EDUCATION FOR THE GLOBAL ENGINEER: A MODULE FOR INCORPORATING CHINESE AREA STUDIES WITH WPI'S ENVIRONMENTAL ENGINEERING CURRICULUM

An Overview of the Module

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Author's Note

For my international studies MQP, I designed a module that is intended to incorporate Chinese area studies into WPI's environmental engineering curriculum. This document represents the work I've done, but it is not the finished product. Ultimately, this module will be hosted on a web site. Therefore, this document will simply help to illustrate the content, organization, and rationale for the module.

In this overview, I will first present the general architecture with all the content eliminated (pages 2-4). This will demonstrate the macro-level organization of the module. Second, I will present an outline of the module with some of the sections filled in (pages 5-27). This way, it will be easy to add content to the website, as all the content will already be organized.

Because of the format this document currently in, however, it is difficult to understand the water balance assignment, as all of the content for this assignment is scattered. On the website, this assignment will make more sense because links will connect all of the different sections. However, for the purposes of understanding the assignment in its non-website form, I have also included an additional document that allows the water balance assignment to be understood better. Please reference that document if you are interested in learning more about the assignment. To understand the module as a whole, use this document.

Section 1: Module Architecture

This section presents the overall organization of the module. Each major heading represents a link that will be visible on the home page. Under each of these links will be a short description of the sections that they will bring you to. When you click on these links, you will be brought to a page in which all of the subheadings are links.

Section 2: Module with Content

Introduction to the Module

Introduction

Increasingly, engineers in the twenty first century will be asked to work in international teams to solve multi-disciplinary problems. Therefore, they will need to have the skills to engage with people across borders and across disciplines (Del Vito, 2008). However, traditional, purely technical engineering educations do not encourage the development of these skills. This module is intended to help address this problem. It is designed for WPI's environmental engineering program, and it contains projects and assignments that will allow students to apply the technical expertise they learn in the classroom to water issues facing contemporary China. In additional to this technical content, it also contains integrated non-technical exercises that are designed to help students to grapple with the implications of their engineering analyses. Upon completion, this module will accomplish six key objectives (adapted from Parkinson, 2009):

1. Introduce students to the history, government, society, and economy of China
2. Expose students to ethical issues that could stem from cultural or national differences (for example, kickbacks or bribes) in order to help them effectively deal with these issues
3. Increase understanding of how cultural differences can affect how an engineering task might be approached. How ill motives of the Chinese government differ from your own motives for completing this engineering project? Will this impact the project?
4. Help students view themselves as "citizens of the world" and to appreciate some of the great challenges of the 21st century, challenges that their technical skillset could be used to solve (water issues, poverty, economic development, public health)
5. Demonstrate that engineering problems are not cut and dry and require thinking that extends beyond math and science
6. Increase appreciation for other cultures and different ways of thinking in a broad sense

Should this module effectively accomplish these objectives, it will enhance WPI's global education program by further integrating global education across the curriculum, and similar modules could be developed in other STEM fields. It could help to reinforce WPI's reputation as a leader in globalizing university STEM education by innovating yet another method to incorporate global context into rigorous STEM programs. The following sections further discuss the rationale for this module's creation.

The world is globalizing

Due to the development of modern communication technology and economic liberalization, the world is more connected now than ever before. This has led to rapid increases in free trade, income, and educational attainment. Between 1990 and 2010, for example, global GDP increased from $22.1 trillion to $62 trillion, and global trade increased by 267%. These developments have allowed once marginal countries to prosper not just economically, but politically and culturally as well. As a result, a new global order is emerging, one, according to Fareed Zakaria, that is "defined and directed from many places and by many people" (p. 4). Within this new order, relative to the rest of the world, United States power is declining. This, though, is not necessarily bad for the United States. If it adapts as a nation, it will not decline in overall prosperity. If it adapts as a nation, it will in fact benefit from global economic growth, as American companies will be able to capitalize on this growth.

For example, by 2020, the middle class in China and India alone is expected to exceed 1 billion people. In other words, a massive consumer market is rising, one that America can tap into. Many American multinationals understand this and are already harnessing opportunities abroad. In 2007, 67% of Hewlett Packard's revenues, 79% of Intel's, and 60% of General Motor's came from foreign markets. The number of major companies with locations outside the U.S. grew from 8% in 1999 to 46% in 2005 (Parkinson, 2009).

Not only are sales becoming international, however, but employee structures are as well. Figure 1 illustrates how the employee structure for Siemens became increasingly globalized between 1995 and 2004. This trend is not unique to Siemens. Major American companies, such as Microsoft, Cisco, GE, Dell, and IBM, have adopted the Global Collaborative Model in which employees work in multinational teams to innovate new products (Camuti, 2006) As a result, American workers increasingly interact with people from other nations, both at home and abroad. In a recent survey, 47% of corporate respondents reported an increase in ex-patriot assignments over the previous year (Camuti, 2006).

