

REMEDIATING WATER QUALITY IN CHINA

Creating a platform that enables opportunities for global
private entities



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Executive Summary

Wastewater treatment from industrial and agricultural practices is a daunting task for local governments in China given limited funding, incomplete administrative measures and poor legislative implementation (Miao et al, 2015). To tackle these challenges, the central government released multiple policies that have reframed the traditional ways of pollution control — “polluter treats the wastewater”, into a new form of “polluter pays and environmental professionals treat the wastewater” (China Water Risk 2015). We view these as game changing policies that provide new business opportunities and challenges to stakeholders: investors, industry and environmental firms who are inherently involved in the water business.

Industries are looking for efficient and cost-effective techniques to treat effluents, environmental firms are searching for clients and providing techniques, and investors can make investments on treatment projects, equipment or technologies from environmental firms for future returns.

This Master’s Project has created a platform called SinoAtlas (sinoatlas.asia) that aims to enable the stakeholder groups to provide essential information about Chinese water markets and allow them to interact with other groups and cooperate based on mutual interests through **Public Private Partnership (PPP)** or **Industrial Private Partnership (IPP)**.

We selected agriculture as the industry to set up the fundamental framework for our site because it accounts for the most Chemical Oxygen Demand (COD), Nitrogen and Phosphorus pollution among all industries in China. We completed chronological reviews on policy over PPP, foreign investment and environmental third party treatment, which demonstrated increasing central government commitments to promulgate PPP projects with detailed local administrative measures. Though barriers for foreign investments have been reduced, the relatively new concept of “environmental third party treatment” hailed by the State Council has not yet received solid legislative support.

Apart from offering essential policy and market trends, to help evaluate how water relevant projects are working in China for different sets of users on the SinoAtlas platform, we provided brief case studies of successful water businesses for foreign companies (Veolia/Suez), domestic companies (Origin Water) and environmental firms (Hunan Xiangniu).

The most important part of the platform, water project formulations, can be accessed through a GIS visualization system. The visualization system is essentially a database with IPP project information entered by industries and PPP projects entered by platform managers. To make sure farmers (industrial users) type in their project information based on their needs for agricultural wastewater treatment, we developed a simplified treatment diagram based upon conversations with agricultural professionals from Zhejiang Academy of Agricultural Science. Farmers can select from four modules of wastewater treatment systems (Module 1. Feces Dry/Wet Separation / Module 2. Crop Straw Recycling / Module 3. Integrated Farm Design / Module 4. Soil Testing and Fertilizer Recommendation). In aggregate, the modules represent the most challenging steps for ecological agricultural projects. Based on their interests, environmental firms and investors can access project details from the GIS Environmental Inventory Database at SinoAtlas platform.

When the fundamental structure of the platform was complete, Strength-Weakness-Opportunity-Threat (SWOT) analysis was done to ensure the objectives of the platform are met and to make recommendations to subsequent MP groups for the client. The SWOT analysis shows the platform provides essential information for different groups of stakeholders in water relevant businesses, and that they are able to be interactive in the platform. We recommend that future MP projects focus on getting more user feedback with improved level of user engagements and marketing efforts.

Chapter I Introduction

China's rapid economic and industrial growth over the last two decades has significantly stressed its natural environment. Polluted effluents from industrial and agricultural sources are widespread with poor enforcement of pollution regulations (Miao et al. 2015). Analysis of China's evolving GDP structures indicates China is at a critical point of transitioning towards a "post-industrial" service-based economy where science innovation is likely to replace traditional low cost manufacturing (Hu and Cheng 2013). China Water Risk (2015), a non-profit organization committed to increased social awareness for water related issues, summarized eight key policies on environmental issue that have been promulgated in the past two years and demonstrated the commitments from central governments on water issues. Many of the policies target mitigation of industrial pollution using both stringent regulation and financial incentives. As a result, industry and other affected social groups such as investors and environmental service providers are confronting opportunities and challenges at this critical point of economic transition.

Environmental service providers, primarily environmental consulting firms, offer services and advice on remediating environmental impacts of their clients. Traditionally, service providers are compliance driven and have an active role in Strategic Environmental Assessment (Wu et al. 2011). In 2014, the nation's first guideline on third party treatment was promulgated with strong state support for third parties and participating industries. Along with increasingly stringent rules, the guideline becomes a pivot point for global environmental consulting agencies with rising treatment demands.

At the same time, investors, who seek revenue and returns from various types of business, may consider environmental fields as a fresh investment. The best opportunity is through **Public Private Partnership (PPP)** in the business of public water/wastewater utility. Due to insufficient budgets from local governments for modernizing the utilities, central governments have strongly supported the adoption of PPP as a way of fundraising for water treatment plants (Thieriot and Dominguez 2014). Specifically, the Chinese State Council has published "*Guidelines on Innovation of Investment and Financing Mechanisms for and Encouraging Private Investment in Key Sectors*" (State Council 2014). These guidelines urge local municipal governments to build equivalent legislations and regulations on the PPP. Furthermore, in mid-2015, another guideline on "*Promoting Environmental Third Party Treatment*" was released (State Council 2014),

providing systematic ways of claiming pollution liability, effectively treating industrial water, and financing the treatment plants through market mechanisms.

While increased legislative reforms on PPP provide a great opportunity for investors and environmental firms to profit from the water industry, most of the wastewater treatment plants in this context are meant to be “centralized”, which means the priority for water utility projects is to areas with existing industrial zones and with multiple industries that can share and maintain the treatment volume of a wastewater plant.

However, when a public centralized wastewater treatment plant is not available, geographically isolated industrial users must look for alternative ways to handle their wastewater. In such cases, industrial users have the option to use third party environmental firms with a point-to-point contract to leverage environmental responsibility and potential financial loss. This mode is an **Industrial-Private Partnership (IPP)** where private environmental firms and industry collaborate, and industry pays for the treatment service.

Finding an environmental service provider that can provide cost-effective and efficient treatment/recycling is difficult, especially when the budget, regulatory implementation and relevant concepts wastewater treatment are limited. PPP projects, published by local governments, also bear risks from financial, legislative and socio-political perspectives (Lee et al. 2009). These projects have relatively little exposure to foreign investors or to broad global investors. As a result and despite the efforts from the central government to expand the investor base, local private investors are dominant participants in PPP in the Chinese water sector (Cheung and Chan 2011).

Now is the best of times for making changes, and it is the worst of times for China’s accumulated issues on pollution. With problems faced by all types of stakeholders (environmental firms, industry and investors) in the water supply/treatment field, our project creates a platform that helps global private entities identify benefits and risks from water business, and are motivated to take subsequent actions by forming projects with cooperative initiatives.

Chapter II Objective

Recent individual enthusiasm in water related issues has improved environmental performance in China (Haddad 2015). Haddad suggests “a transparency-based platform” that would “serve an important coordinating function across multiple sectors, creating a mechanism through which market forces are channeled in pro-environmental way.” Sino Atlas, developed in collaboration with Monterey Institutes of International Studies, aims to be the pioneer platform to support different types of stakeholders in the Chinese water sector for 1) interactive information exchange based on mutual need, 2) access relevant state policy and benefits 3) proactively involve in water relevant projects. Eventually, projects will benefit water quality and the water users in China.

Specifically, private entities have the following interrelationships in different types of projects relevant to water supply and treatment:

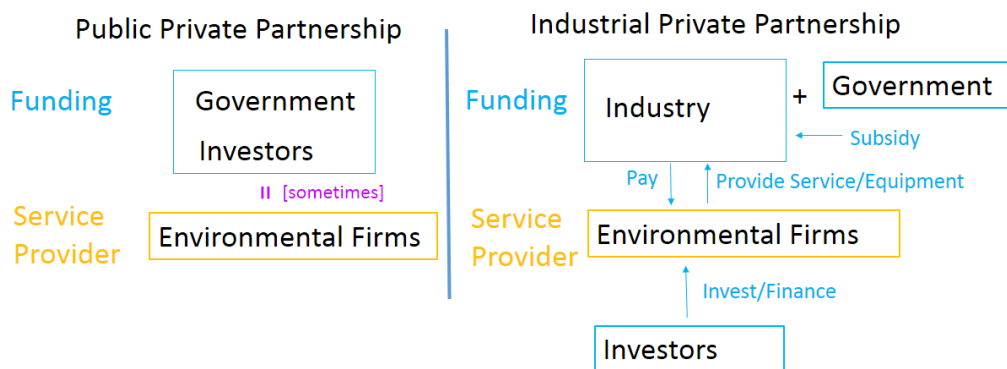


Figure 1 Relationship between investors, environmental firms and industry, and the role of government in incentivizing cooperation.

For PPP, in certain circumstances, environmental firms with strong funding capacity can be investors as well. For example, the renowned French-based water company Suez Environment, entered the Chinese water market by setting up a joint venture with local municipal government, acting as a both treatment technician and a private investor (WaterWorld).

Bearing on these relationships, the Sino Atlas platform provides a framework to inspire industrial users and enable the following tasks:

- 1) Access the most up-to-date pollution liabilities, regulatory trends and cost-benefits of adopting ecologically friendly treatment methods in their industry, with the purpose of providing appropriate environmental education and recognizing the benefits of third-party treatment.
- 2) Publish IPP projects based on modules of technical difficulties encountered in the process of wastewater treatment.

