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Doctoral Thesis

Triggering Earthquakes in Science, Politics and Chinese Hydropower: A Controversy Study

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Louise Lyngfeldt Gorm Hansen

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Triggering Earthquakes in Science, Politics and Chinese Hydropower

- A controversy study

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For Claus and Mikkel

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Abstract

This thesis conducts a controversy study focusing on the intermingling of political considerations and emerging science in a controversy over whether or not the Zipingpu dam in China's Sichuan Province caused the magnitude 7.9 Wenchuan earthquake on May 12th 2008. The 2008 Wenchuan earthquake was one of the deadliest, costliest and biggest earthquakes in China in three decades. Over 90,000 people died, went missing or were presumed dead, and economic damage was estimated at over 100 billion US dollars in 2013. For scientists to suggest that such an unfathomable disaster could have been man-made was controversial to say the least. Not only because the root cause of the earthquake pointed to was a dam, and dam projects are inherently rife with conflict, but also because the Zipingpu dam was itself a high priority project for the Chinese central government and the Sichuan Province.

Taking the controversy over the Zipingpu dam as the empirical point of departure for the thesis means that the thesis spans two disciplines: That of contemporary China area studies and that of the constructivist tradition of Science and Technology Studies (STS), more specifically controversy studies as developed within STS (Jasanoff 1986 and 2004; Nelkin 1979/1992, Venturini 2010 and 2012) and the notion of Fragmented Authoritarianism (FA) as developed in contemporary China studies (Lieberthal and Oksenberg 1988; Lieberthal and Lampton 1992; Mertha 2008 and 2009). Theoretically, the thesis seeks to contribute to a budding conversation between contemporary China studies and STS by bringing the reflexive analytical vocabulary from controversy studies in STS into contemporary China studies in the analysis of a controversy originating in China. The aim of such attempted bridge-building between different disciplinary traditions is to seek out the interesting questions such a meeting may

pose to both. Only a limited number of controversy studies have been conducted in China, the reason for which can be related to Chinese language capability being a significant barrier to following discussions, reading papers, doing participant observation or interviewing Chinese speaking actors taking part in controversies. Controversy studies have been a stable element within the broader field of STS since the field's inception in the late 1970s and the concept of expertise is at the heart of controversy studies. Thus, questions such as the following are explored: How is expertise constituted in China? Which types of expertise can legitimately be drawn on in the Chinese political system? Which ones not? How are such matters determined? And how is expertise connected to notions of legitimacy in China?

The research agenda for the thesis is thus structured around the central problem statement: What historical conditions led up to the controversy over the Zipingpu dam and the Wenchuan earthquake and what role did expert knowledge play in assessing the risk of Chinese major dam projects?

The thesis is structured in three basic parts. Part I, comprising Chapters 1 and 2, discusses how the two disciplinary traditions may come together in the thesis and outlines the methods employed, the conditions of conducting a controversy study in a Chinese context and how these have shaped the study. Methodologically, the thesis builds on qualitative methods drawing upon methods from anthropology, contemporary China studies and STS such as multi-sited ethnography (Falzon 2016; Marcus 1995), following the actors (Latour and Woolgar 1979), controversy studies (Nelkin 1979/1992; Jasanoff 2004, Yaneva 2005, Venturini 2010 and 2012) and doing ethnographic fieldwork in China (Heimer and Thøgersen 2006).

Part II, comprising Chapters 3 and 4 focuses on the historical conditions of the political use of expert knowledge in political decision making in China and how

these conditions have influenced the hydropower industry and hydropower policy making in China. This part particularly draws on contemporary China studies.

Part III, comprising Chapters 5 through 8, analyses the controversy. Over four chapters a detailed analysis of the controversy over whether the Zipingpu dam did or did not cause the Wenchuan earthquake is analyzed. The study of the controversy first analyses the historical antecedents of the political decision to build Zipingpu in Chapter 5. Second, the scientific controversy as it unfolded in academic journals after the Wenchuan earthquake occurred is analyzed in Chapter 6. Third, Chapter 7 analyzes the negotiations around the potential risk of a large earthquake happening at, or near to, the Zipingpu dam prior to its construction. Lastly, the public controversy over Zipingpu is analyzed in Chapter 8 detailing the strategies experts employed to gain credibility and legitimacy, and ultimately how this may have impacted on hydropower policy making in China.

The thesis concludes that contemporary China studies, in the form of FA, and controversy studies in STS supplement each other well. Firstly, in that the combination effectively breaks up the traditional categorizations in FA based on the bureaucratic logic of “where you stand depends on where you sit” (Allison 1971 as quoted in Brødsgaard 2013). The analysis of the scientific arguments employed in the controversy over Zipingpu for instance shows that scientists at the China Earthquake Administration (CEA) argued both for and against the Zipingpu dam causing the Wenchuan earthquake. FA tells us that the CEA, as a government agency belonging to the ‘establishment’, should not logically have argued both sides of the debate. Thus, the thesis shows, that FA alone cannot account for the way CEA scientists argued in the scientific debate. Drawing on the reflexive vocabulary from STS effectively broke up such categorizations and in turn the analysis of the controversy could conclude that the way scientific actors argued was more related to the *scientific field* they belonged to (e.g. engineering or

seismology) than which agency they worked for or which country they belonged to.

Bureaucratic ranking as understood in FA is also highlighted in the thesis as a factor shown to be of importance in the analysis of a controversy taking place in a Chinese context. The analysis of pre-construction negotiations about earthquake risk at Zipingpu shows that in the negotiations bureaucratic ranking could have tipped a ‘scientific debate’ to fall out in favor of the Zipingpu Company against the provincial branch of the CEA, so that a high priority project could be built within budget - regardless of the scientific evidence presented by seismologists on each side.

Lastly, the thesis concludes that the risk of large dams causing earthquakes once built is, on the part of engineers, considered a risk that can be contained within engineering science. The thesis shows that engineers play a key role as experts in assessing the risk of Chinese major dam projects. Furthermore, engineers make what is tentatively called a ‘compartmentalization move’ where the risk of earthquakes is divided into what is the task of engineers and – perhaps more importantly – what is *not* the task of engineers. Thus, the science of building earthquake proof dams can be taken care of within engineering science. This ‘compartmentalization move’ means that it does not matter if an earthquake is man-made or not, as long as the dams built are able to withstand them. In this way, the risk of man-made earthquakes is ‘compartmentalized’ outside of a debate coming out of the controversy over Zipingpu – namely the debate whether large dams should be built at all if they can cause earthquakes. For hydropower policy making in China, the ‘compartmentalization move’, on the part of engineers, means that as an anti-dam argument, the fact that dams can cause earthquakes does not work very well in China. The thesis thus concludes that this is perhaps not because the government is unwilling to listen to different scientific actors, but

because the government, in listening to engineers, foregoes the policy option of *not* building dams in earthquake prone zones in China.

Dansk referat

Afhandlingen er et kontroversstudie med fokus på interaktionen mellem politiske overvejelser og ny viden i kontroversen om hvorvidt Zipingpu dæmningen i Kinas Sichuan provins forårsagede Wenchuan jordskælvet d. 12. maj 2008. Wenchuan jordskælvet målte 7.9 på Richter skalaen og var et af de største, mest dødbringende og omkostningstunge jordskælv i Kina i tre årtier. Over 90.000 mennesker blev dræbt, forsvandt eller blev formodet døde. De økonomiske konsekvenser af ødelæggelserne blev anslået til over 100 milliarder US dollars i 2013. Det faktum at forskere kunne fremsætte formodninger om, at en så ubegribelig stor katastrofe kunne være menneskeskabt var yderst kontroversielt. Ikke kun fordi man pegede på Zipingpu dæmningen som årsagen til jordskælvet, og dæmningsprojekter traditionelt er yderst konfliktfyldte, men også fordi Zipingpu-dæmningen i sig selv var et højt prioriteret projekt for den Kinesiske centralregering og den Kinesiske Sichuan provins.

At tage kontroversen omkring Zipingpu-dæmningen som det empiriske afsæt for afhandlingen betyder, at afhandlingen spænder over to discipliner: moderne Kina studier og den konstruktivistiske tradition STS - Science and Technology Studies (videnskabs- og teknologistudier). Mere specifikt, kontroversstudier udviklet i STS-traditionen (Jasanoff 1986 og 2004; Nelkin 1979/1992; Venturini 2010 og 2012) og begrebet Fragmented Authoritarianism (FA) som udviklet indenfor moderne Kina-studier (Lieberthal og Oksenberg 1988; Lieberthal og Lampton 1992; Mertha 2008 og 2009).

Teoretisk søger afhandlingen at bidrage til en spirende dialog mellem moderne Kina-studier og STS ved at bringe tankegangen bag kontroversstudier i STS ind i moderne Kina studier. Formålet med et sådant forsøg på at bygge bro mellem forskellige traditioner er at finde frem til de interessante spørgsmål, som en sådan

brobygning kan give anledning til for begge discipliner. Der er kun gennemført et meget begrænset antal kontroversstudier i Kina. Årsagen til dette kan være, at det kinesiske sprog kan være en betydelig barriere i forhold til at følge diskussioner, læse artikler, lave deltagerobservation eller interviewe kinesisk talende aktører i kontroverser.

Kontroversstudier har været et stabilt element inden for det bredere STS felt siden feltet blev introduceret i slutningen af 1970'erne. Kontroversstudier kredser omkring ekspertisebegrebet og undersøger bl.a. hvordan ekspertviden interagerer med samfundet gennem teknovidenskabelige kontroverser. Således søger afhandlingen at undersøge spørgsmål som: Hvordan konstitueres ekspertise i Kina? Hvilke typer ekspertise er det legitimt at trække på i det kinesiske politiske system? Hvilke er ikke? Hvordan bliver sådanne spørgsmål afgjort? Og hvordan legitimeres ekspertise i Kina?

Forskningsdagsordenen for afhandlingen er således struktureret omkring en central problemstilling som går på hvilke historiske forhold der har ført til kontroversen omkring sammenhængen mellem Zipingpu-dæmningen og Wenchuan jordskælv, samt hvilken rolle ekspertviden har spillet i vurderingen af risici forbundet med større kinesiske dæmningsprojekter.

Afhandlingen er organiseret i tre dele. Del I, der omfatter Kapitel 1 og 2, diskuterer hvordan de to forskningsdiscipliner afhandlingen bygger på kan kombineres, skitserer de anvendte metoder og betingelserne for at gennemføre et kontroversstudium i Kina, samt hvordan disse betingelser har formet studiet. De metoder, der er anvendt i studiet, bygger på kvalitativ metode med inspiration fra antropologien, moderne Kina-studier og STS så som 'multi-sited ethnography' (Falzon 2016; Marcus 1995), 'følg aktørerne' (Latour og Woolgar 1979), 'kontroversstudier' (Nelkin 1979/1992; Jasanoff 2004; Yaneva 2005;

Venturini 2010 og 2012), samt metoder til at gennemføre etnografisk feltarbejde i Kina (Heimer og Thøgersen 2006).

Del II, der omfatter kapitel 3 og 4, fokuserer på de historiske forhold, der ligger til grund for politisk brug af ekspertviden i Kina, samt hvordan disse forhold påvirker dæmningsindustrien og politiske beslutninger omkring dæmninger i Kina. Del II af studiet trækker især på moderne Kina-studier.

Del III, der omfatter kapitel 5 til og med 8, udgør selve kontroversstudiet. Over fire kapitler udføres en detaljeret analyse af kontroversen om, hvorvidt Zipingpu-dæmningen forårsagede Wenchuan jordskælvet eller ej. I undersøgelsen af kontroversen analyseres først de historiske faktorer der ligger til grund for den politiske beslutning om at bygge Zipingpu dæmningen. Dette undersøges i Kapitel 5 hvor også aktørerne i kontroversen kort introduceres. Dernæst analyseres den videnskabelige kontrovers, som den udfoldede sig i akademiske tidsskrifter og forskningspublikationer efter Wenchuan jordskælvet. Analysen af den videnskabelige kontrovers fremlægges i Kapitel 6. I Kapitel 7 analyseres forhandlingerne omkring den potentielle risiko for at et stort jordskælv ville opstå ved, eller i nærheden af, Zipingpu-dæmningen før den blev bygget. Endelig analyseres den offentlige kontrovers over Zipingpu dæmningen i Kapitel 8. I dette kapitel analyseres ligeledes hvordan eksperter positionerer sig for at opnå troværdighed og legitimitet, og i sidste ende hvordan dette kan have påvirket politiske beslutninger omkring dæmningsbyggeri i Kina.

Afhandlingen konkluderer, at moderne Kina-studier i form af FA og kontroversstudier i STS supplerer hinanden godt. For det første, fordi kombinationen bryder de traditionelle kategoriseringer som FA opstiller op. Kategoriseringer baseret på den bureaukratiske logik af "hvor du står, afhænger af hvor du sidder" (Allison 1971 som citeret i Brødsgaard 2013). Analysen af de videnskabelige argumenter, der blev anvendt i kontroversen om Zipingpu

dæmningen, viser for eksempel, at forskere ved den kinesiske jordskælvsadministration (China Earthquake Administration - CEA) argumenterede både for og imod at Zippingpu-dæmningen skulle have forårsaget Wenchuan jordskælv. FA fortæller os, at jordskælvsadministrationen, som en del af det Kinesiske administrative apparat, tilhører 'etablissementet' og derfor kun burde have argumenteret imod. Således viser afhandlingen, at FA ikke alene kan redegøre for, hvordan forskere i jordskælvsadministrationen agerede i den videnskabelige debat. Ved at trække på det analytiske vokabularium fra STS brydes FA kategoriseringen således op. Derved kan det på baggrund af analysen af kontroversen konkluderes, at den måde hvorpå de videnskabelige aktører argumenterede, var mere relateret til deres videnskabelige disciplin (f.eks. ingeniør eller seismolog) end til hvilken institution de arbejdede for eller hvilket land de kom fra.

Bureaukratisk rang som forstået inden for rammerne af FA fremhæves i afhandlingen som en faktor der viser sig at være af betydning i analysen af en kontrovers der udspiller sig i Kina. Analysen af forhandlinger omkring risiko for store jordskælv ved Zippingpu dæmningen før den blev bygget, viser at bureaukratisk rang kunne have givet det selskab som var ansvarlig for bygningen af Zippingpu dæmningen en fordel i en ellers "videnskabelig debat" med jordskælvs administrationen. Bureaukratisk rang viser sig således at kunne benyttes til at få et højt prioriteret projekt bygget inden for budgetmæssige rammer, næsten uanset de videnskabelige argumenter fremført af seismologer på hver side af forhandlingen.

Endelig konkluderer afhandlingen, at risikoen for at store dæmninger forårsager jordskælv når de er blevet bygget, af ingeniører anses for at være en risiko, der kan inddæmnes af ingeniørvidenskaben. Kontroversstudiet viser, at ingeniører spiller en nøglerolle som eksperter i vurderingen af risici forbundet med store Kinesiske dæmningsprojekter. Desuden benytter ingeniører det, der i afhandlingen

kaldes ”kompartimentalisering” i deres argumentation, hvor risikoen for jordskælv bliver opdelt i separate domæner. Dette betyder at risikoen for jordskælv opdeles i hvad der er en ingeniøropgave og - måske vigtigere - hvad der ikke er. Denne ’kompartimentalisering’ betyder, at det ikke er vigtigt, om et jordskælv er menneskeskabt eller ej, så længe de dæmninger der bygges er i stand til at modstå dem. På denne måde bliver risikoen for menneskeskabte jordskælv ’kompartimentaliseret’ som værende uden for den debat, der fulgte lige i hælene på kontroversen over Zipingpu - nemlig debatten om hvorvidt man overhovedet skal bygge dæmninger i potentielle jordskælvszoner hvis de kan forårsage jordskælv. For så vidt angår politiske beslutninger omkring dæmningsbyggeri i Kina betyder ’kompartimentaliseringen’ fra ingeniørernes side, at argument at dæmninger forårsager jordskælv ikke kommer til at fungere særlig godt som et argument mod at bygge flere store dæmninger i Kina. Afhandlingen konkluderer at det ikke er fordi den Kinesiske regering ikke er villig til at lytte til forskellige videnskabelige aktørers argumenter, men fordi regeringen ved primært at lytte til ingeniører simpelthen ikke giver sig selv den politiske valgmulighed at undlade at bygge dæmninger i potentielle jordskælvszoner i Kina.

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List of abbreviations

CCP	Chinese Communist Party
CEA	China Earthquake Administration
CFS	Coulomb Failure Stress
CSHE	Chinese Society for Hydropower Engineering
EIA	Environmental Impact Assessment
FA	Fragmented Authoritarianism
FN	Field note
FYP	Five year plan
GSHAP	Global Seismic Hazard Assessment Programme
ICOLD	International Commission on Large Dams
IHA	International Hydropower Association
INT	Interview
IWHR	Institute of Water Resources and Hydropower Research
MEP	Ministry of Environmental Protection
MWR	Ministry of Water Resources
NDRC	National Development and Reform Commission
NPC	National People's Congress
PGA	Peak Ground Acceleration
RIS	Reservoir Induced Seismicity
RTS	Reservoir Triggered Seismicity
SASAC	State-owned Assets Supervision and Administration Commission of the State Council

SOE	State-owned enterprise
SPCC	State Power Corporation of China
STS	Science and Technology Studies
USGS	United States Geological Survey
WCD	World Commission on Dams

Introduction

At 2:30 local time on May 12th 2008, a magnitude 7.9 earthquake struck Wenchuan County in China's Sichuan Province. The epicenter was close to the city of Dujiangyan some 50 kilometers north west of Chengdu, the capital of Sichuan Province (See map Figure 1). The earthquake has been called the Great Sichuan Earthquake or the Wenchuan Earthquake¹ and was one of the deadliest, costliest and most destructive earthquakes in China in three decades (Daniell 2013). Approximately 69,185 people were killed, 18,467 went missing and were presumed dead. 374,171 people were injured and more than 5 million left homeless. Total economic loss was estimated at 86 billion US dollars in 2008 and that number rose steadily to over 100 billion US dollars in the ensuing years. Entire villages were completely destroyed (USGS 2008; Encyclopedia Britannica 2013; Daniell 2013; Sorace 2017). The gravity of the event and extent of the disaster is hard to comprehend.

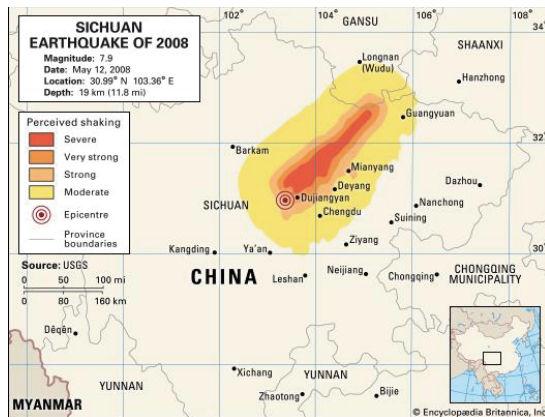


Figure 1: Map of the location of the Sichuan or Wenchuan Earthquake in China, May 12th 2008. Source: Encyclopedia Britannica (2013).

¹ In China the earthquake is referred to as the Wenchuan earthquake. Therefore this term will be used throughout the thesis.

In January 2009 the respected journal *Science* published a small article, provocatively entitled: “A Human Trigger for the Great Quake of Sichuan?” The article opened with a controversial idea. The idea that the Wenchuan earthquake might have been man-made:

“Natural disasters are often described as “acts of God”, but within days of last May’s devastating earthquake in China’s Sichuan Province, seismologists in and out of China were quietly wondering whether humans might have had a hand in it. Now, the first researchers have gone public with evidence that stresses from the water piled behind the Zipingpu Dam may have triggered the failure of the nearby fault, a failure that went on to rupture almost 300 kilometers of fault and kill some 80,000 people” (Kerr and Stone 2009).

In the article, evidence from scientists was reported which suggested that the weight of the water behind the 156m high Zipingpu dam, located close to the epicenter, might have triggered the Wenchuan earthquake. For scientists to suggest that humans are able to make or trigger an earthquake of such destructive magnitude as Wenchuan, an earthquake with so grave consequences, was a serious issue. Not only to other scientists, who did not think there was enough evidence to suggest that Wenchuan was man-made, but also to the public.

When I first encountered the concept of a man-made earthquake, I was baffled. I had no idea that today an earthquake is not just an earthquake. I had no idea that an earthquake is no longer ‘just’ a natural disaster that we can claim came out of nowhere. But how are we to know – let alone be certain – whether an earthquake is man-made? To that end, we need experts. In other words, we need an intermediary to interpret the events in the ‘natural world’ in order to help us understand the phenomenon at play before our very eyes. That intermediary is usually called science and is performed by scientists, or experts, if you will.

American STS scholar, Sheila Jasanoff, has pointed to an interesting paradox in today's complex societies. On the one hand "... there is hardly a move we can make without relying on experts" (Jasanoff 2003: 161). On the other,

"...the view of the disinterested expert, standing apart from values and preferences, has all but eroded over the past few decades. Experts, we have begun to realize, do not know 'best' according to some principled, linear scale of assessment" (Jasanoff 2003:160).

In many ways, this thesis revolves around this paradox and how it unfolds in the context of discussing man-made earthquakes. But man-made earthquakes are not only the concern of science and experts. As soon as the Zipingpu dam was drawn into the analysis of the causes of the Wenchuan earthquake the issue of man-made earthquakes became political. Not only is hydropower part of the energy sector - a strategic state sector in China - the Zipingpu dam itself is the property of the Sichuan Province and was a high-level national prestige project.

The suggested link between the Zipingpu dam and the Wenchuan earthquake surfacing after the Wenchuan earthquake prompted a number of actors to take action. Scientists, journalists, NGO organizations, government agencies and many others researched and reflected upon the issue of whether the Zipingpu dam had caused the Wenchuan earthquake or not. Their writings were published in academic articles, in the news, in opinion pieces, books and specialized magazine articles, in reports, on blogs and the issue was discussed at conferences. Actors from China, the US, Japan, New Zealand and other countries participated. As all these different actors expressed opinions on the issue of Zipingpu's possible role in causing Wenchuan, the issue of Wenchuan perhaps being man-made grew. New questions were posed. Questions such as: Are dams safe? Should dams be built in earthquake prone zones? If dams can trigger earthquakes should they be built at all?

As the issues and the questions multiplied, the debate about Zipingpu was linked to an almost archetypical development issue: the issue of dam building. Disputes over dam building have that David and Goliath type quality to them where international financial institutions such as the World Bank are backing dam projects and environmental movements intent on e.g. protecting indigenous people's rights fight the same projects. Dam building is more than rife with conflict meaning that, more often than not, dams are at the center of controversies (World Commission on Dams 2000).² A dam at the center of speculation about being the cause of a major earthquake thus provided fuel to an already smoldering fire.

The heightened attention around the possible role the Zipingpu dam might, or might not, have played in causing the Wenchuan earthquake and the linking of the Zipingpu dam to other, bigger societal issues such as dam development carry all the markers of a classic *controversy*. A phenomenon which, very openly defined simply refers to: "...situations where actors disagree (or better, agree on their disagreement)" (Venturini 2010:261) particularly where a technical or scientific component is central to the controversy (Venturini 2010). In Science and Technology Studies (STS) such situations have since the late 1970s been a central point of entry to study and understand the close connection between scientific knowledge production, technological change and socio-political order (Bruun Jensen et al. 2007). The study of controversies has thus been a stable element within the STS field since its inception in the late 1970s. Controversies were seen as a way to explore science-society relations, opening up what might otherwise be taken for granted assumptions among different professional and expert groups contributing to the discussion of science and democracy (Jasanoff 1986; Nelkin

² Dams are defined as: "...built structures that impede the flow of a river in order to derive social benefits such as irrigation or power generation" (Magee 2015:216)

1979/1992). For example, cases on controversies over animal rights, fetal research, nuclear energy, and DNA research highlighted the blending of facts and values in technical disputes over politically sensitive science (Nelkin 1979/1992). Politics were thus central to studies of techno-scientific controversies playing out in the public and policy making domains (Nelkin 1971 and 1979/1992).

In many ways the controversy over the Zipingpu dam fits this classic idea of a *controversy*. However, what is not classic about this controversy is the simple fact that it takes place in China. Controversy studies in STS have traditionally grown out of studying cases in ('Western') democratic countries. What happens then, if we take the controversy study to China? Will it be business as usual? Do we meet the same kind of issues in China as when studying a controversy in the US or the EU? Is conducting a controversy study different in China? And if so how? This thesis traces the process of doing a controversy study focused on the Zipingpu dam in China and discusses the implications.

Only a limited number of controversy studies have been conducted in China, the reason of which can be related to Chinese language capability being a significant barrier to follow discussions, read papers or interview Chinese speaking actors taking part in controversies.³ Furthermore, it can also relate to the fact that doing fieldwork in China into highly politically sensitive issues, persons or industries - such as large-scale hydropower development - can literally get you arrested. For example one of my informants spent six months in house arrest for publishing about the possible link between earthquakes and dams in China. The stakes are high in politically charged circumstances.

Choosing the controversy over Zipingpu as the empirical point of entry for this study has meant that the thesis spans two disciplines: That of contemporary China

³ A notable exception is Kirkegaard (2015) although it should be mentioned that she draws on a different branch of STS than is drawn on in this thesis in her comprehensive study of the Chinese wind power sector.

area studies (hereafter contemporary China studies) and that of STS. As most controversies, Zipingpu calls for an interdisciplinary approach. The thesis is therefore guided by controversy studies in the constructivist tradition of STS⁴ but the choice to focus on a controversy originating in China opens up for interpretation of the controversy's Chinese context by drawing on contemporary China studies literature - thus grounding the controversy study in a particular cultural and political context. In sum, this thesis draws together a range of diverse subjects such as the role of expertise in controversies, the science of earthquakes, hydropower development and Chinese politics and policy making.

In this thesis, I aim to make clear how the combination of contemporary China Studies and STS can open up a discussion about how to study controversies in a non-democratic context such as the Chinese. Furthermore, I also aim to discuss how expertise mobilized in a controversy, and in turn used in policy making, might – or might not – have particular characteristics in a Chinese context. Thus, through the facilitation of controversy studies in STS, the thesis seeks to open up a conversation between 'contemporary China studies' and 'STS' and ask questions such as: How is expertise constituted in China? Which types of expertise are legitimate to draw on in the Chinese political system? Which ones are not? How are such matters determined? How is expertise connected to notions of legitimacy in China?

In sum, the research agenda for the thesis is encompassed in the problem statement centering on the questions:

⁴ The constructivist foundations broadly refer to the notion that STS "...starts from the assumption that science and technology are thoroughly social activities" and that "there is no abstract and logical scientific method apart from the actions of scientists and engineers" (Sismondo 2004:10). There is of course significant variation within STS which discusses these matters in much more detail, but here it should suffice to explain one basic assumption that the field draws on.

What historical conditions led up to the controversy over the Zipingpu dam and the Wenchuan earthquake and what role did expert knowledge play in assessing the risk of Chinese major dam projects?

The problem statement is addressed through the following research questions:

- What are the historical conditions for the use of scientific and expert knowledge in political decision making in China?
- How have these historical conditions influenced hydropower policy making in China?
- How did the scientific and public debate around Zipingpu and man-made earthquakes affect hydropower policy making in China?
- What strategies did experts use to gain credibility and legitimacy in the debate around man-made earthquakes in China?

I will explore these questions through conducting a controversy study focused on how science and politics are co-produced in matters of expertise in the events surrounding the Zipingpu dam and its possible relation to the Wenchuan earthquake.

Reading guide

Apart from the present Introduction and the Conclusion, the thesis is structured in three basic parts.

Part I, comprises Chapter 1 and 2. The purpose of Part I is to make clear how the study has come about, in terms of methods employed, and to discuss the interdisciplinary approach the thesis is grounded in. The aim of Chapter 1 is to discuss the limitations and challenges of conducting a controversy study involving hydropower and earthquakes in China. The choice to start the thesis with a

meditation on methods enables an understanding of how the research has come about and what the choice to conduct a controversy study in China has entailed. Chapter 2 positions the study in the literature and outlines the foundational discussion of the thesis. It comprises of a literature review focused on highlighting relevant studies in STS which have focused on the intermingling of science, politics and expertise and discusses how STS and contemporary China studies meet in a controversy study setting. The purpose of Chapter 2 is to open the discussion of how the two different research traditions may meet in a controversy study so as to lay the conceptual foundation for conducting the controversy study in Part III.

The purpose of Part II is to take us into the Chinese context. Part II marks a step towards the empirical level of the controversy study (as presented in Part III) as chapters 3 and 4 are zooming more closely in on specific policy dilemmas and the history of hydropower development in China. First, Chapter 3 presents the historical conditions of the interrelationship between science and politics in China since 1949. The chapter draws on the parts of contemporary China studies focused on Chinese politics and the relation between the political sphere, intellectuals, knowledge and science, thus grounding the controversy study in the Chinese context. Second, Chapter 4 focuses on how the historical conditions outlined in Chapter 3 have influenced the Chinese hydropower sector. The chapter outlines the basics of hydropower development and the history of hydropower in China, including an overview of the complicated character of the hydropower industry and the bureaucratic set-up around hydropower policy and decision making in China and beyond.

Part III presents the controversy study and consists of Chapter 5 through 8 in which the controversy is laid out in detail. The chapters cover the history of Zipingpu, the scientific controversy over Zipingpu, risk negotiations, and the use

of expertise in hydropower policy making. Chapter 5 presents the history of the Zipingpu dam and the actors in the controversy over Zipingpu. Chapter 6 presents the scientific controversy over whether Zipingpu caused Wenchuan or not. Chapter 7 focuses on evaluating the risk of earthquakes at Zipingpu prior to the Wenchuan earthquake. Lastly, Chapter 8 analyzes the strategies used by experts to gain credibility and legitimacy and in turn how this may affect the use of expert knowledge in Chinese hydropower policy making. In sum, the four chapters analyze and discuss different aspects of the controversy in an effort to show how conducting a controversy study in a Chinese context plays out and what the implications for the political use of expertise may be.

Following Part III is the conclusion. The conclusion completes the study by summing up the main findings of the thesis in order to conclude on how bringing together STS and contemporary China studies in a controversy study has panned out. Lastly, further implications of the study are discussed.

Now, let us turn to how the thesis came about, the methods employed and the data collected.

Part I: Positioning the study

Chapter 1: Method meditations - putting together a controversy study

The present chapter shows how and why such different elements as earthquakes, Chinese politics, controversies, expertise and hydropower are coming together in this thesis. The chapter presents the theoretical and empirical motivations behind the thesis, shows which methods were employed to conduct the study and the details of how it has come about. Lastly, the chapter presents why all of these different elements are necessary for the analysis of the Zipingpu-Wenchuan controversy.

An open-ended approach

My thesis draws on methods used in contemporary China studies and in STS, both of which draw on e.g. history, anthropology and sociological methods. I am inspired by a long standing tradition in STS where following the development of new technology, an unfolding scientific discovery, a controversy or a dispute over science and technology is often a starting point. Consequently, my point of departure was the very simple idea of taking STS to China. Why? First, because only a limited number of controversy studies have been conducted in China (Kirkegaard 2015). New ground could perhaps be covered here by thinking through questions of controversies in a Chinese context. Second, China is becoming a significant player when it comes to scientific knowledge and technological development (Benner et al. 2012; Cyranoski 2016; Seger and Breidne 2007). Taking STS to China seems relevant not just in the context of China's huge investment in this area, but also because China offers a completely different setting for studying the intersections between scientific controversies, politics and the role of experts in this. Most studies in STS have taken the

(‘Western’) democratic state as a given in their investigations of how scientific knowledge and political systems interact (Cao 2014; Fu 2007; Jasanoff 2004; Lin and Law 2014; MacPhail 2009). China is not a democratic state and the STS of tomorrow must be able to investigate the complex interweaving of science, technology and society into a non-democratic setting such as the Chinese as this is becoming prominent in modern scientific and technological development.

Drawing on what can broadly be described as the constructivist foundations of STS⁵, I have taken an open-ended approach to study controversies unfolding over science and technology and then study such controversies in a Chinese context. This means that at the outset of my studies I did not know that I would end up focusing on the controversy over the Zipingpu dam and its possible relation to the 2008 Wenchuan earthquake. Such open-endedness, then, was fully intended.

Studying global phenomena such as controversies over hydropower development or the seismological science related to earthquakes thus warrants a multi-sited approach to data collection. Seismic events do not take place in one location and the knowledge and debates they generate tend to spread like wildfire. Here I have found inspiration in the method of ‘following the actors’ developed by - now renowned - STS scholars, Bruno Latour, Michel Callon and John Law as a consequence of their work in the 1970s (Bruun Jensen et al. 2007). This approach coupled with historical and ethnographic accounts has also been employed to form the backbone of many STS case studies into techno-scientific issues (Bruun Jensen et al. 2007; Sismondo 2004). The approach of following the actors draws heavily on the multi-sited ethnography approach (Falzon 2016; Marcus 1995). An approach which has been employed in STS and social anthropology in order to study for example globalized corporations (e.g. Garsten 1994). Gathering data at multiple locations or sites and following actors – as far as possible - across

⁵ See note 4.

national boundaries has become increasingly practiced in anthropology since the 1980s (Hannerz 2003) and is today almost an obligatory move in STS due to the nature of the empirical phenomena studied in this field.

An enduring feature of a number of STS studies is the focus on controversies in different types of controversy studies. Controversies over technical, scientific and risk issues have been points of entry into analyzing the constitution and deployment of expertise in contested processes of political decision making, negotiation and struggle. Thus, controversies over new science and technology and how it should be regulated are often areas ripe for studying the co-production of science and politics in matters of expert decision making. *Controversy studies* will be described in more detail in Chapter 2.

According to Sismondo, “Case studies are the bread and butter of ST&S” (Sismondo 2004: vii).⁶ In other words, STS scholars often prefer to address seemingly ‘larger’ and theoretical discussions - such as e.g. links between science and democracy or the socio-political consequences of classifications – by way of detailed empirical explorations of particular cases. By and large, STS has tended to favor ‘thick description’ of particular cases. Paraphrasing Geertz (1973), ethnography is ‘thick description’ in the sense that the ethnographer needs to show the meaning behind words and deeds and not just present events from the view of a disinterested spectator. Producing thick description requires simultaneously a practice of ethnographic field work and the practice of thinking and reflecting about the meaning of events in different contexts.

Taking departure in the focus on specific cases in branches of the STS tradition, it did not take a leap of faith to combine the open-ended approach with approaches in contemporary China studies as rich empirical case studies are also the norm here. In the study of the Chinese political system and policy making in China for

⁶ ST&S refers to Science, Technology & Society – a precursor of what is today called STS (Sismondo 2004).

example, detailed descriptions of bureaucratic structures, the importance of ranking and personnel decisions, biographies of the life of top-ranking officials etc. are all part of the empirical context. Drawing on these detailed and ‘thick’ descriptions opens up paths into understanding e.g. how and why a particular policy came about at a particular point in time or the impact of leadership rotations on the current national policy climate in China. One important difference, to me, is that what contemporary China studies do not seem to do by nature – but what STS seems to have in its DNA - is to be extremely reflective about the concepts deployed in the research and the consequences and impacts they have both for researcher and the researched. Reflexively in discussing categorizations of others’ as well as one’s own work at the same time is thus important in the present study in order to study an empirical phenomenon such as a controversy, where precisely categorizations and positions of actors change continuously.

In sum, the approaches employed both in STS and contemporary China studies are combined so as to conduct a *controversy study* in a Chinese context. Taking departure in fieldwork and particularly doing fieldwork in China, the rest of the chapter outlines my journey through the research process, the methods used to circumvent problems of access and the different kinds of data the thesis builds on.

Finding the issue(s)

The aim of the following section is to describe how I have built the present study and to show how I have come to explore controversies over emerging science in a Chinese context. The following describes how the contested nature of hydropower development coupled with the Chinese state’s push for reduction of greenhouse gas (and thus more hydropower) combined with state-owned dominance of the hydropower sector serves as fertile ground to explore controversies in a Chinese

context. Thus, the background upon which the thesis is built has its roots in contemporary China studies.

When I started out my dissertation research in late 2011, I did not know that I would end up writing a thesis focused on the case of the Zipingpu dam's possible connection to the Wenchuan earthquake. My project was founded in a larger research project on public sector reform in China, particularly related to large state-owned enterprises (SOEs), so I knew early on that my project was to relate to Chinese SOEs. SOEs are at the heart of many studies on party-business relations in China. Through continuous reforms of the state sector over the last decades, SOEs have increasingly become independent enterprises, while at the same time the Chinese Communist Party (CCP) has managed to retain control through appointment of business executives through the *nomenklatura* system (Brødsgaard 2017). The position of the SOEs being on the one hand independent enterprises but on the other being controlled by the Chinese state presents a paradox to many China researchers and has provided an interesting foundation for building a more thorough understanding of the consequences of the close party-business relations for the state.

As a strategic sector of the economy, the energy sector has been the subject of a number of studies on Chinese SOEs, their party and state relations. After reading political scientist and China scholar Andrew Mertha's book *China's Water Warriors* (Mertha 2008) detailing cases on hydropower decision making in China, I became fascinated with hydropower in general and the Chinese hydropower sector in particular. Particularly so, as during the last decade, China has increasingly moved toward a low carbon energy pathway, changing policies and making new ones in order to, amongst other initiatives, reduce the country's substantial greenhouse gas emissions (International Energy Agency 2014). In more general terms, China has increasingly focused on sustainable development and protecting the environment and has poured enormous resources into the so-

called ‘green’ industries since the mid-2000s (10 FYP; Christensen 2013). In terms of renewable energy, hydropower is at the center of a strategy to reduce greenhouse gas emissions due to China’s large hydropower potential, particularly concentrated in the south western parts of the country (Brown, Magee and Xu 2008). To understand Chinese hydropower, however, it is also important to understand the wider context of the global hydropower industry. Hydropower projects across the globe routinely face opposition from e.g. indigenous peoples and/or environmental groups opposing large-scale infrastructure development. Controversies have erupted over hydropower development for decades and China is no exception. Thus, when choosing to focus on a controversy involving hydropower in China it is necessary to take the wider (contested) context of hydropower development into account.

The intermingling of local (Chinese) concerns over hydropower with wider concerns over hydropower as e.g. represented by international NGOs was highlighted in Mertha’s (2008) study of a controversial case over hydropower development on the Nujiang (Salween) river in south western China. I found Mertha’s (2008) case a good starting point in terms of exploring controversies over hydropower development in China. The case deals with the Chinese SOE, Huadian Corporation which in 2003, together with the Nu prefecture government in south western China, submitted and got pre-approval for building a cascade of up to 13 dams on the Nu River (Dore and Yu 2004). In 2004 the plans to dam the river were abruptly halted. The then-premier Wen Jiabao discontinued the projects and called for more cautious and scientific studies of the environmental and social impacts of the projects (McDonald 2007; Mertha 2008). This decision was very controversial. It had not been seen before that such a high-ranked central government representative put a stop to a large hydropower project as hydropower projects have conventionally held the favor of Beijing officials (Lieberthal and Oksenberg 1988; Mertha 2008). Therefore the decision came as a surprise to many

China researchers (Mertha 2008; Magee 2006a; McDonald 2007). The dam plans for the Nujiang have since been revived, revised and halted again as debates over the dam projects continuously erupts (INT20121210; INT20121214; INT20121120; China.org.cn 2013; CSHE 2011; Daily Economic News 2011; Zhu 2011; Sinohydro 2011).⁷ To this day the Nujiang river projects continue to be subject of debate (International Rivers Press Release 2016) however environmentalists seem optimistic about the state abandoning the full scale project (Phillips 2016). The Nujiang case highlights tensions between different levels of government in China and e.g. environmental NGOs' efforts to halt large scale dam projects. The controversy over the proposed dams on the Nujiang River and the different strategies employed by NGOs, scientists and other dam-opponents – both international and domestic – in effectively linking the Nu River dams to more general themes of viability of dam building in China thus became a starting point for seeking out a suitable techno-scientific controversy to study in China.

The consequences of choosing controversies involving hydropower as an empirical field of study turned out to present a number of challenges with regard to data collection, which will be addressed below.

