[31]

In order to solve the problem of rural drinking water safety the central government set itself a fairly ambitious goal. According to the '12FYP Rural Safe Drinking Water Project', the goal is for 298 million rural residents as well as teachers and students in 114,000 rural schools to be given access to safe drinking water during the period 2011-2015. Additionally, the centralized water supply rate will go up to 80%.



The central government has focused on rural drinking water safety since 2000. Over the decade, almost RMB300 billion has been invested. During 12FYP alone, investment in rural drinking water safety-related infrastructure construction is expected to reach RMB175 billion. Although, compared with the RMB410 billion investment in urban water supply, RMB175 billion seems relatively low, it is still the largest investment in rural drinking water in recent years.

So how effective has this investment been? China Water Risk/ chinadialogue learned that a mid-term evaluation report on the 'National Rural Drinking Water Safety Project 12FYP' was carried out by a third party and given to relevant ministries. A staff member who was part of the evaluation process revealed that the goal of completely solving the rural drinking water safety issue by the end of 2015 was deemed "hard" and "stressful".

Liu Wenjun of Tsinghua University was more direct about the evaluation. He said he believed that "completely solving" the problems would involve more of an administrative planning style than is the current approach. Rural drinking water safety is a highly complex issue, and completely solving the issue for everyone is a 'mission impossible'.

On 29 January 2015, during a video conference on national rural drinking water safety projects MWR minister, Mr. Chen Lei, once again emphasized the need to solve drinking water issues for the remaining 51.63 million rural residents as well as 7.04 million rural teachers and students by the end of 2015.[32]

Premier Li Keqiang,
24 November 2014

2015 is a "decisive year", and the remaining tasks are all "hard bones"

Premier Li Keqiang has said during his visit to MWR that 2015 is a "decisive year", and the remaining tasks are all "hard bones". He also has said that, "we need to bite into these hard tasks", because the government's credibility is on the line and therefore, "this battle must be won."

RURAL WATER IMPROVEMENTS

There have been remarkable achievements in the rural water supply improvement and rural drinking water safety projects. These two projects have already helped a total of over 900 million rural people gain access to clean drinking water. More than 70% of the rural population has access to tap water.

In order to tackle the drinking water difficulties of the rural population, the MoH launched a nation-wide 'rural water supply improvement' project in 1990. Since 2000, the central government has been making large-scale investments into rural drinking water safety projects. Between 2000 and 2004, a total investment of over RMB20 billion helped solve the drinking water challenges of over 60 million rural people. In 2005, the State Council issued the '2005-2006 Rural Drinking Water Safety Emergency Project Plan', which proposed addressing the drinking water of 21.2 million rural people within two years.

These contingency projects brought "life-saving water" to rural people who either lacked water or didn't have drinkable water. In 2005, the Henan provincial government issued the 'Notice on The Plan of Solving Drinking Water Safety in Seriously Polluted Rural Areas Along the Hai River and Huai River Basins'. This included a total investment of RMB240 million for relevant safe drinking water projects. Among the 540 villages covered in Phase I of the plan, the infamous 'cancer villages' in Shenqiu County led to 47 deep wells being dug.

These deep wells allowed residents of 'cancer villages' to have access to safe drinking water. Previously, villagers took water from shallow wells. Analysis of the water quality in old wells in Shenqiu County showed that the shallow groundwater was contaminated by polluted surface water. Epidemiological research later showed that exposure to contaminated drinking water is correlated to the high prevalence of cancer in the region. Continuing to drink the contaminated water would mean continued exposure to health risks.[33]

Correlation between high cancer rates and contaminated drinking water confirmed

"For villagers the worst thing was that there was no alternative water source. People saw that the water was yellow and they knew they shouldn't drink it, but they had no choice", the CDC deputy director Mr. Yang Gonghuan told China Water Risk/ chinadialogue. He led the investigation team surveying cancer villages on the Huai River Basin.

Yang Gonghuan,
Deputy Director CDC

"For villagers the worst thing was that there was no alternative water source."

During the 11FYP, the NDRC, the MWR and the MEP jointly released the first 'National Rural Drinking Water Safety Project' five-year plan. During those five years, the government invested a total of RMB100.9 billion and improved the drinking water safety for over 210 million rural residents.[34]

From the contingency projects to the five-year plan, infrastructure work of rural drinking water safety projects definitely accelerated. On 15 December 2006, the MWR set up the Rural Drinking Water Safety Centre. In 2008 at the central government rural working conference, rural drinking water safety was listed at the top of five key tasks to, "develop public utilities and improve the well-being of rural people".