Through the Sino Atlas platform, environmental firms can access project details and determine if they have expertise in the field of industrial user's needs. The platform will also provide additional information on water market trends and forms of state support for environmental firms.

Investors, in addition to obtaining essential regulatory information, can view PPP projects on a geographical scale for making investment decisions.

Chapter III. Methods

Part 1. Generic Platform User Interface Design

The fundamental structure of the platform was created to fulfill the objectives of the platform. The design procedure involved research on the relationship between individual type of stakeholder, their business interests and case studies on the successful PPP and IPP projects. The key is to ensure there will be an integrated interactive portion among these groups within our platform.

A one-to-one correspondence list is made to confirm if the structure of SinoAtlas is able to meet the stated objectives.

Part 2. Identify an industry to work on

Due to the limit of time frame of this project, it is impossible to expand research on all possible industries. Therefore, our team accessed and analyzed the *First National Pollution Source Survey* 2010. This is the only source survey published by China Ministry of Environmental Protection (MEP). We used the survey to rank the contributions of water contaminations from different industries at a national level.

We selected the industry, agriculture, that contributes the most to water quality issues as the first industry type to establish the platform. Other industries can be expanded on the platform later based on the pattern of the first industry.

Part 3. Literature/Policy Review

To demonstrate the benefits of cooperation and forming/participating water /wastewater relevant projects, it is imperative to also render accurate guidelines for foreign investors, timely market information for environmental firms, and necessary level of environmental education for industrial users.

Since platform users will be more interested in the implementation, as well as the trends of policies rather than their planning and adaptations, we examined the chronological evolution of relevant policy for PPP and IPP projects from 1990 - 2016 to identify the trends, restrictions, benefits of the existing regulatory environment, and also make subsequent recommendations to different types of stakeholders. Specifically, the policy requires reviews are:

- 3) Foreign Investment
- 4) Public Private Partnership
- 5) Environmental Third Party Treatment

Part 4. Case Studies of Pioneer Companies and Their Business Models

Aside from policy, case studies are very important to demonstrate and promulgate successful modes of Public Private Partnership and increasing interests for third party treatment through IPP type contracts.

Thus, three different types of representative companies were selected for case studies:

- 1) Foreign Investors (PPP)
- 2) Domestic Investors (PPP)
- 3) Local Firms (IPP)

Each case study reviewed 1) challenges and goals 2) solutions/steps they took to overcome the hardship 3) achievements and results.

Part 5. GIS Visualization on Projects

To better present the spatial distribution of existing projects, a Web-GIS based map was used for visualization. We set up a database of existing PPP projects, the attributes of which include the location information, investment amount, description, mode of partnerships, released date, and contact information. The database can be updated by administrators or users. A user-interface (UI) page is setup for uploading PPP/IPP projects.

To better fit the web based content in China, Baidu Map API was used to create the map object. Each project in the database is symbolized as a point on the map, and the map content can be updated based on users' filter results or search results. To make a user-friendly interface, we researched existing Web-GIS based projects/policy maps, then developed the components of the page and designed the platform.

Part 6. Interview with Industrial professionals

When industrial users of our platform are ready to form a project and submit their requests to environmental experts, they complete a questionnaire that identifies the relevant wastewater treatment steps they need.

Interviews with industrial wastewater treatment professionals was conducted to seek the representative wastewater treatment processes. The interview enabled 1) the development of an integrated treatment diagram, and 2) a way for users to select from different modules representing the entire treatment process.

Part 7. An Overall SWOT Analysis on the Platform

A critical and adaptive approach is important to ensure effectiveness of the platform and to serve varying needs of different groups. The critical approach is helpful for identifying the next step of optimizing the platform goals and to attract more users. Improving the user interface is a continuous process. Therefore, a Strength-Weakness- Opportunity-Threat (SWOT) analysis was conducted to ensure the objectives were met and to provide recommendations for future Master Project groups.

Chapter IV. Results and Achievements

Chapter IV shows the results of research conducted using the rules set in Chapter III. These results are the structural and informational foundations of platform, and will be used as the essential building blocks of pages at the SinoAtlas platform.

Part 1. Generic Platform User Interface Design

Based on the objective of the platform and their associated type of stakeholders, we developed the following structure of the platform (Figure 2).

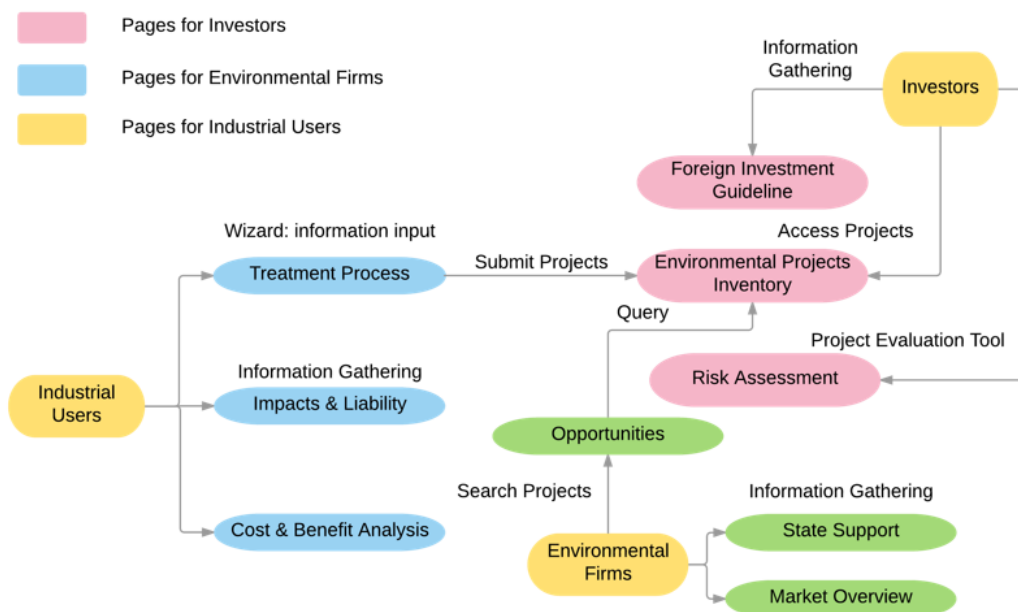


Figure 2 Site structural diagram

To ensure the structure has fulfilled all the goals stated in Chapter II, a one-by-one correspondence list has been made. For each element stated in the objective, there will be an equivalent section in the platform that fulfills the goal.

Table 1 Checklist of the site structure with objectives

Type	Objective	Equivalent Section in Platform
Industry	Essential Environmental Education	Impacts & Liability; Cost & Benefit Analysis
	Publish IPP projects based on modules of technical difficulties	Treatment Method
Environmental Firms	Access project details	Opportunities
	Additional information on water market trends and forms of state support for environmental firms.	Market Trend; State Support
Investors	Essential regulatory information	Foreign Investment Guideline; Investment Risk Assessment
	Geographically view a variety of Public Private Partnership projects	Environmental Projects Inventory

The correspondence list (Table 1) shows the objective of the platform and its equivalent functional expressions on the platform.

Part 2. Identify an industry to work on

As stated previously, we determined a target industry to develop the platform by major contributions to pollution (Table 2).

Table 2 The contribution of agriculture to the nation level pollution on COD, total nitrogen (Total-N) and total phosphorus (Total-P)

Type	COD	Total N	Total P
National	3028.96	472.89	42.32
Agricultural	1324.09	270.46	28.47

Planting		159.78	10.87
Breeding	1268.26	102.48	16.04
Aquaculture	55.83	8.21	1.56
Ratio of Agriculture	44%	57%	67%

According to the *First National Pollution Source Survey* of China in 2010, agriculture contributes 44% of COD, 57% of Total N and 67% of Total P to the nation’s waters. These levels are higher than any other industry and represent about 50% of the total water pollution in the country. Therefore, agriculture was selected to be the first industry for SinoAtlas. Thus, in the context of this project, industrial users are called farmers.

Part 3. Literature/Policy Review

1. Foreign Investment

Since before 2000, foreign investment in water supply and sewage treatment has been encouraged by the Chinese government. To attract more foreign investment, there are policies that advantage foreign investors. Since 2002, fair competition between foreign and domestic investors is encouraged.

After China entered WTO in 2001, the Ministry of Commerce of People’s Republic of China revised existing Provisional Regulations on Direction Guide to Foreign Investment (MOFCOM, 2002), the first version of which was published in 1995. In the new edition of the regulations, foreign investment in sewage treatment is encouraged (article 5). The modes of the projects can be joint venture cooperation only. The Chinese party controls all the shares or the share of Chinese parties is larger than share of foreign investors (article 8). Those projects with large investment and long payback periods including sewage treatment can be expanded after permission from the government planning department and commerce and trade department (article 12).

In the “*Measures on the Guarantee of Fixed Profit Margins for Foreign Investment Projects* (2002)”, the Chinese central government stated that the previous rules with favorable terms for foreign investors were unfair and a fixed rate of return was illegal (Lee, 2009).