My initial phase of research in late 2011 and early 2012 was a period of desk research. Reading up on the hydropower sector in China and globally and getting to understand the basic workings of the hydropower industry more broadly. During this initial phase I found a number of critical issues, such as the debates about damming the Nujiang River, which raised questions about the viability of hydropower as a renewable and sustainable source of energy. These issues are at odds with the current push for hydropower development in China and elsewhere. Another such issue is the question of earthquake risk in relation to large scale

⁷ All interviews are referred to by INT followed by the date of the interview (e.g. INT20121210). Field notes are referred to as FN followed by year and month (e.g. FN201305). Further description of the data is found below under the heading "The data material".

dams and the possibility of large dams being able to trigger earthquakes. This was an issue that was discussed in e.g. news articles and later in 2012 by informants during fieldwork. In conversations (as well as in news articles) this issue was often linked to e.g. the Nujiang River Dams project. I found the issue of earthquake risk ripe with emerging scientific knowledge and conflicting perspectives - in a sense, closing the ring and drawing together my interest in taking STS to China and studying controversies unfolding over science and technology in a Chinese context. Thus, the different components of the study started to come together at this point. I realized that I would have to draw on not only contemporary China studies and STS but also research on the hydropower industry as well as emerging scientific knowledge about earthquakes. Doing research on the hydropower industry seemed to be a good way to prepare for further fieldwork, in terms of finding out how to study SOEs in the hydropower industry. A few words about studying different perspectives on hydropower will follow.

Studying different perspectives on hydropower

As is probably true with most things in life, as well as in research, everyone has an agenda - including oneself. In this thesis a dam is at the center of a controversy and is used as a research object around which to conduct a controversy study. In other contexts a dam can be a construction project, a source of water or energy supply or even a national symbol of development and modernization. In other words, dams serve as the backdrop for a wide variety of studies in many different fields. In the following I will show how diving into this diverse field entails awareness of the ways in which dams are utilized to shape different agendas.

Hydropower decision making, planning, design and construction are characterized by being complicated and encompass a range of different fields and issues within one project – e.g. from geology to indigenous people’s rights. Thus, a great deal of literature is available on different engineering aspects of hydropower construction

in specialized journals (Magee 2006a), and in specialized science journals studying the geological conditions for hydropower construction e.g. *International Journal on Hydropower and Dams* or *Journal of Hydrologic Engineering*. Also, in energy related research numerous studies of different aspects of hydropower have been done (e.g. Energy Policy 2002). A large part of writing about hydropower entails navigating between different actors' articulations about what hydropower development is, what purposes it serves, whom it serves, how to do it 'right', and the impacts and benefits it may or may not deliver for societies.

A common scenario is that comprehensive research reports on hydropower are commissioned with support from intergovernmental organizations such as the Intergovernmental Panel on Climate Change (IPCC), development banks, or under the auspices of the UN. One example is a highly cited report titled *The World Commission on Dams Report (WCD)*. Organizations such as the World Bank, the International Finance Corporation (IFC), and the Asian Development Bank (ADB) publish guidelines and reports focused on environmental and social sustainability in relation to the dam projects they finance as well as research specifically focusing on hydropower development and the energy sector. These documents are also intended for use by policy makers and hydropower companies in relation to hydropower planning and decision making processes (FN201305. See also International Finance Corporation 2012 and Asian Development Bank 2013). Other sources which solicit reports and research are NGOs and grassroots movements that are looking for independent studies of hydropower development projects' benefits and drawbacks for society at large or local communities in particular. This type of research is often directed towards a specific topic such as earthquake risk (Jackson 2012) threats to fisheries or indigenous people's rights in relation to specific dam projects (International Rivers Website). Before I embarked on fieldwork, I tried to sort out these different notions of hydropower.

Studying a scientific controversy means studying documents. My informants are all text producers and it would be impossible to understand them without studying their texts. Consequently, my research builds on comprehensive document studies of research into the types of documents written by international organizations (e.g. IPCC) development banks (e.g. World Bank), hydropower industry associations (e.g. International Hydropower Association - IHA) nongovernmental organizations (e.g. International Rivers, Probe International) as well as books and reports written about water, hydropower and dam development for the general public, policy makers and the specialized (also academic) reader interested in hydropower. Thus, such documents form a big part of the empirical material for the thesis.

In the social sciences, hydropower projects and the controversies which often erupt over such projects have provided numerous case studies and empirical backgrounds for a wide variety of different studies in many different fields such as anthropology, human geography, STS, contemporary China studies and political science (Hirsh 1998; Lieberthal and Lampton 1992; Magee 2006a and 2006b; McDonald 2007; Mertha and Lowry 2006 and 2008; Rogers and Marres 2008; Wade 2011). My research thus draws on case studies into these different types of conflicts over hydropower development. Points of controversy around hydropower in some ways become natural focal points of case studies. Depending on the theoretical perspective, they highlight different theoretical points.

When hydropower conflicts are the only common denominator, the theoretical backgrounds of the studies I have drawn inspiration from are different. However, collectively they are part of the different perspectives and narratives I have encountered in my study of hydropower broadly. For example, Mertha (2008 and 2009) argues a case of pluralization of the Chinese policy making process in general and around hydropower development in particular, through employing the

concept of *Fragmented Authoritarianism* (FA). He puts into perspective the role of NGOs, journalists and other ‘policy entrepreneurs’ in the Chinese policy making process and suggests that these groups continuously engage in manipulating issue frames:

“...in order to mobilize support, constrain government pushback, and link with other interested actors” (Mertha 2008: XVI).⁸

Looking to STS, Rogers and Marres (2008) also focus on aspects of issue formation by NGOs but take a different theoretical approach. They analyze the controversy over the Narmada dam in India through using a digital methods approach developed in an STS context. Their controversy study highlights that issue networks (as represented by NGOs on the web):

“...publicly testify to the fact that processes of issue formation tend to take place at a distance from the sites in which these issues make themselves most forcefully felt” (Rogers and Marres 2008: 274).

Further, they conclude that:

“As the Narmada Dams were adopted as a cause of concern by international NGOs, local issue definitions were exchanged for institutionally-oriented, more structural issue framings, both off and on the Web.” (Rogers and Marres 2008: 274).

⁸ The concept of FA and its potential usefulness in analyzing aspects of the Zipingpu controversy will be addressed primarily in Chapter 2.

Thus, controversies over hydropower development may serve many different scientific and political ends. Drawing on such a wide range of actors' articulations in different documents means that I have paid attention to how I could navigate this host of different narratives about hydropower development that I was sure to meet in the field. In my fieldwork and research I was thus aware of how some stories build more momentum than others, get circulated and perhaps become reinforced while others are neglected, downplayed or fail to build sufficient momentum to become accepted as viable articulations about the benefits or negative consequences of hydropower development. In practical terms this for example meant that I could draw on the narrative most relevant for the informant I was approaching for an interview so as to make my project relevant and interesting to the informant.

That different narratives and perspectives on hydropower and related issues are also presented in the academic literature that I build my thesis on, means that throughout the thesis what is considered 'empirical' and what is considered 'theoretical' and 'conceptual' varies with the context in which a perspective is discussed. This is a much larger discussion e.g. in STS but it should suffice to say that the perspective that "conceptual–empirical mixtures are unavoidable in actual research practice" (Bruun Jensen 2014) applies in this context. This should become clear throughout the next chapters.

Whether dams are able to trigger earthquakes is just one site of contention in science where different arguments about how earthquakes relate to dams are discussed. This discussion is in different ways narrated into larger social issues for instance risks associated with large scale infrastructure development such as dams. The point being that in this thesis the different perspectives – and their associated actors and institutions – are part of taking a new perspective: A controversy study

grounded in the STS interest in inquiring into the relationship between science, expertise and politics.

Bridging disciplines and becoming expert

How to go about studying a controversy where so many perspectives and a variety of different scientific disciplines are involved? I was a newcomer to earth science, seismology, hydropower engineering and the finer details of research on dams only a few years ago. Being interested in ‘following the actors’ (Latour 1988; Latour and Woolgar 1979) involved in a controversy focusing on the Zipingpu dam, however, forced me to do my best to learn the terminology and the science behind the language of hydrological engineers, seismologists, earth scientists more broadly as well as other specialized researchers and practitioners involved in – or with the ability to explain parts of - the issue I was following. In other words, to study the controversy surrounding Zipingpu and its possible relation to Wenchuan I had to understand my interviewees’ science language so I could interpret documents and conduct interviews with the experts involved in the controversy. In Collins and Evans’ (2007) words, I had to gain “interactional expertise” in for example in seismology. This, put crudely, means that as a researcher I had to become knowledgeable about e.g. specialized terminology and arguments made in earth science but not to the extent that I would be able to contribute to a specialized journal article in seismology - or what Collins and Evans (2007) term “contributory expertise”. My choice of participant observation as a method for this thesis springs out of a need for local experts to educate me in understanding issues that require highly specialized language and knowledge. For this, I also had to do language studies to read up on terms used in Mandarin Chinese when talking

about hydropower engineering, earthquake science, water conservation or other topics where more specialized language required it in Mandarin.⁹

Learning the specialized technical languages of the different informants in English, Danish and Mandarin Chinese where required has been building over time. Thus, during my fieldwork I have had countless small encounters and informal talks with different kinds of informants that have shaped my fieldwork and knowledge in different ways. For example on a tour of two large dam sites in the Borneo jungle in Malaysia - where Chinese SOEs were responsible for the majority of the construction activity - I was amongst a group of approximately 21 people of different nationality and specialization.¹⁰ On this trip which comprised – among other specialists - electrical engineers, financial institution managers, hydropower executives and NGO representatives, I had direct access to a wide variety of viewpoints. All of the participants had long-standing experience in the hydropower or dam industry. The possibility to do participant observation of e.g. meetings and technical presentations during this trip (and at other events where many different constituents were gathered such as a large hydropower conference) gave me the opportunity to engage in conversations about almost any aspect of dam building with different types of experts. Participant observation of technical presentations, meetings and workshops in connection with specialized hydropower conferences and participation in field trips both in China and outside China has therefore been a vital part of my fieldwork as it allowed me to more fully understand the context of the case I was studying.

In some ways it may seem counterintuitive that I had to go to Borneo to study Chinese hydropower. However, as access to do interviews with hydropower

⁹ The author reads, writes and speaks Mandarin Chinese.

¹⁰ This trip was arranged by the International Hydropower Association (IHA) and Malaysian Energy Company Sarawak Energy in connection with the IHA's 2013 Hydropower Congress in Kuching, Malaysia. Congress participants could (on a first-come first-serve basis and by paying a large fee) join a post-congress study tour of two large dam sites on Borneo. I was lucky to get an opportunity to join the tour.

company representatives (of which the most important are state-owned in China) and access to go visit specific dam sites proved almost impossible in mainland China, it was easier to get myself introduced at a specialized conference or meeting - most often outside of China – where I got small informal interviews. Thereafter I could contact the people I had met for further interviews, references to other contacts etc. Not all were willing to talk to me again once back in mainland China, but some proved helpful and were instrumental in getting me interviews, information or new contacts. In addition, a visit to a dam site can only tell you so much, if you are going on your own. Tours of the sites in China that I was interested in were not available to the public. Moreover, sites are often blocked off for visitors, declared military sites, fenced off as most construction sites are, or generally difficult to access even on foot, for example due to construction taking place in mountainous regions. In Borneo it took a seven hour drive in four-wheel drives through the jungle, a three hour boat trip and some more driving on rough and muddy logging roads just to get to one of the dam sites. Thus visiting a potential dam site, a site under construction or a finished dam I found that it was more beneficial to go with someone who could either tell me what I was looking at, help me gain access to the site itself and/or to information about the building process, the earthquake engineering or other aspects of the dam or the site.

Doing fieldwork in China

Eliciting information, e.g. in the form of interviews about anything deemed ‘political’ in China is notoriously tricky (Heimer and Thøgersen 2006: 12-13). Hydropower is exactly such an area. Some examples from my fieldwork may help to explain the context of doing fieldwork related to hydropower development in China. During my fieldwork it was not uncommon for potential informants to turn down interviews - if it was possible to get a response from them at all. This is a common feature of field work not only in China and reasons can of course be

many. However, when getting e-mails from informants saying “Very unfortunately, I am not allowed to give them [the information you asked about] because of National Security” (E-mail from informant November 26 2012 on file with author), then suspicion sets in. I was ‘shadowed’ on parts of my field trip to the Nujiang River’s potential dam sites. I was most likely followed by someone from the local public security bureau (PSB) or from a local branch of the ‘Guobao’, China’s national security ministry. I also got photographed (more likely by the Guobao) from a car while interviewing an outspoken individual contributing to the debate on Zipingpu causing Wenchuan (FN201211). Getting photographed as a foreigner in China is not unusual. The circumstances of that particular interview and location, however, led me to conclude that there was nothing usual about these photographs being taken.¹¹ Being followed or photographed was of course not about me, but about the person (or persons) I was interviewing or the location I was visiting. The people I was interviewing were most likely being monitored by the Guobao already as a consequence of controversial writings, opinions and actions in terms of bringing the issue of earthquake risk in relation to large dams in south west China forward. As such, persons engaged in issues that can, or have already, caused public disturbances (e.g. anti-dam demonstrations) are likely being monitored by the Guobao or the PSB so they are able to curb future potential disturbances.

It was challenging for me to do fieldwork in an atmosphere where one informant, a scientist who has intimate knowledge about hydropower development in China said: “I really respect your choice” (INT20130506). By “respecting my choice” he meant that choosing to study “such a complex and sensitive issue” (ibid.) in China

¹¹ That particular interview took place in a small, half empty, hotel lobby, on a rainy Sunday night in November around 10 pm, directly after I got in from the airport (where I had been picked up by my informant). My informant sat with his back to the window. I noticed a grey car driving up close to the window as if to park. The car kept running, a man rolled down the passenger side window and proceeded to photograph us through the window (at first using flash). The car then drove off again. I didn’t think this was the most natural of scenarios to get photographed as a tourist in China (FN201211).

can be very difficult. The difficulties first presented themselves in very practical terms. It took a lot of persuasion to get to do interviews because many of my informants assumed I wanted data, in the sense of (sensitive) numbers on for example water flow volumes in different rivers. Such numbers are not to be shared with foreigners due to national security. The Law of the People's Republic on Guarding State Secrets (1988/2010) stipulates that state secrets cover e.g. "secrets concerning major policy decisions on state affairs" and "secret matters in national economic and social development". Reading the law, it is clear that what actually constitutes state secrets is inherently elusive and hence subject to a wide-ranging and looming state prerogative. Hydropower is part of national economic and social development on a large scale and often involves conflicts locally, provincially and nationally. Some researchers and other potential informants did not want to be associated with political issues in any way or form. However, after some explaining I could often convince people to talk to me as I was more interested in the process of e.g. policy making or how research was conducted rather than the data some of the researchers worked with. Some, however, just outright refused interviews regardless.

Doing fieldwork in China was also challenging in more personal terms as I became increasingly sensitive to how much I myself as a researcher engaged in self-censorship to avoid outright 'political' or 'sensitive issues'. Questioning myself if I was avoiding presenting directly to my potential informants what I was interested in asking them about (such as the link between earthquakes and dams) because I thought this would deter them from talking to me. Was I afraid of repercussions if I was poking too much around sensitive issues? Doing research on hydropower in China can literally get you arrested.¹² It may seem brave and well-

¹² One example is a foreign researcher being arrested during his fieldwork on hydropower development in Yunnan province in China. He seems to have turned the incident of his arrest into some kind of event to display the sometimes difficult nature of his work. Thus his university profile picture displays him sitting smiling in the back of a Chinese police car driving off. When visiting the Nujiang River in Yunnan Province during my fieldwork in 2012,

intended to try to do research on a subject which often bumps up against ‘issues of national security’, but might also just be ill-advised and bad judgement on my part to imagine that it is possible to find out *anything* about what actually happens with regard to Chinese decision making on hydropower development in China. If you add earthquakes into this ‘minefield’ you get a combination where one of my informants was put under house arrest for six months for raising issues around dams causing earthquakes (INT20131001).¹³

In short, the research atmosphere I encountered was one that can be described as full of paranoia and self-censorship on the part of my informants. Living in and experiencing this atmosphere during my fieldwork gave me a perspective on the situations and general atmosphere my informants were navigating daily through e.g. engaging in self-censorship to avoid overtly ‘sensitive issues’. In sum, through my own experience of doing fieldwork I felt I got closer to understanding my informants’ different perspectives. Most researchers and students who have done fieldwork in China on topics that may be considered ‘sensitive’ or ‘political’ (and today it seems that this can really be almost anything depending on how you frame it) have had to grapple with these kinds of issues (Heimer and Thøgersen 2006). No one, not even personnel inside the Chinese bureaucracy, Chinese leaders or Chinese scientists can really say for sure how e.g. policies are ultimately decided (INT20130627). This of course may be said of a lot of different countries but perhaps for different reasons. What is important in this context is to understand that difficulties regarding access to informants, to interviews, documents etc. may be hampered by how you frame your questions, the people you are referred through, by your university affiliation or otherwise. For example, some informants

I was followed around quite openly and I was repeatedly asked by officials (e.g. when showing my passport to enter the Nuijiang region) if I was a journalist or researcher – a category notoriously suspicious in China. See also description of being followed on a field trip to the Nu River in 2015 by International Rivers in International Rivers Newsletter (2016).

¹³ On my informant’s run-ins with the government see also Larson (2008).

I was referred to through NGO-organization contacts, who introduced me first and then put me in contact with the person I wanted to talk to. Others I wrote directly to e.g. asking about their research and presenting myself as being interested in their particular field of research – e.g. environmental assessment of hydropower development. I also made sure to display my Chinese university affiliation with the University of Chinese Academy of Science e.g. when approaching researchers at universities. This because I found that affiliation helped place my research at a domestic university. Not only having a foreign affiliation but also a Chinese one thus implicitly acknowledged that my research topic was formally also part of the Chinese system. In this way perhaps not perceived as too controversial by my potential informants. Nevertheless, the method I employed to get any kind of information can perhaps best be described as snowballing or engaging in a game of Chinese whispers.

Chinese whispers, field notes, interviews and documents

‘Chinese whispers’ is a party game where one person at the end of a chain of people whispers a sentence only they know into the ear of the person next to them. The sentence is then whispered on and on, down through the chain and usually ends up more or less wildly distorted when the person at the end of the chain of people says the words they have heard out loud. Thus, we learn that the truth can be distorted significantly when undergoing repeated slight distortions or interpretations by a number of people. The party game illustrates two points. One, that no matter how accurate one tries to be in order to discover ‘the origins’ behind words, facts or people’s actions, distortion is there for better or for worse. Or rather may not really be discovered as it is ultimately a constructed entity. The second point is that there seems to be an idea that there is something particular about things ‘Chinese’. We will return to the second point in Chapter 3 as this is also a general theme in contemporary China studies.

Chinese whispers in a slightly different meaning can also serve as a metaphor for data collection in China. Not in the sense that all you learn is gibberish but more in the sense of the well-known snow-balling method of data collection.¹⁴

The practicalities of doing research on a sensitive subject in China that touches on political issues surrounding hydropower, water resources and earthquakes have been difficult but not impossible. I found that the best approach to collect data on such a topic was simply going to China and start contacting people. Although having done my research regarding who to preferably talk to, setting up interviews with what I might think was all the right people before I left for China was not feasible. Not only because they did not necessarily answer e-mails, phone calls or requests for interviews while I was still in Denmark, but also because all the preparation and research in the world could not make me available to do an interview in China at very short notice.¹⁵ Furthermore, I did not necessarily know who all my informants were before leaving for China. This meant that I needed my informants to point to the next potential informant (snowballing). My project description may have become more or less distorted by the time I reached the next persons' office, but the point is that I managed to get there. Through connections/*guanxi*¹⁶ or Chinese whispers as it were. This seems to be a common feature of fieldwork almost anywhere in the world and this was no different in China. Nevertheless, the person I was referred through spoke volumes about what my interest was and thus from being referred from someone else the informant

¹⁴ For another use of the Chinese whispers metaphor see Kirkegaard (2015).

¹⁵ When I was doing fieldwork in China I had several of these 'last minute' interviews, where I, shortly after having sent an e-mail or left a message for a potential interviewee received a call asking if I could come by immediately, the same day or the next day. Seldom were interviews scheduled more than one week ahead.

¹⁶ *Guanxi* is the well-known Mandarin Chinese word for relationship connoting personal connections or network ties.

formed ideas about the issue I was interested in.¹⁷ Sometimes that had to be corrected at the actual interview. At other times not.

In her research on the one-child policy Susan Greenhalgh described coping with the situation of quickly realizing that none of her informants were neutral about the policy she was researching: “there were ardent proponents and fierce opponents” (Greenhalgh 2008: 42). I had the same experience in my fieldwork as I found that none of my informants were neutral about dam-building. I didn’t expect them to be, but given the politically charged atmosphere of hydropower development policy in China it was important to avoid talking about overtly political issues in hydropower when I described my research interests.¹⁸ Otherwise I would not get referred onwards. One of my informants for example advised me not to not take sides as his experience was that informants would often ask you if you were pro-dam or an anti-dam and this could derail conversation. His usual response would be to say: “No I’m not anti-dam, I’m anti bad-dam” (INT20121120) which is vague enough to let the informant decide which dams are bad (and which ones are good) and thus perhaps leave the issue open. I was fortunate enough not to be asked that question by the majority of my informants and instead encourage my informants to talk to me about their research and voice their opinions.

As is perhaps clear, it may not be possible to ascertain if the information you obtain is ‘correct’ or neutral on some linear scale of assessment. And the point

¹⁷ I felt there was a difference in how my interests were perceived depending on whether I was introduced by someone from an environmental NGO or by a researcher in environmental science. For example, if I was introduced to a researcher that I was interested in interviewing by someone at an environmental NGO I was more than once assumed to be more interested in getting actual data and information not available to NGOs rather than being interested in talking to the researcher about his or her research as such.

¹⁸ An example of describing my research interest was that I sometimes expressed interest in the process of environmental impact assessment (EIA) of hydropower. Although somewhat controversial – due to some documented corruption in EIA processes - EIAs are not as controversial as earthquakes and hydropower. I found that questions relating to earthquake risk could nevertheless be posed during such interviews as EIAs relate to risk more generally. EIAs are also instruments used by anti-dam activists to draw more attention to the policy making process around hydropower thus signaling interest in EIAs was one way of approaching informants and get them to talk about broader hydropower issues.

here is that it did not matter. What mattered to me during the research process was getting different *perspectives* from different informants - whether an interview was related to earth science, hydropower development, or whether I was participating in a workshop conducted by an NGO or a conference organized by the hydropower industry. My choice of semi-structured interviews as a method for this thesis thus sprung out of a need to gain knowledge about how different experts think, speak and strategically position themselves in different contexts in order to gain legitimacy for their viewpoints. Cross-checking with documents, official policies, newspaper reporting, interviewing journalists, scientists, NGO representatives, academics and other researchers who have knowledge or have been engaging with the issue, controversy or subject of my study helped me group the different perspectives. In this way enabling me to write the story of the Zipingpu-Wenchuan controversy as presented in this thesis and in turn discuss the inter-connected issues of expertise, knowledge and politics.

If someone was to go to China today and do research on the topic of the Zipingpu dam and its possible connection to the Wenchuan earthquake they might find a similar controversy, but more likely, they will find that a different event or a different controversy is more important to focus on today in order to study the co-production of science and politics in matters of expert decision making. Because circumstances may be different today and this particular issue may not be as hot as it was during my fieldwork. However, the analytical point of conducting a controversy study in China should be more robust and my hope is that this controversy study can contribute to finding new ways to open up discussions about science and politics in matters of expert decision-making in China and beyond.

The data material

For the present thesis I have done 48 semi-structured interviews with engineers, earth scientists and other academics, with journalists, NGO representatives and hydropower industry representatives in countries as different as China, the US, Denmark, France and Malaysia. The reason for going to e.g. France or Malaysia was attempting to contact Chinese hydropower companies outside of China - as mentioned above. Also, going to large conferences where a number of international hydropower interests were gathered gave me access to a variety of companies, interest organizations and specialists. In addition to interviews in person, interviews have also taken place over Skype with informants from China and the US. One interview has been by written correspondence. Interviews have mainly been conducted in English and Mandarin Chinese. A few interviews were conducted in Danish. Interview quotes in Danish or Mandarin Chinese have been translated into English by the author. Where possible all interviews have been recorded. All recorded interviews have subsequently been transcribed. Where recording was not possible I have taken notes during and after interviews. In addition, I have done participant observation in meetings, technical presentations and workshops at specialized conferences on water and hydropower, at NGO meetings and workshops. These have taken place in France, Malaysia and mainland China.¹⁹ All fieldwork in China took place during 2012-2013. Two months in 2012: a short trip in April 2012 and a longer stay in late October until December 2012. In 2013 I spent almost five months during the spring and summer of 2013 in China, based in Beijing with trips to various destinations in and outside of mainland China. Interviews have also been conducted in relation to academic conference participation in the US in 2014. Lastly, further additional interviews have been conducted in 2014 via Skype to interviewees in the US and in 2016 in

¹⁹ I participated in the World Water Forum in Marseilles, France, in March 2012 and The International Hydropower Association's Hydropower Congress in Kuching, Malaysia in May 2013. I also participated in events, workshops and talks in China organized by the NGOs International Rivers China and Green Earth Volunteers.

Denmark. The majority of my interviews have been anonymized in order to protect my informants. All interviews are referred to by INT followed by the date of the interview (e.g. INT20121210). Field notes are referred to as FN followed by year and month (e.g. FN201305). Only a few informants are, with their permission, described with their real names as these informants are already highly visible and publicly known for their opinions in and outside China. During my fieldtrips to China as well as during participant observation outside China I have taken more than 170 pages of field notes which I also draw on as part of my data material for the thesis. Secondary literature obtained through my informants such as minutes of meetings, news articles, reports, books and other information is also drawn on in the thesis. Lastly, documents such as news reports, various policy documents, and academic articles obtained through online as well as research in specialized journals that have published on hydropower, earthquake engineering and the possible Zipingpu-Wenchuan issue also form part of the data material informing the thesis.

Data analysis

The data have been manually coded according to themes and sub-themes relating to the controversy over Zipingpu and related controversies over hydropower development in China. Themes have been drawn out from the data so that quotes and field note excerpts have been organized in separate documents relating to the themes and sub-themes. Themes related to specific issues toward more general issues were drawn out from interviews, fieldnotes and documents. Central themes were for example 1) Controversy over the Zipingpu dam itself – construction, history 2) Scientific controversy over whether Zipingpu caused Wenchuan 2) Man-made earthquakes/ reservoir induced seismicity 3) Issues of dam building in earthquake prone zones 4) Chinese state policy towards hydropower development 5) general hydropower policy dilemmas. The themes formed the different focal

points in the overall controversy study as exemplified by the controversy over whether Zipingpu caused Wenchuan or not.

The next chapter focuses on the theoretical underpinnings of the thesis and discusses the relationship between STS and contemporary China studies so as to discuss how to ground a controversy study in a Chinese context.

Chapter 2: Theoretical approach

The present chapter outlines the theoretical approach of the thesis and aims to draw together on the one hand studies in STS focusing on expert politics and controversies,²⁰ and on the other, the parts of contemporary China studies concerned with science and politics in China after 1949. In combining these two broad traditions of social science literature, the delineation of the overall theoretical lens and position of the thesis are presented.

The following review of STS studies and approaches aim to highlight some of the main issues, themes and *questions* that have been foregrounded by these branches of STS. Following this, potential ‘bridging points’ between STS and contemporary China studies are discussed as it is my contention that the combination of the two disciplinary traditions can provide new insights into how expertise is used in policy making in a non-democratic setting such as the Chinese. Lastly, different notions of controversy studies are outlined. The important point of the chapter is thus to highlight what insights the combination of STS and contemporary China studies can provide and to open a discussion of how such insights can be used within a controversy study.

The present chapter opens a discussion between STS and contemporary China studies in order to examine conceptual issues and pose theoretically informed questions that can be addressed empirically through the Zipingpu-Wenchuan controversy.

²⁰ In this thesis, expert politics, in the widest sense of the concept, refers to the political use of expertise in a policy making context. How ‘political use’ and ‘expertise’ is in turn defined in a Chinese context is part of the inquiry of this thesis.

Introducing experts, expertise, science and politics

“The people of this country have had enough of experts” said British MP Michael Gove during the days before Britain voted in favor of leaving the European Union (White 2016). By the look of it, expertise may be on the decline in Europe but also in the US (Jasanoff 2004 and 2005a). This has been discussed widely in the press after the election of US President Donald Trump in November 2016. In Denmark, former Prime Minister Anders Fogh Rasmussen started a process in 2001 of weeding the ranks of what he called “experts and arbitrators of taste” (Prime Minister’s New Year’s Address, January 1, 2002). According to Fogh Rasmussen,

“The people should not put up with finger-wagging from so-called experts that think they know best. Experts can be good enough at conveying factual knowledge. But when it comes to making personal choices, we are all experts” (ibid.).

Despite this seeming decline in the value of expert knowledge we are today living in societies more dependent on expertise and expert knowledge for decision making than ever before. According to Jasanoff “there is hardly a move we can make without relying on experts” (Jasanoff 2003: 161). This means that, while we need experts more than ever the trust in experts and their expertise is perhaps at an all-time low – so much so that people ‘have had enough of experts’ (White 2016).

However, any situation is rarely as black and white once you look closer at any one specific issue, but the outlined tension makes for an interesting lens through which to take a closer look at the constitution of expertise in modern society. Particularly so, as tensions such as the ones described above have been playing out in many different – and related – aspects of modern societies. Take science, for instance. Science is in many ways at the heart of expertise. Thus, when viewed through the political tensions outlined above, the idea of science as a universal

value “characterized by intellectual honesty, integrity, organized skepticism, disinterestedness, impersonality” (Merton 1938: 327) may have changed markedly in political circles:

“...as scientific knowledge becomes more closely aligned with economic and political power, producing new expert elites, the distance between the governors and the governed can be expected to grow - a dismal prospect in societies where low levels of electoral participation and citizen engagement are already causes for concern. Science, moreover, has historically maintained its legitimacy by cultivating a careful distance from politics. As state-science relations become more openly instrumental, we can reasonably wonder whether science will lose its ability to serve either state or society as a source of impartial critical authority” (Jasanoff 2005: 5-6).

Along the same lines of argument, Jasanoff (2005a) on analyzing an unprecedented questioning of the “postwar science-state contract”²¹ in the debates of the 2004 US presidential election campaign, asks: “Why, then, have relations between science and the party in power soured of late?” (ibid 210)

The study of the tensions between science and politics and the role of experts in society has been the topic of numerous studies in STS. Thus, the contribution of STS since the late 1970s has perhaps documented in detail what we already knew: Not only that “expertise (...) becomes politics by other means” (Jasanoff 2003: 159)²² but further that,

²¹Jasanoff refers to the postwar social contract between science and the state as spelled out by presidential adviser Vannevar Bush in 1945 as a contract that in short “provided money and liberty in exchange for knowledge and technical skills” (Jasanoff 2005a:210).

²² It should be noted that Jasanoff is paraphrasing Latour (1988a) here.

“...arguably there never has been a time when the work of science was wholly distinct from the work of politics” (Jasanoff 2005a:213).

In other words, expertise and politics, and politics in particular ideological shapes, are deeply connected:

“Expertise and democracy are no longer adversarial concepts, if they ever were: instead, expertise is almost the foundation stone on which the functioning of modern democracies has come to rest” (Jasanoff, 2003: 162).

Not by far being the first to ponder questions of expertise, science and politics, the next section builds on research into expert politics in different branches of the social sciences.²³ As mentioned, the main theoretical focus is on studies of expert politics from the perspective of STS, supplemented with research in contemporary China studies. However, as STS is a wide ranging field with considerable breadth and depth (as is contemporary China studies) STS writings explicitly focusing on controversies and expert politics are foregrounded. First, however, a few notes on the field of STS in general and the branches of STS drawn on here in particular.

Science and Technology Studies

Regarded as a social science discipline or a more general field of study²⁴, the overall focus in STS studies is most often “...the investigation of knowledge societies in all their complexity” (Jasanoff 2004: 2). Moreover, STS inspired inquiries are “specifically directed toward investigating the place of science and

²³ As mentioned in an earlier footnote ‘expert politics’ in the widest sense of the concept, refers to the political use of expertise in a policy making context. How ‘political use’ and ‘expertise’ is in turn defined in a Chinese context is part of the inquiry of this thesis.

²⁴ Bruun Jensen et al. (2007) provide an in-depth characterization of the difficulties of labelling STS a discipline as such by (amongst other factors) citing interdisciplinarity and diversity of disciplines and focus of studies as some of the main characteristics running through STS. Also, reflexivity and attention to the fluidity of categorizations of almost any kind are highlighted. Some within STS would thus disagree with Jasanoff’s characterization of STS which the following builds on. This, however, should be seen as one of the strengths of STS - i.e. an ability to reflexively discuss categorizations of others’ as well as one’s own work at the same time.

technology in society” (Jasanoff 2004: 2). Thus, at the root, then - of STS inspired analysis - is the enquiry into the relationship(s) between science, technology and knowledge production in contemporary societies. What makes STS stand apart from other social science disciplines is perhaps that through studies in STS, the boundaries between some of the social sciences’ most basic categories such as those between ‘nature’ and ‘culture’, ‘state’ and ‘society’, ‘science’ and ‘politics’ and ‘structure’ and ‘agency’ are challenged (Jasanoff 2004: 2).

Studies in STS have also highlighted the theoretical point that science and technology operate as *political* agents in the sense that they are “indispensable to the expression and exercise of power” (Jasanoff 2004: 14). This line of scholarship in STS has highlighted important discussions revolving around science, culture and political power - and not least the role of experts therein. A central claim that Jasanoff makes again and again in different contexts is that:

“The making of science is also *political*, we argue; indeed the central claim of our collection is that there cannot be a proper history of scientific things independent of power and culture” (Jasanoff 2004: 21).

However, this finding seems to be neglected or sidelined in some social science disciplines (ibid). Indeed, according to Jasanoff (2004: 278):

“for the most part, the disciplinary social sciences still unquestioningly accept the boundary between nature and society as given” (Jasanoff 2004: 278).

Jasanoff (2004) has a relatively simple explanation for this:

“The dominant discourses of economics, sociology and political science lack vocabularies to make sense of the untidy, uneven processes through

which the production of science and technology becomes entangled with social norms and hierarchies” (Jasanoff 2004: 2).

This means that the role of science and technology often gets black-boxed²⁵, neglected or sidelined in social science analyses (Greenhalgh 2008; Jasanoff 2004). STS is interdisciplinary at the root, but it also calls attention to the inherent divisions in existing social science disciplines precisely to avoid the sidelining of science and technology in analyses. Thus, it is important to stress that work in STS:

“...calls attention to the negotiable boundaries of many things whose hardness we ordinarily take for granted, such as facts, institutions, social roles, and even inanimate objects. A core project of STS has been to display the fluidity of the divisions among the social, material, and natural worlds, showing that much of what we know through science or use as technology is produced and given solidity through socially accredited systems of rhetoric and practice. Science, in particular, emerges from this analysis not as an independent, self-regulating producer of truths about the natural world, but as a dynamic social institution, fully engaged with other mechanisms for creating social and epistemological order in modern societies” (Jasanoff 1995b: XV).

For the present thesis, the choice to build the theoretical framework on STS concepts means that the approach to the study of expert politics is based in a constructivist frame²⁶ where science and politics as categories are regarded as ‘dynamic social institutions’. Or to use Sismondo’s words:

²⁵ Black-boxing is a term imported from engineering science by Latour (1988). Black-boxing refers to e.g. when a machine element is drawn on a chart it can be ‘black-boxed’ because the processes inside the machine element are well-known in the context. This means that the complexities of the processes taking place within the black box are essentially rendered invisible. The processes in the black box may previously have been the subject of intense research activity but essentially become irrelevant in subsequent research (Bruun Jensen et al. 2007: 82-83. See also Blok and Elgaard Jensen 2009).

²⁶ See note 4.

“For STS, then, science and technology are active processes, and should be studied as such. The field investigates how scientific knowledge and technological artefacts are constructed” (Sismondo 2010: 11).

The strength of building a theoretical frame on these foundations is that STS provides the conceptual grounding for studying the role of expertise in policy making. The fact that this conceptual grounding is constructivist opens up for drawing on other disciplinary traditions in analyzing e.g. a controversy. In this case, I will be drawing on contemporary China studies. China is neither democratic nor physically a part of the Western hemisphere, therefore it is my hope that drawing on STS vocabularies for studying the use of expert knowledge may yield new insights and perhaps generate new challenges (also for STS) in the meeting with contemporary China studies.

STS and contemporary China studies

Like STS, contemporary China studies constitute a highly interdisciplinary field, albeit in a somewhat different way. Contemporary China studies borrow theoretical inspiration and interpretation of all things Chinese from numerous other social science fields - mostly political science, history, economics and to some extent anthropology. Political scientist and long-time China studies scholar, Andrew Nathan sums it up: “Knowledge is interdisciplinary, especially in the field of China studies” (Nathan in Nathan and Hua 2015: 5). In contemporary China studies, developments within China are most often being analyzed through the use of the different social sciences’ pre-existing disciplinary categories. For example, studies on whether or not China is unique (in e.g. its culture, politics, science etc.) present one vein within contemporary China studies. Such a question could be approached from a number of different disciplines thus analyzing the possible uniqueness of its bureaucratic system through comparing with different political

science models (e.g. Lieberthal and Oksenberg 1988)²⁷, over analyzing whether there is such a thing as a particularly ‘Chinese’ political culture (Nathan and Hua 2015), or specific approaches that one can label ‘Chinese science’ (Particularly the lifelong work of Joseph Needham (1900-1995), see also Cao 2004 and 2014; MacPhail 2009).

Rich in thick description different empirical fields in contemporary China studies, however, most often build on the acceptance of a particular theoretical field’s existing categories. For example, importing more ‘realist’ assumptions with political science in the analysis of Chinese politics may have impact on the way Chinese politics is understood. The contribution of the more constructivist approach of STS in this context would be to question the use of pre-existing categories (and perhaps their inherent assumptions) from other disciplines in the understanding of events in China while nevertheless continuing the empirically rich tradition inherent in China studies at large.

In the combination of conceptual grounding in STS with the tradition of ‘thick’ historical, cultural and political description from contemporary China studies drawing on Jasanoff’s research is particularly relevant. This, because one of Jasanoff’s contributions to the STS field is the insistence on weaving together STS approaches and concepts with other social science fields – perhaps most notably political science and law (e.g. Jasanoff 1986; 1990; 2004). This fits well with the fact that, often studies on contemporary Chinese politics and bureaucratic politics draw on political science as well (e.g. Lieberthal and Oksenberg 1988; Lieberthal and Lampton 1992; Mertha 2008). There may therefore be common ground to explore here. One conceptual road where common ground may be explored, and which is highly relevant to the study of hydropower controversies, is a framework

²⁷ In addition Brødsgaard (2013:33) outlines a variety of different models and approaches applied in the analysis of contemporary Chinese history and politics, also underscoring the point that contemporary China studies is “a collective effort”.

developed for understanding policy making processes in China: the Fragmented Authoritarianism (FA) framework, which was briefly mentioned in the previous chapter. According to Brødsgaard (2017), FA:

“...challenges alternative explanations that claim that it is primarily power or the aggregation of a rational division of labour and interest that drive policy outcomes in China, arguing instead that power can be easily manipulated, even effectively ‘vetoed’, at the policy implementation stages and that policy rationality is constantly being undermined by self-interested, short-term and parochial calculations of institutional actors whose support is essential for the policy to even remotely succeed” (Brødsgaard 2017: 3).

It is my hope, that employing FA as a conceptual tool in combination with conducting an STS inspired controversy study, may lead to a deeper contextualization of a controversy over hydropower in China. This in the sense of exploring the meeting between expertise in controversies, as understood in the STS literature, and the understandings of policy making processes in contemporary Chinese politics as understood through FA. FA is highly relevant to the study of the use of experts in hydropower policy making for a number of reasons. First, the framework was initially developed through empirical studies of the Chinese hydropower sector (Lieberthal and Oksenberg 1988) and was later expanded through, again, Mertha’s (2008) further empirically grounded studies of the Chinese hydropower sector and in particular controversies over dams in China. Most importantly, FA contributes with a deep understanding of the Chinese policy making process. Showing that underneath the surface of authoritarian one party rule the Chinese system is fragmented (hence naming the concept ‘fragmented authoritarianism’). Although it may seem as if the top leadership decides on everything, all decision making from the top does not unilaterally become

implemented directly down through the system (Lieberthal and Oksenberg 1988). This is explained through one of the central elements of FA: so-called bureaucratic bargaining.

Bargaining in FA²⁸

The basic argument of the FA framework is that “the authority below the very peak of the Chinese political system is fragmented and disjointed” (Lieberthal and Lampton 1992: 8). Lieberthal and Lampton (1992: 34) argue that bargaining is at the core of FA and that bargaining occurs particularly in technical and economic decision-making.²⁹ Bargaining most often occurs between what they term:

“proximate leaders”: entities that are “equals in the hierarchy or entities (persons, organizations, factions, localities) one step above and one step below that level” (ibid.: 50).