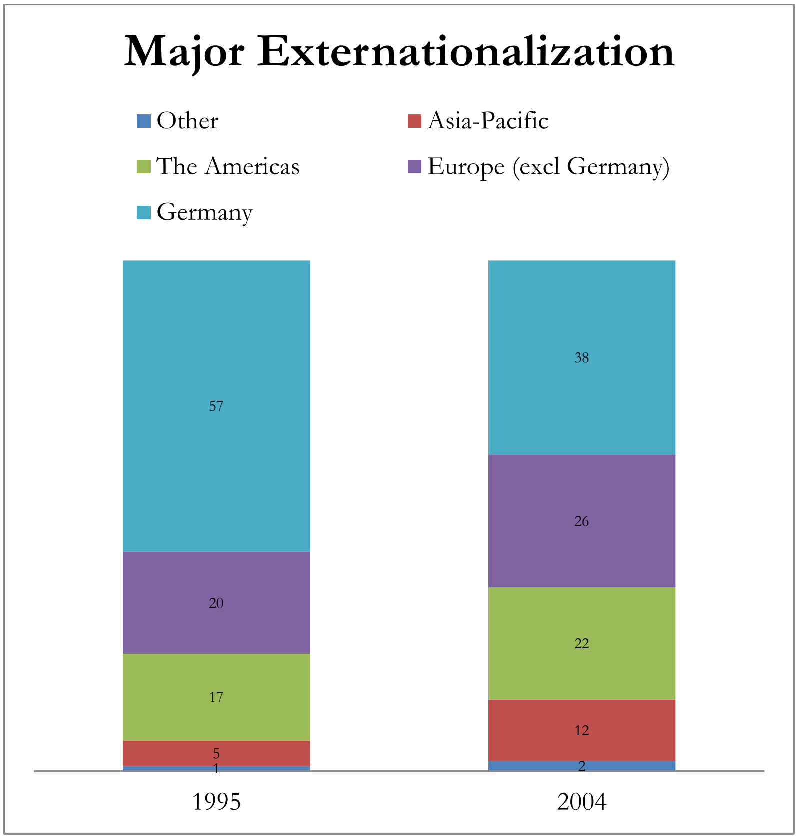

Figure 1: Externationalization of Siemens, a German company, between 1995 and 2004. Demonstrates that multinationals' work forces are becoming increasingly diverse (Camuti, 2006)

The world is changing. American scientists and engineers should too

Both the world and corporations are globalizing; therefore, American engineers, scientists, and researchers must now not only be technically competent, but also excel at working across cultures, traditions, and languages if they want to be successful in this new world order (Del Vito, 2008).

American universities, then, should help students develop these skills so that the students can succeed in this new economic environment. Major U.S. institutions agree. According to the National Science Foundation (2012), "The United States needs to educate a globally-engaged science and engineering workforce capable of performing in an international research environment in order to remain at the forefront of world science and technology." According to the ABET Engineering Accreditation Commission (2007), all engineers should have the "broad education necessary to understand the impact of engineering solutions in a **global***,* economic, environmental, and societal context."

However, according to Downey et al. (2006), in many cases, U.S. universities currently do not incorporate global studies into their STEM curriculums. Instead, scientists and engineers are trained using methods that emphasize purely technical aspects of their chosen field. Students are still often taught that engineering is a five step process: "Given, Find, Equations, Diagram, Solution" (Downey et al., 2006). However, this process does not accurately reflect engineering in the real world, particularly in an international context. An important component of engineering is defining the problem; often times, numbers are not handed to students as they are in so many classes. Defining problems, though, involves working with a diverse group of people, often non-engineers, and it requires knowledge of context. Therefore, helping students understand how to define problems in an international context, which the five step method doesn't do, will help to make them better engineers.

How can schools help students adapt?