In the “*Opinions Concerning the Acceleration of the Marketization of Urban Utilities Industries*” in 2002 and the “*Measures for the Administration of Concessionary Operation of Urban Utilities Industries*” in 2004, all competitors including foreign and domestic investors should participate in a public bidding process to get the contract of urban water service with local governments equally (GWI, 2004).

In the newly revised “*Foreign Investment Industrial Guidance Catalogue*” (MOFCOM, 2015), foreign investors are encouraged to invest in usage of seawater, building and operation of water supply plants, water recycling plants, and sewage treatment plants.

In the “*Opinions of Implementing Market Access Negative List Modes*” (State Council of PRC, 2015), all the investors can enter the market except the fields listed on a negative list equally. From December 1st, 2015 to December 31st, 2017, this mode will be put into trial use in Shanghai, Guangdong, Tianjin and Fujian. Then, after adjustments it will be executed all over China.

2. Public Private Partnership

PPP, stand for as Public Private Partnership, has different meanings in different countries. In China, has been defined by the central government as an innovative way of funding raising that private parties can involve in certain fields that are originally restricted by public investment (State Council, [2014] No.60).

Beginning in 1995, the development of the Public Private Partnership rules has been through experimental, expansion and standardizing, economic stimulus and detailed legal framework phases.

Phase I: Build-Operate-Transfer (BOT) Experimental Phase

In 1995, the government issued “*the Notice of Some Problem on the Issue of BOT Investment*” that targeted foreign investors. This is the earliest regulation relevant to PPP, and BOT was the first model proposed. Subsequently, the “*Several Issues Concerning the Examination, Approval and Administration of Experimental Foreign Invested Concession Projects Circular*” (the BOT Circular) rule was enacted to attract private participants, especially foreign investors. However, scholars have argued that these rules are circumstantial enactments (Lee et al. 2009) because there were no specific guidelines (Wang 2014).

Phase II: Expansion and Standardizing Phase

Projects after 2002 were governed by “the Measures on the Guarantee of Fixed Profit Margins for Foreign Investment Projects” published by the State Council. The measures stated the profits and returns for foreign investment in projects needed to be recalculated due to previous terms that are biased toward foreign investors and are unfair to the domestic parties. A wastewater plant construction project in Jiangsu province was suspended due to this policy (Yuan 2009). However, in the 2009, “The Foreign Investment Industrial Guidance Catalogue” officially permitted foreign investors to construct and operate water relevant projects. And “the Opinions Concerning the Acceleration of the Marketization of Urban Utilities Industries” (2002) codified expansion of PPP to the utilities sector.

The public bidding process for PPP projects originated in 2004 from “The Measures for the Administration of Concessionary Operation of Urban Utilities Industries “ and “Administrative Measures Concerning Urban Utilities Concession Rights.” Both foreign and domestic firms were able to apply and bid through different contracts. Lee 2009 claims this standard model accelerated private investment, especially by foreign investors.

Phase III: The Economic Stimulus Phase

The 2008-2009 Chinese economic stimulus program, a package of 4 trillion Yuan, resulted in loss of interest by local governments in private sector investments; local governments could apply for and finance projects from the central government. However, in 2012, the Ministry of Finance, the National Development and Reform Commission (NDRC), the People's Bank of China and the China Banking Regulatory Commission announced a “Notice to Suppress Local Governments' Illegal Financing Activities.” Following this regulation, in 2013, the State Council again supported accelerating the transition of government’s role to private investment and published “guidance for the government’s procurements from social entities.” This guidance encourages local governments to contract traditional public service to private industry.

Phase IV: The Final Development of a Detailed Legal Framework

In 2014, with financial pressure from local government, the significance of PPP was reiterated by the Central Government with prescribed levels of actions and responses from the local government.

The Ministry of Finance (MF) published “notices to issues concerning the promotion and application of Public Private Partnership.” The notice encourages nationwide expansion of the PPP projects and instructs local governments to actively establish exemplary projects as a foundation to further adoption across the country. Later in 2014, MF, for the first time, released a step by step draft guideline on “the implementation of PPP.” The guideline summarized the required components to form a PPP project, detailed steps for approval, and corresponding liabilities for relevant institutes.

3. Environmental Third Party Treatment

Compared to PPP and Foreign Investment, “Environmental Third Party Treatment” is a relatively recent concept on delineating the role and liability between polluter and treatment service provider, and marketization of the treatment process. “The opinions on promoting environmental third party treatment” by the State Council was the first regulation that delineated these roles.

According to the regulation, the concept of environmental third party treatment transfers the liability of pollution from industry to environmental firms through contracts. However, this system does not yet have detailed central legislative support that explicitly divides responsibilities between the partners. Fortunately, a number of local governments have published their own opinions/principles on promoting third party treatment as a call to the central government to act. Many local governments such as the city of Beijing and the province of Sichuan have declared they will formulate detailed third party treatment administrative measures as the next step in the process.

Part 4. Case Study on Pioneer Companies and Their Business Models

Four cases studies, two for PPP foreign investors, one for PPP domestic investors and one for IPP mode were analyzed. Different modes meet different challenges but the challenges are similar within the same mode. In some cases, the investors use multiple solutions to meet challenges.

A. Foreign Investors (PPP)

- a. Case 1: Suez -- A French utility company which focuses on water treatment and waste management:

- i. Challenges/Purposes: With certain degrees of familiarity of local market, Suez attempted to avoid socio-economic and political risks by directly entering China's market.
 - ii. Solutions (Zhong et al. 2008):
 1. Established Sino-French Holdings (HK) Ltd. with New World Development Company from Hong Kong, 50% shareholdings for each side;
 2. Joint venture with other entities (holding most of the shareholdings) to establish local water supply company and offer advanced water treatment knowledge and technology;
 3. This joint venture company provides high-quality water supply service and bears several obligations, such as planning, investments, construction, operation, and maintenance of the infrastructure under the supervision of local government.
 - iii. Outcomes: Suez is now managing over 30 water contracts in more than 20 cities serving 20 million people, and they built over 240 water and wastewater treatment plants in China. They are also providing environmental services to 8 Chinese industrial parks (Suez, n.d.).
- b. Case 2: Veolia -- A French transnational company with activities in water management, waste management, energy services and utility areas traditionally managed by public authorities:
- i. Challenges/Purposes: Veolia has a failed experience on a "Wholly Foreign Owned Enterprise" established in Chengdu, which caused large economic losses to the government (Lee, 2009). Veolia was then very cautious of avoiding any potential economic risks.
 - ii. Solutions (Lee, 2009):
 1. Wholly Foreign Owned Enterprise in Chengdu, entirely invested and owned by Veolia in BOT mode (Build – Operate – Transfer);
 2. Joint Stock Company projects in Shenzhen, Shanghai, and Lanzhou, which are established by Chinese in order to list on stock market;

3. Veolia made investments with local strategic partners, and they together hold a part of share for the joint venture company (JVC) with local municipal government. And the local municipal government holds the rest share of the JVC.
- iii. Outcomes: Veolia owns 24 projects in China, and the total amount of investment reached over US\$ 1.3 billion until 2007. Veolia provided urban water services to over 35 million people in 2007, including 21 million customers via full service concessions.

B. Domestic Investors (PPP)

- a. Case 1: Origin Water -- A domestic company in water treatment and waste treatment in Beijing:
 - i. Challenges/Purposes: The government financial payment process is relatively slow. The market share of MBR technology (origin water owned) in the water treatment market is less than 10%. There are large amount of competitors (more than 5000 water treatment companies in China with low efficiency and out-of-date technology).
 - ii. Solutions:
 1. Origin Water used to use EPC mode (Engineering, Procurement, Construction) to cooperate with local government;
 2. Established joint venture companies locally with local government to get market shares by technologies (Sina Finance, 2015).
 - iii. Outcomes: Origin Water has established more than 30 PPP-mode companies, which treat 10 million tons of water every day. The projects cover more than 20 provinces and more than 60 million people. The investment for all the contracts exceeds 10 billion RMB (Ouyang, 2015).

C. Local Firms (IPP)

- a. Case I: Hunan Juntai Pulp & Paper Company and Hunan Xiangniu Environmental Protection Company (IESM, 2014) -- The cooperation project by these two companies started in 2014:
 - i. Challenges/Purposes: Juntai set up a set of sewage treatment equipment in 2006 but the technique was out of date in 2012. Juntai hoped to

minimize the risk of environmental management and improve the efficiency of treatment.

ii. Solutions:

1. Juntai began a bidding process for operating its sewage treatment system in Hunan Province and finally selected Xiangniu;
2. The two companies signed a ten-year third party operation contract starting from 2013. In the contract, Juntai will pay more than 50 million RMB to Xiangniu for operation every year;
3. Xiangniu upgraded the sewage treatment equipment with their own technology in order to reach the standard of the sewage going to Huaihua Industrial Park Sewage Plant.

iii. Outcomes: This project was named as an exemplary project in contract based environmental service in Hunan Province. Both companies focused on their production processes to reach a win-win situation.