Thus, the FA model’s units of analysis are the entities that engage in bargaining processes (e.g. persons, organizations, factions and localities). In his extension of the FA model in 2009, Mertha explains that the basic tenet of FA is that it:

“explains the policy arena as being governed by incremental change via bureaucratic bargaining” (Mertha 2009: 996).

Mertha also expands the model to include previously excluded actors in the policy making process – such as activists, the media and disgruntled officials – as a group termed “policy entrepreneurs” (ibid.).

²⁸ Parts of this next section has already been published in Brødsgaard (2017) Chapter 7: “Bargaining Science: Negotiating Earthquakes” written by the author. Permission to freely change and adapt the text to fit the present thesis has been given by Routledge.

²⁹ Bargaining is defined as: “. . . a form of reciprocal accommodation among the leaders of territorial and functional hierarchies” (Lieberthal and Lampton 1992: 37).

Using Mertha's (2008 and 2009) vocabulary, the focus on earthquake risk could be deemed a new 'issue frame' – in this case seismicity, or seismic activity in designated dam building areas. According to Mertha (2008):

“Although policy entrepreneurs deliberately choose from a wide array of symbols to construct their issue frames, these frames must be meaningful to the people whom they wish to mobilize for their cause. Moreover, the process is not a fishing expedition or an arbitrary mining of such symbols but rather is calculated to employ strategically those elements that will resonate as robustly as possible and thus draw the greatest number of potential recruits” (Mertha 2008: 14).

As an issue frame mobilized by policy entrepreneurs such as NGOs, seismic risk in relation to dams evokes powerful symbols – such as the risk of major disaster. This can in turn be used to forward a specific agenda or outcome, in this case the fight against building more large-scale dams in China. Other types of issue frames have been employed in earlier anti-dam campaigns. A case in point is one of the major campaigns led by anti-dam activists in China at the beginning of the 2000s: the campaign against the decision to build 13 dams on the main stem of the Nu (Salween) River. In this campaign, the main focus was on preserving biodiversity and the pristine natural environment of the upper Nu River gorge – a UNESCO World Heritage Site (Mertha 2008 and 2009; UNESCO.org 2003/2010). This campaign evoked symbols of pristine natural environments, threat of biodiversity destruction and the extinction of unique species of plants and animals in the designated dam areas. According to the activists themselves, the campaign resulted in an unprecedented win over the dam proponents in 2004 when, the then premier Wen Jiabao, called an abrupt halt to the plans in order for more cautious and scientific studies of the environmental and social impacts of the dam projects

to be carried out (Jacobs 2013; McDonald 2007; Mertha 2008;). However, things have changed in the 10-odd years since Wen Jiabao put a moratorium on the Nu River dams in 2004 and as we shall see in Chapter 4, dams are back in vogue. From the perspective of FA, to gain momentum in different campaigns, NGOs and anti-dam activists are policy entrepreneurs. The process one could study with FA is the continuous creation of issue frames, such as seismic activity. With FA we can thus study a bargaining process where policy entrepreneurs, such as these NGOs, find and employ new arguments as tools to fight against further dams being built. Focusing on seismicity issues around dam construction and, for example, calling for more scientific research and transparent decision-making in relation to seismic risk assessments of dams, is an example of one such tool (INT20131001).

In sum, FA not only explores the hydropower sector and controversies therein, the framework builds on knowledge of bureaucratic bargaining and the importance of technical bargaining processes for policy making in China. How is that, then connected to expertise in controversies?

Science and politics

Jasanoff's significant contributions to STS and other fields lie in her ability to bridge gaps between a long tradition of constructivist micro-studies³⁰ in e.g. the sociology of science (which falls under the broad STS hat) and blend these insights with the more macro-oriented political science. This allows her to

³⁰ Constructivist micro-studies refer to a broader collection of laboratory studies characterized by their interest in science as practice and culture. As famously phrased by Latour (1988) these studies take the “back door” approach to science as a vulnerable process of building networks and alliances rather than going through the more grandiose “front door” of undisputable facts. Classics include Trawick's (1988) *Beamtimes and lifetimes*, an anthropological study of natural science in a laboratory setting and Latour and Woolgars' detailed *Laboratory Life* which studies fact making in scientific practice (Latour and Woolgar 1979). Latour would probably disagree with the label ‘micro-study’ as one of his, and other STS scholars', contributions have precisely been attacking the micro-macro divide (see e.g. Latour 1988).

challenge both fields and simultaneously contribute with substantial and empirically rich answers to questions such as:

“To what extent do national political cultures condition the relationship between experts and the lay public in the policy process?” (Jasanoff 1986: 7).

And,

“What do we actually know about the uses of science in policy decisions, and what does this suggest about the place of experts in the regulatory process?” (Jasanoff 1990: 4).

Thus, building from here, it is my hope that bringing the richness of the tradition of ‘thick’ historical, cultural and political description from contemporary China studies into combination with the reflexive vocabulary of STS in the study of a controversy in a Chinese context may tease out new questions to contemporary China studies and STS alike. Questions such as: How is expertise constituted in China? Which types of expertise can legitimately be drawn on in the Chinese political system? And how do experts gain credibility and legitimacy in a non-democratic context such as China?

My point being that contemporary China studies need STS concepts for more context sensitive analyses of the role of expertise in policy making. For example controversy studies have pointed to the ways in which science and politics co-produce in scientific and technical disputes. Although FA also analyses technical disputes, the framework does not take into account the science being discussed in the dispute but rather focuses e.g. on the ranking of the institution to which the scientist belongs. FA contributes with a view of the Chinese bureaucracy that highlights the intricacies of the Chinese system which is invaluable to understanding the bureaucratic aspects of a controversy in a Chinese context.

However, the way FA categorizes in more static units of analysis, assuming that when e.g. a person belongs to an NGO this person cannot simultaneously be part of another category (e.g. a journalist), means that the framework does not have the conceptual vocabulary to 1) explain the role of scientists and 2) explain the role scientific expertise plays in technical disputes such as a controversy.

However, STS also needs contemporary China studies. As mentioned, FA can explain some of the bureaucratic intricacies in the Chinese system which can be hard to grasp for newcomers to the study of policy making in China. In addition, contemporary China studies can provide a more thorough understand of non-democratic policy environments such as the Chinese, and thus how expert politics may play out in a Chinese setting. Here e.g. bureaucratic ranking is important. Essentially FA needs to take scientists and science into account, but lacks the vocabulary to do so and this is where STS comes in. The other way around, STS studies on controversies has been developed with cases based in democratic settings. Contemporary China studies can contribute with understandings of how a non-democratic bureaucratic system such as the Chinese use and treat expertise in policy making. Thereby bridging gaps between STS and contemporary China studies.

The agenda of mixing Chinese insights with STS has already been taken up by e.g. Greenhalgh (2008) in her study of the making of China's one-child policy and by Cao (2014) in his analysis of China's pursuit of the Nobel Prize. Furthermore, using STS in a Chinese context has also been taken up through the founding of the Journal of East Asian Science and Technology Studies (EASTS). Debates about the acceptability of an 'application of STS sentiments in a Chinese context' seem to abound here (Fu 2007). Discussions about a 'post-colonial STS' exploring questions such as "How might Science and Technology Studies learn from the intersection between 'Western' and 'other' forms of knowledge?" (Lin and Law

2014) are also found in this vein led by prominent scholars from other branches of STS such as John Law. Rather than going down the ‘post-colonial’ road, the thesis is positioned so as to combine 1) the rich and detailed empirical studies of Chinese politics, policy making and dam controversies done under the broad umbrella of contemporary China Studies with 2) the sophisticated conceptual tools of STS in analyzing expert politics through the lens of a controversy study. Through combining these two strands, fundamental questions such as the role of science and expert knowledge in policy making in China may perhaps be discussed in new ways.

Where do you go to study experts and expertise at work in policy making? How to go about studying expert politics? The key to studying expert politics and the role of expertise is controversies. The next section focuses on STS literature concerned with controversies and further work in STS which has expanded upon controversy studies to broaden the framework for organizing studies mindful of the fluid boundaries between science and politics – also deemed work in “the idiom of co-production” (Jasanoff 2004).

Controversy studies

Controversy studies in STS have provided a prominent avenue by way of which STS has achieved its more general ambition, i.e. to understand the close connection between scientific knowledge production, technological change and socio-political order (Bruun Jensen et al. 2007). While some STS scholars were busy inventing new and radical ways of studying scientific controversies and knowledge-production in laboratories (Bloor 1976; Collins 1975 and 1981; Pickering 1984; Latour and Woolgar 1979; Knorr Cetina 1977, 1981, 1995 and 1999; Traweek 1988), others focused more on how science and technology became controversial outside the laboratory and in wider socio-political processes

(Nelkin 1979/1992; Jasanoff 1986 and 2004). The scholarship of Sheila Jasanoff dominates in this latter vein in STS. For a good reason, as she is one of the most persistent within this STS branch to continuously have studied expert politics in different empirical settings since the 1980s (Jasanoff 1986, 1990, 1995a, 2003, 2004, 2005, 2005a; Jasanoff and Wynne 1998). Jasanoff is of course not the only STS scholar to have delved into, or touched on, matters of expertise and expert politics. Others STS scholars, such as Wynne (1992, 1992a and 2002), Funtowicz and Ravetz (1994), Benessia et al. (2016), Irwin (1987 and 1997), Collins and Evans (2002 and 2007), Lynch and Cole (2005; see also Lynch et al. 2008) have made significant contributions to the understanding of matters of expertise. I will primarily be drawing on this latter branch of STS as the Zipingpu-Wenchuan controversy is very much a controversy implicating wider socio-political processes in China. Thus these types of studies can provide useful concepts for analysis.

Studying different kinds of controversies has been at the core of STS since the early 1970s.³¹ Controversies were seen as a way to explore science-society relations, opening up what might otherwise be taken for granted assumptions among different professional and expert groups contributing to the discussion of science and democracy (Nelkin 1979/1992). Politics were central to studies of techno-scientific controversies playing out in the public and policy making domains. Nelkin (1971; 1979/1992) was one of the early pioneers in bringing together analyses on the politics inherent in technical controversies. According to Nelkin (1979/1992):

“Controversies over science and technology revolve around the question of political control: Who controls decisions about the development and application of science?” (Nelkin 1979/1992: x).

³¹ For a very early study of technical controversies providing some antecedents for later ‘controversy studies’ see Nelkin 1971.

This question was explored through cases on e.g. animal rights controversies, fetal research disputes, nuclear energy controversies, AIDS and DNA research debates (Nelkin 1979/1992). The cases highlighted the blending of facts and values in technical disputes over politically sensitive science (Nelkin 1979/1992). Studies of risk controversies developed out of this vein (e.g. Jasanoff 1986).

To close controversies in favor of one position or another (if at all), different actor alliances and constituencies attempt different strategies to close the controversy according to their understanding (Bruun Jensen et al. 2007). Often, this is where scientific evidence comes into play as science is seen as source of epistemic and social authority. However, this is in many ways also where the problem originates from, as knowledge is often uncertain and emerging, and consensus may never be reached or be prolonged so that disagreement and controversy simply persists (Venturini 2010 and 2012). This point has been corroborated in numerous STS inspired controversy studies over the years (e.g. Barry 2013; Schaffer 2005; Jasanoff 2005a). In Barry's (2013) words, studies of knowledge controversies demonstrate that:

“...we should not expect that the disagreements that exist between experts will necessarily lead to a consensus (...) , or that scientific evidence will provide a firm foundation or ‘rational solution’ on which political decisions can then be made” (Barry 2013: 7-8).

Evaluating societal risks is central to technical or expert controversies in the political domain. According to Irwin (1987);

“What is also clear is the fundamentally *uncertain* nature of risk decisions – where action must inevitably be made in a climate of technical and political disagreement” (Irwin 1987: 354).

In expert or technical controversies that are inherently political, different nation states have been shown to have different approaches in terms of policy making in order to come to terms with uncertain scientific data and emerging science. Building on what is essentially the same scientific evidence, studies have time and again shown that different countries take different policy making roads, depending on, among other factors, political systems, bureaucratic arrangements, political cultures and ideas of scientific independence from politics (Jasanoff 1986; Brickman et al. 1985). Exploring this in a Chinese context is part of the aim of this thesis.

Controversies over technical, scientific and risk issues have thus been points of entry into analyzing the constitution and deployment of expertise in contested processes of political decision making, negotiation and struggle. One example of such a case is Brian Wynne's (1989) case on risk communication. Wynne analyzes conflicts between sheep farmers and officials in Cumbria after radioactive contamination from the Chernobyl accident affected parts of the UK, particularly Cumbria. The case points to specific cultural and social assumptions that affected the overall credibility of experts and expert science used to regulate sheep farming in the wake of fallout from the Chernobyl accident.

Controversies, debates and disagreements in parliaments, courts and in the public domain across Europe, the US and to some extent Asian countries have served as fertile ground in STS for studying how experts and expertise are constituted and constructed in policy making processes, policy debates, during trials in court etc. This has resulted in cases on diverse subjects such as biotechnology and stem-cell research (Jasanoff 2005), potentially carcinogenic and toxic substances (Jasanoff 1986) and fingerprinting technology (Lynch et al. 2008; Lynch and Cole 2005). Other examples are controversy studies on anything from oil pipelines (Barry

2013) over dams in India (Rogers and Marres 2008) to studies on disagreements in Parliament over compulsory seat-belt wear in Britain (Irwin 1987). In other words, controversies over new science and technology and how it should be regulated are often places ripe for studying the intermingling of science, politics and expertise (Barry 2013; Jasanoff 2004; Jasanoff 2012; Nelkin 1979/1992).

As may be surmised, studying controversies involving the intermingling of scientific evidence with political deliberation often centers on expertise. Jasanoff points to the notion controversies can serve as a “means of organizing work in the co-productionist idiom” (Jasanoff 2004). For Jasanoff (2004):

“...co-production offers new ways of thinking about power, highlighting the often invisible role of knowledge, expertise, technical practices and material objects in shaping, sustaining, subverting or transforming relations of authority” (Ibid.: 4).

Thus, co-production can serve theoretical aims by focusing on the study of a controversy. This point finds particular resonance with the present thesis, where analyses of the case of Zipingpu involves a particular scientific controversy and related hydropower controversies that are not only complex and cross-disciplinary in nature but also highly politicized at the same time. Thus, the production of knowledge and the exercise of power become intertwined and *co-produced* (Jasanoff 2004) in such cases. This makes controversy studies an apt point of departure in attempting to understand the constitution of expertise in the Zipingpu controversy and start a discussion of the role of expert knowledge in hydropower policy making in China.

Controversy or controversies?

One important issue in studying controversies is that often the involved parties do not necessarily agree on what the controversy is actually about (Barry 2013; Tsing 2005). In other words, the issues in controversies are open to multiple framings (Wynne 2002). Seen in this way, it becomes clear that

“Controversies have contested identities and multiple vectors of contention. In this sense the scope of a controversy ‘is part of its effects, of the problem posed in the future it creates’” (Barry 2013: 9).

Thus, taking the controversy at the center of this thesis as an example means that not only is the Zipingpu controversy revolving around whether the dam triggered the Wenchuan earthquake itself a scientific controversy, but one of the effects of discussing this in scientific journals was that hydropower could be framed as a problematic policy option for sustainable energy. Raising questions such as: Are dams safe? Should more dams be built in earthquake prone zones? Consequently, the scope of the controversy broadened in time. To, follow Barry’s characterization further:

“Controversies are neither static locations nor isolated occasions; they are sets of relations in motion, progressively actualized. They contain multiple sites and events that may lead to ‘vast chains of new events’, interfering with the dynamic evolution of other controversies” (Barry 2013:10).³²

³² Barry quotes May and Thrift (2001), Thrift (2006: 549) and Born (2010) within the quote. These references have been taken out of the quote for clarity. The precise quote including original references is as follows: “Controversies are neither static locations nor isolated occasions; they are sets of relations in motion, progressively actualized (May and Thrift 2001). They contain multiple sites and events that may lead to ‘vast chains of new events’ (Thrift 2006b: 549), interfering with the dynamic evolution of other controversies (Born 2010)” (Barry 2013:10).

To sum up, controversies not only generate heat – in terms of heated debates over particular societal issues. They also generate light – in terms of illuminating competing perspectives and assumptions.³³ In other words,

“It follows that important aspects of political behavior and action cluster around the ways in which knowledge is generated, disputed, and used to underwrite collective decisions” (Jasanoff 2005: 6).

Points of controversy in this way highlight the role of expertise where politics and science meet. In terms of the role of expert knowledge, we can perhaps now ask what role do experts and expertise play in China considering what we know of the ways in which science-politics relations seem to have evolved in the Western hemisphere? If in a democratic system government decisions regarding for example the regulation of carcinogens (Jasanoff 1986) are subject to scrutiny from ‘the public’ as the ultimate authority. What – or rather who – is the higher authority in the Chinese system? Chinese public opinion does seem to matter a great deal to Chinese policy makers - e.g. as a way of ensuring legitimacy of the Party (Naughton 2007; Teets 2013). However, the Chinese Communist Party (CCP) is probably a more accurate authority to put at the top of policy makers’ list in terms of securing legitimacy for policy decisions as it seems nothing is above the party in China (Constitution of the People’s Republic of China 1982/2004). Let us now have a look at how Chinese science-politics relations have developed during the last decades and then return to the questions which have been opened up in the above.

³³ I am indebted to Professor Alan Irwin for directing my attention to this point.

PART II: Contextualizing China

Chapter 3: Science and politics in the People's Republic of China

The present chapter outlines the history of science-politics relations in China from the establishment of the People's Republic in 1949 to today, based on literature from contemporary China studies.³⁴ In particular, focus is directed to the branches of contemporary China studies analyzing the history of contemporary Chinese politics, and the interrelationship between science, intellectuals and political elites in China after 1949 (e.g. Cao 2004; Goldman 1996 and 1999; Greenhalgh 2008; Halpern 1989 and 1992; Lieberthal and Oksenberg 1988; Lieberthal and Lampton 1992; Mertha 2008).

This chapter therefore primarily draws on contemporary China studies for its structure and content. The aim is to provide contextualization through a description of the changing relationship between science and politics in China as portrayed in literature focused on the Chinese political system and thus show the political constitution of science in China since 1949.

The chapter is divided into periods corresponding to the changing top leaderships in China after 1949 encompassing five different top-leadership periods from Mao Zedong to Xi Jinping. Subdividing the inquiry according to leadership reflects a long-standing practice in studies of contemporary Chinese politics. Referring to the top leader naturally grounds the study at particular times and places in the political history of China, the logic of which is natural to observers and researchers of Chinese politics as shifts in policy focus often follow in the wake of changes in top-leadership. Since China to a large extent exercises a “leader-centric politics of discourse” (Greenhalgh 2008: 51) it is suitable to divide the shifting

³⁴ Contemporary China studies focus solely on ‘modern China’ – i.e. developments after the establishment of the People's Republic of China in 1949.

relationship between politics and science into periods of the different leaderships as the leadership and their discourse influenced not only policy making but science making as well (Greenhalgh 2008: 51). There have, of course, been reforms, plans, people and party discussions that cross the span of the different leaderships. The most important of these in relation to the political constitution of science will be addressed under the relevant leadership.

Conducting a review of science-politics relations in a chronological manner based on a review of literature from a broad field spanning contemporary China studies and more narrowly studies on contemporary Chinese political history and the interrelationship between science, intellectuals and political elites in modern China provides some challenges. For example, following a categorization such as ‘intellectuals’ through Chinese history since 1949 and up till today begs the question as to how an intellectual is actually defined (Cao 2004). Given what we know from studies in STS, as reviewed above, about the fluid and changing nature of categorizations it should come as no surprise that what constitutes an intellectual changes with changes in political winds and political views of science. This issue will become evident throughout the next pages. The baseline in contemporary China is Mao, so let us first focus on the Mao leadership.

Science-politics relations under Mao (1949-1976)

In the first years after the establishment of the People’s Republic in 1949, China imported the Soviet model with substantial Soviet support (Lieberthal 2004: 71). The model entailed “specialized universities combined with a large network of research institutes” (Zhong and Yang 2007: 319). In 1949, what would later become the Chinese Academy of Science (CAS) – “China’s most important scientific establishment” (Cao 2004: 1) – was established as a government agency. The establishment of a national academy was part of following the Soviet model

where scientific activity was placed in research academies closely related to various ministries (Cao 2004: 27). CAS has endured to the present day and still has a dual role of both conducting research and acting as an honorific society for outstanding scientists, unlike the e.g. the Royal Society of London which is a purely honorific society (Cao 2004: 1).

Lieberthal regards the view of science and technology imported with the Soviet model as follows:

“this model stressed full utilization of technical expertise while maintaining a tight rein on the artistic and creative intelligentsia”
(Lieberthal 2004: 71).

Indeed, under Mao, most scientific research was focused on centrally planned projects related to the military (Greenhalgh 2008; Zhong and Yang 2007: 319). Mao had a dislike of intellectuals and this dislike subsequently came to provide a great deal of influence on Chinese politics. His views also quickly clashed with parts of the Soviet model (Lieberthal 2004) - particularly with regard to intellectuals. According to Lieberthal (2004: 71) Mao’s anti-intellectualism was reflected in his view of science. Although Mao emphasized scientific inquiry, his view seemed to have been far removed from what is largely understood as critical inquiry or scientific method but seemed to be more a case of “selective empiricism” i.e. trying out ideas in one or a few places then summing up results. This then counted as ‘scientific’ (Lieberthal 2004: 71). Mao’s understanding was based on so-called ‘democratic centralism’ which emphasized practical experience among the revolutionary masses. Science under Mao was thus more a class issue with the goal of serving a revolutionary purpose and not an apolitical, abstract ideal. According to Shih (1970):

“Many scientists were told to learn from “countrified experts”, that is, from those who possessed practical ingenuity rather than theoretical knowledge or understanding” (Shih 1970: 233).

Shih (1970) concluded that:

“In reality, what the Chinese Communists are really looking for is not science but applied technology” (Ibid).

The Mao era was thus characterized by the focus on practical experience. This turned science into serving primarily revolutionary and political ends under Mao (Shih 1970).

A 12-year plan (1956-1967) for “scientific and technological development”, a top-down and state directed model based on the Soviet system, was presented at the CCP’s 8th national congress in September 1956 (Sullivan and Liu 2015: Iii). Among other goals the program was to aid rapid development of science and technology catching up with world science (Cao 2004: 29). Furthermore, the program was the first to promote “missions-led disciplinary development” (ibid). “Missions” were politically oriented and the program has, according to Cao (2004: 29), left a legacy of “politicization of science, state-led research endeavor, big science, resource concentration and top-down interference”.

In May 1958, the soviet model was generally radicalized by the new ideologically infused development strategy of the Great Leap Forward (1958-61) which was endorsed by the CCP central committee (Sullivan and Liu 2015: Iiii). However, in terms of science and technology the Great Leap Forward departs from the Soviet Model in the view of science. During the Great Leap “local scientific activities expanded through “worker’s innovation” (Qureshi and Kharbanda 1980). “Worker’s innovation” seems to be perfectly aligned with the promotion of the “popularization of science” campaign during the Great Leap. The CCP

mouthpiece, People's Daily promoted this campaign declaring that "science is no mystery" (Sullivan and Liu 2015: liii). The disastrous consequences of the Great Leap Forward's goal of attempting to overtake Britain economically in 15 years have been well documented elsewhere (Shapiro 2001; Sullivan and Liu 2015). Nevertheless it highlights the Mao-era trend of campaigns revolving around anti-intellectual sentiments. Anti-intellectual sentiments were thus also among the drivers behind the anti-rightist campaign (1957) and the Cultural Revolution (1966-76). During the Cultural Revolution scientists and intellectuals as a group more generally were decimated. Indeed, according to Lieberthal (2004: 242) the Cultural Revolution "crushed all semblance of intellectual input and prestige". Only military research survived relatively unscathed from the upheavals of the Cultural Revolution decade (Cao 2004: 29; Greenhalgh 2005 and 2008; Lieberthal 2004: 71).

As should be clear, the Mao-era was a turbulent time in Chinese history, not least as seen through the relations between the shifting political agendas and the place and organization of the sciences in Chinese society. Political struggles between different factions and people in the party also contributed to the radical campaigns and contradictory policies towards intellectuals as the party under Mao attempted to come to terms with this group. This, particularly as Mao throughout his life according to Lieberthal (2004):

“...detested the Chinese intelligentsia, which included doctors, scientists, engineers, and journalists, as well as scholars and creative writers” (2004: 71).

Despite later periods' departure from the chaotic and struggle-filled period under Mao, the Mao-era left a legacy for subsequent leaders to deal with. Deng Xiaoping was the first leader to have to tackle the legacy of Mao.

Science-politics relations under Deng Xiaoping (1978-1989)

In the mid-70s Deng Xiaoping, in the position of vice-premier and Hu Yaobang³⁵ (who later became general secretary) drafted a number of documents that caused significant debates in the party, but nevertheless can be seen as a preview of the coming shift in political winds in China. The three most important documents drafted by Deng and Hu emphasized 1) the importance of research and education, 2) the need for economic development and ways of encouraging this and 3) stable and professional leadership in the state (Vogel 2011. See also Brødsgaard 1997: 32-33).³⁶ Around 1976, the campaign against “three big poisonous weeds” (*san zhu da du cao*) - referring to the three documents – was initiated and subsequently Deng was purged from all his posts. Nevertheless, after the death of Mao in September 1976, and an ensuing period of intense power-struggle in the party, Deng regained power.

From the late 1970s the well-known “reform and open up” period began under the leadership of Deng Xiaoping. Deng managed to turn the Mao-era’s anti-intellectualism on its head by steering China down the path of “the four modernizations”. The four modernizations had the goal of modernizing agriculture, industry, national defense and science & technology (Lieberthal 2004: 134). This meant changing the core idea of Maoist ideology towards “seeking truth from facts”³⁷. This path was endorsed at the third plenum in 1978 (ibid: 136). The emphasis on “seeking truth from facts” marked the beginning of a period where

³⁵ From December 1977 head of the powerful communist party organization department.

³⁶ The documents were called: 1) The Outline Report on the Work of Science and Technology” or “Some Problems Concerning the Work of Science and Technology”, 2) “Some Problems Concerning the Acceleration of Industrial development” and 3) “The General Programme for All Work of the Party and the Country” (Li and Lok 1995: 385-386).

³⁷ Seeking truth from facts (*shi shi qiu shi*) was actually a quote from Mao, who in turn had borrowed the concept from the writer Ban Gu from the Eastern Han period (25-220AD). Mao interpreted the original phrase and gave it new meaning in 1941 in line with his ideas of emphasizing practical experience from the revolutionary masses. In 1981, the phrase was officially reinterpreted by the CPC so that the term came in line with the new leadership’s views, although it had already been used in the newer interpretation prior to 1981. See Li and Lok (1995) for a more detailed description of the evolution of the concept.

government decisions were to be based on scientifically derived knowledge or “scientific decision making” (Halpern 1989: 159-161) in many ways ushering in an emphasis on modern scientific methods as a basis for policy making (see also Cao 2004: 50). In a speech in May 1977, Deng referred specifically to this new turn:

“We must create within the Party an atmosphere of knowledge and respect for trained personnel. The erroneous attitude of not respecting intellectuals must be opposed” (Deng as quoted in Halpern 1989: 158. See also Marinelli 2013: 119).

In 1978 intellectuals, including scientists, were rehabilitated. This meant that their previous ‘stinking number nine’ category - a label they had received during the Cultural Revolution – was removed and they were accepted as part of the working class.³⁸ This for example became clear as Deng proclaimed that “natural science has no class character” (Sullivan and Liu 2015: x). The apparent turn towards knowledge and modern scientific methods marked a clear departure from Mao’s anti-intellectualism. In turn, at the end of 1978, the third plenum of the eleventh central committee declared that,

“henceforth the top priority goal would be to achieve the four modernizations (...) and that the correctness of all policies would be judged in terms of whether they facilitated or hindered achieving that goal rather than in terms of their fidelity to Mao Zedong Thought” (Lieberthal 2004:136).

³⁸ The ‘Stinking number nine’ (*chou lao jiu*) category was applied to intellectuals as one of nine categories of political-social undesirables during the Cultural Revolution. Number nine was at the bottom of the list after landlords, rich peasants, counter-revolutionaries, moral degenerates, rightists, renegades, enemy agents and capitalists. On the historical origins of the concept from the Yuan Dynasty and a more in-depth description of the concept see Li and Lok (1995:27).

In achieving the four modernizations Deng emphasized that “the modernization of science and technology are the key” (Deng Xiaoping as quoted in Sullivan and Liu 2015: x). However, modernization also entailed opening up and attracting foreign investments. China’s international image became something Deng cared about as he and his colleagues found that they needed help from abroad (Goldman 1996: 41). The prioritization to open up and reform the Chinese economy and the prioritization of science and technology as a key to modernization kept some check on the few campaigns that, as during the Mao years, were still initiated against intellectuals. The campaigns in 1981, 1983 and 1987 were against a few writers, against ‘spiritual pollution’ and against ‘bourgeois liberalization (both references to western values) respectively (ibid: 42). However, the campaigns were more narrowly defined than campaigns under Mao, and science and technology were most often ‘off limits’ so that the campaigns were directed at particular individuals (often to discipline political rivals) or a limited group of people in e.g. arts and literature (Sullivan and Liu 2015: xii-xiii). The campaigns were also short lived (Goldman 1996: 40-41).

Expert advice and disciplining the bureaucracy

Despite the campaigns - which were most often an outcome of internal party struggles - the 1980s marked a clear turn towards including experts in the policy making process. This was done not only through the “recruitment of educated individuals into leadership positions” (Halpern 1989: 157) but also through the establishment of expert advisory bodies:

“Deng reorganized the advisory system by creating new bodies to supplement bureaucratic sources of advice, and, more important, to structure that advice so as to overcome bureaucratic deficiencies” (Halpern 1989: 160).

Five research centers were set up in the period between 1980 and 1982 with the purpose to solicit advice from experts from both inside and outside the bureaucracy.³⁹ Experts from the Chinese Academy of Science (CAS) and the Chinese Academy of Social Science (CASS) were here considered as ‘outsiders’ to the bureaucracy. This is of course a point of debate, as researchers in CAS and CASS were - and still are – state employees and while not part of the core of the bureaucracy such as e.g. employees in a ministry, “independent” does perhaps not cover their position entirely either.⁴⁰ Nevertheless, despite each center having a particular purpose in itself, there were common purposes to organizing expert advice through the centers. Thus the centers were to provide alternative sources of advice than those coming from the traditional core bureaucracy, sort out conflicting views coming from different sectors of the bureaucracy, improve long-term planning, and channel external advice to the top leadership (Halpern 1989: 162-163. See also Halpern 1992). Inter-ministerial rivalries and turf battles have long been an issue in Chinese politics and policy making (Lieberthal and Oksenberg 1988; Lieberthal and Lampton 1992; Brødsgaard 2017) - the Deng-era being no exception (Goldman 1996). Halpern (1989) suggests that the inclusion of experts into the policy making apparatus in the 1980s can be seen as a part of attempting to mediate and navigate such conflicts within the bureaucratic system and the policy making process more generally as “China shifts to a new basis: expertise, rather than ideology”(Ibid: 166). She goes on to argue that:

³⁹ These were: The Economics Research Center (ERC), the Technical Economics Research Center (TERC), the Price Research Centre, the Rural Research Centre and the Economic Legislation Research Center. Already in 1985 three of the research centers (ERC, TERC and the Price Research Centre) were combined into the Economic, Technological, and Social Development Research Centre (ETSRC) (Halpern 1989:162).

⁴⁰ For a fuller discussion of the organization of the research centers and a discussion of bureaucratic bargaining and “competitive persuasion” processes see Halpern 1989 and Halpern 1992. For further consideration of experts’ independence in China see Cao (2004).

“While still political, this ‘politics’ operates in a new fashion and suggests that experts have acquired a more central position within the political system” (Halpern 1989: 166).

This meant that according to Halpern’s (1989) analysis already in the mid-1980s:

“... political competition appears to be conducted at least partially through competing use of experts and expertise” (Halpern 1989: 174).

The ability of top leaders - notably then premier of the State Council Zhao Ziyang - to draw on different experts, not only those connected directly to line bureaucracies, but also ‘outsiders’ such as researchers at CAS, CASS and other relevant institutions pertinent to a certain policy process helped discipline the bureaucracy. This meant that in some ways the traditional information flows in the bureaucracy were disrupted by the establishment of the centers, which in turn meant that the bureaucracy had to:

“consider more fully the externalities of their policy proposals during the drafting process, as the bureaucrats knew that their proposals would have to compete with those of the pertinent research institutes” (Lieberthal and Lampton 1992: 14).

The bureaucratic system under Mao did not invite a broader vision and expert consideration of policy externalities in this sense (Halpern 1992; Lieberthal and Lampton 1992:14-15).

In sum, in the Deng era, while the policy making process was turned towards “scientific decision making” by relying more on trained and educated expertise, and a newer understanding of science, the increasing reliance on experts also seems to have contributed to the policy making process becoming more complex.

Science-politics relations under Jiang Zemin (1989-2002)

The demonstrations on Tiananmen Square in June 1989 and subsequent party infighting resulted in Deng replacing Zhao Ziyang with Jiang Zemin as party general secretary that same year (Goldman 1999: 701-703).⁴¹ Also in 1989, Jiang succeeded Deng as chairman of the party's central military commission. In 1993, Jiang Zemin became president of China (Marinelli 2013: 119-120). Although Jiang formally took over in 1989, Deng continued to influence Chinese politics until his death in 1997.⁴² Particularly Deng's famous "southern tour" (*nanxun*) in 1992 where he visited special economic zones in the southern Guangdong Province in many ways served to quell internal party disagreements between those who were supporting the move towards a market economy and those who warned against "the evils of capitalism" (Goldman 1999: 703). Although Deng was officially not leading China, his southern tour reignited the economic reform program and the 'opening up' policy which had slowed down after the events of 1989 (Vogel 2011).

Like the leadership under Deng, the leadership under Jiang continued to have campaigns against intellectuals such as against "all-out westernization" (Goldman 1999: 702).⁴³ Campaigns could be used, as they had been previously, in party infighting between e.g. those who opposed further market reforms and those who did not. Like under Deng, the campaigns were short-lived. Furthermore, they "did not stop the inflow of Western ideas and products" (*ibid*). Intellectuals, artists and professionals who stayed away from politics suffered little restraints during the

⁴¹ Not only Deng supported and orchestrated this change other central figures close to Deng such as Chen Yun and Li Xinnian were instrumental in getting Jiang Zemin chosen – see Vogel (2011) for an in depth description of events.

⁴² How much Deng dominated in his later years has been the subject of debate. See e.g. Cheng and White (1998: 236).

⁴³ The purpose of the "all-out Westernization" campaign was to halt the inflow of Western ideals from abroad – which could be anything from democratic ideals to western products (Goldman 1999).

1990s (ibid: 702-703). In her review of the relationship between intellectuals and the state in the 1990s Goldman (1999: 711) concludes that:

“...there is no question that most Chinese intellectuals and students in the 1990s enjoyed more individual and intellectual freedoms, access to foreign counterparts and a more pluralistic cultural environment than at any other time in the history of the PRC” (ibid.).

Jiang in many ways continued Deng’s line of argument in his view of intellectuals and furthered their prominence in China’s “socialist modernization” (Marinelli 2013: 121). According to Marinelli’s (2013) analysis of Jiang’s speeches and the discourse on intellectuals under Jiang:

“...science and technology are indirectly presented as one of the fundamental preconditions for social stability, and, by extension, as a contribution to the authority of the CCP and its monopoly on power” (Marinelli 2013: 123).

Intellectuals under Jiang more officially became part of the working class and in several speeches in 1990 Jiang emphasized that intellectuals were to play an “irreplaceable function in socialist modernization” and that:

“...if intellectuals do not participate in (socialist) construction and the victory of the reform policy, both become truly impossible” (Jiang as quoted in Marinelli 2013:121).

Another group that officially became more fully accepted by the CCP during the Jiang leadership was private business entrepreneurs. With the inclusion of Jiang’s “Three Represents” (*sange daibiao*) into party constitution at the 16th national congress of the CCP, private entrepreneurs – another word for capitalists – could become members of the CCP (Brødsgaard and Christensen 2002). This was an

important and unprecedented move by the CCP so as to be able to ensure that the party had some sway over the private sector, which during the 1990s became an increasingly important force in Chinese economic development (for further discussion of this point, see Brødsgaard and Christensen 2002).

During Jiang's leadership, reforms of the science and technology system which had been initiated under Deng continued. The national strategies of 'revitalizing the nation through science and education' and 'acceleration of progress in Science and technology' pushed further the orientation of science and technology towards commercialization (Benner et al. 2012: 261). In 1998, a leadership small group on science, technology and education under the State Council was also established.⁴⁴

Enter the technocrats

A striking characteristic of the leadership under Jiang as opposed to the Deng leadership was the dominance of so-called technocrats⁴⁵ in the leadership. In 1997, when the composition of the 15th Central Committee of the CCP was completed, 18 out of 24 Politbureau members were educated in engineering (Cheng and White 1998: 231). According to Cheng and White (1998) technocrats have increasingly figured more prominently in Chinese politics since the early Deng years. With Jiang's leadership consolidation, technocrats for the first time dominated in top-level political positions (ibid; Marinelli 2013). During the 1990s, the CCP also started institutionalizing rules and norms regarding e.g. the criteria for educational background for leading cadres (Brødsgaard and Christensen 2002). The fact that so many top leaders under Jiang had technical backgrounds (engineering being the dominant one) may have had an impact on their policy preferences – although this is subject to some debate (Cheng and White 1998:

⁴⁴ On the importance of Leadership Small Groups see Grünberg (2015).

⁴⁵ Cheng and White (1998: 231) define technocrats as having three traits "technical educations, professional experience, and high posts".

234-235). Nevertheless, it seems that the Jiang-era ushered in changes furthering the departure from the Mao-years in terms of the political establishments' relationship with intellectuals as well as capitalists. The overriding focus during the Jiang years was, according to Marinelli (2013), to preserve stability and ensure the authority of the CCP. Rule by technocrats and the further inscription of intellectuals and capitalists into the socialist modernization cause can thus be seen as part of this project. In terms of e.g. party politics, the stability and authority of the CCP became easier to preserve and balance when previous 'class enemies' were assimilated into the party.

Science-politics relations during the Hu Jintao leadership (2002-2012)

The transition from Jiang Zemin to Hu Jintao was, despite rumors about factional in-fighting within the party, outwardly a relatively smooth process (Brødsgaard and Christensen 2002). However, according to Holbig (2009: 46) as a consequence of Jiang Zemin's 'Three Represents' being written into the CCP party constitution, with the inclusion of the so-called 'new economic elites' into the party, Hu Jintao, on taking over, faced serious discussions regarding party legitimacy. Public discussions and criticism over including capitalists and 'exploiters' into the party eventually led to a ban on media, party organizations and academic discussions of the subject (Ibid: 47, see also Fewsmith 2005). As such, it seems that under the leadership of Hu, there was a move to back away from the increasing tolerance of the freer expression of ideas under Jiang Zemin (Fewsmith 2005).

Getting a grip on science-politics relations from Hu Jintao onwards becomes increasingly complicated as China had now been through a long period of relative openness to the flow of ideas from the outside. At this stage 'intellectuals' were

included at all levels of party and state from the top leadership and into the bureaucratic administration – also as a consequence of reorganization of recruitment and promotion criteria in the state apparatus (Brødsgaard and Christensen 2002: 10).

In a sense, the socialist modernization process under Hu Jintao became even more deeply intertwined with the push for the development of modern science and technology. According to Benner et al. (2012) a commercialization of science trend begun under Deng Xiaoping came into full force from 2005 onwards, where the Chinese innovation system developed into a firm-centered phase (Benner et al. 2012:260; OECD 2008). Thus, science and technology were to be integrated with innovation so as to bring China forward in terms of new science based products and solutions. In 2006, the State Council announced the “The National Medium- and Long-Term Program for Science and Technology Development (2006-2020)” (*Guojia zhong chang qi kexue he jishu fazhan guihua gangyao*) (People’s Republic of China. National Development and Reform Commission, 2007). The plan runs to 2020. It outlined important areas where China was to put extra emphasis as regards the development of science and technology. This included:

“...research in basic sciences and frontier technologies, with priority given to energy, water resources and environmental protection” (Wen 2008: 649).

According to Seger and Breidne’s (2007) analysis of the plan, one of the plan’s defining features is the technical approach to achieving goals:

“...the contribution to China’s future growth from innovations should be 50% larger than that from labor and capital inputs” (ibid: 162).

This approach is cited as an example of an “obsession with numbers and formulas” (ibid). Seger and Breidne (2007) cite the composition of the Politbureau as one of

the reasons for this highly technical focus of the plan. The nine members of the Politbureau Standing Committee were from 2002 and until the 17th party congress in 2007 represented by seven engineers and two members educated in geology and mining (Brødsgaard 2002: 140). From 2007, this composition of educational representation only changed marginally with engineers still dominating the Politbureau Standing Committee (Li 2007; Miller 2008). In sum, technocrats continued to dominate at the top of the party after Hu Jintao took over.