How, then can universities help students develop these skills? Ideally, all American students would be able to travel abroad, but, as Grandin and Hirleman (2009) explain, this is challenging. Table 1 summarizes the many obstacles that prevent students in STEM fields from traveling abroad. Largely because of these challenges, The Institute for International Education reports that fewer than 3% of all engineering students are actually going abroad for educational experiences during their undergraduate years (Grandin and Hirelman, 2009)

Obstacle	Explanation
Curricular Rigidity	Little flexibility to include non-technical aspects in engineering curricula
Lack of Tradition	There is little tradition of sending engineers abroad – "void of experience among engineering faculty and administrators"
Lack of Support from Study-Abroad Professionals	Study-abroad offices not engineering oriented
Lack of Support for Cross-Disciplinary Activities	Though there is considerable expertise at universities, there is often little interaction between different fields
Lack of Support by Departments, Colleges of Engineering, or Faculty	Absence of advisors who are knowledgeable about study abroad opportunities or who are willing to commit necessary time.
American Monolingualism	Very few Americans learn foreign languages
Academic Rewards System	Building successful international programs takes significant time, and "since faculty are promoted and tenured by traditional teaching, publication, granstmanship, etc., and not by sending students abroad, there is little incentive for faculty to work in this area"
University Financial Restrictions	Requires significant labor
Student Financial Restrictions	Studying abroad is expensive
Difficulty Transferring Credit	
Negative Perception	Some view study abroad as a vacation
Disconnect in the Corporate World between CEO and HR	CEO's say study abroad is important, but it is often not an area that human resource officers value highly
Difficulty in Recruiting	Students may be hesitant about taking the risk or do not see the value in spending time abroad
Lack of Cultural Preparation	Engineering students are often especially underprepared to study abroad because they lack courses in international politics, world history, etc.

Because of this, many technical universities, including WPI, have required that all students fulfill requirements in the humanities and social sciences. However, these efforts may not make explicit the connections between engineering, the globalizing world, and non-technical considerations. They also typically do not help students to define technical problems in collaboration with others.

Therefore, integrated, on-campus programs may be more effective at globalizing STEM education. These programs could fluidly introduce students to the importance of context and global competence in the field of engineering. This module is intended to function as one of those programs. It will help to accommodate STEM students who are not able to travel abroad during their undergraduate careers, and it will enhance the study abroad experience for those who do travel. In some ways, it will be similar to ID 2050 at WPI. However, rather than being taken as a separate course, it will fit within WPI's traditional engineering curriculum. In particular, this module is designed for the Environmental Engineering Department. It deals with engineering issues surrounding water in China, and it will be one of the first in a series of modules that seeks to incorporate Chinese area studies into WPI's STEM curriculum. If successful, it will ultimately be available to other environmental engineering programs that are seeking to globalize their students' educations as well.

Why China?

China was selected for this module for numerous reasons. It is now the world's largest country, fastest growing major economy, largest manufacturer, and second largest consumer (Zakaria, 2009). It is an up-and-coming R&D leader, and trade and investment flows between it and the United States reached a record half trillion dollars in 2012. It is also increasingly important to the United States in areas ranging from national security to climate change policy. It is for these reasons that, in 2009, President Obama pledged to send 100,000 American students to China in four years. It is for these reasons that many herald the U.S.-China relationship as the most important of the 21st century. In other words, knowledge and understanding of China is a valuable asset in today's global environment.

In addition, Professor Jennifer Rudolph is building a China hub at WPI that will not only include other similar modules, but also a China Humanities and Arts track, a Chinese major, and Chinese study abroad opportunities. Therefore, this module, in combination with these other emerging resources, will allow students to integrate global competency and China expertise with their STEM expertise in an innovative and effective manner.

How is this module organized?

This module is organized in two primary sections:

1. *Water in China, the Context*
2. *Course-Specific Content.*

Water in China: The Context contains non-technical information about water issues in China. It will serve as a source for students to help them understand some of the non-technical context surrounding water issues in China.

Course-Specific Content contains various courses that this module has content for, and it is organized around these courses. Each course has its own section, and within these sections are projects and assignments that professors can integrate into their classrooms. These exercises will allow students to apply the engineering skills they learn in class to real world issues. These exercises will also link to relevant sections in the *Water in China: The Context* section as well as to external sources. These readings will help students to understand the broader context surrounding the engineering problems they are addressing. Based on this understanding, students will be asked to consider some of the social, economic, political, and environmental implications of their engineering analyses.

References

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Water in China: The Context

This section would contain the non-technical information regarding water in China, such as the important political, economic, cultural, and historic considerations. Assignments and projects within the *Course-Specific Content* section will link to the information in this section.

Water Scarcity in China

Between 1982 and 2010, China's population grew by over 330 billion people (World Bank, 2013), and its economy grew on average by 9.5% annually (China Water Risk, 2010). With these increases in population and economy also came increases in water use: between 1949 and 2007, China's water use quintupled (Yardley, 2007). China, however, contains only 6.5% of the world's water resources. With these resources, it must feed 22% of the world's population and fuel the world's second largest economy (Peng, 2011). Vast water demand, inefficiency, scarcity, and overuse, however, threaten China's ability to accomplish these goals. In an average year, among 662 Chinese cities, 300 will have insufficient water supplies and 110 will experience severe shortages (Jiang, 2009). Pollution further exacerbates this water shortage. In 2009, 43% of China's seven major rivers were characterized as grade IV or worse – unsuitable for human consumption (China Water Risk, 2010).