Part 5. GIS Visualization on Projects

Our database focuses on the first round and second rounds of water related PPP projects in Zhejiang Province (ZJPDRC, 2015; ZJPDOF, 2015). There are 34 published PPP projects in 9 cities with a total investment of 50 billion RMBs. The attributes of each project include longitude, latitude (used to locate each PPP project point), province, city, name, PPP mode, whether the project is exemplary nationwide or not, release date, description, contact, and phone number. Part of the information, like description, contact, and phone number, is only available to registered users.

The Web-GIS based map has a map frame and a search frame. The map shows all the project points in the database. Different colors of the points represent IPP and PPP modes of projects. The points in the map can be updated based on the search command made by users. For each point, a pop up bubble shows the detailed information about the selected project based on attributes in the database. The search frame has drop down lists such as location and PPP modes that can be selected by users. The workflow of the page is shown in Figure 3.

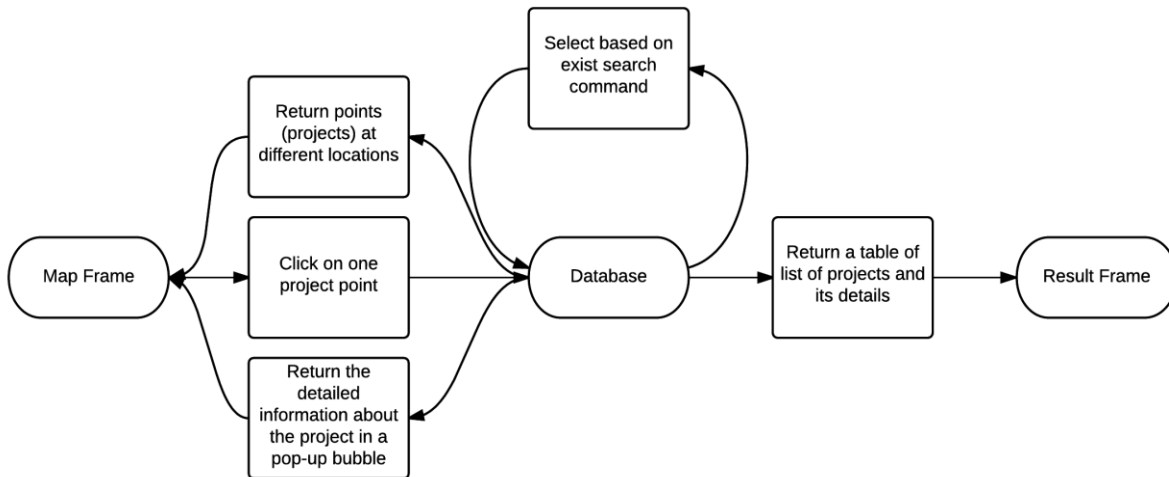


Figure 3 Workflow of GIS page, all of the three frames are linked to the database through certain actions by users.

To make the map section more interactive, the framework for next stage is also designed as Figure 4 shows. If the user clicks the “go to my projects” button, the users’ projects page will pop up showing the list of project the user creates and his favorite projects list. User can also edit or delete the projects uploaded by himself and upload new projects through upload/edit page.

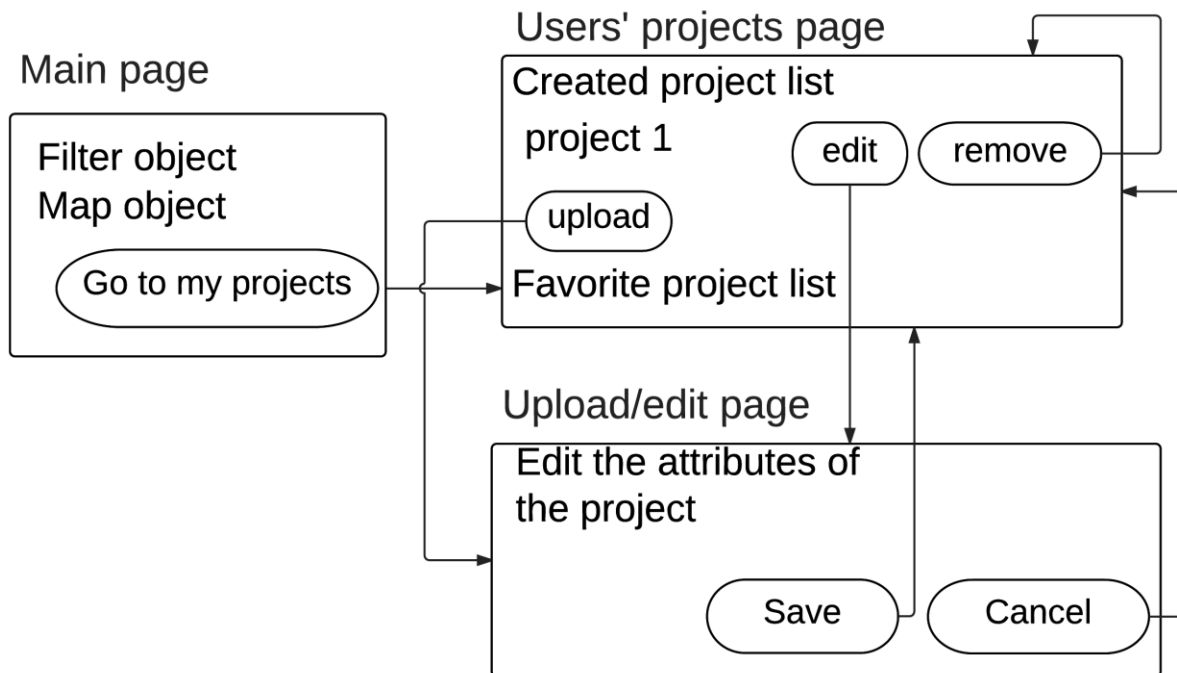


Figure 4 Next stage for environmental project inventory section. There are three pages in this part, the main page shows when users click on environmental projects inventory. The arrows in the figure shows which page will show up if the user click the corresponding button.

Part 6. Interview with Industrial professionals

Since agriculture is the industry that has most significant effects on water quality in terms of COD, Total-N and Total-P, agriculture was selected as the first industry to work on for the platform. We interviewed senior professionals and engineers from Zhejiang Academy of Agricultural Science (Zhejiang AAS) to establish a simplified treatment process for agricultural pollution. Four professionals were asked the following questions:

- 1) What are the traditional steps for ecological agriculture?
- 2) What are the main challenges to form a successful ecological agricultural project?
- 3) Is there an existing successful case study?

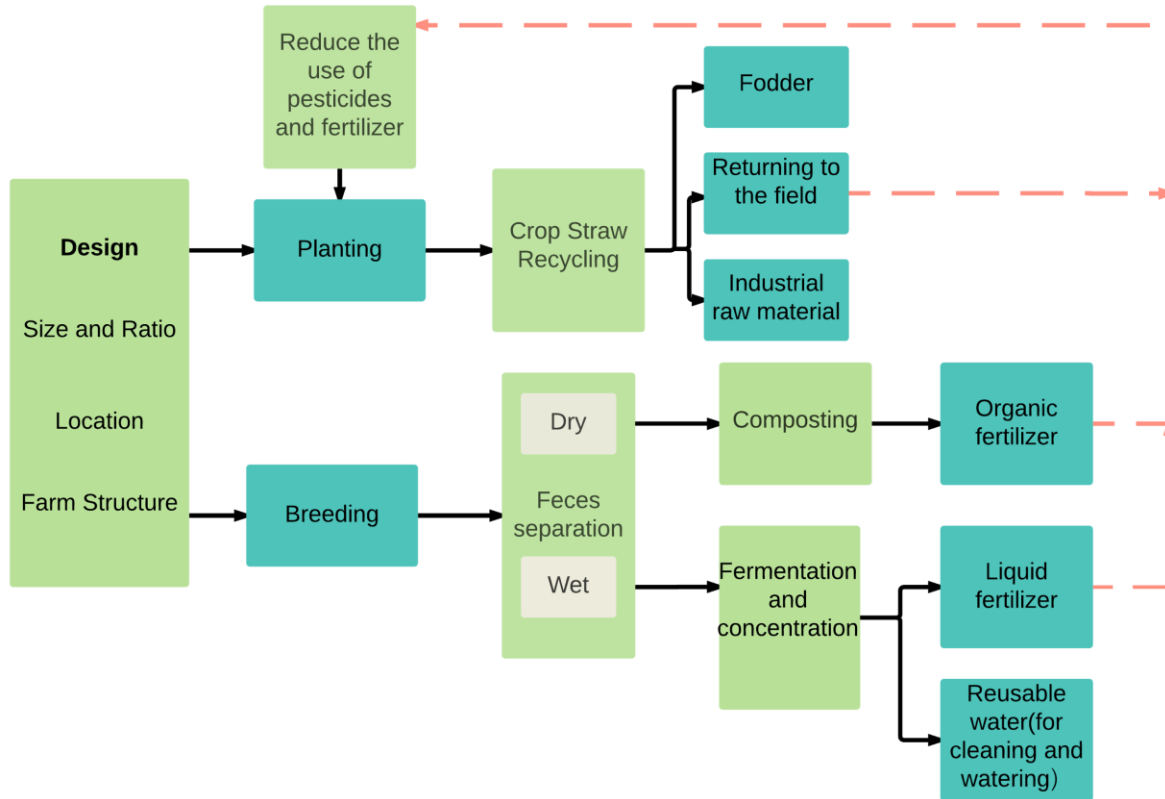


Figure 5 A simplified ecological agriculture treatment diagram.