During the 12FYP, new challenges also emerged in addition to the existing issues of rural drinking water safety. A survey jointly carried out by the MWR and the MoH showed that of the 298 million rural residents with drinking water safety problems to be addressed during the 12FYP, 56.2% have substandard quality water and the remaining 43.8% face water shortages to varying degrees.[35]

A reduction in incoming water, climate change and overuse of groundwater has led to significant reduction or depletion of surface and groundwater sources in certain rural areas. This means that some of the people who were helped through the previous projects are once again facing a lack of safe drinking water.

Additionally, a further 104 million rural people are at risk from unsafe drinking water due to substandard water quality. According to the 12FYP, worsening water pollution has led to the deterioration in the quality of some water sources and is one of the reasons for the increase in rural people without safe drinking water. The sources of this pollution include mining, industrial wastewater discharge, excessive use of pesticides and fertilizers, livestock breeding and domestic sewage discharge, as well as improper waste disposal in rural areas.

A careful look at the 12FYP shows that water pollution and severe water shortages have been included as priorities to be addressed. Yang Linsheng, a researcher from the Institute of Geography, commented to China Water Risk/ chinadialogue that, "The 11FYP of rural drinking water safety mainly targeted the 'Three Highs' (high fluorine, arsenic and salt) and did not cover drinking water safety issues caused by pollution. But the 12FYP has included these into the plan".

By the end of 2012, the 'Rural Water Supply Improvement' projects benefitted an accumulated total of 913 million rural residents. In addition, nearly 570,000 waterworks or water stations, 33.19 million hand-pump wells and around 2.13 million water storage units were retrofitted.

Data from the NHFPC shows that in 2012 the proportion of the rural population with access to tap water reached 74.5%, an increase of 3.3% since the end of the 11FYP.[36]

RURAL WATER CHALLENGES

The problems with rural drinking water safety projects are becoming apparent, along the following themes: heavy on construction, light on management, an unclear water pricing mechanism and a challenge to sustainability.

A staff member involved in the mid-term evaluation mentioned previously revealed that a group of experts did an assessment of early achievements and problems with the rural drinking water safety projects during the first half of 12FYP, and that "feedback and suggestions were submitted". A worry of the staff member is that in the quest to achieve the central government goal of "completely solving" rural water problems, construction will be completed in a hurry by the end of 2015; but water supply might still not be guaranteed.

"When my mother was still unable to drink clean water it was very hard for me to give an objective opinion to the rural drinking water safety project", said this staff member.

When reviewing the completed projects during the 11FYP, it was clear that many lacked long-term operating mechanisms. The majority could only ensure daily operation, but were not able to cover the costs of equipment depreciation and repairs, not to mention that they lacked the ability to do major renovations and retrofitting.

By the end of 2010, China had already built 520,000 rural centralized water supply works, each with an average daily water supply capacity of 154 cubic meters and benefitting 1,061 people. Among these projects, 90% only supply to one single village, each with an average daily water supply capacity of only 50 cubic meters and benefitting only 522 people. The price of water from these projects comes to an average of RMB1.63 per tonne. When considering only the cost of electricity, worker salaries and daily maintenance costs, the base operation cost is RMB1.45 per tonne and the average total cost is RMB2.3 per tonne.

In places where the dual water supply is adopted, water sources of high fluorine, arsenic or salt, special treatment technologies require membrane treatment and the cost of water can be RMB4-5 per tonne, several times higher than the national average. If depreciation is considered, the cost could even reach RMB8-9 per tonne.[37]

Who should pay?
Advanced treatment can cost
from ~RMB1.6 to RMB 4-5 per tonne of water

Research related to the rural drinking water safety-related policy measures carried out by the MWR in 2011 looked at 2,216 centralized water supply projects of different scales across 21 provinces (autonomous regions and municipalities). Of these projects, 80% were being paid below operating costs and almost 96% of the projects were receiving payment at less than the full cost of the water.[38]

The 'hollowing out' problem in Chinese rural families also presents another challenge to project designers: Elderly people left behind when their children migrate to cities are not used to or may not be willing to use tap water, while the urban-rural migrant workers might put a strain on the water supply system when they return to the countryside during the holiday season.