The Scientific Outlook on Development

Shortly after becoming president of China in 2003, Hu Jintao (who took over as General Secretary of the CCP in 2002) introduced the concept of Scientific Outlook on Development (*kexue fazhan guan*). In 2012, when Hu Jintao gave the reigns over to current president Xi Jinping, the concept was written into the party constitution on par with the ‘theories’ of the previous leaders:

“Together with Marxism-Leninism, Mao Zedong Thought, Deng Xiaoping Theory and the important thought of Three Represents, the Scientific Outlook on Development is the theoretical guidance the Party must adhere to for a long time” (Hu Jintao’s speech at the 18th party congress as quoted by Xinhua 2012b).

The concept of Scientific Outlook on Development builds on the projects of the previous leaderships – primarily from the time of Deng Xiaoping onwards and his steering China on the path of ‘socialist modernization’. Citing “seeking truth from facts”, “revitalizing the nation through science and education”, “Sustainable Development” and the new addition of “Harmonious Society”, Hu Jintao reinterpreted the future path for China by building on concepts and drawing on reforms initiated under Deng and Jiang. According to Hu:

“... the salient features of the Scientific Outlook on Development are freeing up the mind, seeking truth from facts, keeping up with the times and being realistic and pragmatic” (Hu quoted by Xinhua 2012b).

Fan (2006) interprets the meaning of the concept:

“Scientific Development is, in essence, a euphemism used by the Chinese leaders for economic growth that takes into consideration the welfare of disadvantaged people and regions as well as environmental concerns” (Fan 2006: 709).

During Hu Jintao’s leadership, environmental concerns and balanced growth thus came firmly onto the agenda. Beginning from the 10th five year plan (2001-2005) and speeding up in the 11th five-year plan (2006-2010) protecting the environment, cleaning up pollution, enhancing energy efficiency and investing in renewable energy featured more and more prominently (10th FYP; 11th FYP; Fan 2006; People’s Daily 2001). As for the view of science embodied in the scientific development concept and more generally under Hu, the then Premier Wen Jiabao, a geologist by training, stated that:

“...we need to embrace a scientific culture by promoting scientific rationality while cherishing Chinese cultural heritage. Enlightened by Science, the rich and profound Chinese culture is bound to shine more gloriously” (Wen 2008: 649).

As an extension of this notion, in an interview with *Science* in 2008, Wen highlighted his belief that,

“Only science and the spirit of seeking truth from facts can save China. I firmly believe in this” (Xin and Stone 2008: 363).⁴⁶

It seems that science under Hu (and Wen Jiabao) was still looked to as a tool to aid state development, but the statements from the premier in many ways also give a clear understanding of how important modern science had become in political life in China by the time Hu Jintao gave over power to Xi Jinping.

Science and Politics in Xi’s China

Since the entry of Xi Jinping as China’s paramount leader in 2012 changes have been put in place that have shifted focus to what has been called China’s ‘new normal’. This particularly refers to the fact that the focus is shifting from high-growth to “balanced development and the quality of economic growth, with industrial upgrading, innovation and green development at the centre” (Brødsgaard 2015: 98). The ‘new normal’ also refers to changes in the governance of the CCP which have been put in place as “party leadership and institutional strengthening have been a central issue for the leadership since Xi Jinping took over” (Brødsgaard 2015: 102). For example, a wide spread anti-corruption campaign has been initiated. Many central and local leaders have been brought down during the campaign so far and it is still going strong (Brødsgaard 2015:102-103). China’s 13th Five-Year Plan was approved on March 16th, 2016. Innovation through science and technology are priorities in the plan:

⁴⁶ At this point, the meaning of the phrase “seeking truth from facts” has changed markedly from Mao’s interpretation. Mao used the phrase in 1941 to describe the practice of drawing on practical experience among the revolutionary masses. The phrase was then re-interpreted by Deng and then Wen Jiabao who here presents the phrase - clearly referring back to Mao. In Wen’s interpretation however, “the spirit of seeking truth from facts” refers to science as a modernizing force and savior of the Chinese economy.

“China also intends for its research expenditure to rise to 2.5% of gross domestic product by 2020, from less than 2.2% over the past five years” (Cyranoski 2016: 424).

The trend of investing heavily in research and development that was started during the previous Five-Year Plans thus continues as China is increasing efforts in the area of science and technology. This can also be seen from China’s steady increases in spending on research and development as a percentage of GDP having risen from 0.728 per cent of GDP in 1991 to 2.047 per cent of GDP in 2014, now higher than that of the 28 European Union countries’ aggregate spending on research and development which was at 1.951 per cent of GDP in 2014 (OECD 2016).⁴⁷

In tandem with increasing spending on research and development and focusing on science and technology as a means to upgrading the economy and ‘rejuvenating the nation’, the composition of CCP members has also changed significantly. Today, the CCP has become a party for the elite (Dickson 2014). This is also the case in other countries where e.g. the ability to fundraise and network can be a significant factor in the ability to pursue a political career. Nonetheless, the systematic way in which the CCP selects its members coupled with the significance of CCP membership in securing an attractive position – political or in the administrative apparatus – points to a major shift the CCP has undergone in the last decades. According to the latest statistics of the CCP published by the CCP’s powerful organization department (Xinhua 2015) the traditional base of “workers and farmers” now makes up about 38 per cent of the party membership base. Newer and highly educated groups have increasingly entered the party, such as technical, professional personnel and managers in private enterprises, students

⁴⁷ China’s spending does still trail behind US spending at 2.742 per cent of GDP in 2014, Korea at 4.292 per cent of GDP in 2014, Japan at 3.588 per cent of GDP in 2014 or Denmark’s at 3.051 per cent of GDP in 2014, but is more on par with Singapore’s spending at 2.197 per cent of GDP in 2014 (OECD 2016).

and government staff. Combined, these educated groups made up more than 40 per cent of party members in 2014⁴⁸. There is also a

“...glass ceiling in many career paths for people who are not Party members. The CCP controls the top positions in most sectors – state bureaucracy, education, state-owned enterprises, banking etc.” (Dickson 2014: 49).

Education has thus become an important indicator in terms of entering the Party as the preferred members today are “young, well-educated, urban men” (Dickson 2014:45).

In the top leadership after Xi Jinping has taken over, the Politbureau Standing Committee is composed of seven members of whom there is one chemical engineer with a PhD degree in law/Marxism (Xi Jinping), three economists, a historian, one member educated in missile guidance and a teacher further educated at the Party School (Chinaviva 2016; Li 2013; Miller 2013: 14; Xinhua 2013). Thus, the majority of the top leadership is highly educated although with less dominance by engineers than earlier.

In a speech on May 17, 2016 at a symposium on social science and philosophy, Xi Jinping remarked that:

“Efforts should be made to ‘care for, foster and make full use of’ the many intellectuals in philosophy and social science fields and make them ‘advocates of advanced thinking, trailblazers of academic research, guides of social ethos and staunch supporters of Party governance.’” (Xi quoted in China Daily 2016).

⁴⁸ Numbers based on CCP statistics as published in Xinhua (2015). See also Dickson (2014).

It seems safe to say that the importance of the Party in matters of both social and natural science is a priority for the top leadership. Thus, the trend from the earlier leadership seems to continue in the sense that science and politics are very much intertwined in China today and likely to remain so in the future.

Bureaucracy, the party and legitimacy

The CCP and the government bureaucracy together play very important roles in Chinese society. Something that is often pointed to as a unique feature of the Chinese system is the negotiated character of decision making. Time and again, one of the pervasive China myths has been debunked by China scholars: The notion that the top makes decisions and then they get implemented at different government levels down to the local level without much change. From the above it may look that way too – as if everything changes with the new leader. And to some extent, a great number of things do change. To follow the idea of the uniqueness of the Chinese system, we see from the above section that the party, through its wide-ranging influence throughout the bureaucracy, plays a central role in most issues in China. One of my advisors once asked me “how far do you go in China before you meet the state?” I replied that you probably already meet the Chinese state on your flight to China (e.g. being scanned to see if you have a fever). Chinese bureaucracy is everywhere, and with it the CCP. The notion that things do not get to be discussed in China, however, is erroneous. Granted, public discussions, as we know them in e.g. Europe or the US may not be the same in China. But open discussions occur - albeit often within the party. And open disagreements are there too. The party has factions and people wanting to take China in different directions. Thus, as the previous pages showed, some campaigns e.g. against ‘westernization’ or other concepts most likely have roots in internal party disagreements rather than being about the people the campaign may have punished. What the previous section also outlined, is a change the CCP has

undergone during the last decades: enrolling different constituents into the party in part to keep discussions internally in the party and thus keep a firm grip on power (see e.g. Brødsgaard and Christensen 2002). By molding party history and by inscribing e.g. capitalists (private entrepreneurs) and others into the party, factional turf wars can be fought *within* the party and not through the media or in the public at large. Thus helping the CCP maintain a firm grip on power.

The notion of FA (Lieberthal and Oksenberg 1988), which was referred to in Chapter 1 and 2 was developed in the 1980s and has gained traction again in recent years (Brødsgaard 2017). FA seeks to explain exactly the apparent conundrum that what looks like consensus does not necessarily cover the realities of practices of policy making in China. In other words FA seeks to capture what most researchers find when they start to do fieldwork in China: paradoxes, contradictions and negotiations. Paradoxes such as implementing market economic principles in a socialist state or e.g. reading about a policy and its implementation and then during fieldwork finding that at local levels officials do something completely different. There are documented and deep seated policy enforcement problems in China – particularly on environmental issues and implementation of environmental laws (Economy 2004; Stern 2013). Lastly, researchers often find that a lot of bargaining is taking place in the Chinese bureaucracy when it comes to the development of new policies and regulations (Brødsgaard 2017; Lieberthal 2004; Lieberthal and Lampton 1992). FA seeks to capture and explain some of these paradoxes, contradictions and the negotiated character of policy making in China. FA is employed to analyze aspects of the controversy over Zipingpu in Chapter 7.

Summing up on the development of science-politics relations

There is no question that anything related to knowledge in China is also linked to politics. From the Mao to the Deng leadership the notion of intellectuals, scientists, experts and science seems to have changed. From outright dislike and deep skepticism towards modern ‘Western’ science under Mao, over Deng’s turning Mao’s ideas around to today where the push for innovation and upgrading relies heavily on applied science. This development has implications for the role of expertise in policy making in China. An increasing reliance on applied science suggests that scientific disciplines and drawing on expert knowledge capable of solving practical problems, produce new products or improve technical capabilities are favored. As we have seen, today the view of science in CCP and government discourse has undergone profound changes. A near total integration of scientifically educated personnel into the bureaucratic apparatus, the significance of higher education for party membership as well as the changed composition of the top leadership in terms of educational level are telling indicators of the emphasis placed on scientific activity and education as forces of modernization at all levels of government in China. Increasing investments in research and development underscores this trend.

But where does this lead us? In terms of the provision of scientific advice to government we can see that the nature of advice and not least the sources of advice have perhaps not changed so markedly. Yes, more university graduates have entered the administrative apparatus and party top positions, but scientific advice to government still originates from well-established universities and within the bureaucratic apparatus connected to particular branches of government or government think tanks. The conditions for an organization or an individual to be invited to provide advice to the central government thus depends on affiliation

with a high ranking research institute, think tank or university and a high educational level (preferably from a well reputed university).

Turning now to hydropower and dams, how have the changes in the historical conditions for the use of scientific and expert knowledge in political decision making in China affected the Chinese hydropower sector? The next chapter will look to the history of hydropower in China as well as touch upon events in the global hydropower sector. The chapter aims to give an overview of how the hydropower sector in China has developed during the changing years of reform. Furthermore, it presents some of the main ‘pros and cons’ of hydropower development more generally. The next chapter then marks a move towards the empirical level where we start to dive more into the details of the hydropower sector, both globally and within the atmosphere of changing political climates in China since 1949. Understanding the general policy dilemmas presented by hydropower development globally and in China more specifically situates the Zipingpu-Wenchuan controversy in an environment not only dominated by factors originating within China geographically, but also within a broader and more globalized industry environment with its own particular logics.

Chapter 4: A history of dams and hydropower in China and beyond

The aim of the present chapter is to provide contextualization for the analysis by focusing on historical development of hydropower and dams in China from 1949 onwards. In line with the previous chapter focused on science-politics relations in China, the present chapter presents a history of dam and hydropower development in China. This chapter mirrors the previous one to provide an understanding of some of the ways in which science-politics relations may have influenced China's hydropower development plans and policies - and continue to do so today both domestically and globally - as Chinese state-owned hydropower companies go global (McDonald 2009). In many ways, the history of hydropower development in China reflects the practicalities of the different ways in which science and politics have been co-produced in China over time. Here, hydropower and dams represent an industry where science and politics play out more concretely in the form of plans, policies and large scale infrastructure projects.

However, the hydropower industry is not confined to China but is a globalized industry. Therefore, the chapter also covers basic knowledge of dams and hydropower and the policy dilemmas inherent in dam building. The chapter starts with basics on dam building in order to introduce general policy dilemmas hydropower policy makers face. This is followed by a more detailed history of hydropower and dam development in China.

Dam basics

The energy in water has been used a long time back in history for running a mill to grind flour, to pump or direct water to fields for irrigation, or like today for electricity generation (Wang et. al 2014). Hydropower utilizes this energy in

falling or running water to generate electricity.⁴⁹ Prior to harnessing water energy for electricity generation, the control of water has been important for societal development around the world (Goldsmith and Hildyard 1984; Plummer 2013). Counting irrigation works, man has been pursuing the control of water since before ancient Egyptian times (Goldsmith and Hildyard 1984: xx). For example in China, the Dujiangyan irrigation system, which is still functioning to this day, was built around 200 B.C. (Magee 2015).

Water control systems in the form of dams have been a pivotal part of development all over the world, especially during the 20th century (Plummer 2013; Scudder 2005; World Commission on Dams 2000). Dams have been built to harness a number of benefits such as flood control, irrigation, drinking water supply, tourism/recreation, aquaculture, transportation/navigation and electricity generation (Brown et al. 2009; Magee 2015; Plummer 2013; World Commission on Dams 2000). The first dams producing electricity came into operation in the 1880s’ England and the United States and since, the promise of cheap and reliable electricity supply often in combination with flood control and irrigation has motivated the building of a vast number of large dams - above 15 meters in height (Plummer 2013; World Commission on Dams 2000) - around the world.⁵⁰ Dam building took off in earnest in the middle of the 1900s (World Commission on Dams 2000: 8-9). By 1949 there were approximately 5000 large dams in the world, the majority of them in industrialized countries such as the US (Wang et al. 2014).

⁴⁹ Put in another way: The key elements in hydropower are elevation drops and flow volume. The combination of elevation drops and flow volumes determines the theoretical hydropower potential of a river – the sharper the drops and the higher the flow volume the larger the theoretical hydropower potential (Magee 2015).

⁵⁰ The main focus is on large dams (above 15 meters) and mega-dams (above 150 meters) according to the World Commission on Dam’s definition (World Commission on Dams 2000). It should be noted, however, that this definition has been questioned in recent years. Notably The IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation’s Chapter on Hydropower states that: “There is no worldwide consensus on classification by project size (installed capacity, MW) due to varying development policies in different countries. Classification according to size, while both common and administratively simple, is—to a degree—arbitrary: concepts like ‘small’ or ‘large hydro’ are not technically or scientifically rigorous indicators of impacts, economics or characteristics” (Kumar, Schei et al. 2011).

By the end of the 20th century there were over 45,000 large dams distributed in 140 countries (World Commission on Dams 2000: 8).

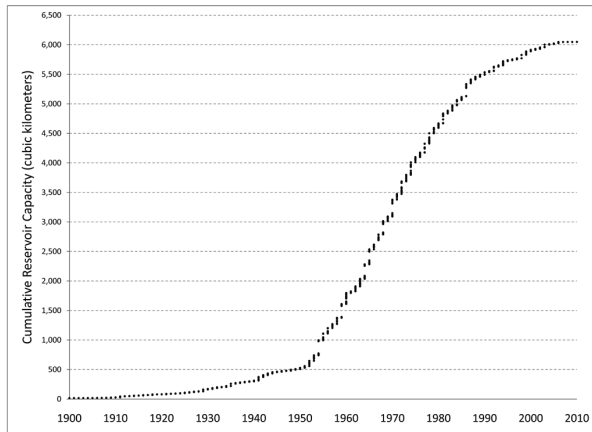


Figure 2: Cumulative capacity of dams across the world 1910-2010.
Source: Gleick (2012).

As shown in the graph above the cumulative capacity⁵¹ behind the world's dams rose sharply from the 1950s onwards. During the 1990s there was a lull in building activity, as financiers such as the World Bank withdrew from financing large dams (Richter et al. 2010: 15-16). This lull in activity was also a consequence of - among other factors - waiting for the results of the World Commission of Dams (WCD) report⁵².

⁵¹ Cumulative capacity refers to the size of the reservoir behind a dam or how much water the reservoirs built worldwide hold - combined. The graph thus shows how much water was 'trapped' behind the world's reservoirs as dams were gradually being built during the last century (Gleick 2012).

⁵² According to Plummer (2013: 4) many dam development projects around the world in the late 1990s were delayed due to financiers and private investors awaiting the results of the World Commission on Dams (WCD) process. The WCD process was a series of comprehensive studies on the impacts and benefits of hydropower globally that resulted in a final report. One of the most influential and highly cited studies of the impact of dams, the WCD's final report came out in the year 2000. According to the UNEP: "Brokered by the World Bank and the World Conservation Union (IUCN), the World Commission on Dams (WCD) was established in May 1998 in

Today, however dams are back in vogue:

“the search for low carbon and sustainable alternatives to fossil fuel has reviewed interest in hydropower, just as concern over climate change have reviewed interest in dams for water storage and flood protection, despite concerns over methane emissions from certain types of reservoirs” (Plummer 2013: 5).

Water and dams in China

A number of great rivers run through China - most significant are the Yangze, Yellow, Lancang (Mekong), Yarlung Tsangpo (Brahmaputra), Heilong (Amur) and the Nujiang (Salween).



Figure 3: Map of China with important Chinese rivers. Source: National Geographic Society.

response to the escalating local and international controversies over large dams” (UNEP.org). However “three of the biggest potential dam builders India, China and Brazil” did not accept the report (Plummer 2013:4).

For the large part, China's great rivers spring from the Tibetan Plateau and carry high volumes of water. The combination of high altitudes and large amounts of water makes China the country in the world with the largest theoretical hydropower potential at 694 GW according to the latest Chinese large-scale survey in 2005 (Huang and Yan 2009). China's rivers have been, and are still, of central importance for the nation (Shapiro 2001: 48). Its rivers bring water, life and potential for social and economic development. However, throughout the ages China has continuously battled its rivers – especially in terms of trying to control floods (Elvin 2004; Lieberthal and Oksenberg 1988; Shapiro 2001). As in many other parts of the world, societal development in China has gone hand in hand with water control (Elvin 2004; Shapiro 2001). Indeed, skills in water control contributed greatly to Chinese economic development in ancient, medieval and the early parts of late imperial times (Elvin 2004: 164). Controlling water is however, not unproblematic. Paraphrasing China historian Mark Elvin, water control systems are the places where society and economy meet the environment - most often these relationships are adversarial (Elvin 2004: 115). This line of argument seems to hold regardless of whether a project was built in medieval China or is built today. Looking for example to water-control systems in the form of dams, a number of ways in which dams 'meet the environment' in an adversarial manner come to mind: silting problems and changes to sedimentation patterns of rivers, destruction of fisheries and fish migration, water salinization, water temperature changes, evaporation and changes in weather patterns, decline of water quality, biodiversity loss, flooding of fertile cropland, earthquake risk, methane emissions and pollutants in the reservoir. This list is of course not exhaustive but describes some of the most important environmental impacts of large dams⁵³ (see e.g.

⁵³ Not to disregard social impacts - of course most importantly the relocation of people away from the coming reservoir area. Albeit of utmost importance in the considerations of dam projects (INT20121206), relocation is not dealt with in the thesis as the study of relocations, compensation for relocation and other related questions would merit a complete thesis in itself. For a discussion of relocation issues in China today see e.g. Vermeeer (2012) and Tilt (2015).

Brown et. al 2009; Magee 2015; McCully 2001; Scudder 2005; World Commission on Dams 2000). Environmental impacts such as these are not solely related to China, but are general issues that trouble dam constructors to this day.

Water control systems in the form of dams have a long history in China and some of the first dams built in the early 1900s were mainly for irrigation and/or flood control purposes. The first hydropower dam in China, the Shilongba, came online in 1912 in Yunnan Province (Huang and Yan 2009) and provided electricity and flood control services. During the first part of the 19th century not many dams were built in China as a consequence of political fragmentation, the Sino-Japanese war (1937-1945) and the following civil war between the Kuomintang and the Communists (1947-1949).

Dam building in China gained momentum after the establishment of the People's Republic in 1949 (Wang et al. 2014). During the 1950s, dams were still mainly constructed for irrigation and flood control. Dams were constructed during e.g. the 'hundred flowers' and 'anti rightist' campaigns (1956-57) and the Great Leap Forward (1957/58-61) as well as during the Cultural Revolution (1966-76). However, these dams were often built very fast and built by people with little or no knowledge of engineering or hydrology (see more below). From the 1970s onwards, electricity generation became a central part of dam projects, although more often than not in combination with flood control and transportation services. Thus, dam projects in China have traditionally been multi-purpose projects aiming at solving two or more problems with one dam or a cascade of dams (Magee 2015). However, according to Magee (2015), in multipurpose projects different purposes may tend to conflict thus making the projects less effective. As a consequence, many hydropower plants operate at about half their full capacity in terms of electricity output, for example due to a need to maintain a low reservoir level so as to have 'room' in the reservoir for eventual floods (Magee 2015). Nevertheless,

dams have provided a number of benefits to societal development not least the provision of cheap, reliable electricity generation in an age of rising energy demand (Tilt 2015).

Hydropower bureaucracy in China

Plummer (2013) focused on the issue of pre-construction delay of hydropower projects in developing countries. Apart from detailing the literature on delay of hydropower projects, she also unfolds the process of hydropower development. Not only are hydropower projects big infrastructure projects that carry their own issues (Ansar et al. 2014) they also:

“...touch on the nationally sensitive issues of conservation of natural resources, environmental concerns and social impacts” (Plummer 2013: 3).

The case of Three Gorges Dam in China is an apt example.⁵⁴ Regardless of the different impacts – be they positive or negative for e.g. the environment or economic development – in hydropower development, decision making around dams and hydropower in most countries is a lengthy process. China’s fast paced infrastructure growth is often mentioned as an economic growth driver (Rabinovitch 2013; Yao and Chen 2017). The fact that so many infrastructure projects (roads, metro-lines, airports, power plants etc.) have been approved may give the illusion that decision making regarding infrastructure is much faster than in democratically governed countries. However, infrastructure development in the form of dams and hydropower carries its own history in China that contributes to slowing down decision making considerably (Vermeer 2012).

Planning, approving and developing a dam involve a vast array of challenges before a project can go ahead. China is no exception. Labeled as a renewable

⁵⁴ See note 57 for description of the project.

energy source based on technology that has been developed over the last more than 100 years, the dam and hydropower industry is anything but young. As opposed to for example wind and solar power, which are also found in the ‘renewables’ basket, the policy landscape for hydropower in China is characterized by a long history. Where wind- and solar- energy have their own issues they are newer energy forms and the decision making processes in the Chinese bureaucracy have been relatively fast (Christensen 2013; Kirkegaard 2015:45-46). The difference with hydropower is that the hydropower decision making process is weighed down by long-standing inter-ministerial turf wars that are still ongoing. A number of different ministries are involved in the approval process of hydropower. This means that in hydropower, policy and decision making problems stem from overlapping bureaucratic jurisdictions (and preferences) between different ministries - most notably the Ministry of Water Resources (MWR) and the Ministry of Environmental Protection (MEP). Here the MWR is known to push for as many dams as possible where the MEP pushes back to ensure that the environmental risks of projects are properly examined before a project is given approval (Mertha 2008: 27-64).

Moreover, problems in hydropower stem from overlapping bureaucratic jurisdiction between state-owned enterprises (SOEs) and between central, provincial and local government bureaucracies involved in planning and approving new dams. Bureaucratic ranking plays a role in how policies are decided upon in China – particularly when coordination between different ministries and between ministries and SOEs takes place (Brødsgaard 2012). The top 53 central SOEs (including the most important hydropower companies) have retained their bureaucratic ranking at vice-ministerial level (ibid). A small number of CEOs of the top SOEs, however are ranked as ministers (ibid). For some SOEs to have vice-ministerial rank goes a long way to trump decisions made further

down in the system. Thus central government level trumps provincial level, which trumps county and township levels. The fact that more than one ministry is involved in planning and approving dam projects conducted by SOEs means that ranking is sometimes equal between an enterprise CEO and a minister (Brødsgaard 2012). If there is not agreement between them then who can trump whom? In effect, this means that ranking is an influential factor in negotiations between ministries and between ministries and SOEs. If conflicts are not solved at lower levels in the system this means that in order to make policy decisions in the face of conflicting interests, decision making gets pushed upwards in the system (Mertha 2008: 27-64). In this way, decisions end up on the table of the National Development and Reform Commission or with the State Council - the top two policy making organs in China (Mertha 2008: 27-64).

As regards hydropower, conflicting interests and bureaucratic entanglements such as these mean that hydropower policies and decision making regarding large hydropower projects can drag on for years and years (see Vermeer 2012). This is FA in a nutshell. Hydropower is one of the prime examples of how FA works as the framework is built on empirical studies of e.g. the decision making processes in large hydropower projects in China (Lieberthal and Oksenberg 1988; Mertha 2008). Thus turf wars between involved ministries, between central government and provincial governments, between SOEs and ministries is a central issue in hydropower policy making in China (Mertha 2008; Tilt 2015).

Looking back at the history of hydropower in China and beyond opens up for understanding how the sector has developed in China and how the changing political landscapes have influenced the place hydropower occupies in China today.

Mao and dams

During the 1950s, Soviet experts were intimately involved with China's dam planning. According to Shapiro (2001: 49) harnessing China's rivers (and more generally controlling nature) became one of the distinguishing characteristics of Maoism and in many ways came to shape early communist China.⁵⁵ Early on, the new regime began focusing on national water resources (Lieberthal and Oksenberg 1988: 291) and in this context (as well as in matters of ideology) soviet advisors had a great deal of influence (Lieberthal and Oksenberg 1988: 291; Shapiro 2001: 50-51). The involvement of soviet expertise resulted in plans to harness the power of the Yellow River at Sanmen Gorge and in plans for a dam at The Three Gorges on the Yangze River. These plans were spurred on especially by the promise of controlling floods but also the idea of accumulating water for irrigation. Generally the 1950s was a period of optimism in hydropower and dam construction in China (Lieberthal and Oksenberg 1988: 291).

Mao's view of science, as outlined in the previous chapter, in many ways dominated the decision making climate around dam-building up to the end of the Cultural Revolution. During the turbulent years of the Great Leap Forward (1957-61) a virtual dam construction boom was set off as a result of policies to boost agricultural production. Accumulation of water for irrigation (so as to provide grounds for a great leap in agricultural production) and the promise of flood control were some of the main drivers. Thus, in 1958, over 100 small and medium sized dams were constructed in Henan province alone (Qing 1998). Construction was hastily started on the Danjiangkou reservoir on the Han River (started 1958) and the controversial Sanmenxia Dam on the Yellow River (started 1957). Both of

⁵⁵ In her book *Mao's war against nature*, Shapiro details a number of cases of extreme Mao-era campaigns to 'control nature' one of which was the coordinated battle against sparrows that were seen as a "pest" for eating the crops. Millions of people were coordinated and mobilized to go out banging pots and pans until birds fell dead from the sky from exhaustion. The result being that insect infestation and consequent crop loss caused starvation. Furthermore, the campaign resulted in sparrows being virtually extinct in China for years after (Shapiro 2001: 86-89; Lieberthal 2004:105; Hansen, 2009).

these dams suffered problems due to inadequate expertise in planning and construction (Lieberthal and Oksenberg 1988: 291 and 303). Shapiro (2001: 49) points to the fact that the Sanmenxia dam (completed in 1962) across the notoriously silt-filled Yellow River was a project that was meant to make the folk saying “when a great man emerges the Yellow River will run clear” (*shangren chu, huanghe qing*) come true so as to underscore that Mao was indeed that ‘great man’. The Sanmenxia Dam made the Yellow River ‘run clear’ in the sense that the dam trapped large parts of the silt in the river and quickly silted up. The dam has continued to battle severe silt problems (Shapiro 2001). The Danjiangkou Dam on the other hand suffered from the hasty decision to start construction with sub-standard concrete and without adequate resolution of technical issues. The dam was not completed until 1973 after a long series of cost overruns and construction stoppages mainly due to national economic crises, particularly after the Great Leap (Lieberthal and Oksenberg 1988: 302-303). The Banqiao dam on the Ru River was built during the early 1950s with Soviet assistance. This dam failed catastrophically in 1975 during a great rain flood set off by a hurricane, which also caused 62 other, smaller, dams in Henan province to fail. Despite being an ‘iron dam’ (one that was thought not to be able to collapse) the earth-filled dam could not withstand the severe flooding and collapsed, causing more flooding. Over 85,000 people died as a result of the floods exacerbated by the dam collapses (Yi Si in Qing 1998: 33-34; Shapiro 2001: 62).

Around half of the dams built during the 1950s later collapsed and had to be reinforced or rebuilt due to poor planning, lack of technical knowledge and fast paced construction. The subsequent devastating effects of the Cultural Revolution years (1966-1976) did not improve the years of poor planning and fast paced construction by people without sufficient technical knowhow. The fast pace of dam building in the 1950s slowed down during the Cultural Revolution.

Nevertheless, large dams such as the Gezhouba on the Yangze started construction during this period (Lieberthal and Oksenberg 1988: 306-308; Wang et. al. 2014).⁵⁶

Dam construction during the Mao era was generally influenced by the view of science espoused by Mao in the sense that fast-pace and learning by doing took precedence over e.g. planning based on technical knowhow (Shapiro 2001).

Dams and hydropower in the reform era (1978-)

Achieving the ‘four modernizations’ became a guiding principle during the Deng era along with turning China down the ‘opening up and reform’ path. The opening up also entailed attracting foreign expertise and investments. In dam building, the first Chinese hydropower project financed by the World Bank, the Lubuge dam in Yunnan province, was approved in 1984 (World Bank 2007: 5-6). According to the World Bank (2007):

“Lubuge was selected as a pilot by the Chinese government to test its “open door” policy and the Bank’s modern project management techniques.” (World Bank, 2007: 5).

As in other policy areas, the approach to reform was - and today in many ways still is - incremental. In other words, in reforming and modernizing the hydropower sector and the economy more generally, the approach followed the logic of ‘crossing the river by groping for stepping-stones’ (Naughton, 2007: 5).

The period since the beginning of reforms and up to around the turn of the century have been called China’s third period of dam building (McDonald 2007: 56). This period saw the previous fast pace of dam building slowing down and the prioritization of larger scale hydropower projects (ibid). Thus, throughout the

⁵⁶ Construction on the Gezhouba dam started in 1970. This dam project also suffered from siltation problems and after over ten years of construction had to be redesigned (Magee, 2006a: 243).

1980s the hydropower component of dams in China became relatively more important vis-à-vis other purposes such as irrigation and flood control mainly as a consequence of escalating Chinese economic growth and subsequent rising electricity demand (Brown, Magee and Xu 2008; Magee 2015).

In 1981, US specialists were invited in and a five year agreement was reached where the US was to provide technical assistance to Chinese dam builders (Adams 1997). The largest and most famous of projects initiated during this third period was the Three Gorges Dam project which was finally approved by the National Peoples' Congress (NPC) in 1992.⁵⁷ Prior to the approval by the NPC, however, there was intense debate in the bureaucracy, between technical specialists and to a more limited extent in the public (Qing 1994). In 1986, Ministry of Water Resources and Electric Power commissioned a feasibility study of the three gorges project from the Canadian Government (apparently fearing too much opposition to the dam if US interests were involved). The feasibility study was supervised by the World Bank (Adams 1997; Gleick and Cohen 2008). The “Canadian-World Bank “Three Gorges Water Control Project Feasibility Study”” (Gleick and Cohen 2008: 147) was completed in 1988 and recommended construction to start at “an early date” (Ibid.). In 1989, after the study was completed, the book *Yangze! Yangze!* a collection of critical interviews and essays by scientists, journalists and public figures about the three gorges project was released. The publishing of the book marked the first-time large-scale public lobbying campaign against a major hydropower project occurring in China (Qing 1994: xxiii). However, shortly after its publication the book was banned in China (Mertha 2008: 2) and in the same

⁵⁷ The story of the Three Gorges Dam goes back to 1923 where, under Sun Yat Sen, a dam across the Yangze was proposed. In great detail, Lieberthal and Oksenberg (1988) have documented the early processes up to the end of the 1980s of bargaining back and forth about whether to build or not to build a dam at the Three Gorges. Final approval was not secured until 1992. This approval was a very controversial vote in the NPC where one third of the delegates either voted against or abstained from voting on the project. Something which was unprecedented as voting in the NPC would normally be a matter of formality. For more on The Three Gorges process see e.g. Lieberthal and Oksenberg (1988) and Qing (1994 and 1998).

year, 1989, the democracy movement swept through China resulting in significant upheaval and restriction on public debate (Lieberthal 2004: 146). By 1992, the Three Gorges Project was approved, but later that same year the Canadian Government cancelled its development assistance for the project, and in 1993 the US Bureau of Reclamation, which had earlier made an agreement to provide technical assistance, also withdrew from the project. The bureau cancelled its involvement on the grounds of economic and environmental impacts of the project (Gleick and Cohen 2008: 147). Nevertheless, the three gorges project went ahead, started construction in 1994 (Wang et. al 2014) and was finally completed in 2012 (Clark 2012; Vermeer 2012: 418).

In the 1990s, environmental groups increasingly entered debates over dam projects in China, perhaps spurred on by the early momentum in connection with the publication of *Yangze! Yangze!* Incidentally, the 1990s not only marked an era where the possibility to form non-governmental organizations was opened up by the Chinese government and environmental NGOs started flourishing (Saich 2000). The 1990s also marked a low-point in terms of World Bank financing of large dam projects and by the turn of the century the Bank had all but abandoned financing dams (Richter et al. 2010: 15-16).⁵⁸ The lull in global building activity changed again in the early parts of the new millennium. Particularly in China, where a new leadership took over and a new round of reforms of the energy sector was initiated along with turning the Chinese economy towards sustainable development and green growth.

The ‘great western development campaign’

A central part of the Hu-led leadership from 2002 was tackling a widening income gap between poor western regions of China and the richer eastern parts while

⁵⁸ According to Plummer (2013:4) many dam development projects around the world in the late 1990s were delayed due to financiers and private investors awaiting the results of the WCD process. See note 52 above.

turning the Chinese economy onto a green growth path. Balancing the rapid development of China's eastern coastal areas with the western parts of China became important in order to strengthen national unity (Magee 2006a). One of the most influential campaigns during Hu's political reforms was the 'great western development campaign' (*xibu da kaifa*). The policy campaign was initiated as a central part of the 10th Five-year Plan (2001-2005) with the aim of alleviating poverty in the western provinces through for example investments in resource extraction. Coupled with a turn towards sustainable development and protecting the environment, hydropower came back on the agenda as it provided an apt alternative to coal due to abundant water flows in China's poorer western provinces. The development of hydropower was not only a part of reducing greenhouse gas emissions but was also to solve electricity shortage problems in the high-growth eastern parts of the country. Another campaign called 'send western electricity east' (*xi dian dong song*) was therefore deeply intertwined with hydropower development plans in the south western parts of China (Magee 2006a; Tilt 2015). Hydropower development projects were to boost local economies with job creation, investment and rural electrification while also supplying eastern provinces with much needed electricity (Magee 2006a). The Zippingpu dam on the Min River in Sichuan Province was one of ten 'key projects' under this national development campaign. The historical antecedents of Zippingpu are analyzed in Chapter 5.

The place of hydropower in China today

As of the turn of the century, the strategy for hydropower development has changed in China, as well as in the rest of the world. Hydropower has now become a central part of plans to reduce greenhouse gas emissions and greening the energy sector in China (Tilt 2015). Since the implementation of the 10th five-year plan (2001-2005), China has embarked on this greening trajectory and has increasingly

emphasized sustainable development, clean energy and circular economy as new paths for development (10th FYP). Today, however, China has become the largest emitter of greenhouse gas in the world (International Energy Agency 2014). The greening trajectory can thus be seen as a reflection of China's well-documented and steeply rising environmental problems or rather China's environmental crisis (Economy 2004; Shapiro 2001 and 2012) which has been estimated to cost the country between 3 and 8 per cent of annual GDP (Shapiro 2012: 7). In the 12th five-year plan (2011-2015) China's central government set ambitious goals for improving environmental protection and this entails reducing the country's rapidly rising greenhouse gas emissions. The 13th five-year plan (2016-2020) is to continue along these lines (Brødsgaard 2015; 13th FYP). Reducing emissions involves increasing the share of renewable energy in the energy mix and so China's hydropower potential has once again come into focus. Especially the south western parts of China have been targeted for significant hydropower development in order to reduce overall greenhouse gas emissions and promote more integration of renewable energy. Since January 2013, a number of large-scale hydropower projects on the main stems of big rivers in south western China and Tibet that seemed to have been scrapped ten years ago have been resurrected (Yan 2013). These plans form core parts of the plan to "raise the share of renewable energy in total primary energy consumption" to 15 per cent by 2020 (People's Republic of China. National Development and Reform Commission, 2007). The re-focus on large scale hydropower projects as an important part of achieving the 15 per cent target set by the National Development and Reform Commission (NDRC) has come after a virtual moratorium on large-scale hydropower construction projects in some parts of China, most notably on the Nu River (Deng 2013; Zhu 2011). The revival of the Nu River projects and other projects has put the anti-dam movement in China on alert and the latest 'dam-building spree' is causing controversy and debate in the media and in

environmental activist circles in China as well as internationally (Deng 2013; International Rivers 2015a; Yan 2013).

Part and parcel of the recent push to once again develop large-scale hydropower projects in China are reforms of the energy sector. Reforms of the energy sector have run in parallel with economic reforms and had great impact on the organization of the Chinese hydropower industry which has undergone a number of restructurings along with the reforms of the energy sector more generally. Restructurings from which also stem the bureaucratic entanglements that hamper hydropower development.

Energy sector reforms – reorganizing the bureaucracy

The general aim of the Chinese economic reforms up through the 1980s and 1990s was to reduce the role of central planning, increase market operations and separate policy making from commercial operations (Arruda 2003: 15). The energy sector was no exception. Before 1978, the sector was a vertically integrated and state-owned utility (Yeh and Lewis 2004: 445). Through a series of reforms in 1981-1983 and 1985-1989 the energy sector was ‘corporatized’ through creating corporations out of former ministries in order to decrease direct government control over the sector. In 1996 and 2002-2003 further reforms were carried out. Thus, 1996-1997 saw the Ministry of Electric Power reorganized into the State Power Corporation of China (SPCC).

However, most significantly, in terms of the structure of the hydropower sector today, the 2002-2003 reforms finally separated generation from distribution by splitting the SPCC into no fewer than 11 companies (Magee 2006b; Magee and McDonald 2006: 40-41). The split resulted in five companies responsible for power generation (China Huaneng, China Datang, China Huadian, China Guodian,

and China Power Investment Corporation)⁵⁹, two distribution companies (State Grid Corporation and China Southern Power Grid)⁶⁰ and four companies responsible for design, construction and related services (China Power Engineering Consulting Group Corporation, China Hydro Consulting, Sinohydro Corporation, and China Gezhouba Company) (Magee 2006b; Magee and McDonald 2006: 40-41).⁶¹

The purpose of the restructuring of the SPCC was to separate the different functions so as to create more independent companies and increase competition on market-based terms. The restructuring of the SPCC coincided with a more general reform of Chinese SOEs during the same period (Brødsgaard and Li 2013). Today, the government, through its State-owned Assets Supervision and Administration Commission of the State Council (SASAC) retains some control of these now more independent enterprises (Magee 2006b). Thus, the five generation and two distribution companies feature on the SASAC list of – currently 102 (sasac.gov.cn 2016) - central enterprises where SASAC has the responsibility for appointing top executives and approving mergers and acquisitions (Brødsgaard and Li 2013). The last four companies, the ones responsible for design, construction and related services, albeit not on the SASAC list, are nevertheless regarded as SOEs because of their close ties to the government (Magee 2006a and 2006b). So although one of the main aims of the reforms of the energy sector was to increase competition, the reforms also exacerbated the bureaucratic problems which were briefly mentioned above. A number of companies retained their government ranking despite becoming ‘independent’ enterprises. Being carved out of former ministries, some of the largest SOEs today have vice-ministerial rank which is only slightly

⁵⁹ In Chinese: Zhongguo Huaneng Jituan Gongsi, Zhongguo Datang Jituan Gongsi, Zhongguo Huadian Jituan Gongsi, Zhongguo Guodian Jituan Gongsi, Zhongguo Dianli Touzi Jituan Gongsi.