The picture above (Figure 5) summarizes the recommended common design mechanism for ecological agriculture projects from agricultural professionals from Zhejiang AAS. Based on the interviews of anonymous professionals, 1) dry and wet separation, 2) wet feces treatment and 3) crop straw recycling are the most challenging steps for formation of ecological agriculture projects. To realize all the functions of an ecological agriculture project, an upfront design for the farm structure is very important. For example, one professional mentioned it is very important to ensure the ratio between planting and breeding to optimize the use of recycled organic fertilizer from feces if you are raising them both.

A successful example of the implementation of this ecological mode can be found in Ningbo Tiansheng Nongmu Development Limited Co, which is touted by professionals from Zhejiang AAS.

Chapter V. Discussion and Platform Formation

Based on the research results above, the platform was created as follows:

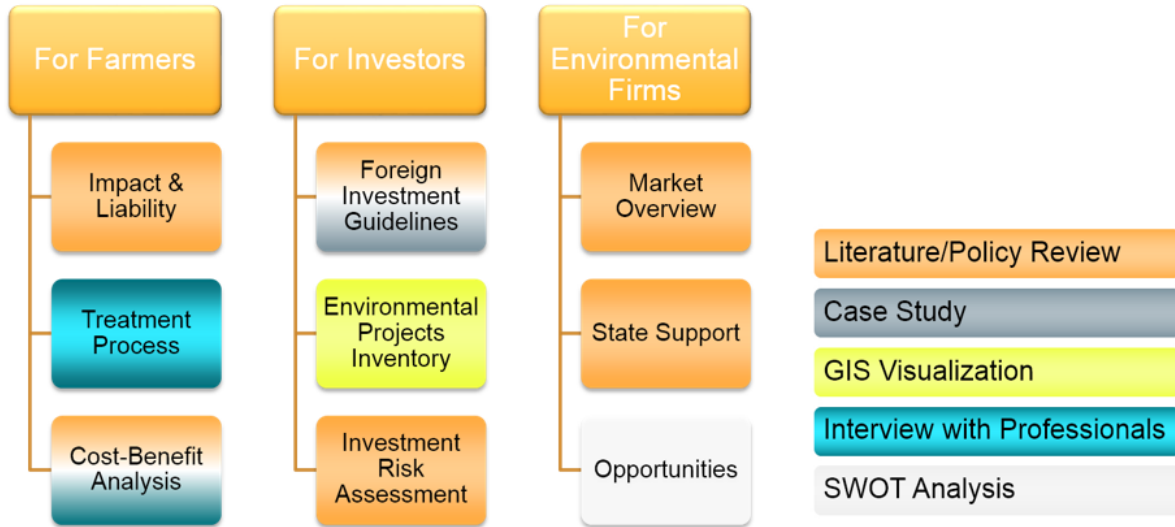


Figure 6 Platform pages with their formulation method (discussed in Chapter IV)

Users (environmental firms, farmers and investors) are able to select pages in their category.

Part 1. Site Information:

Name SinoAtlas (sinoatlas.asia)

Logo



Figure 7 Logo of Sino-Atlas

The logo above was designed by Feng Guo from Zhejiang University of Science and Technology. It includes the traditional Chinese character and English character of SinoAtlas.

Part 2. Industry

Industry Selection

Given the significant amount of pollution produced by agriculture through effluents of COD, Nitrogen and Phosphorus, agriculture is selected to be the key industry to build the framework for industrial users on this platform.

Page 1. Liability and Industry

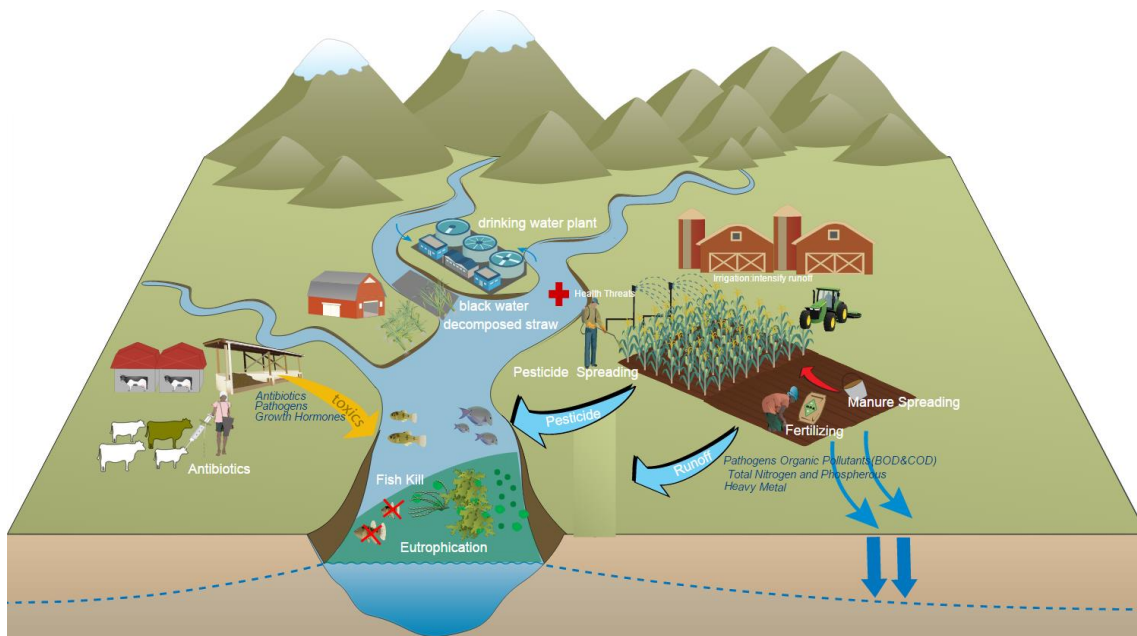


Figure 8 Agricultural Water Impacts

What is causing agricultural pollutions?

- Excessive use of fertilizers

Farmers are using too much fertilizer (costs money) and do not get increased returns. Moreover, the residual fertilizer pollutes groundwater. Similarly, the utilization level of pesticide is about 30% of that applied. The remainder pollutes the ambient environment (Food and Agricultural Organization 2013).

- Excessive use of pesticides

- Aquaculture: overfeed
- Aquaculture: antibiotics
- Livestock Raising: animal waste
- Livestock Raising: antibiotics

Agricultural Practitioners: Regulatory Trending

The 2014 *Agricultural Practitioner Responsibility Scope and Relevant Regulations* as well as the 2015 *Action Plan for Water Pollution Prevention* for agriculture has put more emphasis on the zonation to avoid ecologically vulnerable areas.

- Zoning: Away from ecologically fragile zone and population
- Pollution Treatment Facility: According to needs and size of livestock breeding
- Livestock and Poultry Farm build after 2016: Requires wastewater and stormwater separation system, and facility for fecal sewage recycling
- Farming by 2020: Soil Testing and Formulated Fertilization needs to cover 90% of the land, the utilization efficiency of fertilizer has to reach at least 40%

Page 2. Treatment Methods

Based upon technical difficulties in ecological agriculture design and wastewater treatment process, four modules were developed for farmers. Each module can be formed as an individual project. Farmers could select the module that would benefit them most.

Module 1. Feces Dry/Wet Separation

Module 2. Crop Straw Recycling

Module 3. Integrated Farm Design

Module 4. Soil Testing and Fertilizer Recommendation

To provide enough information about their needs, farmers are required to fill out a form for each module that could be accessed by service providers later for task assessment and quotation. They also have to filled out their fundamental information about name, locations and size of the farm before submitting any further requests.

Please enter your name, or the name of the farm (recommended) to get started.

[TEXT]

Please specify the location, or expected location of your farm.

City Province

[Text] [Text]

Eg. Hangzhou Zhejiang

Please enter the size, or expected size of your farm.

[Text] mu 亩

In each module, industrial user will go through a series of questions asking them 1) the specific difficulty in each step; 2) their desired treatment method (if they have any); 3) their desired treatment end-product (if they have any); 4) additional comments they have.

A detailed questionnaire for users can be found in **Appendix A**.

Page 3. Identify Costs and Benefits

For farmers to change from traditional agricultural practice to modern ecological agricultural solutions, it is useful to identify the costs and benefits associated with the change. According to the 2014 *Agricultural Practitioner Responsibility Scope and Relevant Regulations*, the change to modern practices is imperative in China, especially in Zhejiang province, which is the experimental province for ecological agriculture. Based on the discussion with agricultural professionals, and our research on agricultural regulations its traditional routes for water pollution, the following costs and benefits are summarized:

Additional Costs

- 1) One-time down payment for designing the agricultural structure for an individual unit of farm
 - Ecological agriculture requires careful design on spatial distribution of species and the design of farm house (Zhao et al. 2010)
- 2) Transportation cost for material recycling
 - Due to the internal recycling of materials, ecological agriculture will generate an additional amount of transportation
- 3) Equipment of animal feces treatment facility

Additional Benefits

1) Savings from overused fertilizers (Data collected by Food and Agriculture Organization)

Fertilizer application rates, utilization rate and economic loss to farmers per hectare¹.