"It is a headache to figure out exactly how much water supply capacity needs to be built. For example, for a water supply system with a design daily capacity of 50,000 tonnes, the average daily use is probably only 10,000 tonnes. However, it may also not be enough over Chinese New Year when everyone comes home", said Yang Linsheng, a researcher at the Institute of Geographic Sciences and Natural Resources Research of CAS, who is familiar with the rural drinking water supply.

Mr. Liu Wenjun also worried that even with the goal of "completely solving" the rural drinking water challenge, there will always be people who are missed out. These are usually people living in remote areas with no, or only poor quality water due to geographical limitations. Moreover, with limited economic conditions, it is extremely difficult to solve the drinking water issue for these people.

In areas not yet covered by government projects, civil society organizations have started taking action. In 2014, the initiative 'A Glass of Clean Water', from the NGO Greenovation Hub started a project in Huzhu Tu Autonomous County in the northeast of Qinghai province with the help of charitable funds. The project aims to provide simple, portable water purification systems to local schools so that students have access to clean drinking water.

Previously, these schools either had to get water from a collection point 20 to 30 kilometers away and store it in an underground water tank or rely on rainwater collection. During particularly dry seasons, some schools even had to borrow water from neighboring villagers. Tests of the rainwater collected in the water tanks show turbidity at 7 times the acceptable levels, and with very high bacteria count. The water is also yellow and often contains insects, roots and other impurities.

Prior to this project, the NGO visited nearly 100 villages and 6 schools across Beijing, Hebei, Yunnan, Inner Mongolia, Guangdong and 6 other provinces (municipalities). The survey report found that local governments have favored large-scale, low-cost rural drinking water construction projects with larger numbers of beneficiaries in an effort to achieve central government goals. As a result, remote and small-scale project construction has lagged.

The report said that, "in the future, local governments need to be prepared to resolve the remaining difficult-to-solve 'small problems', regardless of cost".[39]

PUBLIC HEALTH CONCERNS RELATED TO RURAL DRINKING WATER

Even though the 'National Drinking Water Quality Standard' has been somewhat relaxed when implemented in rural areas, it's still hard for rural water quality to reach standards. Along the Huai River Basin, the correlation between drinking contaminated groundwater and cancer has been confirmed. Rural drinking water sources face all sorts of pollution risks and some villages even need to replace their water sources frequently.

According to the national standard, in villages with a daily water supply below 1,000 cubic meters or with a population below 10,000 people, both centralized and distributed water supply systems can adopt provisional measures. In these cases, a few select indicators can be relaxed as long as drinking water safety is ensured. Nevertheless, the 106 indicators overall are still suitable to assess the drinking water quality in rural areas.

'National Drinking Water Quality Standard' indicators are relaxed in rural areas

The indicators included under the "relaxed" measures are bacteria counts, sensory indicators and a few general chemical indicators. Also included are three toxicological indicators: arsenic, fluoride and nitrate. If we look at arsenic, the conventional standard is 0.01mg per liter of water, whereas in rural areas this has been relaxed to 0.05mg per liter.

One of the standard-setters said candidly that rural drinking water infrastructure construction started a lot later that urban projects and the situation is a lot more complicated. Changes can't all be made at one time. It is therefore appropriate to relax some indicators to allow the base infrastructure projects to move faster.

He also added that although the rural arsenic standard is about 5 times higher than the urban standard, the original arsenic level in the old standard set in 1985 was 0.05mg per liter and, "no problems were found" in terms of public health. In the future, if we want all 520,000 rural centralized water supply systems to meet all 106 water quality indicators, we must also include rural environmental improvements and rural cultural development.[40] To achieve this, we must first consider economic factors.

In an article published in the internationally renowned medical journal 'The Lancet', Tsinghua University professor Gong Peng wrote that many cities have implemented policies or changed the industry mix to cut industrial water use in order to secure water for domestic use. Some cities have even looked to underdeveloped suburbs for water. Even so, the rise in water demand has led to some water supply companies (particularly in water scarce regions) having no choice but to use contaminated water for domestic use, with consequences for public health.