Worse, water supply within China is not evenly distributed (see Figure 2). The South, with only 55% of the population, holds roughly 80% of the available fresh water resources (Jiang, 2009). Therefore, the North, a hub for economic development, is suffering even more than the overall statistics for water resources in China suggest. The water resources per capita in the North are approximately 830 m^3 per person (China Water Risk, 2010). The United Nations (2012) classifies a region as water scarce if it contains 1000-1700 m^3 of water per capita. A region is in water poverty if it contains less than 1000 m^3 per capita (United Nations, 2012). In other words, water availability in Northern China is dangerously low. In some places, the situation is even direr. The capital city of Beijing, for example, contains only 230 m^3 of water per capita (China Water Risk, 2010b).

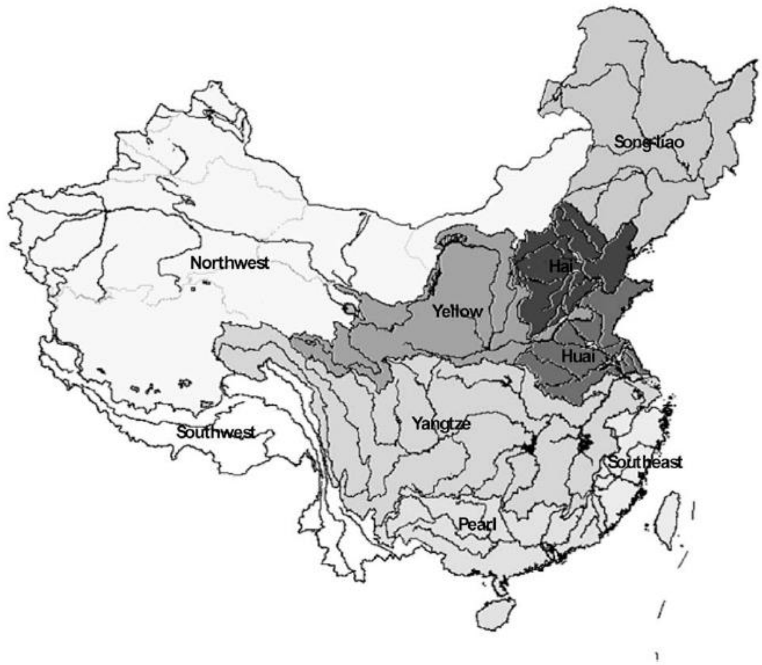
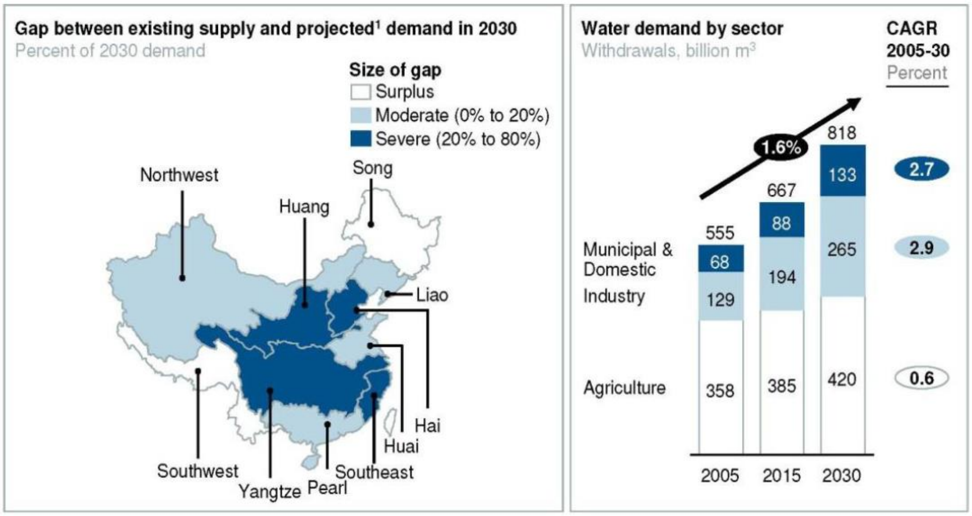


Figure 2: Map of China's major water sheds in China. Darker areas indicate areas of greater per capita water scarcity (Jiang, 2009)

Though bad now, these water issues are only expected to worsen. According to China Water Risk (2010a), China's population is expected to increase by 10% (150,000,000 more people) over the next ten years, and by 2020, its GDP is expected to quadruple. For these reasons, water demand, exacerbated by increased standards of living, industry demands, and agriculture, will boom. Figure 3 shows both the expected water demand in 2015 and 2030 as well as the expected water supply gap should China's current water use practices continue. As the Figure demonstrates, an enormous area of China (all the dark blue areas) is not expected to meet between 20 and 80 percent of its water demands should current water resource management practices continue.