Kinds of crops	Fertilizer nutrient	Average application rate (kg/ha)	Utilization rate (%)	Utilization of nutrient in season (kg/ha)	Cost of fertilizer loss in RMB/ha	Total cost of fertilizer loss at end of season in RMB/ha	
Food crops	Rice	N	205.6	45	92.5	452.3	
		P ₂ O ₅	52.8	25	13.2	178.2	
	Wheat	N	182.2	45	82.0	400.8	609.7
		P ₂ O ₅	61.9	25	15.5	208.9	
	Corn	N	197.1	45	88.7	433.6	608.8
		P ₂ O ₅	51.9	25	13.0	175.2	
Oil crops	Peanut	N	117.7	45	53.0	258.9	491.4
		P ₂ O ₅	68.9	25	17.2	232.5	
	Rape	N	175.9	45	79.2	387.0	621.2
		P ₂ O ₅	69.4	25	17.4	234.2	
Vegetables	N	304.4	30	101.1	813.2	1 312.7	
	P ₂ O ₅	148.0	25	37.0	499.5		

Figure 9 Overused Amount of fertilizers in China and their equivalent financial loss estimated by FAO (FAO 2013).

- 2) Potential of forming an experimental project with local state government with funding
- 3) Subsidy from local governments from using organic fertilizer
 - Usually compensated by per ton purchased
- 4) Improved soil productivity
 - Through the use of organic fertilizer and alternating species

Target

Increased Production

- The target is critical and highly depends on the investment and design of the ecological agriculture system.

Part 3. Environmental Firms

Page 1. Market Overview

Market Trend

- Both government and the public are paying more attention to China’s rising environmental problems. The demand for environmental solutions as well as relevant consulting services is increasing. According to the data from the existing China PPP database, the demand for sewage treatment plants is driving public private partnerships for sewage treatment projects.
- Due to improved environmental quality standards, the requirements for treatment technology are stricter and more comprehensive. For example, in late 2015, the Department of Science, Technology and Standards from the Ministry of Environmental Protection of China released a draft of “National Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (MEP, 2015).” The draft added two additional basic control pollutants and 39 more optional control pollutants. Private industry owners, especially those in heavy polluting industries, are forced to implement high-quality environmental treatment services and will thus expect assistance from professional environmental service providers.
- Foreign environmental firms are realizing opportunities to become involved in the market of environmental services in China. In 2015 China loosened market access and reduced a negative list in order to attract more foreign investment (State Council of PRC, 2015). With fewer barriers for foreign environmental consulting companies to enter China’s environmental service market, companies are no longer required to open an office in China in order to compete for the projects except for environmental monitoring or pollution source inspection.

Key Factors to be Competitive

- 1) The most important factors to compete in China’s environmental service provider market are known and qualified experience. Governments list criteria on the formal invitation for bid (IFB) that is relevant to the experiences of contractors. For example, in the IFB of Huangnan Reservoir project in Songyang County, Zhejiang (Government of Songyang County, 2016), bidders are required to have experience in the same field in the past five years. Bidders must present certificates of their former experiences. The reputation for a company for providing environmental solutions increases competitiveness.
- 2) A qualified team of specialists is very attractive to clients. Clients prefer technologies that are low-cost, energy-saving, and profitability-enhancing. According to the IFBs of PPP projects in our database, the principle of the group to bid need to have a related certificate and have worked on this field for at least 5 years.

- 3) The last, and sometimes the deciding factor is connection with the local government. Local connection is very important for starting any business in China, and for foreign companies, connections are even more important. With connections, companies can get more information about local social economics and other conditions, which helps them tailor their approaches to local conditions. Taking advantage of existing connections and using these connections to generate more relationships is vital to succeed in China.

Market Entry for Foreign Companies

For foreign environmental firms, there are three ways to enter the Chinese environmental service market:

- 1) Direct entry: this is uncommon in China environmental service market because it requires knowledge of market trends and related regulations. This information is often hard for foreign companies new to market in China to obtain and understand.
- 2) Partnering with a domestic company is the most feasible method: As the market is growing very fast, a number of environmental consulting firms are eagerly looking for market opportunities. Leveraging operational or technical skills and partnering with domestic companies can quickly build up local networks. For example, Veolia invites domestic investors to cooperate in projects, and acts like a third-party service offering firm (Cai, 2005). Veolia established a company in China with Beijing Capital Group in 2003 in order to become more involved in China's market.
- 3) Partner with another foreign company that has existing connections in the local market: Suez entered China's market by establishing Sino-French Holdings Limited with New World Development Company Limited in Hong Kong (Zhong et al. 2008). Sino-French Holdings has established 21 local cooperating companies in 16 cities and has offered water supply services to 20 million people.

Page 2. State Support

State Support for Environmental Service Providers

Principal Regulations

January 14, 2015: Opinions on Promoting the Treatment of Environmental Pollution Using a Third-party

April 16, 2015: Action Plan for Prevention and Control of Water Pollution

Many local governments have published similar regulations on combating pollution using a third-party as a response to these national policies. One example is the local government in Yunnan, Hebei Province.

Financial Support

- There is a national fund for combating pollution using a third-party. In order to apply for this fund, help from the State government is required.
- Banks and lenders have been encouraged to develop similar green investment opportunities to assist third-parties. For example, Zhejiang Financial and Exchange Center has created many projects for financing water-relevant public-private partnership projects.
- Local governments such as Shenzhen provide subsidies to qualified third-parties for treatment projects or environment-relevant projects.
- Funding organizations for social and public affairs supported by department of finance in many provinces highlight environmental industries.
- Key fields that are highlighted by government financial supports: environmental public service, treatment projects on pollution intensive industries, and centralized industrial zones.

Regulatory Support

- Many cities such as Shunde and Lanzhou implemented an experimental system of environmental emission rights trading and exchange.
- For environmental public service projects (sewage plants, water plants etc.), the state government will start to ensure the participatory firms can do independent accounting on operational management to make sure processes such as investment, construction, operation and regulation can be independent and transparent.
- Future industry will be geographically centralized based upon regulations.
- Both central and local governments encourage environmental pollution liability insurance. State governments are promoting third party treatment project surety bonds.

Successful Examples

There are already many water relevant projects financed through Zhejiang Financial and Exchange Center through P2P. Below is one example:

Financing Through Government Backed Programs

City of Jian De: Ma Nan High Tech Industry Development Co. Ltd.

This company is qualified for constructions of municipal utilities such as wastewater treatment plants or water supply plants.

Challenges: Lack of funding for municipal utility construction.

Solutions: Bank of Xingye, the municipal government of Jian De and Zhejiang Financial and Exchange Center have together determined to finance through the city's "Five Water Program", a program promulgated by provincial government and requires province-wide participation. Ma Nan High Tech Industry Development Co. Ltd. is one of the service providers who cannot afford to complete the construction task, and is thus the main financing entities of the project, while the Bank of Xingye serves as the supervising institutes and funds trusteeships. The Zhejiang government and the municipal government of Jian De both provide many conveniences and supports for financing projects that are aimed for the "Five Water Program."

Outcome: Ma Nan High Tech Industry Development Co. Ltd. is able to finance 400 million Yuan through the P2P platform supported by Zhejiang Financial and Exchange Center (ZJFEC). City of Lanxi, City of Anji and City of Tonglu all have similar financing projects through ZJFEC.

Page 3. Opportunities

Players in the agriculture industry are proposing potential projects on SinoAtlas based on their needs and technical difficulties. Registered environmental firms with expertise can gain access to the published projects database and decide if they are interested in providing a solution.

Environmental firms interested in being involved should complete the form below to request an account:

Environmental Firm Account Request

Company Name*	Country*
<input type="text"/>	<input type="text" value="Select Country"/>
First Name*	Last Name*
<input type="text"/>	<input type="text"/>
Email*	Tel*
<input type="text"/>	<input type="text"/>
Message	
<input type="text"/>	
Verification Code*	<input type="text" value="47fe"/> Change
<input type="text"/>	
<input type="submit" value="Submit"/>	

Figure 10 Screenshots of the “Opportunities” page.

Environmental firms are able to register on our platform and view project details posted by farmers. If any of the projects match their expertise, they will potentially form an IPP project with farmers.

Part 4. Investors

Page 1. Foreign Regulatory Guideline

Suggested Investment Fields

- 1) **Equipment Manufacturing:** The equipment used to for preventing water pollution and waste water treatment. As for the water pollution treatment equipment, foreign investors are welcomed to invest in high-technology treatments. When a group of 20 mayors from Zhejiang Province visited Portland in 2015, they specifically asked to see the latest technology in waste water treatment (Lehr, 2015).
- 2) **Environmental Services:** As the government is encouraging the development of third party treatment as well as public private partnership, environmental services especially the design

and construction projects on waste treatment and the operation of environmental facilities are highly recommended for investing. There is a rapid increase in demand of waste water treatment and water pollution source control. According to the National 12th Five-Year Plan for Environmental protection (Xinhua News Agency, 2011), industrial waste water treatment was given a priority and in the new released National 13th Five-Year Plan (People's Daily, 2015), wastewater treatment is still a key project.