⁶⁰ In Chinese: Guojia Dianwang Gongsi, Zhongguo Nanfang Dianwang.

⁶¹ In Chinese: Zhongguo Dianli Gongcheng Guwen Jituan Gongsi, Zhongguo Shuidian Gongcheng Guwen Youxian Gongsi, Zhongguo Shuili Shuidian Jianshe Jituan Gongsi, and Zhongguo Gezhouba Jituan Gongsi.

lower than the ministries that are to supervise them. In hydropower, long standing turf wars between different ministries such as what is today the MWR and the (since 2008) MEP have deeply affected the progress (or lack thereof) of hydropower development in China. Large-scale hydropower projects with budgets over a certain amount need to have national approval in the NDRC. This also means scrutiny from e.g. the MEP for example in terms of approval of Environmental Impact Assessments (EIAs). However, as the MEP has a ranking only slightly higher than that of the companies they supervise (e.g. China Huaneng building dams on the Lancanjiang) the approval process can be circumvented in a number of ways. This means that projects can stall for years and years due to technical disagreements. On the other hand, projects can also get sudden revival e.g. with a change in leadership as has happened with the change from the Hu-Wen leadership to Xi Jinping.

Due to projects often being stalled by bureaucratic entanglements over e.g. technical issues, hydropower companies have started construction without proper official approval on a number of hydropower projects. In an informal interview with a hydropower engineer from China Huadian, he mentioned that starting construction prior to approval was not a problem as they knew that the project would eventually gain approval (FN201305). Another informant was more cynical about the possibility to halt planned hydropower development “all dams that have been planned at one point will eventually be built” (INT20121116). Mertha (2008) highlighted the role played by hydropower engineers in this process and showed how engineers often go unheeded as group of experts with significant stakes in promoting new hydropower projects:

“Indeed, a large professional class of hydroelectric engineers help lubricate the state's drive for increased hydropower: even as a project is being undertaken, these engineers are already active in promoting future projects that will keep them gainfully employed” (Mertha 2008: 49).

In other words, along with the increasing focus on applied science and technology technical experts, such as engineers, have a strong base from which to gain influence on hydropower policy making - effectively lobbying for more dams and thus more work.

With significant push for new projects there are reasons for circumventing bureaucratic approval processes. One example of such circumventing, which also goes to the heart of the bureaucratic issues in hydropower, is the EIA approval process. The rules are very clear as to how the process should operate (Zhu and Lam 2010). The enforcement of the EIA rules, particularly achieving public disclosure in accordance with the EIA law, however, is not so straight forward (INT20121214; INT20130506; INT20130705; FN201212; Magee 2006a). Here it should suffice to mention that non-compliance with the EIA process and the EIA law in hydropower is not a rarity (Magee 2006a: 256). During my fieldwork there was often mention of EIA reports filed after a project had started or even reports being filed after the hydropower dam had been built (FN201305). From a technical point of view this should be impossible (FN201305). That such circumventing of the rules is possible is due to overlapping bureaucratic jurisdiction e.g. between the national level, the provincial and the local level (Vermeer 2012). Historically, local levels have often approved projects which can improve local economic growth while the national level has then had to stop projects due to e.g. insufficient EIAs. The planned 13-dam cascade on the Nujiang River is a case in point (Magee 2006a; McDonald 2007).

One of the aims of the reforms of the energy sector was to increase competition between Chinese hydropower companies. However, during the reforms, and particularly the 2002-2003 reforms the country's rivers were divided up so that certain rivers or provinces were given to certain companies (Magee 2006b). As a result, competition for projects internally in China did not increase significantly as companies focused on developing the rivers they had been allocated. One of the consequences of this has been that Chinese companies have seen opportunity to utilize their significant engineering capacity and resources for dam building to go overseas or 'go global' (McDonald 2009). This has also in part been fueled by the government's push for SOEs to become national champions with global reach (Nolan 2001). Thus, Chinese hydropower developers are now building dams in e.g. Malaysia and other Southeast Asian countries and in a number of African countries, often in competition with private global hydropower developers and transnational financiers (FN201305).

"The Chinese will go where no one else will go" (FN201305) or "The Chinese take the projects the World Bank and all the rest have given up on and try to develop them" (FN201305) were some of the views expressed by global hydropower executives and financial institutions about Chinese hydropower companies that have now 'gone global'. During informal interviews in connection with my participation at the International Hydropower Association's Hydropower Congress in Kuching, Malaysia and a fieldtrip to two large hydropower construction sites, delegates from e.g. the Asian Development Bank and private global hydropower companies expressed that Chinese SOEs are not necessarily warmly welcomed in the global competition for hydropower projects. Particularly the fact that the Chinese SOEs often present a 'full package deal' where everything is sourced from China - workers, equipment (literally down to bolts and screws) - was frowned upon (FN201305). Including state-backed financing in

that package was by some seen as leaving no room for e.g. local sub-contractors to bid in projects. The Chinese companies were regarded as not willing to compete on the same terms and generally not holding back on taking on risky projects that e.g. the World Bank had withdrawn from. This is perhaps not an easy position for the reformed SOEs as they are under pressure domestically to show their ability to compete on a global level playing field.

All in all, the Chinese hydropower sector is an example of how changing political winds in China have had impact on not only the overall structure of the energy sector, with significant impact on hydropower, but also the ways in which hydropower is developed today. Focus shifted from early on being about fast-paced learning-by-doing towards modern management techniques and more cautious and scientific development of hydropower. Today, applied science and global competition have become important features of Chinese development. In this, the hydropower sector has followed. Today, Chinese hydropower engineers are a powerful group of highly educated technical experts that are also gaining global expertise. However, as we have seen, the bureaucratic entanglements in hydropower open up for different ways of circumventing rules and regulations - particularly with regard to technical issues.

Let us now turn to the controversy over the Zipingpu where technical, scientific and risk issues coupled with bureaucratic entanglements played into the policy making around future hydropower development in China.

Part III: Analyzing a controversy - of triggering earthquakes in science, politics and Chinese hydropower

The introduction gave a peek into what the controversy over Zipingpu is all about. The following chapters analyze that controversy – or perhaps more accurately controversies – surrounding Zipingpu in more detail. As was pointed out in Chapter 2, one of the problems with analyzing controversies is that controversies are often not just about one thing. They are unfortunately not like new, neat balls of yarn that just unfold linearly if you pull on the thread in one end. Controversies are more like a ball of yarn after the cat or your kid has played with it: Difficult to untangle in a linear fashion. In other words, there is not just one story here, but multiple. As a whole, the next four chapters will present a controversy study centering on the Zipingpu dam.

The main issue around Zipingpu is the dam's possible relation to the Wenchuan earthquake: Did the Zipingpu dam play a role in triggering the Wenchuan earthquake or not? The controversy in scientific journals thus centers on this question. As the scientific controversy was reported in the news it grew into another kind of controversy and got bigger. Questions were posed such as: Is it safe to construct big dams in earthquake prone zones? Then came discussions related to policy: Should China build more big dams in earthquake prone zones? Involved in all of these questions are a host of different actors with different positions, arguments and policy preferences.

The central question here is to provide an empirical background to engage with the problem statement: What historical conditions led up to the controversy over the

Zipingpu dam and the Wenchuan earthquake and what role did expert knowledge play in assessing the risk of Chinese major dam projects?

In engaging with this agenda first we need to understand the physical conditions in which Zipingpu has been built. This entails taking a tour through current consensus in earth science which helps contextualize the scientific controversy around Zipingpu as well as the technical negotiation around constructing Zipingpu which relates to issues of dam safety in earthquake prone zones.

To get background into the policy implications of the controversies over Zipingpu the controversy is set into historical context. Why was Zipingpu built in the first place? What spurred on the idea of a dam across the Min River? How was it built? And who was involved?

Reading through the next chapters will for the reader perhaps feel a bit like going back and forth between contextualization and analysis, back and forth in time and back and forth between different places. This controversy study is not built linearly but rather presented by way of pulling threads out of a messy ball of yarn – showing and analyzing different elements surrounding the Zipingpu dam. For example contextualization from Chapter 5 feeds into analyses in Chapter 7 and Chapter 8 which reflect different parts of the arguments brought forth. The aim is that by the end of the next four chapters we have a clear picture of the controversy, and more importantly, how to think about controversies in a Chinese context and the role of expert knowledge therein. Below figure 4 illustrates the next four chapters and the different elements relating back to the Zipingpu dam itself:

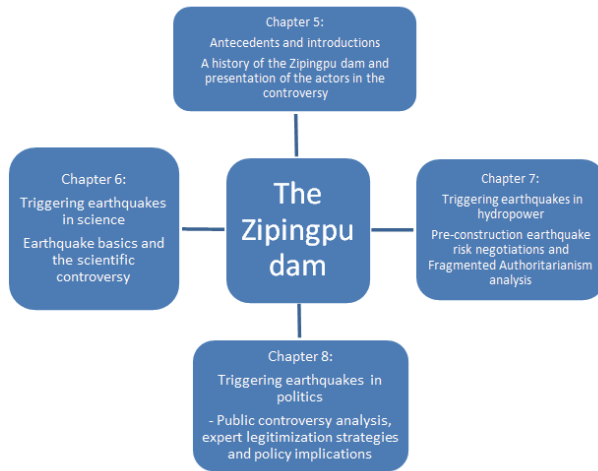


Figure 4: Illustration of the different elements of the analysis of the controversy over Zipingpu.

Chapter 5 provides the historical background of the Zipingpu dam from the inception of the idea of a dam across the Min River in the 1950s to today and introduces the key players and their positions in the controversies surrounding Zipingpu. The story in Chapter 5 follows a classic approach in contemporary China studies where historical documentation, such as news reports in the official CCP mouthpiece People’s Daily are drawn upon in order to piece together the rationale behind a policy decision such as the political decision to construct the Zipingpu dam.

Chapter 6, entitled triggering earthquakes in science, focuses on the science of earthquakes. The chapter first outlines some basic understandings of earth science to give a sense of the general consensus in earth science that the controversy builds on. The chapter then analyses the controversy as it unfolded in scientific journals – the controversy here centering on the central question: Did the Zipingpu dam play a part in triggering the 7.9 magnitude Wenchuan earthquake? The

analysis in Chapter 6 is guided by approaches to studying controversies as were presented in Chapter 2 and FA is drawn into the analysis where relevant.

Chapter 7, entitled triggering earthquakes in hydropower, focuses on analyzing technical negotiations taking place before the Zipingpu dam was built.⁶² The chapter first analyses negotiations concerning seismic risk in relation to Zipingpu and then further analyses these events by drawing on the concept of FA (Brødsgaard 2017; Mertha 2009). The technical negotiation at the pre-construction stage is analyzed using FA as a classic example of bureaucratic bargaining over technical and economic matters in China.

The analyses in Chapters 6 and 7 are thus examples of drawing on FA in the context of a controversy study to deepen the understanding of how domestic issues in China contribute to the unfolding of a controversy.

Chapter 8, entitled triggering earthquakes in politics, deals with the controversy as it unfolded after the Wenchuan earthquake occurred. The chapter is primarily drawing on interviews and fieldnotes as well as representation of the controversy in the global and domestic Chinese media. This part of the controversy study thus focuses on the public controversy over Zipingpu and analyses the policy consequences of the wider debate over Zipingpu and whether or not other large dams could potentially trigger a large earthquake once built. Chapter 8 focuses on the experts engaged in the public debate, their strategies of legitimizing their viewpoints and ways of gaining policy impact with regard to hydropower policy making in China.

The controversy study centering on Zipingpu puts at stake policy decisions about dam building and the expertise used in such decisions. Firstly, it provides an

⁶² Parts of the text in Chapter 7 has already been published in Brødsgaard (2017) Chapter 7: “Bargaining Science: Negotiating Earthquakes” written by the author. Permission has been given from Routledge to freely change and adapt the text to fit the present thesis. Specific referencing in Chapter 7 to sections of text already published will therefore not be given apart from this note.

example of how a scientific controversy is connected to the Chinese state's decision to build a host of large dams in earthquake prone zones. Secondly, it points to the distinction between legitimate and illegitimate expertise in hydropower policy making in China. Thus, the case as presented in chapters 5 through 8 is also an example of one Chinese approach to managing risks associated with large dams. This may in turn be compared with how other dam-building nations have approached evaluating the risk of the same relationship. The context of the controversy is thus one where emerging science and hydropower policy decisions co-create a policy environment where science itself becomes politicized.

In sum, the controversy study highlights changing relationships between state actors, SOEs, NGOs, media, different scientists and the science they all draw on. Furthermore, the chapters speak to a theoretical discussion about the ways in which scientific knowledge and expertise play into technical and risk controversies and how this co-creates with political decision making.

But let us start at the beginning. With the idea of the Zippingpu dam - and swimming!

Chapter 5: Antecedents

- A history of the Zipingpu dam and controversy actors

The Zipingpu dam is located in Sichuan province on the Min River (Minjiang), a tributary to the Yangtze River, about 50 kilometers upstream from the city of Chengdu and approximately seven kilometers from the historical Dujiangyan irrigation system completed in 251 B.C (Mertha 2008: 95-98). The Wenchuan earthquake epicenter was located less than 20 kilometers from the dam.⁶³



Figure 5: Map picturing the location of the Zipingpu dam, the city of Chengdu and the epicenter of the Wenchuan earthquake in relation to the Min River and known fault lines in the area. Source: He and Choi (2009).

⁶³ Estimates of the precise location of the epicenter vary between 5 and 17 kilometers from the dam according to which source you quote.

Sowing the seeds for a controversy

The story of the Zipingpu dam begins with swimming. In the 1950s, Chairman Mao visited the famous water control project Dujiangyan.⁶⁴ Dujiangyan is an important symbol on par with the Great Wall and other large-scale engineering marvels in Chinese history. Mao wanted to swim the Min River, but was convinced otherwise due to the turbulence of the river. This was an embarrassment to the Sichuan Party Secretary at the time, so he suggested that a reservoir be built at Yuzui, close to Dujiangyan. This way, Mao would be able to swim the Min River next time he visited. There were other reasons for constructing Yuzui apart from pleasing Mao. Boosting the irrigation capacity of the Dujiangyan irrigation system (and thus boosting agricultural output) was one. However, it was not one that carried the same symbolic weight as Mao swimming the river. Stories of Mao swimming, particularly his famous swim in the Yangze River in 1966 just before the start of the Cultural Revolution, has been chronicled many times stressing the symbolism and political significance of Mao's swimming (Li 1996; Mertha 2008). According to Mertha, Mao used swimming on various occasions to demonstrate his strength and political determination (Mertha 2008: 96-97. See also Shaprio 2001).

In 1955-56 a plan was drawn up where the Yuzui (later to be called Yangliuhu) and Zipingpu dams were included in an 8-step plan for the development of the Min River (Mertha 2008). The two dams were to be built first. The main reasons for constructing the Yuzui was flood control and in combination with Zipingpu the overall project also included power generation, water supply and irrigation bolstering the capability of Dujiangyan. Construction started in 1959 and was documented with pictures in People's Daily, the official government mouthpiece.

⁶⁴ The following section relating the historical antecedents and history of the Zipingpu is primarily based on Mertha (2008), chapter four.



Figure 6: On page two of People's Daily on February 2, 1959: "Towards getting power from the Min River" (Chen 1959).

Construction was stopped again in 1961 (Mertha 2008) although earlier reports in People's Daily mentioned that the dam would be finished by 1961(Sun 1959).⁶⁵

In 1986, plans to revive the projects were forwarded in an internal watershed plan for the Min River put together by the Sichuan Province Water Resources and Hydropower Design and Survey Institute (Mertha 2008: 96). People's Daily had one mention of planned construction at Zipingpu within the next ten years in 1991 (Zhao and Bao 1991) and until the 2000s People's Daily did not report anything officially regarding Zipingpu. Then in March of 2000 the State Council officially approved the feasibility report for the Zipingpu dam (Liang 2001). At the same time the project was inscribed in the 10th Five-Year Plan (10th FYP) as one of the

⁶⁵ I have not been able to determine the reasons for construction being stopped in 1961, but given the turbulent political climate at the time it would not be surprising that political decisions were reversed. Also, an article in People's Daily from 2005 chronicles that (in the article unspecified) "foreign experts" helped the Chinese government build/plan the Zipingpu. However, the geological conditions were very complicated and due to a gas explosion the foreign experts concluded that "Zipingpu was not suitable for dam construction" (Liu 2005). This might explain the reasons behind stopping the project in the early 1960s.

top-ten key projects to be carried out under the concurrent ‘great western development’ campaign (*xibu dakaiifa*) (Liang 2001) – the high priority policy program which was initiated in 1999 (Magee 2006a and 2006b).

In March 2001, the Zipingpu project was officially approved by the State Council and listed as a “number one” project for Sichuan Province with a total estimated investment of 69.8 billion Renminbi (Liang 2001). As the bank of choice for implementing the Western Development Campaign, The Import-Export Bank of China provided financing for Zipingpu and in August 2001 the Sichuan Province Department of Finance signed a transfer agreement on 321.99 billion Japanese Yen as part of financing the project (Qu 2001).⁶⁶

The responsibility for the construction of the dam was placed with the Sichuan Province Zipingpu Development Co., Ltd. (hereafter referred to as the Zipingpu Company) (Xinhua Net 2002). The Zipingpu Company was founded in October 1998 as a key state enterprise under Sichuan Province with the sole responsibility to construct and subsequently operate the Zipingpu hydropower station. The timing of the founding of the company being almost concurrent with the 1999 initiation of the ‘great western development campaign’ suggests that, although not officially announced, planning of the project had been underway for years.

As a provincial level company, the Zipingpu Company would refer to the Provincial SASAC office (Provincial State-owned Assets Supervision Management Committee) but also to the Ministry of Water Resources (MWR) as the company responsible for a major construction project related to water resources. With the status of key state enterprise in Sichuan Province and with the

⁶⁶ The article in People’s Daily states the currency as Japanese Yen. I have not been able to determine from the article why the amount was not stated in Chinese Renminbi. However, during a long period from 1978 onwards, Japan provided so-called Official Development Assistance (ODA) to China through the Import-Export Bank of Japan (Muldavin 2000). The article does mention that the Japanese government provided development assistance to Sichuan Province. Development assistance from Japan may therefore explain why the transfer was stated in Japanese Yen. See also Qu (2001).

construction of the Zipingpu project being inscribed as a part of the central government ‘great western development’ (*xibu da kaifa*) policy it is clear that the Zipingpu Company, while not being one of the largest state-owned hydropower development enterprises in China, was nevertheless an important player in terms of spear-heading the visible implementation of the Central Government’s campaign.

In November 2002, construction was officially started at Zipingpu. Then Party Secretary of Sichuan Province Zhou Yongkang⁶⁷ officially ordered the closing of the Min River at an on-site event on November 23rd 2002 (Liu 2002). The event was documented with a picture of bulldozers pushing rocks in the river on the front page of People’s Daily the next day (Liu 2002).



Figure 7: Front page picture, People’s Daily November 23, 2002. Article entitled: “Zipingpu project successfully cuts the flow” (Liu 2002).

⁶⁷ Zhou Yongkang was Minister of Land and Resources prior to becoming Party Secretary of Sichuan Province, a post he held between 1999 and 2002. He later held the post as Minister of Public Security and became member of the 17th Politburo Standing Committee in 2007. In 2013-2014 after he had retired, he became the center of corruption charges in connection with President Xi Jinping’s anti-corruption campaign. The case received wide press coverage in Chinese and international media as it was unprecedented that a former member of the Politburo Standing Committee was tried for corruption. He was sentenced to life in prison for taking bribes, abusing power and leaking state secrets in 2015 (Forsythe 2015; Huang 2014; Zhai 2014).

Already three years later, in September 2005, People’s Daily could again report from Zipingpu that the project would be finished soon and showed a picture of workers inside the Zipingpu site (Liu 2005). Power generation was reported to start in October of 2005 (Liu 2005). The lengthy article in People’s Daily highlighted both the history and details of the technical breakthroughs of the project:

“50 years ago foreign experts aided the start of construction of the Zipingpu project on the upper reaches of the Min River, between the Yingxiu and Dujiangyan segments of the river. As a consequence of complicated geological structures, there was a gas explosion when the excavation of the river diversion tunnel took place and construction had to come to a stop. At the time, the foreign experts withdrew and declared: Zipingpu is not suitable for dam construction!” (Liu 2005).

“The difficult problems encountered at Zipingpu 50 years ago did not disappear or decrease with time...” (Liu 2005).

The article highlighted that the Zipingpu Company had overcome many technical problems at the site that foreign experts could not solve. Problems were reported as stemming from the complicated geological conditions at the site such as high concentrations of methane gas underground, intensive groundwater, crisscrossing underground coal caves and many fault cracks. Faultlines as wide as 80 meters had been “bored through” (Liu 2005).

Tan Jingyi, a water conservancy and hydropower expert from the Chinese Academy of Engineering and winner of the National Science and Technology Progress Award 1985 (Cae.cn 2017) is quoted in the article saying that “Zipingpu has very complicated geology so it is almost like a geology museum”, this meaning that so many different kinds of geological problems are very seldom

found in one place (Liu 2005). The article was published in People's Daily. The detailing of technical problems (and their solutions) at length highlighted the success of the Zipingpu Company in overcoming the many technical issues in record time – a full year ahead of schedule (Liu 2005). This type of article is a good example of an official emphasis on showcasing the superior capability of Chinese engineers, scientists and the modern management methods implemented by the Zipingpu Company (vis-à-vis) “foreign experts” and the strong commitment by both scientists and the Zipingpu Company to aid the state in providing sorely needed water supply, energy, and irrigation services to society despite very difficult geological conditions.

According to Mertha (2008), who looked closely at the bureaucratic negotiations around the decision making process in relation to the Zipingpu dam, there was not much public controversy over the decision to construct the Zipingpu itself. Some of his informants did report that ‘gag-orders’ were in effect during hearings about the project which effectively means that criticism regarding the project could not be reported. Zipingpu’s proposed “sister dam” the Yuzui (or Yangliuhu) project, however, was surrounded by much more open controversy and ended up being cancelled (Mertha 2008: 97 and 103).

Zipingpu was finally completely finished in 2006 and began full operation in 2007 (Sichuan Province Zipingpu Development Co., Ltd. 2015). According to official reporting (Liu 2005) the 156m high dam with 11 billion cubic meters of water in the reservoir kept within budget at approximately 7 billion yuan. In conclusion Zipingpu was a very successful project, when understood through official reporting.

The above section of the chapter is an example of a classic contemporary China studies approach to unfold the historical and political context of a case by drawing on e.g. official newspaper sources and then piecing together the historical context

of a policy decision or a large construction project. The symbolic significance of events and persons provides indications as to the importance of the project for the Chinese central government and Sichuan Province. This may be common sense to China scholars but not necessarily to someone who does not engage with contemporary China studies regularly. The symbolic significance of an important figure in Chinese politics, such as Mao (even today) being one of the primary reasons for suggesting a dam across the Min River in the first place, should not be underestimated as Mao having suggested it boosts Party determination to see the project come to life. The fact that the then-Party Secretary of Sichuan Province, Zhou Yongkang, who later went on to become member of the Politbureau Standing Committee, officially ‘opened’ the construction at Zipingpu, point to the political significance of the project for Sichuan Province. The fact that Zhou Yongkang was later convicted of corruption also puts Zipingpu in a different light. Meaning that finally getting Zipingpu constructed and inscribed in central government policy could have been an important part of Zhou Yongkang’s promotion. That he was then later sentenced for taking bribes – which often happen in connection with dam construction in China (Yang 2013) – means that although Zipingpu was described as an outward success, there is a significant likelihood of corrupt practices having taken place in connection with the project. Understanding the meaning of issues such as these, add significance to the deeper Chinese context and shows the importance of such aspects for a controversy study conducted in China.

From history to controversy

Looking back at the historical antecedents of Zipingpu and understanding that a project at Zipingpu had been envisioned and in the making since the 1950s broadens the understanding of the underlying mechanisms of hydropower decision making in China. The story of Zipingpu supports the perspective that hydropower

planning and decision making in China are long-term processes often with considerable historical antecedents (Brown, Magee and Xu 2008; Magee 2006a). Perhaps one of my informants did have a point in saying: “all dams that have been planned at one point will eventually be built” (INT20121116). The already incurred costs of years of planning, designing and surveying at Zipingpu without any result in either the 1950s/1960s or after 1986, when an internal watershed report by Sichuan Province Water Resources and Hydropower Design and Survey Institute had revived construction plans, can be good reasons for inscribing Zipingpu into the 10th five-year plan. It could be argued that because the project blueprints were already there and that Zipingpu could be built within time and budget once started, the decision to go ahead in the 2000s was made easier. Zipingpu was not significantly delayed once given the go in the 2000s - unlike some of the dam projects referred to in Chapter 3 - i.e. projects that often ran into technical problems with years of delays as a consequence. With the historical perspective in mind, it is arguable that Zipingpu has been delayed since the 1950s. Nevertheless it was presented in official reporting as a successful project, built on time, within budget and was highlighted as a beacon of superior modern management and technical expertise on the part of Chinese engineers and scientists (Liu 2005).

Wenchuan

A year after Zipingpu had been finally completed and the dam had been put into full operation, the May 12th 2008 Wenchuan earthquake struck. The epicenter of the magnitude 7.9 earthquake was close to the city of Dujiangyan and ruptured the so-called Longmen Shan fault line. The Wenchuan earthquake was one of the deadliest, costliest and most destructive earthquakes in China in three decades. Dujiangyan was one of many villages that were completely destroyed (USGS 2008; Encyclopedia Britannica 2013; Sorace 2017).

Wenchuan opened a scientific debate about the role of the Zipingpu dam in possibly triggering the earthquake – a debate that has yet to be settled, if it ever will be (see e.g. Chen 2009; Ge et al. 2009; Lei 2011; Tao et al. 2015). So a dam that had been built without major public controversy (Mertha 2008) unexpectedly became the subject of a scientific controversy over its role in possibly causing Wenchuan. Directly linked to the scientific controversy, a public controversy about the role large dams may play in triggering earthquakes quickly got the attention of the global media. The intertwined scientific and public controversies have resulted in increased interest in, and scrutiny of, the decision-making processes around decisions to build large dams, such as the Zipingpu, in earthquake prone zones.

A simple google search on the word “Zipingpu” comes back with over 19,000 hits. Many of them linking to articles devoted to discussing the relationship between Zipingpu and Wenchuan either in the news media or in academic journals. Searches in mandarin Chinese on only the word Zipingpu results in over 2 million hits while searching ‘Zipingpu Reservoir’ yields more than 98,000 hits. If google can be taken as any indication these days it perhaps suffices to say that a lot has been written about Zipingpu online. I am not attempting to cover everything that has been written about Zipingpu. However, the next chapters will outline the core arguments in the controversy surrounding Zipingpu and its possible relation to the Wenchuan earthquake.

But a controversy is not a controversy without actors. Below, some of the most important actors who have taken part in the controversy are outlined.

A network of different actors and interests at work

Different actors may provide data or analyses towards assessing damage or contribute to scientific as well as public debates over whether Wenchuan was triggered by Zipingpu. Below follows an overview of some of the most important actors partaking in the debates involving the Zipingpu dam both before and after the Wenchuan earthquake. Some of the actors listed below have played an important part in construction phase decisions that have implications for dam construction in earthquake prone zones more generally, but they may also be important in post-earthquake evaluations, in providing policy advice regarding dam safety and publishing in scientific journals about Zipingpu possibly causing Wenchuan. Some actors are directly connected to the Chinese government and others are self-proclaimed as independent. The actors' positioning in the controversy and the opinions (as far as it has been possible to ascertain them) of the different organizations and individuals are outlined below.

China Earthquake Administration (CEA)

The main authority on earthquake related matters in China is the China Earthquake Administration (CEA). The administration has officially been in existence since 1971 and has developed slowly toward a central, national level administration since the founding of the People's Republic in 1949. In 1953, not long after the establishment of the People's Republic, the Chinese Academy of Science set up the 'Seismic Work Committee of the Chinese Academy of Science' (*Zhongguo kexueyuan dizhen gongzuo weiyuanhui*) which consisted of two work groups (a geological and a historical one) with the main responsibility to provide consulting and auditing services for the State Planning Commission on major projects. During the 1960s the efforts to develop a national level seismic bureau gradually advanced – particularly after the 1966 and 1969 Xingtai and Bohai earthquakes. In order to strengthen the monitoring of earthquakes the State

Seismological Bureau (*Guojia dizhen ju*) was founded in 1971, hosted by the Chinese Academy of Sciences. In 1975, the State Seismological Bureau was placed directly under the State Council. Subsequently, in 1998 the name of the bureau was changed to the current China Earthquake Administration (*Zhongguo dizhen ju*).⁶⁸ Today, the CEA is a so-called public service unit (*shiyew danwei*) under the direct responsibility of the State Council. The CEA is responsible for overseeing and coordinating all earthquake related work in China and is represented on provincial and local levels by provincial and municipal Earthquake Administrations (Gov.cn 2012; China Earthquake Administration 2015a). One of the main responsibilities of the CEA is:

“To formulate national seismic intensity zone maps and ground motion parameter zone maps. To manage seismic safety evaluations for major construction projects and possibly occurring secondary disasters, and to approve seismic safety evaluation results and determine anti-seismic fortification requirements”. (China Earthquake Administration 2015a)

Director General Chen Jianmin, who graduated in geology from Beijing University and has been employed at the Geophysics Research Institute at the Chinese Academy of Science, has been head of the CEA since 2004. With a background in geology and having been employed with the CEA since 1983, both in the earthquake administrations’ forecast center and research office, Chen Jianmin has professional insight into scientific matters relating to earth sciences under the responsibility of the CEA (China Vitae 2015). As a member of the CPC from 1993 and since 2012 member of the Central Committee, Central Commission for Discipline Inspection,⁶⁹ Chen Jianmin is also in some ways a political figure. It is a normal feature of Chinese bureaucratic organization that the top leader is often

⁶⁸ For an in-depth description of the history of the CEA, see China Earthquake Administration (2015b).

⁶⁹ Central Committee, Central Commission for Discipline Inspection is responsible for anti-corruption, among other tasks. There are 130 members of the commission (China vitae 2015; Xinhua 2012a; China.org.cn 2012).

both party secretary and director of the organization (Lieberthal 2004).⁷⁰ Indeed, most leaders within the Chinese bureaucracy are well educated and often educated within the particular area they manage (see Chapter 3). A leader such as Chen Jianmin in many ways embodies the particular Chinese mixture of science and politics where it becomes difficult to tell the difference between the two.

The CEA is an important actor in terms of providing information and guidance on seismic hazard and other earthquake related matters to the central administration and other bodies, such as construction companies. It is also important in terms of general regulation, policy making and approval of specific project calculations.

Scientists from - or affiliated with - the CEA have been active in the scientific controversy over Zipingpu and have published articles both supporting the argument that Zipingpu played a role in triggering Wenchuan and that it did not. An article with four authors published in 2015 where the controversy is summed up (Tao et al. 2015) concludes that “Wenchuan earthquake was likely triggered indirectly by reservoir impoundment” (Tao et al. 2015). One of the four authors is affiliated with the CEA. The CEA is directly under the responsibility of the State Council. Therefore, it might be easy to assume that the CEA politically supports conclusions that do not question state policy on hydropower. However, suggesting that Zipingpu could partly be blamed for Wenchuan can be seen as questioning state policy. Therefore, an article such as the one mentioned above (Tao et al. 2015) does not corroborate that the CEA unilaterally supports state policy. This means that while the CEA is a Chinese central government agency, scientists at the CEA are not necessarily restricted in terms of publishing scientific results in scientific journals. Although the political attention around the discussion of dam building in earthquake prone zones is heightened, a central government agency is

⁷⁰ Nomenklatura lists and interlocking directorates are two features through which the CCP controls important positions within the bureaucracy (Lieberthal 2004).

still allowed to contribute to international scientific journals on the subject. And even conclude that a state-backed project might be to blame for a serious disaster. Consequently, the position of the CEA can be seen as double - both as a politically administrative/regulatory agency and as a scientific organization. Where the line is drawn between politics and science is hard to determine a priori. Factors such as the audience addressed - academic, news, advisory role to government etc. – could factor in here. The next chapter analyses the scientific controversy, and CEA’s role in it. In Chapter 7, the regulatory agency role of the CEA is examined in an analysis of pre-construction risk negotiations at the time of the final construction at Zipingpu.

Research institutes and industry organizations

Most hydropower companies in China employ seismologists, geologists and engineers specializing in seismic design. However, if this type of expertise is not found within the company it is often sourced from centrally placed research institutes focused on hydropower such as the Institute of Water Resources and Hydropower Research (IWHR). Hydropower companies are also represented by industry organizations. Organizations - such as the China Society of Hydropower Engineering (CSHE) also do research and provide consulting to hydropower companies. In a sense, research institutes, industry organizations and the hydropower industry in China mix together in these types of organizations.

The Institute of Water Resources and Hydropower Research (IWHR)

IWHR is such a centrally placed national research institute primarily tied to the Ministry of Water Resources (MWR) but also the major Chinese hydropower companies (INT20130715a; IHA Website 2; Tilt 2015).

In Tilt’s words, the IWHR is located at:

“... the epicenter of expertise, financing, and planning for water resources in China: the China Three Gorges Corporation is next door, the project offices for the South-North Water-Transfer Project are around the corner, The SinoHydro corporate headquarters is a block away and the MWR is down the street” (Tilt 2015)⁷¹

The IWHR offers a wide range of services related to hydropower such as “(...) technical consultancy, construction supervision, project monitoring and safety evaluation” (IWHR.com). The IWHR also has a special research center focused on earthquake engineering (INT20130715a).

Research and consultancy for hydropower companies and the government are the main tasks for the organization (INT20130715a). IWHR hosts the Chinese chapter of the international organization the International Commission on Large Dams (ICOLD), the China National Committee on Large Dams (CHINCOLD) (IWHR.com), and also hosts the China National Office of the global hydropower interest organization the International Hydropower Association (IHA) (IHA Website 3). Research and consulting for hydropower companies and the government being some of the organization’s main tasks (INT20130715a) places the IWHR in a position where their primary ties are with the government - in the form of the MWR a reportedly pro-hydro ministry (Mertha 2008) - and with SOEs. In this way, the IWHR has a double role both as a research institute publishing hydropower related research, and as an organization working primarily in the services of what can be called pro-hydro forces such as the MWR and SOEs whose purpose is hydropower development. In line with this ‘pro-hydro’ view, in January 2010, engineers from the IWHR published an article in the industry

⁷¹ China Three Gorges Corporation is solely responsible for the Three Gorges dam and is featured on the SASAC list mentioned in Chapter 4. The South-North Water Transfer Project is a high-level government project with efforts at directing water north to arid regions from more abundant water resources in China’s south west. The Sinohydro Corporation is the largest state-owned corporation responsible for design, construction and other hydropower related engineering services to SOEs.

journal *International Water Power and Dam Construction* arguing that the Zipingpu dam did not play a role in causing the Wenchuan earthquake due to, among other arguments, that the earthquake was unlike other induced earthquakes (Chen et. al 2010). More on the position and role played by the IWHR in the scientific debate is provided in Chapter 6.

China Society for Hydropower Engineering (CSHE)

CSHE is also an influential organization when it comes to research and decision making in relation to hydropower. The organization is:

”...a non-profit national academic and social organization for hydropower engineering professionals under the guidance of the China Association for Science and Technology” (Hydropower.org).

The organization works closely with the IWHR and also has a committee working on seismic issues related to dam design. Members of the organization include the MWR and all the central Chinese hydropower companies as well as universities, grid companies, and a host of hydropower companies on provincial and local levels (CSHE 2012). Their vice secretary general Zhang Boting is a hydropower engineer who participates in international conferences, has served as editor of the *Journal of Hydroelectric Engineering* and has published hundreds of papers on issues related to dams (IHA Website 1). The position of the CSHE is favorable to dam development and Zhang Boting, in particular, has been very focused on assuring the public and the central government of the safety and soundness of building large dams in earthquake prone zones (INT20130715). Zhang Boting is a central figure in the public controversy over Zipingpu. In Chapter 8, his positioning in favor of building dams in earthquake zones is analyzed.

Non-governmental organizations and individuals

International as well as domestic NGOs and Chinese scientists have been speaking or writing publicly about the Zippingpu controversy. The NGOs International Rivers and Probe International has devoted a lot of resources to discuss the relationship between dams and earthquakes⁷² and have been quite successful in fueling further debate in both Chinese and global media about the risk of earthquakes being triggered by dams (INT20121012; INT20130607; INT20131001). Taken together the organizations and individuals described below are not in favor of dam building in general or dam building in earthquake prone zones in particular.

Probe International

The Canadian international NGO Probe International has dedicated a number of publications to Zippingpu as well as the relation between dams and earthquakes more broadly in south western China. The NGO is:

“...an independent environmental advocacy group that fights to stop ill-conceived aid, trade projects, and foreign investments” (Probe International Website 1).

The organization has backed several researchers' efforts into writing reports about the negative relationship between dams and earthquakes. One such report by an anonymous international geologist came out in 2012 and was very often referred to by different NGOs during my fieldwork and in interviews (Jackson 2012). As may be clear, the organization is not in favor of large dams.

⁷² See for example Probe International reports and special section on earthquakes (Probe International 2015; Probe International Website) as well as articles by International Rivers published on their website (International Rivers 2009; International Rivers 2015b).

International Rivers

The California based international NGO International Rivers has also devoted time and effort to create awareness not only about Zipingpu but also about the risks associated with building dams in earthquake prone zones. The NGO is the only international NGO with a specific focus on rivers and dam construction worldwide and has special programs focusing on dams in China, Latin America, Africa, South Asia and Southeast Asia (International Rivers Website). International Rivers has a wide network of contacts counting both academia and journalists (INT20130607). In addition, the organization started a policy dialogue with SinoHydro, the largest state-owned hydropower project contractor in China, among other topics discussing the company's environmental standards (International Rivers 2011a). International Rivers is not in favor of dam building anywhere in the world and continuously advocates for dam decommissioning, and finding other solutions to energy shortage problems both through their network in academia and through blogs, newsletters and news stories.

Green Earth Volunteers

The Chinese domestic NGO Green Earth Volunteers (GEV) does not state directly that dams are part of the organization's focus. Their president, a well-known public figure, journalist and activist Wang Yongchen, is widely known for her promotion of awareness of the negative effects of economic development on the environment in China – hereunder dam building – especially on China's south western rivers. She was one of the major forces behind the campaign in the 2000s to stop the 13 planned dams on the Nu River in south west China. The campaign ended with a – by NGOs - declared victory in 2004 when a moratorium was put on further dam development on the Nu. Wang Yongchen was celebrated in a 2008 special report in Time Magazine titled "Heroes of the Environment 2008" (Time 2008) for her work. While not overtly focusing on dams or earthquakes the

organization is an important actor in terms of promoting awareness about the health of rivers in China and the risks associated with large scale construction projects. They promote awareness e.g. through the organization of ‘journalist salons’ where NGO representatives, technical experts and journalists meet to discuss e.g. dam building or new policy initiatives (FN201305).⁷³

Individuals

Two Chinese individuals are, and have for a long time been, very outspoken and critically addressing the relationship between dams and earthquakes. They are often referred to as experts by both foreign and domestic journalists and NGO organizations alike. Both have been interviewed numerous times in international and domestic media when the topic of dams and earthquakes comes up in relation to China.

Fan Xiao, chief engineer at the Sichuan Geology and Mineral Bureau in Chengdu, has been very outspoken about the risks of earthquakes in relation to dams and has published a number of Chinese language articles on the topic. He is often interviewed and cited in international media on the topic. He was for example cited in the article in *Science* (quoted in the introduction) which was published in January 2009 (Kerr and Stone 2009). An article that in many ways helped spark the debate in the news media. *Science* also made a follow-up interview with him (Kerr and Stone 2009a). His point of view is that the science is clear and that Zipingpu and other dams play major roles in relation to triggering earthquakes in south western China. I interviewed Fan Xiao on his role in the debates in 2012.