1 The unconstrained projection of water requirements under a static policy regime and at existing levels of productivity and efficiency

Figure 3: The image on the left illustrates projected water scarcity in China by 2030 should current water use practices continue. The image on the right shows projected water demand increases between 2005 and 2030 (Addams et al., 2009).

Because of these challenges, China needs to change the way it manages its water resources if it wants to avoid consequences to its food security, environment, and economic development as well as its citizen's quality of life.

References

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China Water Risk. (2010a). *China's water crisis part I -- introduction.*

China Water Risk. (2010b). *China's water crisis part II -- water facts at a glance.*

Jiang, Y. (2009). China's water scarcity. *Journal of Environmental Management, 90*(11), 3185-3196.

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Area-Specific Content

The Heihe River Basin

Agriculture in the Heihe River Basin – the major economic driver

According to Tao (2006), the economy in the Heihe River is divided into three key zones: grazing in the mountainous regions of the upper reaches, small-scale intensive agriculture in the middle reaches, and large-scale extensive agriculture in the lower reaches. 83% of the population is farmers (Chen et al., 2005). The largest water demand comes from the middle reach, as this is where 90% of the irrigated farmland and 85% of the population is located (Tao, 2006).

As a result of this agriculture-based economy, the Heihe River Basin exports significant amounts of crops. Because crops consume water, then, this means that the Heihe River Basin also exports significant amounts of "virtual water." Virtual water is defined by the volume of freshwater required to produce a product (The Virtual Water Project, 2013). Crops that require more water for production, then, also contain more virtual water. Chen et al. (2005) attempted to quantify the amount of virtual water leaving the Heihe River Basin. As shown in Figure 4, they concluded that 823 Mm^3 were exported each year, 391 Mm^3 of which was green water (from precipitation) and 441 Mm^3 of which was blue water (from irrigation). Though the region exports a significant amount of virtual water, particularly for a water-scarce region, farmers' incomes are partly dependent on these exports (Chen et al., 2005). Is there a way to remedy this situation?

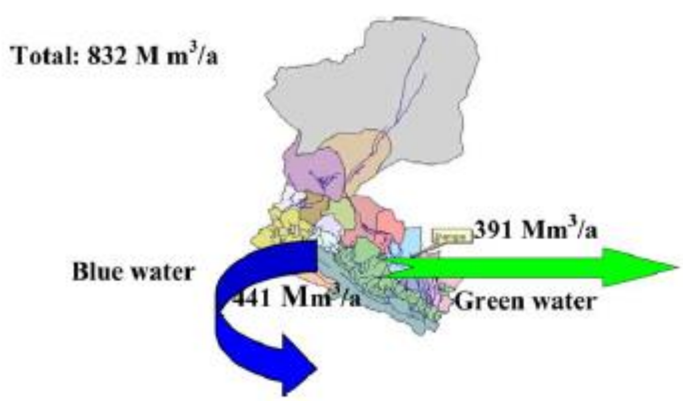

Figure 4

In addition to virtual water exports, another factor contributing to water scarcity in the Heihe River Basin is water use inefficiency. According to Jiang, 2009, current water resource management in the Heihe River Basin is typical of water resource management in China. Historically in China, peoples' water needs were met by large scale engineering projects, such as the construction of canals. This approach is supply-driven and makes no effort to reduce the demand for water (through increasing the price of water, restricting water rights, etc.) For example, in Northern China, less than 10 percent of well owners surveyed obtained permits for their well prior to drilling it (Jiang, 2009).

In the Heihe River Basin, water demand is not strictly enforced. Currently, there are no defined, enforceable water rights. There is no volumetric metering of water at the farm level. Instead, farmers pay for water based on the size of their farm, and water is inexpensive, both of which discourage efficiency upgrades (Jiang, 2009). Therefore, according to Chen et al. (2005), 97% of farmers use traditional, inefficient irrigation methods such as flood and furrow because of their low costs of adoption. Also, the canals that supply the water for this irrigation are unlined and, as a result, 48-62% of the water transported in these canals is lost to seepage (Chen et al., 2005).

References

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Environmental Degradation in the Heihe River Basin

Over the past thirty years, the population and the economy of the Heihe River Basin have boomed. Much of the economic growth in the economy resulted in increases in agricultural land and by increases in farming productivity. Figure 5 shows the increase in irrigated land in population between 1949 and 2002 (Tao, 2006).