- 3) **Integrated utilization of waste resources and the recycling and renewal of resources:** the key businesses receiving the most attention are 1) wastewater generated in the industrial production processes and 2) the recovery, utilization and renewal of wastewater generated during production or by different sectors like citizens' daily use.

Opportunities

- 1) **System of Market Access Negative List:** Since September 2015, China has committed to loosen market access negative list to attract more foreign investment (State Council of PRC, 2015). This model will be put into trial use in parts of China from December 1st 2015 to December 31st 2017, and after that it will be executed all over China. Any entities in the market can compete equally if the field is not on the list. The first four provinces that will apply this mode is Shanghai, Guangdong, Tianjin and Fujian.
- 2) **Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA):** Under Supplement IV since January 1st 2008, Hong Kong service providers may establish wholly-owned sewage discharge service enterprises in the mainland. Particularly in Guangdong Province, Hong Kong service providers are permitted to provide environmental pollution controlling services since January 1st 2009 (Supplement V) and provide environmental monitoring services since January 1st 2013 (Supplement IX). Hong Kong origin-product can be imported to the mainland at zero tariffs, and the track record of Hong Kong companies can also be authorized for the assessment of qualification in the mainland. These advantages make Hong Kong an ideal intermediary for investors interested in the Chinese mainland market but wish to avoid the relatively complicated process of direct entry (HKTDC, 2015).

Related Regulations and Programs

- 1) China's Foreign Investment Approval Regime (Santander, 2016):

- a. According to the “*Interim Measures for the Administration of Examination and Approving Foreign Investment Projects*”, foreign investors need to submit their proposals of the investment project in China to the National Development and Reform Commission or to the provincial or local Development and Reform Commissions. The Development and Reform Commissions will assess whether it follows current laws and regulatory, information and economic security, and other potential economic threat to the market.
 - b. If the Development and Reform Commissions approves the project, investors need to legally establish a company by applying through the Ministry of Commerce. The review process will include: a review of all types of future investment in China, an anti-monopoly review and a security review.
 - c. For environmental investment, investors are also required to get approved by the Environmental Protection Ministry and its Ministry of Land Resources.
- 2) The Environmental Protection Standard for Water: Department of Science, Technology and Standards of the Ministry of Environmental Protection has established various National Environmental Standards and offered relevant techniques requirements (MEP, 2013; MEP 2015). These standards are updated periodically.
 - 3) The China Environmental Labelling Program (HKTDC, 2015): The Ministry of Environmental Protection started this program hoping to encouraging producers to take more environmental responsibilities as well as to contribute more to environmental protection by producing more environmental-friendly products. The qualification to the program includes an examination of the production process from design to disposal to guarantee that the project is low toxicity, low resource consumption and low hazard risk. As the public are paying more attention to environmental problems, there is an increasing demand in environmental-friendly products, which forces the producers to apply for such kinds of labelling program even though it is voluntary.

Page 2. Environmental Projects Inventory

The SinoAtlas GIS page helps users see the spatial distribution of the existing/potential projects. Compared with existing inventory from other platforms which only show a list of projects, the Web-GIS based map has three advantages:

- 1) investors gain knowledge of market trend spatial distribution in China before they enter China's water-related environmental market. This could help them to decide which location to start with;
- 2) users can search for projects based on location at different physical spatial scales. Both political spatial scale and physical spatial scale can work in search process, which can give users more choice;
- 3) For IPP projects, the restriction of spatial distance is stricter than PPP projects. In most cases for industrial third party contract environmental services, the distance between the location of service provider and the industrial factory are short. The platform shows physical distance on map, which helps service providers find opportunities for IPP projects.

The map is just an approach for visualizing the information. A key factor will be to build the projects and update the database. For IPP projects, the project information will be established by industrial users. Users can upload requirements, contact information and become the administrator of their project. The status of the project (not started, under bidding process, processing, finished) can be updated by the project administrator or the service provider who signs the contract. The platform will act as a bridge between industrial users and service providers. For PPP users, we have uploaded information available for existing PPP projects. However, as most of the PPP projects are released through paper-based approaches, it is hard for websites to keep the information up to date if the team doesn't have anyone at the location. In order to update the PPP project database, we designed a reward to encourage users to upload PPP projects. Those who upload PPP projects have access to more details of other PPP projects in the database.

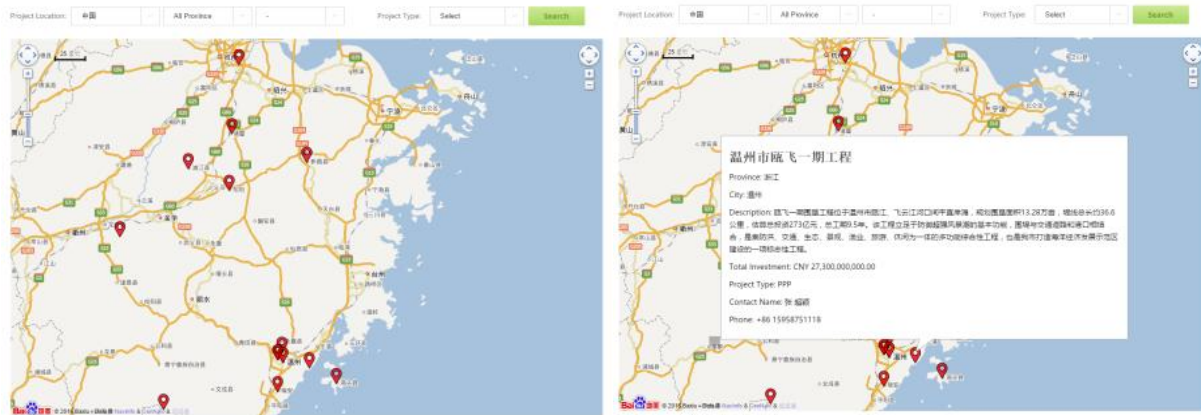


Figure 11 GIS page on website, using Baidu Map API for web-GIS visualization.

The left frame is what it looks like when user enters environmental projects inventory, the right frame is what it looks like when user clicks one project point on the map.

Page 3. Investment Risk Assessment

The policy and literature reviews from the results section shows shifting policies from the central government are one of the most significant underlying risks for PPP projects. In addition, the financial barriers faced by local government have been transferred to the private entities, who may have the techniques but lack funding to support projects. The changeable policy also poses risks on the financial sector. For example, government interference may extend the construction period of a project and result in additional investment.

Risk Allocations of Water Public Private Partnership

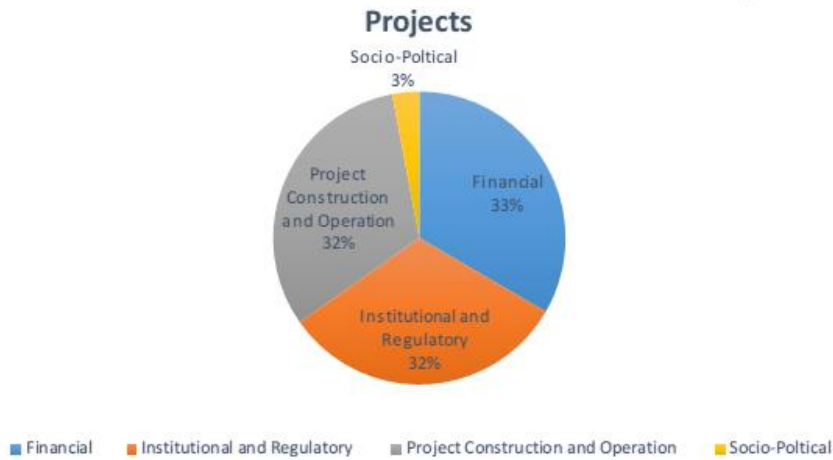


Figure 12 Risk Allocation of Water Public Private Partnership Projects.

Cheung & Chan (2011) listed 20 different risks for water relevant PPP projects in China with intensity rankings (Table 3). Coupled with research from Lee (2010), the 20 risks are in four categories: 1) Project Construction and Operation, 2) Financial, 3) Institutional and Regulatory and 4) Socio-Political. The sum of mean risk scores for each category was calculated and weighted. The percentage of risk allocation (Figure 12) shows risks from Project Construction and Operation, Financial and Institutional and Regulatory are equally important.