Many cities changed industry mix to secure water for domestic use

In the Huai River Basin, the correlation between drinking water and public health damage has been confirmed. In June 2013, the former deputy director of the CDC, Yang Gonghuan, published data from her 8 years of research. The results showed that the extreme pollution of the Huai River Basin and the high incidence of gastrointestinal cancer among Shenqiu, Yingtung and 6 other counties are both time-wise and geographically consistent and correlated.[41]

These 'cancer villages' are mostly located along first and secondary tributaries of the Huai River, as well as along a few smaller tributaries. Although monitoring data have shown improvement of water quality in the Huai River since 2005, the dams built on the tributaries have trapped industrial wastewater and resulted in serious, localized pollution.

Drinking water is the main way that people living in the Huai River Basin are exposed to water pollution. According to Zhuang Dafang, a researcher with the Institute of Geographic Sciences and Natural Resources Research (Chinese Academy of Sciences), analysis of rural drinking water from wells and the surface water of the Huai tributaries shows that, in heavily polluted areas, shallow groundwater and surface water have essentially the same composition. This means that harmful pollutants in the surface water have contaminated the groundwater. In the polluted areas, not only cancer patients but also other villagers have been drinking the contaminated groundwater.

The studies of cancer cases along the Huai River also illustrate an important point: Groundwater doesn't necessarily mean clean water. In the past, people tended to think of rural areas as far away from pollution and that groundwater was a relatively clean drinking water source. If the water wasn't found to have high fluorine, arsenic and salt content, then its quality was pretty much guaranteed. But in reality, this isn't the case.

In 2009, the MEP carried out a water quality analysis of 641 drinking water wells across 8 provinces/ autonomous regions/municipalities. The results showed that only 2.3% of the wells were found to be Class I-II water, which can be directly used as drinking water. 23.9% were labeled Class III, suitable to be used as a centralized drinking water source. More than 70% were Class IV-V water quality, mainly falling short in indicators including total hardness, ammonia, nitrite, nitrate, nitrogen, iron and manganese levels.[42]

In recent years, there have been increasing cases of rural drinking water sources being contaminated by illegal wastewater discharge from factories. On 22 January 2015, the people's court in Xiangtan County, Hunan province, handled a case of pollution from a local company. The water quality of at least 7 villages had deteriorated over the previous three years to an undrinkable state, containing excess levels of ammonia.[43]

Pollution is everywhere in China. Not only wastewater from factories enters drinking water sources through a variety of channels, but harmful particles in the air from factory emissions will also cause contamination via rainfall and runoff. In some places, the continued deterioration of water sources means that there is no choice but to frequently change drinking water sources.

The project manager of 'A Glass of Clean Water', Shi Liling, told China Water Risk/ chinadialogue that during their survey they found some villages had to change wells a few times in a few years. In some eastern and central regions, some villages had to switch their water sources from rivers and ponds to shallow wells and then to deep wells, simply because of the spread of pollution.

Shi Liling,
Project Manager of 'A Glass of Clean Water'

"If the deep wells get contaminated, it will be a very scary prospect. That would mean that people in these places might not have any water to use"

"If the deep wells get contaminated, it will be a very scary prospect. That would mean that people in these places might not have any water to use", Shi Liling said.

Still, China Water Risk/ chinadialogue have learned that the deep wells dug to combat the pollution of Huai River Basin have been showing some water quality issues. Huo Daishan, founder of a local NGO, Guardians of the Huai River, said that many villagers have dental fluorosis due to excessive fluoride levels in the deep water wells. She worried that if villagers, who have been living under the shadow of 'cancer villages', continue drinking this water without further filtration, disinfection and treatment, they may face additional risks to their health.

ARE WATER IMPROVEMENTS SUSTAINABLE?

Rural drinking water safety projects have been accused of being, "heavy on construction, light on management", the collection of water fees has been difficult and project operations face difficulty around sustainability. The 13FYP might put emphasis on 'sustainability' and continue to explore effective, long-term funding mechanisms.

The Chinese government has been investing heavily in rural drinking water safety projects over the past decade. The 12FYP is coming to an end and the 13FYP will begin next year. According to the plan, the next stage is to "completely solve" rural drinking water safety issues. China Water Risk/ chinadialogue found that the sustainability of rural drinking water projects is starting to be taken into account by decision makers.