Yang Yong is an independent geologist and founder of The Hengduan Mountain Society, a non-profit center for research and activism based in Chengdu. He has been an independent geologist for over 20 years and through his center he and

⁷³ I did participant observation at one of these salons in May 2013. It was a full day event where the environmental impact of dam building on river systems in China was discussed.

other volunteers have travelled all over the south western provinces Yunnan and Sichuan as well as eastern Tibet gathering data on river ecosystems (Yong 2008/2009). Yang Yong is one of two people in China (Fan Xiao being the other) who have publicly criticized the government's fast-paced hydropower development of western and south western China. He was the first to publish a report in China about the relationship between earthquakes and dams in China. The report was not favorable towards dam building in earthquake prone zones. He has spent six months in house arrest for raising the issue (INT20131001). In 2013 I interviewed Yang Yong about his role in the debates. His role as an expert is analyzed in Chapter 8.

After analyzing the historical antecedents of the decision to build the Zipingpu dam and having become familiarized with some of the key players in the scientific and public controversy centering on Zipingpu that we will meet in the next three chapters, we now turn to the scientific controversy. The next chapter analyses the scientific controversy as it unfolded in scientific journals centering on the main question: Did the Zipingpu dam play a part in triggering the 7.9 magnitude Wenchuan earthquake or not?

Chapter 6: Triggering earthquakes in science

The key technical issue in the present chapter revolves around the scientific controversy over whether an earthquake is “man-made” – i.e. directly caused by human activity such as the construction and operation of a dam reservoir – or not. First, a quick tour of broad academic consensus in seismology related to earthquakes, magnitudes etc. are presented. These basic understandings of consensus in earth sciences are pertinent to the understanding of the scientific controversy over whether the Zipingpu dam reservoir did or did not trigger the Wenchuan earthquake. Next, the core of the scientific controversy related to Zipingpu, a debate about the phenomenon called Reservoir Induced Seismicity (RIS) is discussed. Lastly, the debate as it unfolded in academic publications over whether Zipingpu played a role in triggering Wenchuan is analyzed. We start with the basics.

Earthquake basics

Most people know that earthquakes occur when the earth is moving or shaking and that the shaking has something to do with plates in the earth bumping up against each other. That is the simplest of explanations. A seismologist, someone specialized in the study of earth science, would perhaps explain it with more detail along the lines of: The earth’s crust is built up of large plates, called tectonic plates, that slowly move on the surface of the earth. The edges of these plates are rough and therefore parts of the plate can get stuck on each other while the rest of the plate keeps moving. These plates are immense and the tensions that build up between them can be enormous. Sometimes the tension becomes very high when plates are stuck together in one place but the rest of the plate keeps moving. At

one point a release – or rupture - happens and the plates move abruptly - this is usually what is called an earthquake. Most people know about continental plates and that for example on the coast off California the Pacific plate and the North American plate meet and that this meeting has caused powerful earthquakes in the past. Such places where plate boundaries meet are called faults, fault lines or fault zones (INT20131001; INT20131014; INT20121125; Andersen et al. N.D.; GEUS Website 2016; USGS 2016).⁷⁴

There are three major types of faults: Faults where the plates move toward each other and are pressed together so that material is subuded (normal faults); faults where plate move toward each other and material is pressured upwards (thrust faults) and faults where the plates rub up against each other (slip-strike faults). There are a large number of variations on these three kinds but the general consensus in earth science is that these are the major types of faults. It is important to know what kinds of faults exist in a given area when for example building infrastructure of any kind close to or on fault lines. Knowing what kind of fault is found in a given area provides information about how the earth is likely to move and thus, should an earthquake happen, how to build infrastructure that can withstand this particular kind of movement in the best possible way (Andersen et al. N.D; Kerr et al. 2003; University of Leeds 2016).

Magnitude

When reading about earthquakes in the news most often headlines will feature a number along the lines of: “7.0-magnitude earthquake hits SW China’s Sichuan” (Xinhua Net 2013). Most people also know about the Richter scale and that this has to do with how big an earthquake is. The Richter scale is also called the open Richter scale and is a logarithmic scale (each step on the scale is 10 times more

⁷⁴ For a critical appraisal of earth science, the history of earth science and the history of the consensus of plate tectonics as a unifying theory see Oreskes (1999) and Oreskes and LeGrand (2003).

than the previous one) which is based on the measurements of seismographs (a device for measuring ground shaking as a result of earthquakes, explosions, volcanic eruptions etc.). The vibrations measured by seismographs usually range between 0 and 9. However, as the scale is open it means that measurements have occurred of very small shaking by fine-tuned seismographs and that shaking can potentially exceed 10. The number on the Richter scale is a measurement of magnitude of an earthquake and is broadly designated by an M (The Constructor 2015; Gregersen 2015).

Today the Modified Mercalli Intensity Scale (MII) is often used in hazard communication. The MII Scale goes from I-XII and describes an earthquake's effect locally (United States, California Department of Conservation, California Geological Survey 2002). For example X refers to major damage. For hazard communication purposes the MII scale is perhaps easier to relate to as it communicates levels of potential damage e.g. to buildings or other structures rather than the magnitude of the earthquake itself as measured on the Richter scale.

Earthquake hazard and hazard maps

The most common way to identify earthquake hazard, and thus the risk of 'ground movement' or earthquakes, in a given area is by using a so-called seismic hazard map.⁷⁵ Seismic hazard maps are maps with information on peak ground acceleration (PGA) for a specific area. PGA designates the maximum degree of vibration in a specific site expected to be exceeded in 50 years with a probability of 2-10 per cent (INT20130622; USGS 2015). In order for engineers and dam designers to build structures that can withstand earthquakes, hazard maps are thus an important tool as they provide the baseline for how much ground movement the

⁷⁵ For a critical discussion of hazard maps, the uncertain evidence on which they are based, why they are often not accurate and what to do about it see Seth et al. (2012).

structure is to be able to withstand. Hazard maps for specific areas are normally produced by geologists and/or seismologists or by people educated within engineering seismology and earthquake engineering. These disciplines are a combination of civil engineering and seismology dealing specifically with focus on designing earthquake-safe structures (Stein & Wysession 2003:14). The responsibility for the production and maintenance of hazard maps in most countries lies with a central authority dealing with earthquakes such as the United States Geological Survey (USGS) in the US or the CEA in China.

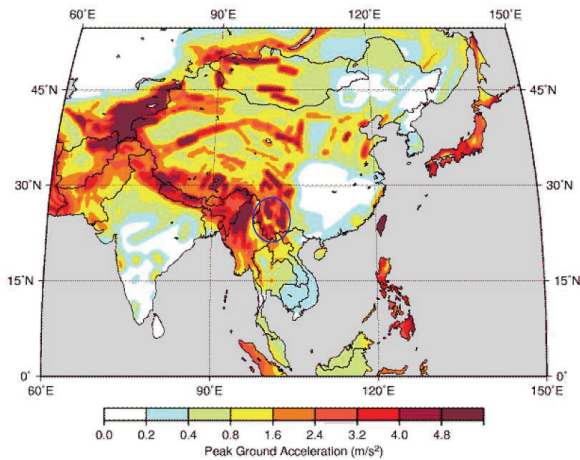


Figure 8: An example of a hazard map where the PGA of a certain size across different countries in Asia is shown according to a coloring code. The circle in the middle of the map approximately designates the south western parts of China (GSHAP 1999)

According to the Global Seismic Hazard Assessment Programme (GSHAP):

“The most effective way to reduce disasters caused by earthquakes is to estimate the seismic hazard and disseminate this information for use in improved building design and construction” (GSHAP Report 1999).

However, prior to the GSHAP program's initiation in 1994 seismic hazard estimates were not available for many countries in continental Asia (GSHAP Report 1999). In addition, information was not necessarily shared across national boundaries. The GSHAP was therefore designed to initiate scientific data-sharing and harmonize earthquake hazard estimation calculations across national boundaries because earthquakes do not respect national boundaries (GSHAP Report 1999). GSHAP cited an example of the consequences of the lack of consensus and data-sharing in terms of evaluating earthquake hazard:

“...mismatches occur along most national boundaries. For example, along the China-Myanmar boundary, the expected earthquake intensity in 50 years is VII on China side, but is IX across the border in Myanmar” (GSHAP Report 1999).

The quote above from GSHAP points to the fact that different nations used different methods to calculate the intensity of earthquakes. The example refers to China and Myanmar, two countries with a long shared border but where expected earthquake intensity varied from 7 to 9 depending on which side of the border you were on. The GSHAP was designed to build consensus and share data globally (but organized in regional groups) so as to improve seismic hazard estimations across national boundaries. In this way, building consensus between countries in terms of data-sharing and agreement on methods to calculate e.g. expected earthquake intensity.

The map above (Figure 8) is the result of the GSHAP work in 1999. Figure 9, below, shows a more recent natural hazard map of China from 2007 with earthquake intensities shown in colors ranging from pale green (low) to dark red (high). The more recent hazard map for China below designates earthquake hazard on the MII scale as opposed to the 1999 hazard map which designated hazard in PGA.

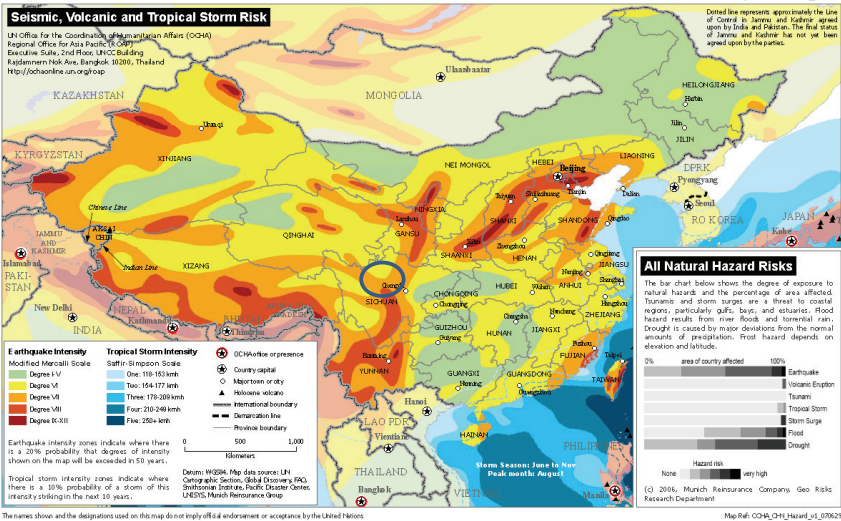


Figure 9: Map of natural hazard risks in China. The area northwest of Chengdu, capital of Sichuan province, is encircled. It signifies the approximate location of Zippingpu. Earthquake intensity was estimated between VI and VIII on the MMI scale in the designated area in 2007. Source: United Nations Office for the Coordination of Humanitarian Affairs - Regional Office for Asia and the Pacific (OCHA ROAP) (2007).

The 'maximum possible earthquake'

Is magnitude related to PGA then? PGA designates one way of discussing strong ground motion – by acceleration - showing possible maximum vibration at a given site and thus describes a local phenomenon. Magnitude is another way of talking about strong ground motion this time by magnitude or the actual size of the earthquake (energy released) for a measured earthquake. When building infrastructure, engineers need hazard maps designating PGA but they also need to know about the distance to nearby fault lines, the magnitude of historical earthquakes in the given area, modern seismic measurements of modern

earthquakes and frequency of earthquakes during the last at least e.g. 100 years. In seismology, the more data that is available about a certain area the better the hazard estimations for that area are (INT20160405). This scientific paradigm thus assumes that the more data on the area, the better, as less data means that more uncertainties have to be taken into account (INT20160405). Meanwhile, from other perspectives, this point is debatable as studies in the sociology of science have shown that the amount of data is not necessarily equal to more precise estimations but, quite the contrary, becomes a source of greater uncertainty (See e.g. Price 2003: 97). All available and relevant data for the given hazard area goes into calculating the ‘maximum possible earthquake’ for a given site (INT20130622). The ‘maximum possible earthquake’ is usually expressed in magnitude. This means that the constructor not only needs to be informed about the possible ground acceleration (hazard map estimations) but also about the possible magnitude of a potential future earthquake close to or at the site. This is important in terms of constructing a structure that is able to withstand a certain level of ground motion. Knowing the ‘maximum possible earthquake’ or the maximum magnitude for a future potential earthquake at a given site should also enable dam designers and engineers to design a structure that is able to withstand the level of ground motion but also to accommodate for other earthquake related hazards such as rockfall or landslides.⁷⁶ According to the chairman of the committee of seismic aspects of dam design at the International Committee on Large Dams (ICOLD):

“...it must be pointed out that in the case of dams the earthquake hazard is a multi-hazard, which comprises of other hazards such as rockfalls and so on. In mountainous regions rockfalls are very important. This hazard has been underestimated up to now” (INT20130511).

⁷⁶ Background source for this paragraph INT20130622.

India meets China

If we turn to the more specific geological conditions of south western China, where Zipingpu has been built and where the most abundant water resources in China are located, and thus where the most dams in China are being built and planned, we see that this area is quite complex geologically. This is the result of the last 50 million years of continuous movement where the Indian plate is pressing northwards into the Eurasian plate (INT20121125; INT 20120604, INT20130622; INT20131001; Larsen 2008: 4). The Indian plate moves 4-5 cm a year and as the Eurasian plate is not easily moved a lot of pressure builds up as a result of these movements. The pressure from the Indian plate also moves the Tibetan plateau towards the east where it clashes with the Sichuan-basin – where one of the fault lines are represented by Longmenshan fault line – the fault line that ruptured causing the Wenchuan earthquake (INT20131014; Larsen 2008; Lei 2011).

In earth science it is well known that the Himalayas and the high elevations of the Tibetan plateau are formed by the clash of the Indian plate with the Eurasian one. As the area is in continuous movement it is what can be termed an active area e.g. an area where earthquakes of varying sizes happen more frequently than in areas that are designated as more stable. Looking at the hazard maps in figure 8 and 9, it is clear that the potential for ground movement in the area is high in and around Sichuan and Yunnan provinces.

The debate on making earthquakes

At the core of the discussion as to whether the Zipingpu dam has played a role in triggering the Wenchuan earthquake is the concept of Reservoir Induced Seismicity (RIS) or Reservoir Triggered Seismicity (RTS).

Reservoir Induced Seismicity (RIS)

The consensus in earth science is that Reservoir Induced Seismicity (RIS) or Reservoir Triggered Seismicity (RTS) refers to a phenomenon occurring when an earthquake is induced or triggered by a reservoir (Gupta 1992). There is a slight difference between ‘inducing’ and ‘triggering’ in seismological science terms (INT20160405). Where ‘inducing’ is considered a direct and active process ‘triggering’ refers to an indirect process. For example, deep well fluid injection (as e.g. used in hydraulic fracking or geothermal energy production) can cause earthquakes directly (McGuire 2017).⁷⁷ However, given the stress on nearby fault lines, the indirect pressure from for example underground high-pressure fluid injection can indirectly trigger a natural earthquake through the phenomenon of pore pressure diffusion. This increases pressure underground that indirectly influences the stress on a fault line and is thus able to ‘clock-advance’ an earthquake that would happen naturally sooner or later (INT20160405; McGuire 2017). The reason why this is referred to as a phenomenon that is induced or triggered is essentially that it is either directly or indirectly influenced by human activity. Thus, if induced it is not considered a naturally occurring phenomenon, whereas if triggered it is. Deciding whether an earthquake is “man-made” – i.e. directly caused by human activity such as the construction and operation of a dam reservoir – is thus a scientific question. The distinction between direct or indirect influence becomes important here. If human activity has indirectly influenced the rupture of a fault and thus ‘clock advanced’ an earthquake that was going to

⁷⁷ For a description of ‘man-made’ earthquakes caused by geothermal energy production see McGuire 2017.

happen eventually, the earthquake itself is still considered ‘natural’ (INT20131014). In the seismic and dam-related geological sciences the RTS or RIS phenomenon is well known and even quite a natural part of seismological knowledge (INT20160504, INT20131014).

In relation to dams, RIS arises when a large amount of water stored behind a dam - i.e. in a reservoir - puts pressure on the rock below so much so that the mass of the water makes the earth ‘creak’ under its weight (INT20130211). For an earthquake to be induced thus means that the mass change – from a relatively small amount of water in the area to a large amount of water in the area as the reservoir is filled - can cause the earth to shift, move or shake under the added weight of the water. The earth moving in this case is generally referred to as an earthquake caused by the dam’s reservoir. Similarly, if a large mass of water is removed from the same area (if the amount of water in a reservoir is reduced) this can also cause earthquakes (INT20130211; Gupta 1992). As mentioned above, induced seismicity is not a phenomenon unique to dams but also well documented in relation to e.g. large scale open pit mining, oil drilling, shale gas extraction/fracking, carbon sequestration and geothermal energy production (INT20160405; McGuire 2017). The term Reservoir Induced Seismicity (RIS) specifically refers to the phenomenon created by a large scale reservoir.

RIS occurs when the sheer weight of the mass of millions of liters of water in a large scale reservoir (normally over a 100 meters in depth) pressing on the rock below alters the stress on a geological fault so that an earthquake is triggered or “clock advanced as part of the natural seismic cycle” (Klose 2013). RIS refers to geo-engineering activities or large scale constructions such as dams causing earthquakes. In other words:

“Dams have the special problem that they can cause earthquakes. This seems counter-intuitive, because the added weight of the water should increase the pressure on the rock below and inhibit faulting, because the two sides of the fault are pressed together harder, requiring a greater force to overcome the friction. However, it seems that the water impounded by dams sometimes flow into the rock, lowering the friction across faults and making rupture easier” (Stein & Wysession 2003: 18).

The crucial point in the quote above is that to earth scientists, added weight is not necessarily a problem for faults as sometimes faults can actually stabilize as a consequence of added weight. The problem referred to above is that the added weight is in the form of water and water has a special quality: It can flow into the rock and make it easier for the fault to rupture. The phenomenon of water “flowing into the rock” is also called *pore pressure diffusion* and also occurs in relation to large scale dams.

The first known and documented example of RIS took place in the US in the late 1930s at Lake Mead, the reservoir behind the Hoover Dam on the Colorado River (Gupta 1992: 1). The largest earthquake was measured at magnitude 5 (Gupta 1992: 1). However, while many refer to RIS as an established fact in relation to small and medium sized earthquakes (magnitude 1-6) large-scale, more destructive earthquakes (6 and up) are more disputed (Gupta 1992; Klose 2013). The largest documented case of a RIS earthquake occurred in 1967 in Koyna, India, where the Koyna reservoir induced a magnitude 6.3 earthquake that killed around 200 people (Gupta 2002: 280).

For the reader the central question is: But how is it possible to know if it is an induced or triggered earthquake? Or: How do you determine if an earthquake is man-made? This is particularly difficult to determine and requires a large amount of data. However, even then consensus may not be reached. Moreover, this is

where the most scientific disagreements happen as these are complex phenomena with a large number of factors to consider. This is the core issue in the scientific controversy over Zipingpu.

Seen from this perspective RIS/RTS can be considered a scientific problem discussed by scientists in science journals. However, as the general public can be affected if larger earthquakes are, or can be induced, the debate on the RIS phenomenon is not only a scientific problem. Scientific debate thus spills over into more mainstream media and a public controversy is born (Rogers and Marres 2008; Venturini 2010 and 2012). In the case of RIS/RTS, a number of NGOs and the media are interested in reporting on the risk of human activity and in making sure the public is informed and have the possibility to weigh in on the acceptable levels of risk when taking on large scale geo-engineering projects such as dams (INT20131001; Probe International Website). The public part of the controversy is examined in Chapter 8.

Having summed up the basics in earth science regarding RIS, we now turn to the next stage, looking closer at the content of the scientific controversy over Zipingpu itself.

Zipingpu as a scientific controversy

As previously discussed, immediately after the Wenchuan earthquake occurred, seismologists and geologists started speculating and doing research on the possible role played by the Zipingpu in triggering the earthquake. Disagreement on the role played by mass change caused by reservoir impoundment in triggering the earthquake led to a number of published articles in academic journals and discussions in specialized fora (Chen 2009; Let et.al 2008, Lei 2011; Klose 2008 etc.). Foci in the different academic articles are on methods, calculative tools and calculations that prove or disprove hypotheses about the role played or not played

by the Zipingpu reservoir in the Longmenshan fault rupture (i.e. the Wenchuan earthquake).

Whether Zipingpu has had a hand in triggering the Wenchuan earthquake has been the subject of peer-reviewed articles in specialized earth science journals such as *Journal of Geophysical Research: Solid Earth*, *Journal of Asian Earth Sciences*, *Earthquake Engineering and Engineering Vibration*, *Science in China Series D. Earth Science* and a host of other academic journals since the Wenchuan earthquake. Over 70 peer-reviewed articles related to Zipingpu have appeared in such specialized journals since the earthquake in 2008. When I searched the ScienceDirect article database in 2016 and 2017 which includes the earth sciences, earthquake engineering and dam design more generally, I got more than 70 hits on searching the general key-words: Zipingpu or more specifically Zipingpu and Wenchuan. Going through the articles and abstracts a great majority of them referred to the debate over whether Zipingpu had played a role in triggering Wenchuan. In 2016 and 2017 when I did searches in citation databases such as Scopus and Web of Science the databases came back with between 50 and 115 articles relating generally to Zipingpu and Wenchuan. Going through these searches most of the articles were concerned with general seismic analysis and some articles, more than 20 in both databases, related directly to the question as to whether Zipingpu has had a hand in triggering Wenchuan.

Analyzing results in terms of authors and affiliation of authors listed in the citation databases showed participation from scientists primarily with affiliation in China, the US and Japan. In addition there were examples of joint publications across national boundaries e.g. US-China.

Ground zero

In the following, I will show how two different events played a part in fueling interest in the role played or not played by Zipingpu in triggering Wenchuan primarily in academic journals. What can perhaps be called ‘ground zero’ for the controversy happened at the American Geophysical Union’s Fall Meeting, convened on December 15-18, 2008 in San Francisco, California. Here the Wenchuan earthquake which had occurred in May of the same year was on the agenda. At a session focused on different aspects of the Wenchuan earthquake a Columbia University geoscientist, Dr. Klose, forwarded a, to some, rather interesting argument. In his abstract from the conference he wrote:

“In conclusion, the ensemble of geophysical observations suggests that the root cause of triggering the M7.9 Wenchuan earthquake may have stemmed from local and rapid mass changes on the surface” (Klose, 2008).

Without mentioning the Zipingpu dam by name (Kerr and Stone 2009) Dr. Klose planted the seed for a controversy over evidence as to whether the Zipingpu dam had played a role in triggering the Wenchuan earthquake. The core of his argument refers to mass change on the surface, i.e. the impact of the presence of the 11 billion cubic meters of water behind the Zipingpu dam. What seems to have fueled the debate further was that the respected journal *Science* published a short article in January 2009, where the American Geophysical Union Fall Meeting and Dr. Klose’s presentation were referred to.⁷⁸ The article in *Science* was titled: “A Human Trigger for the Great Quake of Sichuan” (Kerr and Stone 2009). Searches in the Web of Science and Scopus citation databases in 2016 and 2017 showed that the article in *Science* has been cited between 35 and 51 times in different

⁷⁸ His address is also referred to in Zielinski 2009 and in Wang 2009.

academic journals focusing on seismic issues related to large scale dams in China and beyond.

In a second article in *Science* entitled “Two years later, new rumblings over origins of Sichuan quake” published in 2010, the authors of the original article from 2009 summed up the academic debate about Zipingpu possibly triggering Wenchuan:

”When experts suggested that the disastrous 2008 Wenchuan earthquake might have been triggered by the reservoir behind the Zipingpu Dam, establishment scientists in China remained largely silent (*Science* 16 January 2009, p. 322) [sic]. Now they’ve weighed in, ruling out reservoir triggering. But many earth scientists don’t buy their arguments ” (Kerr and Stone 2010).

The article focused on disagreement between Chinese-based engineers at the Institute of Water Resources and Hydropower Research (IWHR), scientists from the US Geological Survey (USGS) and Fan Xiao from the Sichuan Bureau of Geology and Mineral Resources in Chengdu. The IWHR as represented by Chen Houqun, a structural engineer who is also co-author of the Chinese design code for seismic safety in dam design (Kerr and Stone 2010), did not think that Wenchuan was triggered by Zipingpu, whereas USGS scientists and Fan Xiao did. In general the article suggested that Chinese ‘establishment’ scientist were on one side of the argument and US scientists and other experts on the other. The 2010 article in *Science* concluded that:

“What researchers still want almost 2 years after the earthquake is wide dissemination of the raw data from the Zipingpu monitoring. Until such data sets become commonplace says Geophysicist Evelyn Roeloffs of USGS in Vancouver, Washington, “it’s always going to be this kind of story”” (Kerr and Stone 2010).

Here we might ask what kind of story that would be? In the following, I am going to argue that it is precisely the kind of story I am analyzing in this thesis: the story of a techno-scientific controversy with policy implications. As shown in the quote above, from some scientists' point of view the release of raw monitoring data was thought to be able to close the controversy over whether Zipingpu had triggered Wenchuan. The raw monitoring data refers to data from a network of seismometers installed around Zipingpu. The network of seismometers would have recorded the occurrences of (small scale) RIS during the release of water from the reservoir or during the filling of the reservoir prior to Wenchuan. *Science* asked why those data were not disseminated widely (i.e. not shared with foreign scientists). As mentioned in Chapter 1 there may be reasons why data is not shared widely as it can perhaps be prohibited according to the Law of the People's Republic on Guarding State Secrets (1988/2010). But is it that simple? Perhaps data was shared with foreign scientists but not in the manner considered 'right' by *Science*?

As we shall see in the following, arguments as to the role of data and calculations went back and forth between scientists from the US, China, Japan and other countries. I am going to argue that dividing up the scientists in neat boxes labeled 'US', 'China', 'Japan' and thus ordering their positions according to whether they belong to a specific country is not enough to account for their positions. Neither will labelling boxes 'CEA', 'IWHR' or the 'USGS' fully account for what is at play in a scientific controversy. In other words, in digging deeper into the scientific controversy, I find that the characterization of the debate in *Science* is not all there is to it. It is not just about Chinese 'establishment' scientists being on the one side of the debate (not blaming Zipingpu) and US - plus US minded - experts being on the other (blaming Zipingpu). It is not that simple. I will argue that we also need to take the institutional set-up in China as well as historical

bureaucratic and scientific infights within the bureaucracy into account, and these are not necessarily divided according to institutional affiliation. In sum, the following is another example of how drawing on contemporary China studies in combination with doing a controversy study may play out. Let us untangle the next part.

Weighing the evidence

The fact that geoenvironmental activities can cause earthquakes was described earlier in the chapter. This fact is not a very controversial issue within the earth science community or with dam engineers for that matter (FN201305; INT20160405). Where is the controversy here then? The controversy over Zipingpu relates to the size of the earthquake. For such a large magnitude earthquake to have been caused by a reservoir – and one that has had high political priority for decades – is controversial.

The important point here is to show that at the core of a controversy such as over the Zipingpu, it *looks like* all the actors are discussing the same thing - namely the question Did Zipingpu cause Wenchuan? However, perhaps they are not talking about the same thing? As mentioned in Chapter 2, Barry (2013) describes the changing nature of controversies and the fact that actors seldom agree on the nature of the controversy. This is also a classic point in controversy studies in STS (Venturini 2010 and 2012). The way the different actors argue their points is a key to unlocking how it can be that actors engaged in what looks like the same controversy are perhaps not discussing the same thing. Thus while the actors may think they see one controversy, the way they argue can reveal that they are perhaps arguing about different issues.

We begin in New York where I met with Dr. Klose who got the ball rolling.

Talking about mass

It is a warm and sunny fall day in New York. We are meeting at Starbucks on 6th Avenue at 3 o'clock. When I get there at ten minutes to three he is already there. We get introduced, get coffee and then walk to Bryant Park nearby where we find a rickety table outside in the sun. I turn on my recorder. The Columbia University geoscientist, Dr. Klose, was the first to forward the argument that Wenchuan might have been triggered by mass change on the surface of the earth. Since this mass change was later described by *Science* as referring to the weight of the water in the reservoir behind the Zipingpu dam, I asked about this mass argument as the first thing and we immediately got to talking about 'man-made' earthquakes:

Klose: "So it's something that... where you can really say humans can cause earthquakes based on mass changes and the bigger the mass change is, the bigger... you can... expect a large earthquake"

LGH: "So there is a relationship between the two?"

Klose: "Yes, you have to have faults zones close to it, to the human...to the reservoir, and you have a large amount of mass change, and the timing is an issue, but not significant. It's more a distance issue and a mass issue".

LGH: "Distance from the fault lines?"

Klose: "Yes" (INT20141014).

What Dr. Klose was explaining to me was his mass change argument. According to him, humans can cause earthquakes by changing the mass on the surface of the earth (e.g. by building a large reservoir). This is basically the same argument as the RIS argument that was presented above. But according Dr. Klose, mass change

is not enough. You also need close proximity to a fault line where the mass change occurs. I then asked about knowing where the fault lines are located:

LGH: “But what if you don’t know where the fault line is?”

Klose: “You don’t know where the fault...you can analyze nearby faults and it’s hard, you can make imaging underneath, seismic imaging, where you can see things. You know what the major earthquakes was in history, like in Zipingpu area. The major earthquake was smaller than what you had now, 2008. So... you can question, now why was the earthquake so large? Suddenly it ruptured 200 kilometers, which is not caused by human...by the reservoir, but the initial trigger was caused by it. The first 15 seconds, the earthquake ruptured right underneath the reservoir and propagated in 15 seconds up to the surface where the reservoir is. And then, it covered... the largest movement was right there. And from there on, it moved 200 kilometers at the slip fault to the north” (INT20141014).

Regarding Zipingpu, Dr. Klose explained that you may know where nearby fault lines are from e.g. seismic imaging. Then you determine from historical data the major earthquakes in the area. Historical data was known for Zipingpu, but such a big earthquake had not occurred here before. So Dr. Klose asked himself why the earthquake was so large. He refers to the earthquake as 200 kilometers of fault ‘rupturing’. The greater part of the earthquake (the 200 kilometers of fault rupturing) was not caused by the reservoir according to him – only the initial trigger. According to Dr. Klose it was the mass on the surface which triggered the initial ‘rupture’ (earthquake) right underneath the Zipingpu reservoir. However, he only argued that the first 15 seconds of the earthquake was caused by mass changes at the surface under the Zipingpu reservoir. He explained it as follows:

“I saw it as an impounding or filling of a reservoir and there was a large amount of mass” (INT20141014).

In this sense Dr. Klose wanted to examine what the impact of mass change (the weight of the reservoir when it was filled) on the surface was – i.e. did it cause the Wenchuan earthquake or not. One reason why *Science* mentioned ‘raw monitoring data’ could thus refer to the measurements of ‘mass change’ that seismometers can pick up. Meaning that when the reservoir fills, the earth may ‘creak’ under the added weight – the ‘creaking’ is small RIS. The raw monitoring data could then be important in determining the mass change and thus the possibility of causing a large earthquake.

So according to Dr. Klose the largest movement of the fault was right at the reservoir and he believed the reservoir served as the initial trigger. This was the first 15 seconds of the earthquake. But what then happened was a ‘natural’ earthquake. He described it as a very fast chain of events – a bit like dominos falling:

So after you started triggering - the earthquake ruptures - you can trigger other earthquakes. So that’s why you have different fault segments that rupture, and if fault makes...other fault segments are close to fail, they start to fail and the next one fails, the next one fails, until there is no other fault zone that is close to fail. So that’s why you have propagation of a rupture for so many kilometers. (...) So you don’t have many earthquakes after each other. You have one major earthquake, but everything is so fast, that the fault zone in 15 seconds breaks, the next one starts and breaks, then 50 seconds, 50, so it’s five times longer, or four times longer, and then the next fault breaks, and it’s so fast...” (INT20141014).

The fault was already close to ‘failure’ i.e. tension was built up so much so that a relatively small event, such as presence of the mass of the Zipingpu reservoir’s approximately 11 billion cubic meters of water, could provide the initial trigger. Then other segments of the fault – that were also close to ‘failure’ (also loaded with high tension) – then ruptured as a consequence of the first segment of the fault rupturing. What Dr. Klose described can perhaps best be described as a sort of domino-effect happening as a consequence of the first initial trigger (the presence of the Zipingpu reservoir).

The Wenchuan earthquake lasted over two minutes in total (Daniell 2013) but in this more detailed explanation Dr. Klose explained it more as a chain of earthquakes happening extremely fast after each other in effect causing one large earthquake. Dr. Klose’s argument was that the first 15 seconds were caused by Zipingpu – not the whole two minutes. There is thus a very fine line between determining whether an earthquake is man-made or not.

In sum, Dr. Klose was convinced that Zipingpu played a significant role in triggering Wenchuan. This was the argument he forwarded at the American Geophysical Union’s Fall Meeting. But others were also looking into the issue. Their arguments centered on the concept of Coulomb failure stress change.

Arguing about Coulomb failure stress change

Dr. Klose played a role in triggering the initial debate over Zipingpu as it spread into *Science*. Other authors were also keen to study the role of Zipingpu. In other places scientists were already working on the mass issue that Dr. Klose referred to - something which is also called surface loading and is connected to the concept of Coulomb failure stress change (Δ CFS):⁷⁹

⁷⁹ Δ refers to change and Δ CFS thus refers to the term Coulomb failure stress change.

“The change in Coulomb Failure Stress, ΔCFS , provides an indication of whether or not a fault plane is prone to slip failure. Specifically, the fault plane is brought closer to slip failure if $\Delta\text{CFS} > 0$, and is moved away from slip failure if $\Delta\text{CFS} < 0$ ” (Ohnaka 2013:239).

In simpler terms what the change (Δ) in Coulomb failure stress can indicate is how ‘tense’ a fault is – or how close it is to ‘failure’ i.e. how likely it is that an earthquake is going to happen on this fault. When a fault ‘has slip failure’ the two sides of the fault move relative to each other and thus if the fault is ‘prone to slip failure’ a small event (i.e. building a reservoir) can make an earthquake. The change in Coulomb failure stress is the key method to determine if an earthquake is caused by a reservoir or not, as it calculates how much stress change is theoretically enough to cause an earthquake.

This means that the different results scientists arrived at when calculating Coulomb failure stress change were important. So Coulomb failure stress change being above or below zero and not least which factors to use in calculation were important arguments in terms of providing evidence of the Zipingpu reservoir playing a role in triggering Wenchuan or not. Already in December 2008, authors from the CEA jointly with The Geological Survey of Japan and Chengdu Earthquake Administration published a paper in the Chinese journal *Seismology and Geology (Dizhen Dizhi)* titled: “Integrated analysis of stress and regional seismicity by surface loading - A case study of Zipingpu Reservoir”. The authors Lei et al. concluded that:

“Both weight loading and pore pressure diffusion resulted in significant Δ CFS on the underlying Yingshu-Beichuan and Guanxian-Mianzhu Faults, which are considered as the source faults of the Wenchuan earthquake. Some clear correlations were verified between the local seismicity and stress change, thus we concluded that the impoundment of Zipingpu Reservoir clearly affected the local seismicity and it is worthwhile to further study if the effect played a role in triggering the Wenchuan earthquake” (Lei et al 2008).⁸⁰

The authors argued that both the mass of the reservoir (weight loading) and the phenomenon of pore pressure diffusion (water flowing into the rock) were important components in their calculation of Coulomb failure stress change. On the basis of their calculation, they concluded that Zipingpu did affect seismicity – i.e. it may have caused Wenchuan and called for further studies of the possible link between Zipingpu and Wenchuan.

This article caused some stir as there were scientists from the CEA who were suggesting that the Zipingpu reservoir may have played a role in Wenchuan. Here we see the ‘double role’ of the CEA as referred to in Chapter 5. Scientists from the CEA should be part of what *Science* called ‘establishment scientists’. Then why were they arguing that Zipingpu may have had a hand in causing Wenchuan with authors from Japan and jointly with provincial colleagues from the Sichuan branch of the CEA? Why did they not argue that Zipingpu had no role to play as they should have if the notion of belonging to the ‘establishment’ means that you argue in favor state development policies? If we think of the article in other terms, it can be seen as a kind of bureaucratic disciplining or signaling exercise internally in China. Here scientists from a government agency can be seen as signaling to companies that they need to comply with regulation set by the CEA – i.e. the CEA

⁸⁰ The fault that ruptured was later corrected to be the Longmenshan fault.

is not willing to ‘protect’ the companies against backlash for causing Zipingpu. If the Zipingpu dam caused Wenchuan, and it could be proven that it did, what would the consequences be for the company responsible for building the dam? If scientists from the CEA were arguing for Zipingpu playing a role, the consequences for the Zipingpu Company would be dire – being blamed for the death of over 80,000 people. Moreover, what would the consequences be for other companies overseen by the CEA? This is a strong signal to send from the CEA. This effectively means that the CEA is not willing to protect even a company vested with the responsibility for a government priority project if the scientific evidence does not hold up and Zipingpu is in fact to blame. Thus this can be seen as ‘disciplining’ companies to comply with regulations. One informant, a seismologist with knowledge of relations between the CEA and dam construction companies, pointed it out to me as follows:

“After the 2008 earthquake, those people [construction company seismologists red.] said: we will not debate with you the intensity [how large an earthquake can be at a given construction site red.] right now. You determine the number - we use it. However if there are some problem occurred that’s your... you should responsible for everything” (INT20130622).

What my informant described was that the companies simply stated that they wanted to comply with regulations after Wenchuan occurred. They did not necessarily comply with them before Wenchuan – as we shall see in Chapter 7. In this way, the companies could place blame with the state if the company has designed a dam according to specifications by the CEA and something like Wenchuan should happen. Chapter 7 looks closer at a bargaining process between the CEA and the Zipingpu Company over precisely earthquake risk.

Now we go back to Dr. Klose and his argument in order to continue with the unfolding of the scientific debate. As mentioned, Dr. Klose was not in doubt about the role of Zipingpu in being the initial trigger. He further explained why it was that raising the issue of the role of Zipingpu became controversial:

Klose: “And this Zipingpu dam basically triggered this earthquake that would have happened...”

LGH: “...it would have happened anyway?”

Klose: “No, you have to be careful with that statement because there is this argument that oh... this earthquake would have happened anyway, I say, no, an earthquake would have happened somewhere along the Longmenshan” (INT20141014).

Earlier in the chapter which examined the RIS argument, the argument that dams can cause earthquakes, also mentioned the notion of ‘clock advancing’ natural earthquakes as a consequence of geoenvironmental activity. So I made the mistake of thinking that Dr. Klose’s argument was that Zipingpu acted as an initial trigger of a natural earthquake that was just waiting to happen and that Wenchuan would have happened anyway. But I was corrected. Although Dr. Klose earlier argued for the first 15 seconds as the initial trigger and the rest perhaps a ‘natural’ domino effect, this does not mean that his argument was that the earthquake was natural. He proceeded to make clear to me why the mass change argument around Zipingpu becomes so controversial. In his opinion an earthquake would have happened on that fault line, but:

LGH: “But not necessarily right there?”

Klose: “But the earthquake happened exactly at *that* point where the highest stress change occurred for the last thousands of years. Remember, a mass change caused by a reservoir like Zipingpu, no geological process can cause such a rapid mass change in such a short time period, except a volcanic explosion. So we humans, can do processes, or induce processes, that are much larger than what nature does in a shortened time period. And that’s the whole understanding why that earthquake might have... or happened there, or the argument why it happened there and not somewhere else” (INT20141014).

The fact that humans can cause earthquakes is the center of the argument above. First of all Dr. Klose argued that the earthquake happened at this particular point, close to the Zipingpu reservoir. This was not a coincidence. According to Dr. Klose humans have the ability to build something that can cause enough change on the surface of the earth within a short time and with forces so great that in explaining it to me he compared it to a volcanic eruption. That is a very powerful force. The essence of his point being that not in thousands of years would an earthquake have happened ‘naturally’ at this particular point had it not been for the presence of Zipingpu dam’s reservoir.

In sum, Dr. Klose’s argument and initial mentioning of mass change at the American Geophysical Union’s Fall Meeting was controversial in the sense that his argument highlighted the role played by Zipingpu. A natural earthquake might have occurred at some point along the fault line in some distant future. However, the fact that Zipingpu was built and that the earthquake started right at the point where the largest mass change occurred, sums up his argument as to why it started precisely at Zipingpu. The earthquake was anything but natural according to Dr. Klose.

There were other scientists who agreed with Dr. Klose about the role of mass changes at Zipingpu. In a four author paper titled: “Did the Zipingpu Reservoir Trigger the 2008 Wenchuan Earthquake?” by scientists with affiliations at US Geological Survey, and three US-based universities, published in the journal *Geophysical Research Letters* the authors argued that the Zipingpu Reservoir did play a role in Wenchuan:

“This study evaluates the stress changes in response to the impoundment of the Zipingpu Reservoir and assesses their impact on the Wenchuan earthquake. We show that the impoundment could have changed the Coulomb stress by - 0.01 to 0.05 MPa at locations and depth consistent with reported hypocenter positions. This level of stress change has been shown to be significant in triggering earthquakes on critically stressed faults. Because the loading rate on the Longmen Shan fault is <0.005 MPa/yr, we thus suggest that the Zipingpu Reservoir potentially hastened the occurrence of the Wenchuan earthquake by tens to hundreds of years” (Ge et al. 2009).