Table 3 Risk Factor Ranking for water relevant PPP Projects

Name of risk factor	Definition	Mean	Ranking	Category
Financing risk	Financial difficulties experienced by the consortium as a result of poor financial market or lack of financial income	4.71	1	Financial
Completion risk	Project takes longer than the predicted time to complete	4.43	2	Project Construction and Operation
Subjective project evaluation method	Subjective evaluation at the beginning of a public project to decide the procurement method	4.33	3	Project Construction and Operation
Government intervention	Public sector interferes unreasonably in the facilities/services	4.14	4	Institutional and Regulatory
Public credit	The reliability and creditworthiness of the government to fulfill obligations	4	5	Financial

Poor public decision-making process	Government makes wrong or poor decisions owing to lack of knowledge or interest	4	6	Institutional and Regulatory
Inflation	Unanticipated changes to inflation rate	3.33	7	Financial
Operation cost overrun	Operation cost overrun resulting from overpriced operation and slow operation	3.29	8	Project Construction and Operation
Price change	Improper tariff design or inflexible adjustment framework leading to insufficient income	3.25	9	Financial
Conflicting or imperfect contract	Improper arrangements in the contract such as inappropriate risk allocation among stakeholders	3.2	10	Institutional and Regulatory
Interest rate fluctuation	Unanticipated fluctuations in interest rate	3.2	11	Financial
Government corruption	Bribery of bureaucrats resulting in inappropriate privileges and benefits being offered to the private sector	3.17	12	Institutional and Regulatory
Imperfect law and supervision system	Lack of specific laws for PPP projects	3	13	Institutional and Regulatory
Project/operation changes	The likelihood of unexpected changes and errors occurring during the project operation	2.83	14	Project Construction and Operation
Insufficient project finance supervision	The financial status and expenditures are not monitored and controlled	2.75	15	Financial
Inability of concessionaire	The consortium not being able to perform its obligations as agreed	2.6	16	Project Construction and Operation
Delay in project approvals and permits	Delay or refusal of project approval or permit by government	2.57	17	Project Construction and Operation
Inadequate competition for tender	Lack of transparency and structure during tender, lack of opportunities for tenderers, few tenderers	2.57	17	Institutional and Regulatory
Foreign exchange fluctuation	Fluctuation in currency exchange rate and/or conversion difficulties	2.57	17	Financial
Change in market demand (noncompetition factor caused)	Demand change, the need for the services and facilities have changed, maybe not needed or less needed than before	1.88	20	Socio-Political

The institutional and regulatory trends are highly relevant to the credibility of municipal government (Lee 2010). Therefore, we added data from the 2013 China City Commercial Credit

Environment Index, which sorts the overall investment credits for over 250 primary cities in China. Users are able to check the “credit score” of their target city in this page. For example, Beijing has the highest municipal credit score of 86.06 out of 100. This indicates Beijing is a relatively reliable city for investment and the Municipal government of Beijing is credible.

Additionally, we looked through different PPP contractual types that have different levels of private involvement. The Canadian Council for PPP points out that with increasing level of private control over projects, the level of risks for private parties will also increase. SinoAtlas lists different types of PPP that are popular in China, and assigns each contract type a score that represents its risk level (Table 4). Users can compare the risk level of their projects by selecting a specific PPP cooperation mode.

Table 4 Different PPP mode and their corresponding financial risk for private party.

Type of Partnership	Full Name	Details	Financing responsibility	Financial Risk for Private Partner
(D)BOT	(Design)-Build-Operate-Transfer	Concession	Private	4
(D)BOOT	(Design)-Build-Own-Operate-Transfer	Concession, and take longer than BOT before transfer	Private	4
DBLOT	Design-Build-Lease-Operate-Transfer	A bank or a finance company will provide the funding.	Private	3
TOT	Transfer-Operate-Transfer	Infrastructure already built. Government get the funding to build new infrastructures.	Public	2

Type of Partnership	Full Name	Details	Financing responsibility	Financial Risk for Private Partner
DBO	Design-Build- Operate	Operator/Constructor taking low/minimal financial risks; Government negotiates a contract with a private firm for the design, Build, and operation of water facilities	Public	2
Contract Operations	Utility enters into a contract with private partner for operations and maintenance of one or more components of the water system	Government (assets owner) can reduce the operation and management cost through market competition	Public	1
Outsourcing	(1) private sides provide various services and supplies including laboratory work, meter reading, and the supply of chemicals; (2) private operation and maintenance on water utilities;			1

Chapter VI. SWOT Analysis and Conclusion

To better evaluate whether the objective of the platform has been met and a foundation of the platform has been built upon the current methods, a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis has been conducted with the entire platform as the analysis objective.

Table 5 SWOT analysis of the SinoAtlas platform.

Strengths	Weaknesses
No competitor with the similar objective; GIS projects visualization; Advice from industrial professionals; Users are able to get latest market/policy trending;	Little user engagements at the moment; Uncertain about platform user friendliness
Opportunities	Threats
PPP/IPP projects are still at the incipient stage; Seek engagements and supports from government;	PPP data inflow; Lack of user interests; Potential growth of future competitors; Lack of transparency from project details (users unwilling to share)

Table 5 shows the existing structure of SinoAtlas meets the fundamental requirements of the platform with user information about trending policy and market orientations. The platform is especially useful for foreign investors who may not be able to obtain Chinese materials. The structure of platform and interactive phase is functional, with farmers able to type in their needs based on the modules they are having difficulties with.

However, the user engagement component is still lacking and is the next target to focus on. To attract more user engagements and test the platform effectiveness, it is suggested that the next MP group focus on the marketing of the platform, and optimize the interactive tools according to the feedback from users.

Appendix

Appendix A. Question for farmer users to form a project

Module 1. Feces Dry/Wet Separation

1. Typically, if you would like to treat the wastes of livestock and turn it into your desired end-product, you will need to separate the dry and wet feces first. Are you having any problem in this step?
 - A. Yes. (to 2)
 - B. No, I am rather having problems with their treatment end-product. (to 2)

2. Apart from the separation process, dry feces will usually go through “composting” (堆肥) and become fertilizer. Is this your desired end product for dry feces?
 - A. Yes. (to 3)
 - B. No, I am interested in _____ (specify your desired end-product). (to 3)
 - C. Please make recommendations for me. (to 3)
 - D. I don't have problems in dry feces treatment. (to 3)

3. Wet feces are traditionally more difficult to treat than dry feces. We have proposed using fermentation and concentration to get liquid fertilizer and recyclable water that could be reused in your farm. What is your desired end product?
 - A. Liquid fertilizer and recyclable water
 - B. Other, I am interested in _____ (specify your desired end-product).
 - C. Please make recommendations for me.
 - D. I don't have problems in wet feces treatment.

4. Do you have any other comments/concerns that you would like the professionals to know?

Output Project Format:

Profile

Name: [Text]

Location: [Text]

Size: [Text]

Problems

Dry/Wet feces Separation: [Yes / No]

Dry feces treatment: [Yes / No]

Desired dry feces treatment end-product:

[Composting à fertilizer / user specified/ recommendation requested/ N/A]

Wet feces treatment: [Yes / No]

Desired wet feces treatment end-product:

*[Fermentation and concentration à liquid fertilizer and recyclable water / user specified/
Recommendation Requested/ N/A]*

Comments (describe the problem in detail):

Module 2. Crop Straw Recycling

1. You have indicated you have some problems doing crop straw recycling for your ecological agriculture plan, please select from your desired treatment end-product (Multiple Choice):

- A. Fodder
- B. Fertilizer (returning to the field)
- C. Industrial Raw Material
- D. Other_____ (Specify)

E. Need Recommendations from Professionals.

2. Do you have any other comments/concerns that you would like the professionals to know?

Output Project Format:

Profile

Name: [Text]

Location: [Text]

Size: [Text]

Problems

Desired End-Product of Crop Straw Recycling:

[Fodder / Fertilizer/ Industrial Raw Material/ User Specified/ Recommendation Requested]

Comments (describe the problem in detail):

Module 3. Integrated Farm Design

1. Please specify your current or expected farm structure (multiple choice):

A. Breeding

B. Planting

C. Aquaculture

D. Other ____ specify

E. Need Recommendations from Professionals.

2. Do you have an existing farm map?

(Uploading jpg/png/gif option)

3. What is the current ratio or expected amount of each species for the farm that you selected?

Enter Species	Enter Number	Enter Unit
---------------	--------------	------------

Example:

<i>Pig</i>	<i>1000</i>	<i>Units</i>
<i>Cow</i>	<i>800</i>	<i>Units</i>
<i>Rice</i>	<i>1000</i>	<i>Mu</i>
<i>Corn</i>	<i>800</i>	<i>Mu</i>
<i>Fish</i>	<i>5</i>	<i>tons</i>

4. What is the level of renovation you are expecting?

Use an 100% knob to control (用 100%的横向进度拖动条供用户选择)

5. Which part of the farm do you expect to have the highest level of renovating or redesigning?

A. User Specified.

B. No Ideas. Need Recommendations from the Professionals.

6. Do you have any other comments/concerns that you would like the professionals to know?

Output Project Format:

Profile

Name: [Text]

Location: [Text]

Size: [Text]

Problems

Current or expected farm structure (multiple choice):

[Breeding / Planting/ Aquaculture/ User Specified/ Recommendation Requested]

Existing Map for the Farm?

Current or expected Farm Plan:

Level of Expected Renovation:

Parts of farm that require highest level of renovation:

Comments (describe the problem in detail):

Module 4. Soil Testing and Fertilizer Formulation

On average, Chinese farmers have lost an average of around 600 RMB per hectare for crop farming due to the over use of fertilizer. Please fill out the form below to specify your concerns and we will post your questions to professionals.

Profile

Please fill out the form below.

Name: [Text]

Location: [Text]

Size: [Text]

Problems

Soil testing finished: [Yes/No]

Species for experimental soil test:

[User enter names]

Existing soil testing results, if any:

[Upload a picture or file]

Existing soil testing method, if any:

[User type in]

Comments (describe the problem in detail):

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