At the national video conference on rural drinking water safety mentioned before, MWR minister Chen Lei revealed that the 13FYP will be formulated based on the full completion of all the 12FYP targets. The 13FYP will include work related to improving rural drinking water quality and the efficiency of water supply. Steps will be taken to increase the rural tap water penetration rate, the water supply guarantee rate and the water quality levels even further.

Yang Linsheng has raised concerns regarding the future beyond the 13FYP. 'As the climate is changing, will some places have enough water sources in the future? Can their water supply be guaranteed? Meanwhile, the rural environment is also undergoing big changes and will it be possible to guarantee the safety of water sources here?'

He provided examples, including that drinking water problems in some suburban areas were solved by extending the urban water pipe networks. But soon these areas will be urbanized, and there will have to be new networks built with additional investment. Another problem is that many villages are in decline and many young workers are moving out. In some villages, only a few households remain. Can China adequately plan the projects in such cases?

Wang Hao ,
Director of Water Resources with the China Institute of Water Resources and Hydropower Research

China's rural drinking water safety projects have been "heavy on construction, light on management"

Therefore, to refine sustainable operating mechanisms has become a priority. Not having this has been a challenge for rural drinking water safety projects. According to the Director of Water Resources with the China Institute of Water Resources and Hydropower Research, Wang Hao, due to a lack of policy as well as technological and financial support, China's rural drinking water safety projects have been "heavy on construction, light on management".

It's not hard to understand the literal meaning. "Heavy on construction" in Chinese means focusing on water conservation infrastructure, whereas "light on management" means that management is being undervalued. In reality, there are many such cases.

For example, the 'A Glass of Clean Water' team visited a school in Yushan town, Xiangzhou district, Xiangyang city, Hubei province. There, they found that the water supply was unreliable. The water pipeline was extended all the way from the town to the school and as such the water pressure was low. In order to solve the problem, the local government dug a well 320 meters deep. But the well water had a high hardness level exceeding the standard and had to be abandoned.

This type of infrastructure-focused thinking to solve water problems through water diversions or tapping groundwater sources has been criticized by some water industry researchers. They generally believe that while this approach can easily have visible results and supply "life-saving" water, it is not necessarily a sustainable solution. The reality is that as long as groundwater sources face pollution risks, the quality of rural drinking water sources is also at risk. This coupled with the slow groundwater recovery rate, makes it likely that drinking water projects will become obsolete after a short period of operation.

"We need to prioritize. Wells are used to solve the cases of most serious water shortages. The central government is digging wells for salvation, yet this should not be a long-term solution", said Xue Tao.

In his view, the solutions should not rely on water conservation projects, which aren't sustainable. Instead, investments should focus on treating surface water pollution. But the reality is that rural markets are still weak, project operation performance is poor and the management of equipment and facilities is also poor.

In January 2015, China Water Risk / chinadialogue visited the Yuanshang Village in Yongfeng county in Ji'an city, Jiangxi province. Due to difficulties in collecting water fees, the village water supply system constructed several years earlier had stopped providing water a few years previously. Although the pipes were still connected to each household, no water passed through them. Some villagers had no choice but to use old wells. Some more affluent families were able to sort out their own water supply systems by first disinfecting the well water and then pumping it to a certain height to supply water. However, the cost for such a system is relatively high.

A villager said that when they first had tap water, each household offered labor work plus RMB200 payment but now they had to sort out their water supply again by spending several thousand yuan. "I got used to using tap water while working in the city. It is expensive [to install], but you need it".

The fact that some rural residents didn't want to or were unable to pay the water fees, had directly led a number of completed rural water construction projects to come to a standstill. This uncovers another issue threatening the sustainability of the rural drinking water safety projects: the undetermined water pricing mechanism.

"The basic principle at the moment is that all project costs are borne by the state, whereas operational costs are to be covered by residents." However, many rural residents have never had to pay for drinking water before, according to a member of the expert group on national water projects, Liu Wenjun. He has completed field inspections of many rural drinking water safety projects and told China Water Risk / chinadialogue that even on the outskirts of Beijing, some villagers find it difficult to accept the idea of paying for water.

The unclear water fee collection system thus poses a threat to the sustainable operation of even completed projects. Across the country, although most projects adhere to planning requirements and have established regulatory bodies and water metering and fee collection systems, there are still some areas where a per head fee charging system is being implemented and others where water is provided as social welfare. According to Beijing's first water resources survey, "Rural Water Supply Projects Survey Results", apart from a few waterworks that treat water using conventional methods, other projects were all marked "no fee collection".