The paper authored by only US-based scientists reached the same conclusion as Dr. Klose, this time in a peer-reviewed paper. As the quote above shows they were evaluating mass change – based in the Coulomb failure stress change calculation – and arrived at the conclusion that the mass of the Zipingpu reservoir was enough to trigger the already very ‘loaded’ fault line. This means that an earthquake was close to happening on that fault line. However, we have to keep in mind that we are talking geological terms here and that the meaning of an earthquake which is about to happen refers to that it could happen within e.g. hundreds of years. The conclusion by Ge et al. (2009) was that an earthquake that was waiting to happen sometime in the distant future was ‘clock advanced’ by ‘tens to hundreds of years’.

The article thus emphasized that the mass change at Zipingpu played a role causing the Wenchuan earthquake. Although these authors agreed with Dr. Klose their article did not lead to consensus – on the contrary.

In 2010, paper by four authors affiliated with the CEA, Beijing University, and the Sichuan Earthquake Administration was published in the journal *Earthquake Science*. The authors were not agreeing that Zipingpu had played a role and specifically referred to the two papers cited above. The one by Lei et al. (2008) where researchers from the CEA were co-authoring with the Geological Survey of Japan and the one by Ge et al. (2009) by US based researchers cited just above. Both those papers argued that Zipingpu had some influence on Wenchuan and called for further research. The paper by Zhou et al. (2010) quoted below disagreed with the conclusions by Lei et al. and Ge et al. and highlighted that Zipingpu could not be blamed for Wenchuan:

“Among all published discussions, Lei et al. (2008) and Ge et al. (2009) might have a very strong impact on both the scientific community and the society of China. Both these papers presented a result suggesting that the Zipingpu reservoir hastened the occurrence of the Wenchuan earthquake by tens to hundreds of years. Their researches calculated the Coulomb stress change induced by Zipingpu reservoir on the rupturing fault of the Wenchuan earthquake. Their results, however, are critically dependent upon the hypocenter location, the reservoir location, and the fault plane orientation. We have done similar work and infer that Coulomb stress changes alone were neither large enough nor of the correct sign to promote this disastrous earthquake” (Zhou et al. 2010).

At the beginning of the quote, the authors write that the discussion started by the two previous papers is hazardous in the sense that discussing this issue may have a

‘strong impact’ not only on the scientific community but also on Chinese society. The authors however, do not elaborate in the paper as to what kind of impact this is. They then go on to argue that the results, with regard to Coulomb failure stress change, that the two previous papers arrived at were erroneous. They draw in the hypocenter location – which is the exact location down below the surface of the earth where the earthquake started. In addition, they draw on the location of the reservoir and the angle of the fault that caused the earthquake. All three components go into the calculation of Coulomb failure stress change and can thus affect the calculation. According to the calculation by Zhou et al. the Coulomb failure stress change was not significant enough to cause Wenchuan. It was simply not big enough or of the correct ‘sign’ meaning that it was not calculated correctly.

These authors, with affiliations at the CEA, the Sichuan branch of the CEA and the top-tier Beijing University were thus not in agreement with their colleagues who were also at the CEA and with the Sichuan branch of the CEA. The only affiliation difference between the paper by Ge et al. and Lei et al. is that the latter also had an author with affiliation with the Geological Survey of Japan. The first sentence of the quote above by Ge et al. stipulating ‘strong impact’ on the scientific community and Chinese society can be seen as reference to internal disagreement within the CEA. Some at the CEA perhaps did not think it wise to indirectly criticize state policy on dams.

In the quote above, the authors argued that Coulomb failure stress change alone was not enough to cause Wenchuan based on the components of the calculation. The same approach was also used by other authors. In 2009, a structural engineer from the IWHR, Chen Houqun, published an article in the journal *Earthquake Engineering and Engineering Vibration*. Not only did this article focus on the calculative components of Coulomb failure stress change similar to the later article

by Zhou et al. (2010), but a number of additional factors were drawn in. The purpose of which was to forward the main argument that Zipingpu could not have played a role in triggering Wenchuan.

First, it is suggested in the quote below that the article by Lei et al. - authors from the CEA and the Geological Survey of Japan - used an ‘oversimplified’ 2D model – i.e. a model that was not accurate enough to support their argument. Moreover, they assumed that the reservoir was located on a fault:

“... a case study of the Zipingpu Reservoir by Lei et al. (2008) and quoted by Richard A. Kerr and Richard Stone (2009) [the article in *Science* red.] uses an oversimplified 2-D model and assumes that the entire reservoir is located on a fault. Actually, only the narrow Mingjiang River crosses the fault” (Chen 2009).

The argument that only the river crosses the fault questions the logic of the argument about mass. If only the river crosses the fault, how much weight can be on the fault?⁸¹ Like Zhou et al. above, Chen (2009) goes on to focus on the location of the hypocenter as a component in the calculation of Coulomb failure stress change. He concludes that not only is the model “very simplified” it also has ‘large uncertainties’ (Chen 2009). The article by Chen thus questions most of the components of the discussion thus far. Chen even asks outright if the conclusion that such a large earthquake can be caused by a small change in Coulomb failure stress change is even credible:

⁸¹ There is of course more to this aspect of the debate. For example another debate about how the weight might have pressed on one side of the fault was running parallel to this debate (INT20131014). However in outlining the scientific controversy the main arguments about Coulomb failure stress changes are foregrounded.

“An artificial argument can be made that a large earthquake of $M=8$ can be triggered by a small change in ΔCFS , however, is this a credible conclusion?” (Chen 2009).

What is an artificial argument? It seems that in this context an artificial argument is arguing for Zipingpu having triggered Wenchuan. It is simply not a credible conclusion to Chen. As opposed to Lei et al. (2008), Ge et al. (2009) and Zhou et al. (2010), the way Chen argues here is based more on logic than on actual calculation. The language of the article is also different. The articles by Lei et al. and Ge et al. refrain from making statements such as ‘artificial argument’ or ‘oversimplified’ about the evidence. They simply present the evidence. The article by Zhou et al. draws in Chinese society and the scientific community in their argument, but otherwise refrains from statements such as the above. Perhaps, the fact that Chen is a structural engineer has something to do with the way he argues? He draws on arguments previously made in the debate, and has a clear point of view but does not present new evidence to counter it other than disqualifying the arguments. He is very certain in the article that the Zipingpu reservoir could not have triggered Wenchuan and clearly states this in the article (Chen 2009). But what seems to bring his argument home is his point that:

“... the Wenchuan earthquake did not have the basic characteristics of a reservoir earthquake” (Chen 2009).

What are the basic characteristics of a reservoir earthquake? This is essentially what the seismologists are debating - and they are not agreeing. Their arguments are exactly about whether such a large earthquake can be caused by a reservoir. But maybe the logic of Chen’s argument is different? Instead of only looking at the available data for Zipingpu and calculating on the basis of that, Chen (2009)

argues that it is possible to compare with other large earthquakes possibly caused by reservoirs and then conclude from there about ‘the basic characteristics’ – thus suggesting a case study comparison method instead of calculating components of Coulomb failure stress change. It seems then, that engineers and seismologists have different ways of arguing about what should be the same issue.

If we go back to the seismologists some were in agreement with some of Chen’s points. Although the way they argued was different from Chen’s.

Authors affiliated with the Sichuan Seismological Bureau, the CEA, Beijing University and a New Zealand Earth Science consultancy service, GNS Science, were agreeing on some of Chen’s points. In an article published in the *Bulletin of the Seismological Society of America* the authors were arguing against the Zipingpu reservoir in playing a role in Wenchuan. The authors, three from ‘the usual suspects’ - the CEA, the Sichuan branch of the CEA and Beijing University - and one foreign, here New Zealand based, concluded that:

“Both the calculated Coulomb stress variations and the observed seismicity analysis suggest that the probability that the huge Wenchuan earthquake, M_w 7.9, was induced by the Zipingpu reservoir is very low” (Deng et al. 2010).

The argument by Deng et al. again centered on Coulomb failure stress but also brought in an “observed seismicity analysis” as evidence. This seismicity analysis was based on local data about seismic events around Zipingpu – essentially this would be the data recorded by seismometers installed at Zipingpu – or the data which was not ‘widely disseminated’ according to *Science*. The title of the article by Deng et al. made their point clear: “Evidence that the 2008 M_w 7.9 Wenchuan

Earthquake Could Not Have Been Induced by the Zipingpu Reservoir”. The article prompted a reply from the authors Ge et al. who had argued in an earlier paper in the journal *Geophysical Research Letters* (Ge et al. 2009, also quoted above) that the that Zipingpu did play a role. In their article “Comment on Evidence that the 2008 Mw 7.9 Wenchuan Earthquake Could Not Have Been Induced by the Zipingpu Reservoir” again by Ge et al. and published in *Bulletin of the Seismological Society of America* in 2011, they quickly dismissed the argument made by Deng et al. (2010):

“Deng *et al.* (2010) computed the Coulomb stress change induced by the impoundment of the Zipingpu Reservoir and suggested that the reservoir could not have induced the Wenchuan earthquake. They have omitted a crucial term in calculating pore pressure. Thus the calculation of the pore pressure component of the Coulomb stress was flawed, and the conclusions derived from the calculations are unsound. In the following, I [*sic*] elaborate on this omission.” (Ge et al. 2011)

Ge et al. conclude that the conclusion was ‘unsound’ and go on to show how they would calculate Coulomb failure stress and thus qualify the way in which Deng et al. are wrong. Here the argument centers on another component of Coulomb failure stress change - the phenomenon of pore pressure diffusion – or simply water flowing into rock. Ge et al. show how, according to them, Deng et al. did not calculate this component correctly. Note here that Ge et al. use the word ‘unsound’ about the way Deng et al. argue. Remembering that Chen (2009) also made judgements as to the scientific quality of the work he was criticizing above, the difference here is that Ge et al. show how Deng et al. were wrong. Chen (2009) above judges the scientific quality of the arguments based on other arguments forwarded by other scientists.

A scientific conclusion

The above discussion went back and forth between 2008 and 2011 in different journals arguing about the right method to calculate different components of Coulomb failure stress change, based on the data the authors possessed. This led to conclusions regarding whether the reservoir behind Zipingpu could or could not be blamed for triggering the Wenchuan earthquake. Components of the calculation that were most hotly debated were the hypocenter location and pore pressure diffusion. The debate on the role of Coulomb failure stress change in relation to being the main component in triggering earthquakes has continued to today. The latest article published analyzing Coulomb failure stress in relation to Zipingpu was published in April 2017 (Miao and Zhu 2017). There has been no final conclusion in terms of a firm result being able to conclude whether to blame Zipingpu for the Wenchuan earthquake or not. In a summary article published in 2015 in the respected *Journal of Geophysical Research: Solid Earth*⁸² authors affiliated with the CEA, University of California Los Angeles, The Spanish National Research Council and Beijing University sum up the debate. In their conclusion they write:

“The impoundment of ZR [Zipingpu Reservoir red.] perhaps did not cause significant increase of the Δ CFS at the hypocenter of the WE [Wenchuan Earthquake red.], therefore might not have directly triggered the initial rupture of the quake. However, because the reservoir loading significantly increased the Δ CFS on the middle-shallow depth of the LSF [Longmenshan Fault red.] and advanced ~60–450 years of its earthquake recurrence time, a small event in the deeper part of the fault zone could

⁸² In a follow-up interview with a Danish seismologist in 2015, we discussed the debate and some of the journal articles that had been published during the debate. Including the one mentioned here published in *Journal of Geophysical Research: Solid Earth*. My informant related to me that the journal was a respected journal within seismology (INT20150405).

trigger rupture of the asperities above, followed by cascade failure of asperities along the fault zone.” (Tao et al. 2015)

In the above it is important to note that the main debate points are being accounted for, here particularly the location of the hypocenter and how that impacted on the calculation of Coulomb failure stress change. The quote also describes what I discussed with Dr. Klose namely that a small event could cause a ‘cascade failure’ or what was earlier described as a fall of dominos.

In sum, the central debate on Coulomb failure stress change and the arguments about the pore pressure diffusion and hypocenter location components of the calculation were all accounted for in the article, as well as the ‘clock advancement’ argument i.e. there was a natural earthquake waiting to happen somewhere along the fault line. The authors concluded that Zippingpu did not directly trigger the Wenchuan earthquake but that the fact that Zippingpu did *something* opened up for “a small event” being able to trigger a large earthquake i.e. causing a “cascade failure” 60-450 years ahead of time. This article presents the closest to consensus possible as all the arguments are drawn in (and were analyzed at length in the article). The conclusion, however, is a both/and type of conclusion. On the one hand there were changes as a result of the Zippingpu reservoir. On the other, these changes could not be pointed to as a direct cause of Wenchuan as the reservoir was concluded as being only part of causes for Wenchuan, not the only cause.

Affiliations and taking sides in the debate on making earthquakes

In many ways, the above debate is a classic example of a scientific controversy that is not resolved by a clear consensus (as in Zippingpu did cause Wenchuan or Zippingpu did not cause Wenchuan). The consensus is rather made up of a

summary of the evidence presented by the different sides, where the conclusion lands somewhere in the middle of a yes or a no to Zipingpu being a man-made earthquake. To think of it in Venturini's (2010), terms the consensus may be to agree to disagree. In scientific publications, this may be a normal phenomenon – to agree to disagree or to have a both/and conclusion. In this case no ‘smoking gun’ arguments were universally agreed upon. This might all be well and good, if the scientific discussion occurred in some kind of scientific echo-chamber. But it did not. When political decision making hinges upon such decisions, then the issue of which side politicians are listening to becomes important. Thus, also in debating this issue in the public – e.g. through the news - the taking of sides is highlighted as news outlets tend to prefer good stories and good stories often describe controversies. Chapter 8 examines more closely the public side of the debate and the implications for hydropower policy making in China

The core of the scientific debate was focused on the phenomenon of RIS. However, when examining this in more detail, this chapter has shown how arguments went back and forth between different constellations of authors about the concept of Coulomb failure stress, and whether this phenomenon could provide conclusive evidence about Zipingpu's role in Wenchuan. Conclusive evidence was never universally agreed upon, but in summing up the debate, a middle-ground conclusion was found in 2015 (Tao et al. 2015). The article was co-authored by scientists from China, Spain and the US. Looking to *who* were arguing in the academic journals, it is not easy to recognize the characterization made by *Science* summing up the debate in 2010 (Kerr and Stone 2010 quoted above).

The second article in *Science* highlights the difference of opinion between “establishment scientists in China” and other “experts” or “scientists” (Kerr and Stone 2010). The article put forward the notion that the general opinion of

“establishment scientists in China” is that they have ruled out reservoir triggering. What the above analysis shows, however, is that scientific publications arguing about Zipingpu were on more than one occasion co-authored by “establishment scientists in China”, such as scientists from the CEA, and authors from US universities (e.g. University of California), from a New Zealand consultancy or from the USGS. The picture is perhaps a bit more nuanced then. Scientists from the CEA argued both sides of the debate and scientists from US based universities did the same. The article which summed up the debate in 2015 by Tao et al. is an example of such co-authorship.

In terms of institutional affiliation, such as the CEA or IWHR, there is a difference to be found, as (mainly one) engineer from the IWHR did not change his position during the debate. Chen Houqun, from the IWHR, also quoted above (Chen 2009) was quoted at length in the second article in *Science* from 2010 (Kerr and Stone 2010), arguing that Zipingpu did not trigger Wenchuan. A picture of him was inset on a centrally placed picture of the Zipingpu dam in the article. The caption below said: “Did filling the Zipingpu Dam trigger the magnitude 7.9 Wenchuan earthquake? Chen Houqun (inset) says no” (Kerr and Stone 2010). According to *Science* then, Chen Houqun was convinced he had conclusive evidence. As we saw above, indeed, Chen (2009) did argue that Zipingpu could not be blamed. However, his evidence was not universally adopted in other scientific articles, many of which were referred to above.

Perhaps then *Science* was not referring to “establishment scientists” from the CEA at all, despite the CEA being the central authority on earthquake related matters in China, but to the IWHR instead? Thinking along these lines engineers (in the form of Chen Houqun) are pitted against other kinds of scientists, such as seismologists (be they from the USGS, from the CEA or the Sichuan branch of the CEA). Thus,

it is not only different countries' scientists that are arguing but rather different *scientific fields* that are arguing and weighing evidence for or against Zipingpu triggering Wenchuan differently. Perhaps, then engineers have a different way of proving their points than seismologists? Chen's way of arguing as presented above at least suggests this.

Institutional affiliation, which was also touched upon in the introduction of the actors in Chapter 5 and in this chapter thus may have something to say here. The affiliation of authors to countries or to institutions can be ways of categorizing in order to determine how conclusions are framed. FA would for example most likely categorize CEA scientists as 'establishment' or 'government bureaucrats'. Positioning scientists employed at the CEA as 'establishment' would be natural because the CEA, as a Chinese government agency, should be expected to not openly criticize - or indirectly question - government policies that favor the building of dams in earthquake zones. However, from the arguments analyzed above we see that for example being affiliated with the CEA was not necessarily equal to being in opposition to the argument that Zipingpu caused Wenchuan. Scientists affiliated with the CEA argued both sides – supporting evidence both that Zipingpu did play a role in triggering Wenchuan and that it did not.

The categorization used in FA may thus be seen as too rigid and not being able to account for scientists' different positions within the bureaucracy. Therefore, the strength of drawing on FA here is not in focusing on categorization according to institutional affiliation. The fact that different scientists from the CEA argued both sides of the argument highlights another side of FA which works very well in analyzing Chinese policy making: That which may seem an easy conclusion in China on precisely positioning of different institutions is actually not only fragmented but disjointed below the surface. Thus, to conclude on the position of

the CEA by putting the institution in an ‘establishment’ category leads nowhere, but in a larger perspective there is something to be said for FA here. To go back to the history of hydropower in chapter 4, it was related that there has been a long-standing turf war in hydropower development between ministries – as represented by the MWR and the MEP (and its predecessor the State Environmental Protection Agency - SEPA). The two ministries have more often than not been at odds regarding hydropower policy making (INT20130506; Mertha 2008). As was mentioned in Chapter 4, the MEP (which is a relatively new ministry formed in 2008 – a major victory in itself for environmental protection supporters in China) have been fighting an up-hill battle to discipline state-owned hydropower companies to comply with for example environmental impact assessment (EIA) regulations. The CEA, as a public service organization, may be in even less of a position to discipline well-connected and high ranking hydropower companies. But there are other ways of influencing policy making than fighting ministerial turf wars. Scientific arguments may be another way forward. Co-authoring with e.g. ‘foreign’ scientists to boost the argumentation is also a case in point. This may explain why some CEA scientists are arguing for the Zipingpu triggering Wenchuan, although the bureaucratic logic of “where you stand depends on where you sit” (Allison 1971 as quoted in Brødsgaard 2013) would say that they should not.

In the next chapter we move to an argument, also about Zipingpu, between two groups – seismologists at the CEA – and seismologists and dam engineers at the Zipingpu Company. This time, they argued about the magnitude – or size – of a future earthquake potentially occurring near or at Zipingpu and how the risk associated with such an earthquake should be translated into safety measures when constructing Zipingpu. This also illustrates the already mentioned ‘turf war’ component of bureaucratic negotiations in China. Let us now go back to before

Zipingpu was constructed and see how the different groups argued the case of earthquake risk, back when Wenchuan was still considered a statistical outlier (INT20120622; INT20131014).

Chapter 7: Triggering earthquakes in hydropower – constructing Zipingpu

The present chapter focuses on pre-construction negotiations regarding earthquake safety at Zipingpu. In Chapter 5, the history of Zipingpu as seen through primarily official newspaper reporting gave some background to the policy environment in which the decision to build Zipingpu was made. This chapter first analyses technical negotiations concerning seismic safety of dam design for Zipingpu and secondly uses insights from the concept of FA to further analyze the technical negotiations in the Chinese policy making context.

The point of the chapter is to highlight the important role played by probability calculations and trust in engineering capability in China. In the following I am going to argue that the trust in probability calculation and engineering capability on the part of Chinese engineers in many ways overshadow the fact that dams may trigger earthquakes in and of themselves. We start with how risk is calculated in large construction projects such as Zipingpu

Designing Zipingpu: Negotiating earthquakes

When calculating risk in large construction projects a number of actors are involved. Here we focus on the company responsible for a construction project – the Zipingpu Company – and the CEA which is the government authority in charge of approving seismic safety evaluations made by the company. In such large construction projects such as the Zipingpu dam, seismologists at the company level and relevant personnel at the CEA communicate about seismic safety evaluations as the CEA has to approve seismic safety assessments made by the company. In addition, construction companies are to follow hazard map assessments, other guidelines produced by the CEA, as well as the CEA's

estimates of the ‘maximum possible earthquake’, calculated for the specific site. As described in Chapter 6, the ‘maximum possible earthquake’ is calculated on the basis of historical records of earthquakes in the given area, modern seismic measurements and the frequency of earthquake occurrences over approximately the last 100 years (INT20130622; Wang 2004). This number is usually expressed as magnitude (M) (e.g. M6).

According to an interview (INT20130622) with a key informant - a seismologist with intimate knowledge of work conducted at the CEA as well as work conducted by seismologists in large Chinese state-owned companies responsible for dam construction (hereunder the Zipingpu Company) - the construction company may not always agree with the magnitude number that the CEA comes up with:

“They [the construction company] also want to make a feasibility research and to say: “your data is not so correct”. However, the government wants the Earthquake Administration to determine this point [the ‘maximum possible earthquake’ red.]. So the constructor wants to do their own research and see... to debate this number” (INT20130622).

According to this key informant, the magnitude of the ‘maximum possible earthquake’ can be subject to what we can call ‘technical bargaining’ between the construction company and the CEA. The CEA makes their calculations and the construction company makes theirs. Then the data are discussed. This may appear to be a classic scientific debate but as we shall see in the following there is more at stake here. The informant explains the discussion as follows:

“Here [pointing to a circle signifying the CEA on a diagram he has drawn] they say that you should give a large number, here [pointing to the circle in the diagram signifying the construction company] they say you shall give it a more small number. They are very difficult to do really scientific problem. Sometimes it’s not – it’s a political problem” (INT20130622).

Evidently, this discussion is not only a strictly scientific debate where seismologists from the construction company and CEA seismologists discuss the data and the accuracy of the calculations and then agree on a number. The informant also mentions that other factors complicate the debate about the probable size of an earthquake – or the figure for the ‘maximum possible earthquake’ – and mentions that it is “a political problem”. Bargaining about the size of an earthquake is also connected to other non-scientific factors. This does not appear to be a neutral exchange of facts by a well-defined group of experts. As we saw in the previous chapter, no such group of defined experts actually existed for the ensuing scientific controversy over Zipingpu’s possible role in Wenchuan. Thus, when the informant points to a political problem in this context it highlights the fact that bureaucratic issues very likely are drawn into the scientific debate between the two parties. This point was also illustrated briefly in the previous chapter.

According to my informant, there are consequences of such discussions between the company and the CEA. One such consequence occurred in the debate about determining seismic risk at Zipingpu. During our interview, the informant stated that when the estimation of the ‘maximum possible earthquake’ (which already requires some negotiation for the specific site between the construction company and the CEA) is agreed on, the construction company should “plus alpha” (a number between 0.5 and 1) for safety purposes (INT20130622). Alpha thus refers

to an additional safety margin. This means that if the hazard map for the area shows high PGA⁸³ and the ‘maximum possible earthquake’ is estimated at 7 to 8 then the company should “plus alpha” and build a dam that can withstand an event with a magnitude between 7.5 and 9. Thus, the final number depends on the agreed number for the ‘maximum possible earthquake’ (e.g. 7) with alpha added (a number between 0.5 and 1). Therefore, the highest possible number (including alpha set at 1) is 9 if the ‘maximum possible earthquake’ is estimated at 8 and the lowest (including alpha at 0.5) is 7.5, if the ‘maximum possible earthquake’ lands at 7. As the informant stated it: “The local people require... stronger is better” (INT20130622). “Plus alpha” therefore means adding a safety margin in the construction design so that the design exceeds the estimated ‘maximum possible earthquake’ and the dam is constructed to withstand stronger ground motion.

However, adding this safety margin on a high number for the ‘maximum possible earthquake’ is costly:

“However money is another problem...if you increase by one their... the cost will double” (INT20130622).

According to the informant, there is therefore a big tradeoff between safety and cost: if you increase the ‘maximum possible earthquake’ number by one, the cost of construction will double (INT20130622). This means that the number for the ‘maximum possible earthquake’ for the site is not an insignificant issue when talking construction costs. It is actually rather simple: the higher the number, the more costly the dam.⁸⁴

⁸³ See previous chapter for description of hazard maps and PGA.

⁸⁴ Ansar et al. (2014) calculated actual cost of large dams in relation to cost estimations for a sample of 245 large dams worldwide. The authors found that: “Three out of every four large dams suffered a cost overrun in constant local currency terms” (Ansar et al. 2014: 48). One of their conclusions as to why cost overrun was present in so many cases was that “...planners have difficulty in computing probabilities of events that happen far into the future”

From this perspective, it is clear that actors other than the seismologists are influencing the ‘maximum possible earthquake’ calculations – this may be financiers, provincial or central level bureaucrats needing the project to go through within the approved budget. Ansar et al. (2014) made calculations on cost overruns in big dam projects where they highlight that strategic misrepresentation by project promoters have impact on cost calculations. Other actors thus may have an interest in lowering the number, in turn making what should have been a scientific debate between seismologists a “political problem” (INT20130622).

In this context, the fact that my informant labels something a “political problem” can also be seen as his way of positioning himself relative to the debate and in this way show me what side he agrees with in the debate. He presents himself as a scientist and this kind of negotiation makes purely scientific discussions difficult according to him. The point here is that, according to him, we are talking about separate domains: science or politics. He positions himself as on the side of science. Thus effectively separating things technical and scientific - which can here be understood to be undisputable - from things political - which can here be seen as disputable and contestable - as political problems are not neutral but fraught with human error and bargaining in this context. This brings to mind the discussion of science and politics in Chapter 2, where according to Jasanoff (2005: 5):

“Science, moreover, has historically maintained its legitimacy by cultivating a careful distance from politics” (Ibid.).

This ‘move’ by my informant positions him as someone on the side of discussing pure science (i.e. discovering the truth about a natural phenomenon), as opposed to

(Ansar et al. 2014: 48). Estimation of the ‘maximum possible earthquake’ and the impact on cost can therefore also be seen in this context. See also Flyvbjerg et al. 2003).

people who draw other factors into the scientific discussion – such as the question of cost – effectively turning the scientific debate into a bargaining process. Thus my informant is positioning himself so that his legitimacy as a scientist remains intact as he is able to point out to me when the discussion turns political.

In the Zipingpu case, the negotiation or discussion between the Zipingpu Company and the CEA about the size of a future potential earthquake settled around a magnitude 7-8 event as the ‘maximum possible earthquake’ (INT20120622).⁸⁵ According to the informant, the dam was therefore “underdesigned” as the Zipingpu Company should have constructed it to withstand a larger quake – up to a magnitude 9 event when the safety margin is added. He also mentioned that the ‘maximum possible earthquake’ was calculated by “many young scientists” (INT20130622). To the informant, who is a seasoned seismologist with intimate knowledge of the work done by both seismologists at the CEA and at dam construction companies, the fact that the ‘maximum possible earthquake’ calculation was made by “many young scientists” simply means that he thinks they are inexperienced. In his opinion, the fact that they were inexperienced also impacted on the outcome of the negotiation or discussion around the ‘maximum possible earthquake’ and contributed to a lower number being settled upon (INT20130622). In sum, the scientists at the CEA:

“So those people worked for determining these simple number is very... can feel very heavy press... pressure” (INT20130622).

The CEA scientists thus felt heavy pressure from the more experienced scientists representing the Zipingpu Company side of the negotiations. In order to counter

⁸⁵ Journal articles and books written post-Wenchuan contributing to the discussion about Zipingpu cite the seismic intensity at Zipingpu at VII and the design for the dam at VIII. See e.g. Guan (2009) and Yong and Booth (2011). In addition, another informant, Dr. Klose, as quoted in Chapter 6, also related that in this area there was no prior evidence of earthquakes at the magnitude of Wenchuan’s 7.9.

companies' arguments, and way of acting in such negotiations, my informant stated that he wanted to do more research and publish papers that could then help in disciplining companies:

“So I want to do more research and publish some paper to review this, and then maybe we shall... shall struggle with the company” (INT20130622).

Although my informant in an earlier quote positioned himself as being on the side of ‘science’ this quote shows that in effect, science and politics do co-produce in matters of expertise. Thus, here my informant shows what it is he wants to achieve with his science - which is to provide evidence that can discipline companies in negotiations such as the above.

To sum up, were it not for the costs, a seemingly rather technical detail of the dam pre-construction phase where seismologists from the construction company and the CEA discuss technicalities about how large an earthquake the dam should be able to withstand would perhaps not have been interesting. Nonetheless, one of the reasons for it not only being a scientific discussion was precisely as the informant put it: “if you increase by one the cost will double” (INT20130622).

Considering the magnitude 7.9 Wenchuan earthquake, the kind of technical bargaining described above also comes into a new light. When talking about Wenchuan, the informant stated that it was “very lucky” that “nothing happened” this time (INT20130622) as the earthquake was around 10 at the actual site.⁸⁶ That “nothing happened” may come across as an understatement considering the grave consequences that the earthquake did in fact have in other places in Sichuan

⁸⁶ What the informant referred to when he stated that the earthquake was around 10 at the site means that he at this point does not refer to the Richter Scale as with the other numbers but to the Modified Mercalli Intensity Scale which goes from I-XII – and describes an earthquake’s effect locally. X (or 10) refers to major damage. See also: United States, California Department of Conservation, California Geological Survey (2002).

Province.⁸⁷ Here, however, my informant was referring to that the dam did not break, as this would have exacerbated the disaster significantly, spilling 11 billion cubic meters of water on Dujiangyan city which was already destroyed by the earthquake (Daniell 2013; INT20130622). Zipingpu went out of commission due to damages to the dam but withstood the earthquake and could ultimately be repaired (Chen and Wieland 2009; Owen 2008).

Earthquakes - an engineering problem

There are two events at play here: 1) the described pre-construction negotiations, which involved the size of a future potential natural earthquake happening near the proposed dam site; and 2) the fact that the dam could potentially trigger an earthquake once built. In interviews, a number of different informants stated that the fact that large-scale dams can cause earthquakes (Gupta 1992) is not reflected in considerations by the Chinese authorities as uncontrollable risk; rather it is considered an engineering problem (INT20130604; INT20130622; INT20130715; INT20131001). The main issue is that dams need to be constructed safely so that they are able to withstand big earthquakes – regardless of whether they are triggered or not. Construction is a job for engineers. Discussing if dams should be built at all due to the risk of causing earthquakes is not part of this discussion. Thus, while there are examples of dam plans being cancelled in the US due to the risk of a dam triggering an earthquake (INT20131001; Rogers and Gahan 2013), the trend in China is to frame this as a problem for engineers: they should build stronger dams (INT20131001; Chen 2009). This was also related in Chapter 5, where at one point in the history of development at Zipingpu a lengthy article in People’s Daily (Liu 2005) highlighted the superior quality of Chinese engineers citing the evidence that they were able to overcome very difficult geological

⁸⁷ The gravest of consequences was the death of around 80,000 people as well as countless material damage. See also Sorace (2017).

conditions and build Zipingpu nonetheless, while foreign experts had claimed that Zipingpu was not a suitable site for dam construction (Liu 2005).

This way of dividing the discussion around earthquake risk can tentatively be called a ‘compartmentalization move’ on the part of engineers. The risk of earthquakes is simply divided into two separate issues which are not interconnected. Such a move means dividing the problem up into one compartment - which is the job of engineers - and another compartment which is *not* the job of engineers. The first one can be taken care of within engineering science: The science of building earthquake proof dams. The second one - the problem that a dam, once built, can cause an earthquake - is simply ‘compartmentalized’ out of the discussion as it is not an engineering problem (and thus not a job for engineers).

In an interview with a Chinese hydropower engineer and the Vice-Secretary General of the CSHE, Zhang Boting, he was adamant about the need for hydropower development:

“So why does our country continue to develop and build hydropower? It is to solve the fundamental problem of social development, that is, the community needs this” (INT20130715).

Structural engineer Chen Houqun from the IWHR⁸⁸ also explained the necessity of building dams in earthquake prone areas in the article published in the journal *Earthquake Engineering and Engineering Vibration* in 2009 (Chen 2009), also quoted in the previous chapter. In the article he posed the question: “Why is construction necessary in earthquake prone countries such as China?” (Chen 2009). He then proceeded to answer:

⁸⁸ As mentioned previously, Chen Houqun was referred to in the second article in *Science* from 2010 summarizing the scientific debate, which was analyzed in the previous chapter. According to the *Science* article Chen Houqun is also co-author of the Chinese design code for seismic safety in dam design (Kerr and Stone 2010).

“Water and energy supplies are key factors affecting the economic development and environmental improvement of China. Reasonable allocations of scarce water resources to guarantee water supply and prevent flood and draught disasters, as well as the effective utilization of abundant renewable and clean hydropower potential ranked the world’s first, are important measures in sustaining China’s economic development and environmental security. Large dams play an important role in this process. The source of most major rivers and almost 80% of the national total hydropower resources are located in western China. However, this area is part of the China-Pacific Seismic Belt and the Mediterranean Seismic Belt, making it very seismically active. (...) Recently, a series of critical hydropower projects using an arch dam design about 300 m high are under construction in this highly seismic region of western China. (...) Therefore, ensuring the seismic safety of high dams is an important challenge facing Chinese dam engineers.”
(Chen 2009)

In the above quote there is no question about the soundness of Chinese policy regarding dam construction. It is presented as a fact that it is necessary to use the hydropower potential China possesses to sustain economic development in China. It should be remembered here that sustaining economic growth and development in China is a key component in keeping social stability – an important part of keeping the CCP in power (Teets 2013). Thus, there are no two ways about it. According to Chen, it is a simple matter of fact that dams have to be located in earthquake prone zones as this is where water is located and thus were dams have to be built to support economic development. This leads Chen to the conclusion that, as dams are currently being constructed in this area, Chinese engineers have a challenge in ensuring that these dams are safely constructed. At no point in Chen’s

argument is the option presented to refrain from building dams in earthquake prone zones. But why would it be? If no dams are built economic development, stability and the CCP are not supported.

In sum, refraining from building dams in earthquake prone zones is not considered an option if we consider Chen as a representative of Chinese engineers' point of view. As mentioned in Chapter 4, a large professional class of hydroelectric engineers is, according to Mertha (2008), pushing for more work even as dam projects have just started. In sum, it is plausible that this professional class of engineers, of which Chen and Zhang Boting (also quoted above) is part, forward arguments in favor of building more dams. If, rather than refraining from building dams, building dams is necessary, according to these engineers, then it becomes a question of overcoming difficult geological problems and ensuring the seismic safety of such constructions (Chen 2009; INT20120715; Liu 2005).

From this perspective, it might seem that the Chinese authorities downplay the risk of earthquakes and sideline the science when dam building in earthquake zones continues. Particularly so, if listening to engineers e.g. from the IWHR and the CSHE who are suggesting that reservoir induced earthquakes (RIS) is in fact not an issue. However, I would like to argue the opposite. Based on the analysis here and in the previous chapters, on interviews and archival research, the practice in China seems to be to trust science to a degree where belief in probability calculations and engineering capability overshadow the fact that dams may trigger earthquakes in and of themselves. To put it more boldly - in a sense it is not important if a dam triggers an earthquake because the dam is designed to withstand it. Furthermore, experienced hydropower engineers from two different professional organizations, the CSHE and the IWHR, guarantee the scientific quality of Chinese hydropower engineering capability. In other words, dams

designed and constructed according to scientific methods will remain safe. Given the number of deaths caused by the “very lucky” (INT20130622) 2008 Wenchuan earthquake, this trust in engineering capability and science highlights the importance of understanding the role of technical and scientific facts in the bargaining process. Furthermore, the analysis shows that the fact that engineers ‘compartmentalize’ the risk of a dam causing an earthquake in and of itself, as being outside the debate on dams and earthquakes effectively excludes the policy option of *not* building dams in earthquake prone zones in China.

Next, the pre-construction negotiation is analyzed as a classic example of bureaucratic bargaining over technical and economic matters in China as explored through the lens of the FA framework (Brødsgaard 2017; Mertha 2009), different aspects of which have been presented and drawn on in chapters 1, 2, 3, 4 and 6.

Bureaucratic bargaining

From the perspective of the FA framework, the description of the Zipingpu pre-construction events above may seem to be a classic case of bargaining in the bureaucratic system. This, in the sense that a provincial level key state enterprise (the Zipingpu Company) and a central level organization (the CEA) have to bargain over what can be considered a technical feature regarding earthquake hazard in relation to the design of a specific dam. The CEA is - at least on paper - solely responsible for this technical detail. Thus, had the bureaucratic system functioned as it ought to according to the regulations, the construction company would have to comply with the ‘maximum possible earthquake’ number produced by the CEA. Nevertheless, as the decision on the exact number involves significant costs for the company, there is all the more reason to bargain about the size of an earthquake, particularly since a potential earthquake is still a hypothetical event with a small probability of happening in the next 50-100 years, depending on the probability number attached to it in the actual calculations. What

was found above was that the calculations of the ‘maximum possible earthquake’ are *not* up to experts alone to decide. Consequently, the technicality of the size of an earthquake is no longer a strictly scientific problem to be worked out only by seismic experts and dam engineers.

Taking the bureaucratic set-up into account, it is plausible to surmise that the CEA was in no position to directly influence the Zipingpu Company. This means that the CEA would have to go through the Sichuan Province Earthquake Administration office according to the Chinese bureaucratic system. Thus the bureaucratic ranking of the provincial CEA and the Zipingpu Company - a provincial level company was on par. However, the Zipingpu project was one of the first of the ten key projects under the ‘great western development’ (*xibu da kaifa*) campaign. In other words, a central level priority project that needed to be built. In light of the status of the project and the fact that the Zipingpu Company is partly owned by the Sichuan Province, the Zipingpu Company should have had enough bureaucratic leverage to succeed in lowering the ‘maximum possible earthquake’ number in a bargaining process with the provincial CEA. This means that the Zipingpu Company was effectively ensuring a lower cost of construction for a project of high political priority for the central government. Regardless of ‘maximum possible earthquake’ calculations, then, the bureaucratic ranking of the provincial CEA would not have measured up to the Zipingpu Company’s considering the stakes involved in the project.

When this bargaining process is seen through the perspective of FA, it corroborates the analytical point that a bargaining process is indeed occurring between two – at least on paper - proximate bureaucratic entities. However, as we have seen, individual scientists - here seismologists - may also be able to affect a decision. We can therefore tentatively include an epistemic community (seismologists in this case) as a fourth category of policy entrepreneurs, thus

adding one to the tree categories already included by Mertha in his extended version of the FA framework (Mertha 2009). However, what the FA framework does not take into account is that the actors involved do not necessarily maintain fixed positions and may change their status in the course of the bargaining process. In this sense, a scientist is not just a scientist. Thus, scientists cannot necessarily be analyzed as fixed ‘entities’ (e.g. a policy entrepreneur) that can be unproblematically employed as an analytical unit. What this short description shows is that scientists and the science on which they build their arguments become politicized and malleable. It is in fact *science itself* that is being bargained over. In this sense, FA can only take us so far. If the framework takes science, as a category, for granted and does not take into account that science itself is being negotiated this highlights the shortcoming of FA as a lens to fully analyze a controversy involving science and technology in China. As the previous chapter and the section above showed, the science of seismic risk in relation to large dams is contested and alliances across institutions such as the CEA and foreign universities muddle the categorizations of actors involved in a socio-technical controversy. This means that while FA can pinpoint essential bureaucratic features and highlight aspects of technical bargaining processes in China, the framework cannot account for the *scientific* disagreement inherent in technical debates.

A risk worth taking

Had the Wenchuan earthquake not occurred, the type of technical bargaining analyzed above could be accounted for as a natural part of the building process. After the analysis of the scientific debate, it should come as no surprise that experts can disagree. In seismology there are a significant number of variables to take into account when determining probabilities of sizes of earthquakes (INT20130622; INT20131014). It is unfortunate, not only for the Zipingpu Company but also for the CEA, that the Wenchuan earthquake occurred shortly

after the dam started operations – especially since, at the time of bargaining, an earthquake of such magnitude was still very much a hypothetical event or what can be called a statistical outlier. As described in Chapter 6 and above, the known earthquakes in the region were not as big as Wenchuan’s magnitude 7.9. This means that, with a small probability of occurring within the next 50-100 years the calculation of the ‘maximum possible earthquake’ was still about calculating a hypothetical event.