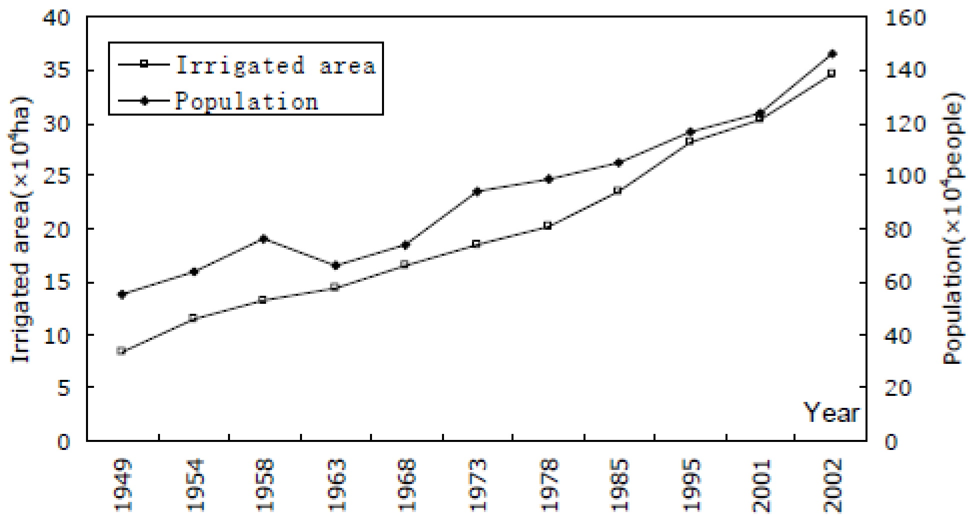

Figure 5: Increase in population and irrigated land between 1949 and 2002

As a result of this growth, water resources in the basin have become (1) increasingly scare and (2) increasingly polluted.

From your water balance, you should have determined that there is no longer enough water to meet demand. This has resulted in extreme water shortages, which have caused surface water bodies to run dry, oases to shrink, biodiversity to decrease, salinization of soils, and desertification. Over the past 50 years, the Heihe River's two terminal lakes as well as 30 of its tributaries have run dry (Cheng, 2005). During the 1990s, flow into the Ejina Oasis decreased from more than 500-600 million m^3 per year to 300-400 million m^3 per year (Tao, 2006). This surface water scarcity has resulted in the overexploitation of groundwater resources, as shown in Table 1.

Table 1: Groundwater exploitation in the middle reaches of the Heihe River Basin for select years between 1980 and 1999 (Shanzhong, 2010)

Year	1980	1984	1986	1997	1998	1999
Water exploitation (10^8 m^3)	0.84	1.14	1.05	2.15	2.20	2.29

This water scarcity has adversely impacted the natural environment. Forest cover decreased by 343 km^2, degraded grassland increased by 3,498 km^2, desertified land expanded by 405 km^2, and salinized land increased by 835 km^2 (Tao, 2006).

In addition to water scarcity issues, the basin also faces extreme water pollution issues. The chemical composition of surface water in the middle and lower reaches has changed significantly. For example, according to Shanzhong (2010), ammonium nitrogen and potassium permanganate, from agricultural runoff, have exceeded the National Water Quality Standards of China in the Shandan River, a tributary of the Heihe River, by 87.5 and 50 percent, respectively. BOD content in this river exceeds water quality standards by 41% (Shanzhong, 2010). Development in the region is only expected to continue, and if current water resource management practices remain, the environment will degrade even further.

References

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Pollution from wastewater discharges in China

Water, the Economy, and the Environment

South-North Water Transfer Project

Mega-Dams

Water Governance

Water and Food Security

Water versus Energy

Water Equity

Course-Specific Content

I list a number of environmental engineering courses in this section. Though it is possible to generate content for all these courses, it probably isn't feasible. Nevertheless, I included all these courses in the outline simply to demonstrate the wide range of potential applications for this module.

The "Hydrology" section is the most developed in greater detail to provide an example of how other courses could one day look. As I show in the "Hydrology" section, there will be multiple assignments/projects available for each course from which Professors can choose. This gives the module flexibility.

Hydrology

Introduction to the Hydrology Module

Hydrology, or the science of understanding earth's water systems to help solve water problems (USGS, 2013), will be vital for China to make these changes successfully. Hydrology with regards to water resource management in China is the topic of this module.