Unclear water fee collection
poses threat to operations;
Many rural residents have never paid for water

The "light on management" problem has its reasons, one of which is lack of human resource. Qu Yonghui, senior engineer at the China International Engineering Consulting Corporation, took part in the mid-term evaluation of the 11FYP rural drinking water projects. He wrote that in 2/3 of the provincial water resources departments there are on average only 1-2 people working specifically on rural drinking water safety. At the county level, human resources are also limited. There is a lack of technical personnel and funding yet there are heavy workloads. These factors impact the progress and quality of the water projects.[44]

Former deputy director of the CDC, Yang Gonghuan, told China Water Risk/ chinadialogue a similar story: The monitoring of rural drinking water safety is carried out by the county-level CDC but there is a lack of monitoring staff, equipment and capacity. Consequently, a lot more investment is needed in order to change the context.

Xue Tao said, that, "in the 13FYP and 14FYP, things will definitely change. This will partly be due to financial reasons, as the central government had to tardily find money to solve [the rural drinking water issue]".

THE RURAL WATER MARKET TRYING TO FIND ITS WAY

The rural water supply market
has huge potential
but the business model is still unclear,
financing channels are lackluster and
success stories are rare.
Specialists expect
improvements after a decade or so.

The State Council's 'National New Urbanization Plan (2014-2020)' includes rural water safety in the urbanization planning and overall coordination. It outlines that decisions should be made according to local conditions on whether a centralized system, a decentralized system or extension of urban supply pipe networks to villages should be chosen to supply water.

Of these three types, the "pipe network extension" option, also known as "urban-rural integration" is the one with a relatively active participation of capital in the rural water market. As the investment environment improves, some water service companies have started providing water treatment services at the township level. However, facing a much bigger rural market, water service companies remain unmotivated.

Xue Tao's analysis is that the marketization of rural water supply services is weak. Even if there is some development, this would still rely on government procurement of services. Overall, marketization takes time and residents need to shoulder most of the costs. Currently, the key challenge is that even if the government leaves the operation part of water supply to the market, after building the pipeline network and other infrastructure, the rural community still isn't ready to pay for the water service.

Liu Wenjun also believes that private capital could be a good complement to help solve rural drinking water safety issues. The rural market is large and will certainly develop over time. The key lies in designing a good system so that businesses can be profitable but also regulated, thereby solving the problem of safe drinking water in rural areas.

"The biggest common feature of the countryside is that everything is spread out and small-scale. This poses technical difficulties. Water treatment technologies are also subject to the rules of economies of scale; the larger the scale, the lower the marginal costs. If we can't find scale-up solutions for rural areas, it's going to be very hard", said Liu Wenjun.

In a recent report about investment into rural water conservation,[45] Finance minister Lou Jiwei pointed out that on rural water conservation issues, the relationship between the government and the market is not yet clear. There has been neither an effective market mechanism to manage water supply, water use, water saving and water conservation, nor an effective and organic coordination mechanism of using "both hands" – the government and the market. Moreover, the agricultural water pricing reforms is progressing slowly. It's difficult for market mechanisms to play their role effectively.

During the 11FYP period, the MWR carried out rural drinking water project management reform in 26 pilot counties across 11 provinces/autonomous regions/municipalities. These pilot projects affirmed several development models:

- Extend the urban pipe network in villages that are close to cities and townships;
- Build cross-village centralized water supply systems in collaboration with the village-township development plan in densely populated villages;
- Build single-village water supply projects in villages with scattered settlements and small-scale water sources; and
- Implement dual water supply in areas that lack high-quality fresh water sources, particularly in areas with high fluoride, arsenic and salt levels, where water treatment costs are relatively high.

The 12FYP clearly sets out the target to increase the rural centralized water supply rate to 80%. As for the remaining 20%, they will use decentralized water supply systems. A number of water industry experts predicted that the integration of urban and rural water supply and cross-village centralized water supply models will continue to be promoted in the future, but there is no particularly good solution for the remaining 20%. These 20% are also the furthest away from the reach of the market.