Specifically, this module contains projects, assignments, and resources to help students understand hydrological concepts while concurrently learning about China and the importance of local context when tackling engineering challenges. It focuses on the Heihe River Basin in Northern China, a large inland river basin that occupies an area of approximately 130,000 km^2. Over the past thirty years, population, pollution, and water use have boomed in the Heihe River Basin, leading to environmental degradation and regional and sectoral water-use conflicts

The module is flexible so Professors and educators can mold it to fit their class. All of the assignments, projects, and resources can be used, or only a single assignment can be used. Course work covers topics such as basic water balances to predictive modeling of stream flows and precipitation. This technical content is always supplemented by information about local Chinese context, helping students to learn to grapple with the non-technical implications of engineering decisions and to think critically.

The objectives for the module are listed below:

1. Help students to understand basic hydrological concepts, such as water balances and predictive modeling of stream flows and precipitation
2. Help students to understand that the social, environmental, and economic contexts of an engineering problem are necessary for successful solutions
3. Foster critical thinking skills necessary for addressing open-ended projects
4. Expose students to contemporary China and make them more informed global citizens
5. Show students that the skills they are learning as scientists and engineers are valuable and can be used to address important and fascinating global challenges

If accomplished, these objectives will help students become not only technically competent, but globally competent as well, an important quality in today's globalizing world.

References

USGS. (2013). What is hydrology and what do hydrologist do? Retrieved from http://ga.water.usgs.gov/edu/hydrology.html

Background Reading

For this assignment, students will be asked to read four sections on this website for background reading

1. Water Scarcity in China
2. Water, the Economy, and the Environment
3. Agriculture in the Heihe River Basin – the Major Economic Driver
4. Environmental Degradation in the Heihe River Basin

In addition, they will be asked to consult three external sources (1 newspaper article and 2 videos)

1. *Sending Water North* – this New York Times video is named for the South-North Water Transfer Project. However, it does an excellent job covering some of the overarching challenges regarding water in China, from water pollution to regional variability. It also includes some discussion on the economic impacts of water scarcity.
http://www.nytimes.com/interactive/2007/09/28/world/asia/choking_on_growth_2.html#story3
2. *A Symbol of Health and Longevity, on the Verge of Extinction* – This is another New York Times video. It is short, and discusses the impact of pollution – both agricultural and industrial – as well as water scarcity on biodiversity in China. It will help students to think about the environmental impacts of poor water resource management.
http://www.nytimes.com/interactive/2007/12/05/world/asia/choking_on_growth_6.html#story2
3. *China Faces Tough Choices on Water* – This is an article in the Guardian that broadly addresses some of the water issues in China, including the conflict between industry and agriculture, scarcity and waste, and the issue of paying for water. It is general, but it provides a good overview of these issues.

They will be asked to apply what they learn in these readings to the technical problem they are addressing.

Fact Finding Worksheet

What percentage of the world's water resources are located in China? What percentage of the population?

What percentage of China's water resources are located in the South? What percentage of the population?

How does the United Nations classify water poverty?

List three types of environmental degradation in the Heihe River Basin.

1. -
2. -
3. -

What percentage of the population in the Heihe River basin is farmers?

How much virtual water is exported from the Heihe River Basin? What percentage of the regions' water resources is this?

How many gallons will the South-North Water Transfer Project transfer to northern China?

Name three of the competing uses for water in China?

1. -
2. -
3. -

What percentage of China's mammals, reptiles and amphibians are endangered?

Is water currently expensive in China?

In what sector is water use most expected to grow in the next thirty years?

Water Balance Assignment

The Problem

The Heihe River Basin, shown in Figure 6, is a large, inland river basin in northwestern China. It occupies an area of approximately 116,000 km^2 and contains three key areas: the upper reach, middle reach and lower reach. Most of the precipitation occurs in the mountainous upper reach, and runoff from this region supplies the majority of the water resources for the rest of the basin. The Heihe River spans the length of the basin and ends in two terminal lakes in the lower reach. The total population of the basin is 1.33 million, and there are 205,230 ha of irrigated land.