12FYP target to increase rural centralised water supply rate to 80%

Tao Tao of the School of Environmental Science and Engineering at Tongji University, told China Water Risk/ chinadialogue that the "integration of urban and rural water supply" will create new problems:

- First is the issue of pipe network construction investment. This may lead to issues of unclear ownership, which also exist in the urban pipe network;

- Second is the issue of pollution and water-leakage in long distance water pipes. Some studies have shown that the leakage rate in the integrated urban-rural pipeline is 4-5% higher than the urban pipeline average; and

- Third is the issue of controlling water pressure and energy consumption.

The industry has come up with possible solutions. One option is instead of transporting treated water from big cities to villages to transfer raw water from urban water sources with relatively good quality to villages, and then treat the water in the water treatment plants within the villages.

Xue Tao said, "there is great potential for rural areas, but no good business model. The outlook for the next ten years isn't great, but there might be some development after that".

Xue Tao
Deputy Director of the Water Industry Policy Research Centre
at Tsinghua University

"there is great potential for rural areas, but no good business model. The outlook for the next ten years isn't great…"

WHO IS RESPONSIBLE FOR DRINKING WATER SAFETY?

PART III:
WHO IS RESPONSIBLE FOR DRINKING WATER SAFETY?

The 'nine dragons managing water' means dispersed responsibilities of water management amongst different government departments. There is also a lack of coordination and liability system. It is hoped that the coming 'Water Pollution Prevention and Control Action Plan' will help in this regard.

In China, there is a well-known saying: "Nine dragons managing water". The saying originally referred to a situation where there were lots of dragons in charge of managing water, but in reality all of them forgot their job, which involved making rain and clouds. In the context of the current administrative structure in China, there are multiple departments responsible for water management. Although each has specific responsibilities, the overall water management is still stuck in the vicious cycle of pollute first, manage later. This represents the "nine dragons managing water" in modern China.

Multiple departments with undefined responsibilities complicates managing China's water

China Water Risk/ chinadialogue have spent several months investigating the problem of China's drinking water safety. Except for some unsolvable technological issues for the time being, all academia and industry experts point to management as the key challenge.

China's water management system is complex. When it comes specifically to drinking water, the NDRC, MEP, MWR, MOHURD, MLR, NHFPC (former MoH) and other ministries are all involved. For water supply services alone, the urban water supply is managed by the MOHURD and the rural water supply is managed by the MWR. However, in the face of rapid urbanization, this dual system of jurisdiction has become problematic. In areas that aren't clearly either rural or urban, the two ministries have faced difficulties coordinating water supply planning and infrastructure investment.

Apart from water supply services, water sources are managed by the MEP. However, when it comes specifically to groundwater, there is also an issue of jurisdiction. About 40% of China's cities of prefecture-level and above use groundwater as their drinking water source. Groundwater quality monitoring is mainly undertaken by the Land Department, while groundwater extraction is managed by the MWR.

Water diversion is just as complicated. To deal with water shortages, many places have launched long-distance water transfer projects. Among them, the most famous is the SNWTP. For the eastern route, when water arrives in Beijing, it is distributed by water companies to reservoirs. Then it is transported to tap water companies. In addition to the SNWTP, many cities have other water sources such as reservoirs, ponds and local water diversion works. Authority over these sources falls on the MWR, whereas water quality and water environment are dealt with by the MEP.

With regard to drinking water quality and safety, the NHFPC is in charge of the monitoring. But in reality it's not only the NHFPC that carries out water quality tests. In fact, because the NHFPC conducts water quality tests from the perspective of disease prevention and control, their tests are nowhere near as frequent as waterworks, and even less frequent than the MOHURD.

So are these the only government departments that are responsible for the safety of drinking water? There are actually many others.

If we trace back, the water source pollution caused by agricultural non-point pollution sources are managed by the MoA, which is responsible for pesticides and fertilizers as well as for providing agricultural technical training. In the case of antibiotics, environmental hormones, cosmetics and personal drugs found in the water, these are not only relevant to the MoA, NHFPC and MEP, but also linked to consumer behavior.

All these ministries are involved in water management, yet their respective responsibilities are not clearly defined. This, coupled with a lack of coordination has led to many internal disputes.

"Many of the provisions in the 'National Drinking Water Quality Standard' were the result of negotiations between the MWR and the NHFPC. In China, once it was negotiated, it could be hard to implement", said a researcher involved in the drafting of the 'National Drinking Water Quality Standard'.

As for the NHFPC which is at the end of the drinking water management chain, grievances are often directed at the MEP by default. A researcher with the CDC told China Water Risk/ chinadialogue that health problems caused by environmental damage have already begun to appear. Over the next 20 to 30 years, environment-related health problems will mainly be concentrated in high rates of chronic diseases, particularly of cancer.

"All environmental problems will eventually have an impact on health. The MEP is not just responsible for managing the environment, they are also responsible for protecting the health of the people", the researcher said.

Researcher with the CDC

"… The MEP is not just responsible for managing the environment, they are also responsible for protecting the health of the people"

Liu Wenjun, Director of the Drinking Water Safety Centre of Tsinghua University said, however, that during the drafting of the national drinking water quality standard, MEP officials promised to improve water source quality. Yet, there has been no significant improvement of water quality and no strong punitive measures have been taken against pollution violations.

"Why is there water pollution? It is mainly due to economic development. If so, the government should bear the responsibility of improving the water quality. Such responsibilities cannot be all put on the waterworks. Pollution in water sources is the main reason for (substandard drinking water quality)", said Liu Wenjun.

Lack of progress by MEP means lower quality water standards used

In light of the lack of significant progress in the MEP's water source protection work, there has been no choice but to decrease the requirement of water source quality from Class II to Class III for surface water. Currently, given the poor water source quality and tightening of drinking water standards after the issuance of the new national standards, the policymakers naturally sought technological measures to ensure drinking water safety. As Tao Tao said in the 'Nature' article, China was back on the old "technology-focused" path previously trodden by developed countries.

Such a mindset is evident in many rural drinking water safety projects. In some places, these projects are "well digging projects". One example is a village in Gansu province. Only two years after using the new well, villagers began showing symptoms of excessive fluoride consumption. Subsequent water tests showed an excessive level of fluoride content in the well water. Similar cases exist in the Huai River Basin.

"The MWR is dedicated to drilling wells. As for water quality, it's not that they don't understand the issues, it's just that these are not their main concern", according to a specialist on rural drinking water issues.

Since currently it is difficult to push management structural reform, some scholars have put forward the idea of establishing a coordinating body above all ministries to deal with water-related needs. Some people have pinned their hopes on the forthcoming 'Water Pollution Prevention & Control Action Plan'. They hope that this plan will result in a breakthrough in cross-ministry coordination and supervision, and the relationship between the government and the market as well as inter-regional coordination and local management. Hopefully, this can break the "nine dragons managing water" stalemate.

Other scholars have also called for the introduction of formal drinking water legislation. Such a law could be based on the US Clean Water Act or the EU Water Directive. However, the ultimate goal is to establish rules and laws that suit China.

13FYP to fill in gaps in drinking water safety issues

China Water Risk / chinadialogue has learned from the Planning Division of the MWR that during the early planning stages of the 13FYP water safety protection and water conservation reform, drinking water safety legislation had been included.

Looking forward, we hope the following issues will be resolved toward securing safer drinking water for China:

- **Governance:** Reform the water governance system; establish a water management and coordination mechanism across different government bodies; establish a supervisory and early warning system; apply integrated watershed management; launch a solution for securing drinking water safety in the longer term based on the above systems and across different government departments

- **Law & regulation:** Launch drinking water-specific legislation; enhance law enforcement in particular with regard to water source conservation

- **Standard:** Conduct a new evaluation of the drinking water standard and adjust this when necessary; upgrade the standard for secondary water supply; set up a special standard for drinking water source protection; set up technical guidance to help waterworks and secondary water suppliers meet the new drinking water standards

- **Finance:** Improve the current finance context; solve the issue of ambiguous ownership; encourage innovations in solving finance challenges relative to the rural and urban drinking water markets

- **Water quality monitoring & information disclosure:** Launch a drinking water monitoring system at both national and local levels and ensure relevant information is available to the public

- **Civic participation:** Encourage civic participation in water source conservation, water quality monitoring and the policy-making process; encourage civic action and innovation in reaching rural drinking water safety goals; adopt or include civic innovation, if any, in official plans on drinking water safety

- **Science & technology:** Conduct basic studies on water and health, especially relative to new challenges facing drinking water quality; develop and improve water treatment technology; divert research & development focus into water treatment technology that is adaptable, affordable and efficient for rural China.

China's march to safe drinking water is still long but there is hope, especially if the above challenges are tackled.

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