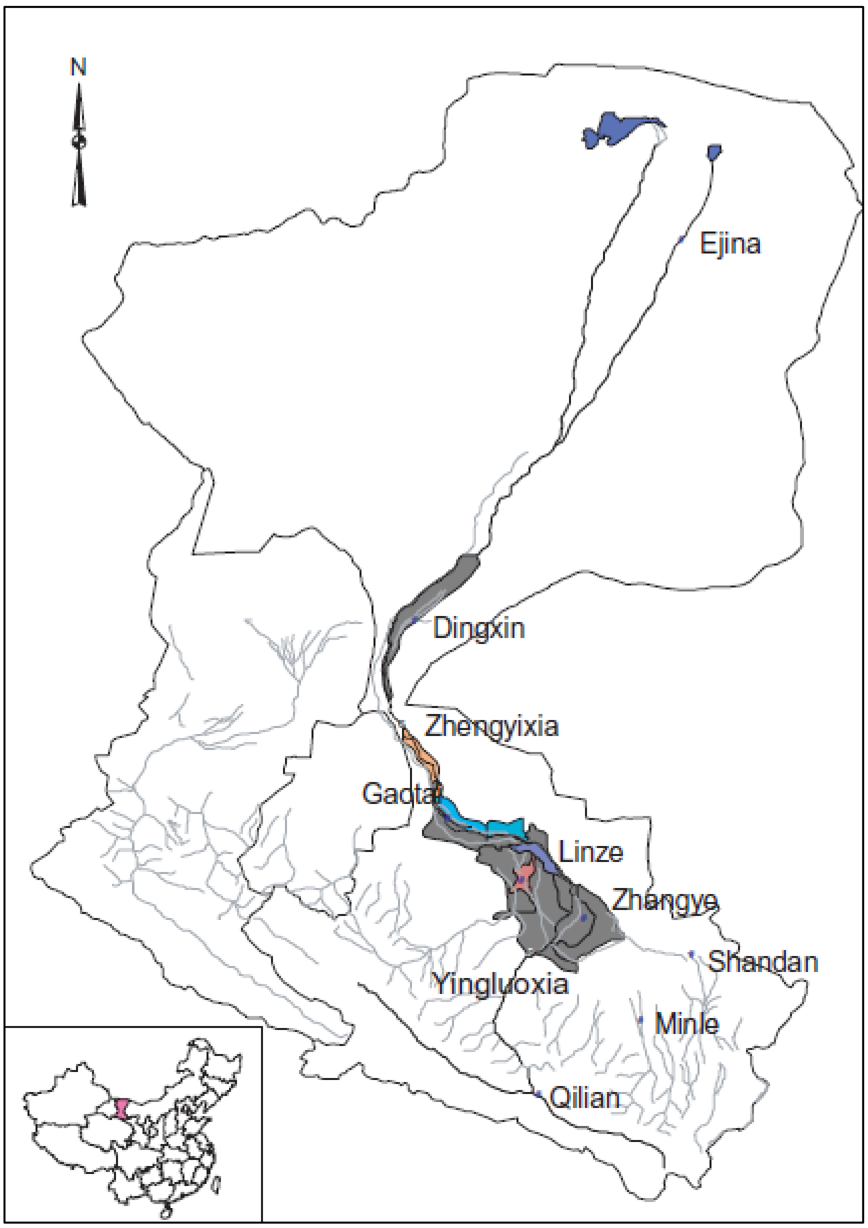

Figure 6: Map of the Heihe River Basin

Due to population growth and economic expansion, water use has increased significantly in this basin over the past 30 years. As a result, the region faces extreme water scarcity issues. The Heihe River now generally dries up before it reaches its terminal lakes, and groundwater levels have declined severely. Therefore, the Heihe River Basin Administrative Bureau (HRBAB) has commissioned you to assess the Basin's water resources and to offer recommendations for managing water demand. It provided you with the hydrological data shown in Table 2 and the water demand data shown in Table 3.

Table 2: Hydrological data for the Heihe River Basin

Area	Mean Runoff	Mean Annual Precipitation	Mean Annual Evaporation	Ground Water Resources	Heihe River Length
km^2	Mm^3/a	mm/a	mm/a	Mm^3	km
116000	2800	108	84	330	821

Table 3: Water demand data for the Heihe River Basin

Domestic Demand per capita per day	Industrial Demand	Ecosystem Demand	Livestock Demand	Agricultural Demand per unit Area
L/person/day	m^3	m^3	m^3	mm
91	95200000	510000000	333200000	1177.897968

Previous research conducted within the basin suggests that there is a large and regular exchange between groundwater and surface water, and therefore the two are impossible to be considered independently. With this information, the HRBAB has asked you to complete the following:

a. A schematic of the region that illustrates the flows entering and leaving the basin.
b. A water balance on the basin that determines if there are currently enough water resources to meet demand.

In addition to these technical deliverables, the HRBAB has also asked that you read two documents:

1. *Environmental Degradation in the Heihe River Basin*
2. *Agriculture in the Heihe River Basin – the major economic driver*

What do these two documents suggest about the relationship between agriculture, the economy, and the environment? Is this relationship sustainable? Should any of these be prioritized over the others? Provide some basic recommendations about future water resource management to the HRBAB based on what you have read about China and the basin.

Assignment 2

Project 1: Predicting Stream Flow in the Heihe River Basin

Project 2

Hydraulics

Water Treatment

Waste-water Treatment

Transport & Transformations in the Environment

Hazardous and Industrial Waste Management

Urban and Environmental Planning

Environmental Analysis

External References

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Acknowledgements