Wenchuan was described as a “fat-tail event” by my informant Dr. Klose (who we met in the previous chapter) during our interview in October 2014 (INT20131014). A “fat tail” refers to that when visualizing the risk of earthquakes in a probability curve, the curve flattens out as magnitude rises - i.e. the probability of a dam causing a magnitude 1 earthquake is significantly higher than magnitude 8. Thus the larger the magnitude, the lower the probability. However, towards the higher magnitudes the curve turns into a so-called “fat tail” where probability is almost equally low for the highest magnitudes. In considering the risk of major earthquakes in construction projects, the “fat tail” is cut off at one point as the probability of an earthquake exceeding the magnitude of historical earthquakes in the area is so low that it makes no significant impact on the risk calculation to utilize the “fat tail” data. In sum, Zipingpu can be described as a “fat-tail event”, or what can also be called a statistical outlier, as the Chinese authorities considered the probability for a magnitude 7.9 earthquake to be extremely low (INT20131014; INT20130622). As my informant quoted above mentioned, Zipingpu was “underdesigned” (INT20130622) - perhaps also due to the fact that such a large earthquake was considered a statistical outlier at the time of construction. Dr. Klose, however, did not believe that Wenchuan was a statistical outlier. He explained this point to me during our interview and had also argued the

same point in a peer-reviewed paper published in *Journal of Seismology* in 2013 (Klose 2013).⁸⁹

Wenchuan opened up questions about dam safety and risk in construction processes. It also strengthened the position of earth scientists as voices - or potential policy entrepreneurs to use Mertha's (2008) vocabulary - in the debate over the relationship between dams and earthquakes, and whether dams can trigger large-scale earthquakes. During the Wenchuan earthquake, the Zipingpu dam did not collapse. It withstood the earthquake, although it went out of commission and needed strengthening and repairs following the quake (China.org.cn 2008; Owen 2008). In many ways, from the CSHE's point of view, this proves the point that the technicalities of dam construction are best left to engineers and that hydropower engineers are more than capable of controlling these kinds of risks in dam projects (INT20130715). Nothing catastrophic happened at Zipingpu, insomuch as the dam did not collapse. However, the notion that technical experts (such as seismologists) negotiate science itself as if it were a political problem to be settled, calls into question the engineering argument that it is possible to have complete control of large-scale risk to dam projects, such as the risk of earthquakes (whether triggered or not). For such an argument to hold it would mean that all dams in earthquake prone zones would be 'overdesigned' for safety purposes. This would mean that the 'maximum possible earthquake' was settled by 'science' and that the highest possible safety margin was then added. However, as the analysis above has shown not only science arguments and scientific data, but also the cost of construction and the estimates of probabilities played a significant role in relation to the pre-construction phase at Zipingpu. In

⁸⁹ Risk calculation such as the described is also discussed in Lee (1998) and from a different perspective by Beck (2007).

this case, science and politics co-produced in the process of achieving the targets of a key political project set high on the agenda of the ‘great western development’ (*xibu da kaifa*) campaign.

The next chapter will look more closely at the post-Wenchuan controversy as it unfolded in the public sphere, the experts involved, their strategies of legitimization and the potential policy impacts on hydropower development in China.

Chapter 8: Triggering earthquakes in politics – post-quake controversy

The present chapter focuses on the public controversy over Zipingpu primarily as it unfolded in the media. The analysis highlights methods of legitimization employed by different experts who participated in the public controversy. Establishing such legitimacy plays an important role for the possibility to have influence on policy making on hydropower development in China. In the following, I will illustrate how the idea of the impersonal ethos of science may have impacted on the positions of the experts in the public debate. Furthermore, I will discuss how different experts positioned themselves in interviews and in relation to other experts publicly discussing the controversy over Zipingpu and Wenchuan - and by extension the risk of dam building in earthquake prone zones. The different ways of positioning ultimately affect whom the Chinese government were most likely to listen to when deciding whether to go on building dams in earthquake prone zones after Wenchuan.

From science to news – introduction to Zipingpu as a controversy with policy implications

As the scientific debate, which was analyzed in Chapter 6, migrated into the media, the nuances of the scientific debate gave way to a somewhat changed discussion. In media reports and newspaper articles after the Wenchuan earthquake, the role of Zipingpu in the Wenchuan earthquake was highlighted and questioned and in turn related to larger questions of risk of earthquakes in south western China. The Wenchuan earthquake and its possible connection to Zipingpu was also linked to China's current strategy of relying on large scale hydropower for future green energy. The scientific controversy over Zipingpu thus got entangled with other

ongoing controversies over China's hydropower policies and plans to rely more heavily on hydropower for future energy supply.

The Wenchuan earthquake itself caused a virtual flood of news stories in the wake of the May 2008 earthquake. Zippingus' role in triggering the earthquake however, did not hit mainstream global media until early 2009. The article published in *Science* in January 2009 titled "A Human Trigger for the Great Quake of Sichuan" (Kerr and Stone 2009) marked a point where major global media began publishing intensively about Zippingpu. During February 2009 alone, global news outlets such as the New York Times, Wall Street Journal, The Guardian and The Telegraph carried articles regarding the possible influence Zippingpu might have had in triggering the Wenchuan earthquake (Moore 2009; Branigan 2009, LaFraniere 2009, Naik and Oster 2009) all referring to either the article in *Science* or experts mentioned therein. Other US based outlets such as Radio Free Asia, the Smithsonian Institution and NBC News also carried articles between February and April 2009 (Zielinski 2009, He and Chou 2009). Specialized industry journals such as *International Water Power and Dam Construction* and Bulletins published by the International Commission on Large Dams (ICOLD) (Chen et al. 2010; Chen and Wieland 2009; ICOLD Website) have also engaged in the media discussion over the role played or not played by Zippingpu in Wenchuan. Since the article in *Science* at the beginning of 2009, earthquakes and their potential impact on dams have entered public debate to the point that earthquakes are now part and parcel of almost every mainstream news story about dams in China, both domestically and internationally (Branigan 2009; Lewis 2013; Sjøgren 2013; Thidemann 2013; The Economist 2013; Qiu 2014; Zhuang 2015).

Before the article in *Science* was published in January 2009, more China focused (although Canada and US-based) NGO organizations, Probe International and

International Rivers were already publishing about Zipingpu's possible role in triggering Wenchuan on their websites. They published articles and analyses in June and July 2008 respectively (International Rivers 2008; Wang 2008; Zhang 2008).

Domestically in China, the Hong Kong-based South China Morning Post was one of the first to publish on a subject related to Zipingpu.⁹⁰ According to the news outlet itself, The South China Morning Post has a reputation for "... authoritative, influential and independent reporting on Hong Kong, China and the rest of Asia" (Scmp.com). In July 2008, the newspaper published a story about NGO organizations' wish to put a stop to dam building in the wake of Wenchuan, mentioning Zipingpu (Shi 2008). Until February 2009, however, stories in Chinese domestic news, such as the official government news outlet Xinhua, were focused on safety issues after the earthquake, rescue efforts and high-level politicians' visits to the disaster area (See e.g. Xinhua 2008). According to Probe International (Berkow 2009) and The South China Morning Post (Shi 2009b) a media ban was issued by the Chinese government prohibiting publicly discussing the theory of the link between Zipingpu and Wenchuan in the Chinese media. This ban lasted until an article was published by the state-run Xinhua News Agency in February 2009 citing Dr. Klose and the scientific discussion about Zipingpu (Berkow 2009; Shi 2009b; Wang 2009). Subsequently, the South China Morning Post published on the subject of Zipingpu and the possible connection to Wenchuan in February and March of 2009 (Shi 2009a and 2009b).

⁹⁰ Hong Kong has officially been part of China as a semi-autonomous territory since 1997. This means that the region in general, and the companies located here in particular, has retained some of the previous independence from mainland China. For a description of tensions between Hong Kong and the mainland see e.g. Bland (2016)

In domestic news about Zipingpu and its possible relation to Wenchuan, The South China Morning Post and Beijing-based Caixin Media⁹¹ have generally been the most engaged outlets in terms of publishing critical articles on Zipingpu and the broader subject of earthquake risk in relation to dam projects (INT20121210; Shi 2009 and 2009a). China Daily, People's Daily and Xinhua News Agency have also brought articles after February 2009 but the approach has been less critical (People's Daily 2008; Xinhua 2008). Xinhua is the official government news outlet and China Daily, which is published in English, is considered "the government mouthpiece to the world" (BBC 2013). The fact that the state owns Xinhua, People's Daily and China Daily means that articles published from these outlets are rarely very critical of state policies and most often function as 'mouthpieces of the party' (Heimer and Thøgersen 2006: 196).

At the center of the wider controversy over Zipingpu is still science - or interpretations of scientific arguments. All newspaper articles regarding the Zipingpu-Wenchuan controversy as it has unfolded in the media refer back to one or more 'experts' regarding for example reservoir induced earthquakes (RIS). Some of them are the same as the ones publishing in academic journals, others are not.

The role of experts, expertise and expert knowledge in the public debate is worth a closer look. In the following I will analyze what kinds of experts the Chinese government listened to with regard to making future policy decisions about dam building in earthquake prone zones after Wenchuan. Besides public news reports, the present chapter also draw on interviews and fieldnotes in order to discuss issues of expert knowledge and expert legitimacy which is drawn on to make

⁹¹ Caixin Media is part of Caixin Media Company Ltd. The editorial staff at Caixin are, according to Caixin itself, "...well-known for independent thinking and professional practices. (...). They are the torchbearers of professional journalism, known for providing high-quality, credible content" (Caixin.com).

hydropower policy decisions in China. We start with the official take on the man that got the ball rolling in the first place - Dr. Klose.

Discrediting Dr. Klose

The article which was deemed the first Chinese official news publication commenting on the link between Zipingpu and Wenchuan was published by a reporter at the state-run Xinhua News Agency in February 2009 (Berkow 2009; Wang 2009). Half of the article is spent on discrediting Dr. Klose, who we met in Chapter 6. As stated in Chapter 6, Dr. Klose played a key role in starting the scientific debate. This carried into the public debate by way of the article in *Science* which quoted Dr. Klose's abstract from The American Geophysical Union's Fall Meeting. In the official Xinhua article from February 2009 Dr. Klose's name and (then) affiliation to Columbia University was mentioned in the second line. As the quotes below show, the article focused on lack of peer-review and emphasized the need for detailed evidence to be published in a journal paper. The article made these arguments by drawing on expert knowledge in quoting mainly a geophysics professor from Texas Tech University, Mr. Zhou. The main point of Mr. Zhou's critique was the lack of peer-review of Dr. Klose's abstract from the American Geophysical Union's Fall Meeting, which according Mr. Zhou, made it: "... flawed in some facts" (Wang 2009).

In other words, the article questioned the scientific integrity of Dr. Klose himself:

““I think that Dr. Klose ought to present more detailed evidence in a journal paper, such as “Journal of Geophysical Research”, that will offer more room for a vigorous analysis”, Zhou said” (Wang 2009).

The article thus relied on expert knowledge to pass judgement on Dr. Klose's work and focused on the abstract presented at the American Geophysical Union's

Fall Meeting. Mr. Zhou concluded that the abstract was “not very convincing” (Wang 2009). Clearly, Dr. Klose’s work was not considered a credible source of scientific evidence regarding Zipingpu’s possible link to Wenchuan by Mr. Zhou or Xinhua who published the article. Particularly due to the lack of peer-review of his abstract and the fact that he had not yet published a peer-reviewed paper with evidence backing up his theory. In our interview in October 2014, I asked Dr. Klose if he had had any personal issues with the media attention around his presentation at the American Geophysical Union’s Fall Meeting:

Klose: “I have had issue. There were some issues that the Chinese Government was interested in calling Columbia University, because Columbia gets lots of funding from China. They have lots of Chinese students, and so if someone studies that is, you know that...all the funding comes from the central organ and China, so there... if somebody questions things that’s why I made my comment before, they were questioning too much.”

LGH: “Yeah?”

Klose: “Yeah, they wanted to know who I am and what I do”

(INT20131014).

In other words, Dr. Klose, also personally, became the center of attention due to his abstract and the fact that this was reported widely by a number of major news outlets. Only Xinhua commented on the lack of peer-review, which can be interpreted as a way of questioning Dr. Klose’s conclusions. Keeping the analysis of the scientific debate in Chapter 6 in mind, however, demanding that Dr. Klose could reach a firm peer-reviewed conclusion already in December 2008 is perhaps

a bit too much to ask.⁹² As shown in Chapter 6, there will probably never be a final and firm conclusion on whether Zipingpu caused Wenchuan or not.

The fact that an article from an official government outlet such as Xinhua highlights that Dr. Klose's facts were "flawed", that his abstract was not peer-reviewed and that he did not publish his research in a scientific journal suggests that Dr. Klose's science is not entirely accurate and this affects his credibility. In this way questioning the root cause (Dr. Klose himself) of the argument about Zipingpu's possible relation to Wenchuan. This brings to mind a classic issue in the analysis of science-politics relations – that separating scientific practice from personal disposition:

“The impersonal nature of scientific authority relates also to the commitment, expressed in the ethos of science and the norms of scientific practice, to separate the content of scientific knowledge from the emotional, ethical, religious or political dispositions of the scientists, both as individuals and as groups” (Ezrahi 2004: 256).

Questioning Dr. Klose himself thus indirectly questions his expertise.⁹³ If Dr. Klose is not a credible source of evidence about Zipingpu then who is? According to Xinhua it seems peer-review serves as an indication of credibility. If peer-review and scientific publications to some extent measure scientific credibility in China, what does that suggest about who can be considered a legitimate expert e.g. in Chinese hydropower policy making? Next we take a look at the sources of expertise in the public discussion around Zipingpu.

⁹² Klose did publish two peer-reviewed papers, albeit not until years later. He published one in the journal *Environmental Earth Sciences* in 2011 (Klose 2011) and one in *Journal of Seismology* in 2013 (Klose 2013) both arguing for his original point.

⁹³ Dr. Klose later chose to leave Columbia University and today work as an independent consultant in his own company. In 2014 he published a popular science book entitled "Frack this!" (Klose 2014) focused on man-made earthquakes (Cdklose.com; INT20141014).

What makes an expert?

Expertise and expert knowledge is subject to cross-national variation (Jasanoff 2002; Irwin 1997). Consequently, expertise and expert knowledge is a complex construction which can be based on a wide range of different factors relating e.g. to the kind of knowledge the expert possesses (e.g. educational background), the organizational affiliation of the expert (e.g. employed as scientist at a university), publication outlet(s) (e.g. publishing in peer-reviewed journals) or other factors such as working experience within a particular field or providing scientific advice to government (Collins 1981; Collins and Evans 2007). In a word: an experts' science does not speak for itself (Lynch et al. 2008) but is inevitably entangled in social norms and hierarchies (Jasanoff 2004). A factor such as organizational affiliation has been pointed to as being of importance in the Chinese context in terms of possessing authority that can be legitimately drawn on in a policy context (Halpern 1989 and 1992).

Let us see how expertise is constructed in the debate about Zipingpu and Wenchuan and the wider controversy about dam building in earthquake prone zones. Below are two excerpts from my field notes written during my research stay in Beijing in 2013. The excerpts illustrate the point that context matters in matters of expertise. I interviewed the two main proponents of extreme opposites of the – at the time - very heated debate about Zipingpu and Wenchuan, and more generally the debate on dams and earthquakes in south western China. The first, Yang Yong, an independent geologist and head of the Hengduan Mountain Society, was briefly described in Chapter 5. The second, Zhang Boting is the Vice-Secretary General of the China Society for Hydropower Engineering (CSHE) - he was also briefly introduced in Chapter 5 and quoted in the previous chapter. In the following I will analyze which factors were drawn into the debate and how the two men relate the kind of expertise they respectively offer in the questions of

whether Zipingpu caused Wenchuan and whether dams should be built in earthquake prone zones.

Yang Yong is an independent geologist, who originally worked in the mining business. However, he did not want to work for the government any longer and left (INT20131001; INT20130604). Since then he has travelled extensively in the mountains of south western China and Tibet, documenting in pictures, books and reports the geology surrounding the big Chinese rivers flowing through south western China's seismically active areas (INT20130604). He now runs a volunteer research network of scientists and students that collect data about the river eco systems in western China (INT20130604). Yang Yong is one of two people in China who has publicly criticized the government's fast-paced hydropower development of western China and was the first to publish a report about the relationship between earthquakes and dams in China. He has spent six months in house arrest for raising the issue (INT20131001). He also openly defied the media ban on discussing the possible link between Zipingpu and Wenchuan (Shi 2009b). To Yang Yong, people like my other informant, Zhang Boting, have no idea of what is happening in the areas where dams are to be built:

“They are afraid of going into the areas where I go, because it is dangerous there. There are landslides, mudslides and rock falls all the time” (INT20130604).

To him Zhang Boting is just another bureaucrat talking from behind his desk in Beijing. This second informant, Zhang Boting, is in fact placed in Beijing at the industry association for hydropower engineers, CSHE. He is a very enthusiastic blogger on hydropower related matters and especially on seismic safety of dam construction. His opinion about dams and earthquakes is very clear when you talk to him or read his blog-posts:

“China needs hydropower. Engineers have built dams in seismically active areas for a long time, so it is not a problem. Of course we would not build anything unsafe” (INT20130715).

Zhang Boting is of the firm conviction that Yang Yong is a “fake scientist who works on tourist related matters” (Ibid), someone who “has no work unit and no proper education” (Ibid). To Zhang Boting the issue of the risk of earthquakes in relation to dams is a non-issue in the sense that this kind of risk is something that can be calculated into dam construction and therefore a risk that can be contained. He thinks that people like Yang Yong are “hyping the argument that reservoirs can cause earthquakes” (INT20130715).

The two excerpts below describe the different settings in which the interviews with Yang Yong and Zhang Boting respectively took place. They provide an illustration of the role that organizational affiliation may play in valuation of expertise. The valuation of expertise may be judged differently, depending on where the person drawing on their respective expertise comes from. If e.g. from an international NGO working in China there may be some wariness of talking to Zhang Boting as he is “part of the establishment” in the sense that “we already know his opinion” (INT20130709; INT20121116). Others, however, are not so wary e.g. the International Hydropower Association (IHA) or the Chinese central government (INT20130715) who value his organizational affiliation, education, publications and experience in the field of hydropower engineering – and thus the expertise stemming from that (INT20130715; IHA Website 1).

Turning to the other ‘extreme’ the fact that Zhang Boting “always hits out on Yang Yong” (INT20130709) gives Yang Yong some credibility in ‘non-establishment’ circles (INT20121116). Furthermore, Yang Yong’s credibility to the NGO and global media also stems from him having been in house arrest, as this begs the question as to what it is that the authorities do not want him to voice

publicly. Moreover, Yang Yong does not openly acknowledge affiliations to officials, government or other ‘establishment’ organizations but makes a point of working independently – only with the aid of volunteers (INT20130604). This could be said to bolster his credibility in terms of not being easily swayed from his cause by government or industry interests. However, he is also considered by some as “radical” (INT20130709), so not all want to associate openly with him – perhaps precisely because he is the embodiment of politicizing the issue of RIS. Some environmental NGOs in China are doing very well within their field and do not want to associate openly with overt political issues, as this can create unnecessary attention from the authorities (FN20130509; INT20121105).

Looking to the two excerpts, they illustrate expert affiliation as viewed from the point of view of the interviewer entering the location of the interview. Thus, the descriptions show how the setting and place of an interview may affect the overall impression of the source of the two different experts’ expertise:

My interview with Yang Yong was agreed on by phone with a ninety minute notice. I was given the address to a Beijing hotel on the phone and rushed into cab as quickly as I could, as getting anywhere in Beijing can easily take an hour or more. I arrived at the hotel a few minutes late and waited in the lobby. When he did not come to the lobby after ten minutes I sent him a text message asking him where to meet. A two word text message buzzed back on my cell phone only with the words “room 5007”. I did not think we were going to do the interview in his hotel room and I felt a bit strange about it since all the other interviews I had done had been conducted in office settings, cafes, in foyers or other public spaces. To be sure before I went up to the room I asked at the reception if they had a person called Yong staying in room 5007. “Yes we do” was the reply. I then took the elevator to the 5th floor and found room 5007. The door was open. I looked through the door and made a small knock while saying “Mr. Yong?” A man in a

white t-shirt with rumpled hair got up from a deep office chair behind a classic Chinese hotel room desk in dark colored wood. “Louise? Come in.” I walked a few steps into the room, and we shook hands in the short entrance hall. Then he turned around and walked back to the desk. He made no move to close the door and neither did I, so the door was left wide open. I followed him into a small hotel room packed with oversized dark furniture. There was a bathroom to one side without much of a door and a big double bed in the middle where the duvet had been sort of thrown over the bed in an attempt to make it look like it had not been slept in. It felt a bit too intimate to be in that small cramped room with him. He looked like he just got out of bed. It was not a fancy hotel room, but not a bad one either by Chinese standards. “A friend of mine paid for the room for me, I don’t have the money to pay for these kinds of hotels myself” Yang Yong said. He did look out of place somehow. I looked at the thick grey carpet, it softened the sound in the room and everything seemed very dark. It was an exceptionally smoggy day in Beijing. Smog in combination with thin almost-grey-from-nicotine curtains gave the room a dim atmosphere. The TV was turned on; a CCTV channel with a Chinese soap opera. Yang Yong sat at the desk where a laptop was running. “Sit down, I am just sending some e-mails” he said, gesturing to one of two oversized lounge-chairs squeezed in close to the side of the bed. I took a seat on the one farthest away from him, my knees almost touching the bed. After a few minutes of emailing he lighted a cigarette, looked at me and said: “you can ask your questions now” (FN20130406).

In contrast to the interview with Yang Yong, the interview with my second informant, Zhang Boting, took place in a whole different context. It was a day with heavy rain and I had arrived 10 minutes early, which I found rather uncomfortable. Once at the address I was confirmed in my initial assumption that his office was indeed located at the headquarters of the biggest hydropower

company in the world. I felt very small as I entered tower B of the building. When I walked into the spacious lobby I found it had an extremely high ceiling which seemed to disappear at the top of the tall glass-fronted building. The guards at the entrance were wearing red berets and military-looking uniforms. I was the only visitor in the lobby. Beside me there were four guards wearing red berets and two dark blue uniformed receptionists behind a counter. There was no sofa or any place in the lobby where I could put down my wet umbrella or have a rest to get my wet clothes in order, so I walked straight toward the reception feeling the eyes of the guards at the door on my back. Before I reached the reception the two other guards had asked me what my business was, and one of them followed me towards the reception. I told the receptionist that I had an appointment with the Vice-Secretary General of the Hydropower Engineering Society, Mr. Zhang in room 1102. The two receptionists looked a bit lost, but then found a worn-out folder with plastic-sheet covered papers that had rooms and telephone numbers listed in it. “We don’t have a room 1102. Who are you going to talk to?” the receptionist asked. Mr. Zhang in 1102 I repeated. “Do you have his phone number?” “Yes”, I said and showed the woman my cell phone where I had his cell number up on the display. She pointed to a red plastic landline phone that she had lifted onto the reception. She said: “Sorry, that number won’t work here, this telephone can only call internally. Do you have another number?” I replied: “Never mind I will just call him on my cell”. I walked a few steps away from the reception and dialed Zhang Boting’s number. He answered immediately and I told him that I was at the reception. “Just take the elevator to the 11th floor and I will come and get you by the elevator”. “Ok, thank you”, I replied. I then told the receptionist, and the two guards who were standing closer to me, that I had been told just to take the elevator to the 11th floor. I started walking towards the elevators. “Wait, someone will take you up” said the receptionist and ushered the male receptionist towards me. He walked me to the elevator and pressed the button for me. The guards

walked back to their positions in the lobby. When the elevator finally arrived, the male receptionist stepped in and I followed him. He pressed 11. There was a thick red carpet on the floor. As the elevator ascended, I noticed that in the middle of the carpet were big yellow characters spelling the word “Monday”. It occurred to me, that this must mean that they have a carpet for every day of the week. When we reached 11, I walked out of the elevator with the receptionist trailing behind. A few steps outside the elevator, I was met by a tall, thin, neatly dressed man in a blue and pink checkered short-sleeved shirt with a red Hermes belt holding up his dark blue slacks. “Louise? Hi. Nice to meet you! I am Zhang Boting”, he said while he stretched out his hand to greet me. (FN201307).

The descriptions of the two settings may look like settings of many interviews conducted in connection with research projects – be they conducted in corporate settings or at someone’s home. The settings as described here can also be seen as part of the way the two informants positioned themselves in relation to me, a foreign researcher, asking about their expert knowledge in relation to the questions of Zipingpu and Wenchuan and the soundness of building dams in earthquake prone zones.

In the case of Yang Yong I was introduced to him by an NGO contact. This meant that I was ‘vetted’ before given his contact information as the NGO contact trusted me with it. Thus by being introduced this way I was signaling that I was somehow sympathetic to his point of view in the debate. One important point about the circumstances of the interview was the ‘personal space’ of his hotel room that I was invited into. In descriptions of him and his work in the news, his person is always drawn into the argument. He is simply the embodiment of independence from government and you are implicitly personally connected to him when you wish to talk to him about his work. He is living his scientific work and also looks like someone who is well travelled – often under rough conditions. He also

mentioned that he did not pay for the room himself and that he did not have that kind of money. This implicitly shows that he does not get paid for his work and that he is not in it for the money but out of interest and personal drive to get his scientific work acknowledged. This is in many ways the source of his expertise in terms of the “non-establishment” where independence, personal drive at your own peril seems to be a source of credibility. However, it is also his weakness, as he cannot separate personally from his work and as we saw above with the discrediting of Dr. Klose, being personally connected to a scientific argument can be a source of criticism in China.

In contrast, the interview with Zhang Boting was arranged by direct contact. I did not need to be referred to him by someone else because his contact information, unlike Yang Yong’s, was accessible online. I wrote to Zhang Boting directly to ask if he would be willing to share his knowledge about the question of dam building in earthquake prone zones as I had read in the news that he had knowledge of this area. Looking to the setting, this worked in much the same way for Zhang Boting as Yang Yong, only the opposite was the case. His source of expertise is affiliation with the government bureaucracy and the well-established hydropower industry. His office was located at the headquarters of the largest hydropower company in the world which spoke volumes as to the level of his professionalism and expertise. The setting was professional, impersonal and impressive. If distancing personally from your scientific work is an indication of your level of expertise then Zhang Boting did it just right. However, this is also his weakness, as the “non-establishment” (and *Science* for that matter) is wary of close connections to the government.

What did we talk about in the two interviews? The two settings were as different as the interview content. Both Zhang Boting and Yang Yong tried to explain to me what the crux of the matter in the RIS discussion is. Greenhalgh (2008) described

coping with the situation of quickly realizing that none of her informants were neutral about the policy she was researching: “there were ardent proponents and fierce opponents” (Greenhalgh 2008: 42). The same issue clearly applies here as both the informants were clearly not neutral about dam-building. Zhang Boting and Yang Yong are perhaps some of the most outspoken individuals I talked to during my fieldwork.

The interview with Zhang Boting can best be described as a lecture, where I was taken through the science-based work his organization engaged in. I was also provided with written material that backed up his viewpoints. The interview with Yang Yong had more of a personal feel to it, where he described his somewhat secretive research, his travels and his struggles to get his work published. Both in the setting, being in the more personal sphere of his hotel room, as opposed to the office setting and meeting room where the interview with Zhang Boting took place, but also in the sense that he emphasized his experience in terms of travelling far and wide in south western China.

The settings and the way the interviews unfolded in many ways fit well into how the debate has been characterized in e.g. the international media but also have importance for the understanding of the sources of two men’s expertise or positions as experts often cited in the public debate. Would the Chinese government listen to the data stemming from Yang Yong’s research? If he has trouble even getting his research published how will his research reach decision makers? If at all?

Interestingly, both informants emphasized that science formed the backbone of their arguments. During our interview Yang Yong responded to my asking about the nature of discussing hydropower development in south western China:

“Sensitive. There is talk about this issue - hydropower development. It is sensitive because of so big disagreements in the discussion of this question. And it is possible to influence some interest groups. When there is influence of some groups, economic interests it will politicize these questions. Actually it is a scientific question. We are discussing science” (INT20130604).

Much along the same lines as my informant from Chapter 7, Yang Yong distinguished between a scientific discussion and a political discussion and emphasized that the scientific questions were politicized. Again effectively separating things scientific (i.e. things undisputable) from things political (i.e. things disputable and contestable). He saw it as a question of interest groups with economic interests in the projects that tried to influence a scientific discussion. Much in the same way as we saw with the informant in Chapter 7, the fact that something is labeled ‘political’ here means not only that he positions himself on the side of impersonal science but also that it is not *his* agenda that turns the discussion of scientific questions into a discussion about something political.

Zhang Boting agreed that the question was about science. However, he does not think that the science produced by Yang Yong and another of my informants, Fan Xiao, chief engineer at the Sichuan Geology and Mineral Bureau in Chengdu (who was also described in Chapter 5 and quoted in *Science*) is of high quality:

“Domestically there is a group of people, these people, often their scientific quality is relatively poor. This includes this Fan Xiao.” (INT20130715).

So he felt that had to engage in discussion with them because “these people”, like Yang Yong:

“Actually he does not really understand science, so there is a lot of debate between us, and now a lot of debate has been concluded” (INT20130715).

It seems, then that there is a discrepancy between how Yang Yong and Fan Xiao, as included in “this group of people”, understand science and how Zhang Boting understands science. Both sides claim that they are on the side of science. However, the debate between them indicates that their disagreement stems from their different ideas of what high quality science actually is. We saw in Chapter 6 that affiliation may have a role to play in such distinctions. Perhaps this also applies in the public controversy?

Does reputed institutional affiliation help?

In some media – predominantly international – Yang Yong was often cast in the role of a David courageously working to defeat Goliath (in the form of the Chinese government or big (SOE) industry). Zhang Boting, on the other hand, was often cast as a man of big industry with perhaps too close ties to government i.e. being in the pocket of big industry interests. He did not see his role in this way but described himself more as the well-educated and experienced expert with a responsibility to root out fake experts and false knowledge being expounded on the subject of hydropower development and earthquake risk. He thought these discussions were clouding the real aim - which was the development of China (INT20130715).

Another source of Zhang Boting’s expertise is a university education as a hydropower engineer as well as long standing experience from work in the hydropower sector. The source of Yang Yong’s expertise is education in geology

from a mining university (INT20130604),⁹⁴ but more significantly his experience and travel far and wide in south western China. His degree in geology is from a mining university and thus a less reputed institution than the university Zhang Boting attended for his hydropower engineering degree. Furthermore, Yang Yong does not have a ‘work unit’ or an official affiliation to a university or other more official institution. The fact that he calls himself independent does not help his reputation domestically in China and neither does the fact that he has trouble publishing his research.

Affiliation to well reputed institutions is very helpful, if not a requirement, in order to get the ear of policy makers. This applies within the bureaucracy – as we have seen in Chapter 3 where the organization of scientific advice to government is enshrined in bureaucratic procedures and advice predominantly originates from universities, the government bureaucracy or government affiliated think tanks.

Another way to reach policy makers is through more public debate, activism or petitioning. Before Wenchuan a number of researchers, including Yang Yong and Fan Xiao, sent an open letter to the central government saying that a magnitude 7.3 earthquake would be devastating for Zipingpu. The letter reached central government leaders and according to Zhang Boting:

“...the central government was very nervous, our central leaders were very nervous” (INT20130715).

That central leaders become nervous is not a small problem in China. Stability is one of the main concerns of the central government and so questions that can lead to large-scale disagreements or civil unrest in some way or form do not sit well with central government leaders (Teets 2013). Natural disasters are of course a

⁹⁴ In China this most often refers to an industry-affiliated lower-level university education as compared with the big universities in Beijing.

concern as they may lead not only to death and destruction, and cost the government dearly, but they also have the tendency to open up more public criticism of government handling of disaster mitigation and recovery (Sorace 2017). The open letter may not necessarily be considered government advice per se, but the group of signatories on the letter got the attention of the central government nonetheless. The central government then asked more official channels to give advice on the issue raised. Zhang Boting’s organization was asked to address the issue:

“So they [the central government leaders] wanted us to answer. We said it is definitely not a problem, we said, these things [the reservoirs] are all scientifically designed” (INT20130715).

The CSHE turned to a science argument in order to back up the claim that a 7.3 earthquake would not be devastating to Zipingpu. “...then we had a 8.0 earthquake. So Zipingpu proved us right” (INT20130715). The dam was soundly designed because it withstood an earthquake larger in magnitude than the one the letter was saying would be devastating for Zipingpu.

For Yang Yong, this is an odd logic. As mentioned before, he wants there to be a scientific discussion – in the sense that to him it should be possible to keep to debating things scientific without drawing in political considerations – or questions of state development:

“But the people that are being affected - or those who have their advantages affected - will let the case be politicized. They will say that you are against the development of the state, that you are disturbing stability. You scare them. So they make it political. When it is politicized it is not good for us. Because they have put this big

hat on your head [symbolizing a suppressed group ed.], because China's main task right now is development" (INT20130604).

This means that people such as himself, in his opinion, get labeled as groups that are against development – here referring to hydropower development e.g. as a poverty alleviation and economic development strategy. Getting this label marks him (and people like him) as a person advocating for viewpoints that are against the development of the state. In sum, he is labeled as someone who may disturb stability. Outspoken individuals like him or Fan Xiao may therefore be shadowed so as to keep an eye on their potentially subversive activities (as described in Chapter 1). Consequently, a purely scientific discussion is not an option in Yang Yong's opinion.

Talking about such issues as earthquakes and dams and how big earthquakes might be devastating for dams is frightening according to both men in the sense that they both understand the impacts of devastating earthquakes on dams. For Yang Yong the understanding comes from his experiences with earthquake impacts first hand through travelling in the areas (INT20130604). For Zhang Boting his understanding comes from experience with risk evaluation and design parameters for dams in earthquake prone zones (INT20130715). According to Yang Yong it is people who are in an advantageous position due to dam development (e.g. investors, contractors, state-owned companies etc.) who are politicizing the discussion (INT20130604). Zhang Boting thinks it is people like Yang Yong who are doing the politicizing with fake science, scaring people and hyping the green agenda, trying to stop dam building - and by extension development of the state and the Chinese economy (INT20130715).

It is no wonder that many news stories have reported on the issue of earthquakes and dams by illustrating the disagreements through a David-Goliath type fight: Zhang Boting, with all his government backing, official affiliations and eye for the

development of China at large versus Yang Yong, the lone-ranger activist, fighting for the safety of ordinary people. But each cast as an expert with certain people listening to their arguments⁹⁵, it is easy to make the claim that they are in total disagreement. However, in the interviews they both emphasized that China needs development, but it is the manner in which this development progresses that is perhaps at the root of their disagreement. Yang Yong is not against all dams being built in China, but he wants an open discussion of the safety of dams and he works to make sure they are built in safe areas where they do not hurt ordinary people (INT20130604). Zhang Boting has the same in mind, but thinks the science base is solid and that dams can be built where they are already planned and that this is safe (INT20130715).

Perhaps drawing on foreign scientists may help bolster either viewpoint in the public debate?

The credibility of foreignness

In 2012, Probe International published a report by an anonymous geologist going by the name John Jackson (Jackson 2012). His report highlighted the RIS issue as a major risk to the continued plan to build more dams across the western parts of China - particularly in Yunnan and Sichuan provinces. I interviewed Jackson in October 2013.⁹⁶ During our interview, he related to me that the basic reason he wished to remain anonymous was that bringing up this issue in China had earlier led to Yang Yong being put under house arrest for six months (INT20131001). Jackson didn't want to draw attention to himself. He was asked by Yang Yong to write a report about RIS because, according to Jackson:

⁹⁵ Often divided as NGOs listening to Yang Yong and industry listening to Zhang Boting, although during my fieldwork I found that it was not that simple (FN201306; FN201307; INT20130709).

⁹⁶ After months of asking informants from different NGOs if they could put me in touch with him, I finally got to interview Jackson via Skype in October 2013.

“ (...) it would be really helpful if we had a report published outside of China, that we could get translated into Chinese and then published in China, because it would have more credibility if it came from a foreign scientist” (INT20131001).

According to Jackson, Yang Yong thought a report written by Jackson or one of his colleagues would help him and Fan Xiao in their endeavor to get into dialogue with the Chinese authorities on the subject of the risk of earthquakes in relation to dams. In the end, Jackson agreed to write the report. He agreed to write it, because no one else would. According to Jackson, other people were asked but were not willing, either because they thought it was going to cause personal problems for them or because it was not going to make any difference in terms of impact on the authorities. Thus, one person asked had, according to Jackson, said “... it’s a waste of time, the government is going to ignore it” (INT20131001). Jackson, however, thought that either way someone should do it: “... well maybe it will make a difference and it’s worth my time” (INT20131001) and being anonymous would then keep his person out of it (INT20131001). Earlier in the chapter we saw that Dr. Klose was personally affected by his public scientific statements. Therefore, being anonymous had the advantage that it provided some measure of protection from personally being affected by questions including the scientific quality of your work and your affiliations.

The John Jackson report came out translated into Chinese in November 2012 concurrent with the leadership transition from Hu Jintao to Xi Jinping

“... so it got lost in the noise. That was a much bigger front page issue than earthquakes and dams” (INT20131001).

Jackson also remarked that:

“Eventually we tried to get some response from the Chinese government but it was totally negative, they just panned the report altogether.... they said our dams won’t fail. And that... we know where all the earthquakes... where are all the faults are... and we didn’t build our dams on any faults. Yeah and that’s not true at all... they don’t know where all the faults are because nobody does ... some of them haven’t been active, so we won’t know where they are until they are active” (ibid).

Although the report apparently did not have much impact on the Chinese authorities, it was often referred to in NGO circles and during interviews with NGO representatives during my fieldwork. Thus, the report became influential as a piece of work deemed independent from government interests and thus influential for international and national NGOs in terms of having independent foreign scientific backing for their arguments. The fact that Jackson was to be kept anonymous and the report was apparently publicly ignored only seemed to add to its credibility in those circles (FN201305; FN201306; FN201307).

The story of the John Jackson report illustrates the apparent gap between the credibility of different organizations – here the central government or international NGOs – as to the source and validity of expertise. It seems that the criteria for determining the credibility of expertise are vastly different for the government and international NGOs respectively. What is at play here then? Why won’t the government listen and why are international NGOs so certain about trusting these few experts?

RIS as an unsuccessful anti-dam argument in China

Chapter 3 took a tour through the development of science-politics relations in China over time through a description of changing leadership constellations and the overall policy trends towards intellectuals and scientists in the different leadership periods. Far from being a linear story with consistent views of science in the different periods, the chapter nevertheless highlighted the interesting trend that since the 1980s scientists and technical specialists have increasingly been integrated not only into the bureaucracy, but also the top leadership. Why is it then, that e.g. international NGOs and journalists remain skeptical about the government's ability to make 'unbiased' decisions? Particularly, as the bureaucracy and the top leadership is well educated and should appreciate and understand the necessity of unbiased research. The inherent norm in western science is to strive for unbiased and independent research and not letting special interests or personal concerns impact on research results or research processes. In China, the same norm seems to be adhered to, however, the fact that the party by definition is above all else seems to be causing skepticism notwithstanding the underlying norms of science being preached by the leadership.

This might be one of the underlying factors in the need for reports written and published outside China, because foreign scientists are perhaps thought of as adhering to these western science norms, and this lends credibility to their publications (INT20131001). The main point of the John Jackson report was to sway a Chinese audience – not an international one. Here with what we could call a 'credibility of foreignness' attached to it with all the norms and values attached to this idea. Thus, if coming from a foreign scientist it would by definition be unbiased and scientifically credible. But it didn't work. Why? Mr. Jackson had a somewhat blunt way of explaining the failure:

“It works in America because we can vote, it doesn’t work in China”
(INT20131001).

The RIS argument is a good way to illustrate this point. RIS as an anti-dam argument, both in the form of the Jackson report, but also as pushed by Fan Xiao and Yang Yong in terms attempting to get into dialogue with the government to have a more open discussion about RIS in China. It does not seem to be catching on with the Chinese government in the way that Yang Yong, Fan Xiao and Mr. Jackson intended. Dams that are planned in earthquake prone zones are going ahead regardless. Furthermore, broader discussions involving e.g. NGOs or people like Fan Xiao or Yang Yong are not taking place in public or within the government bureaucracy. In the US, the RIS argument had previously worked, not only as an anti-dam argument, but also as an opener for dialogue with scientists and activists not part of the established system. According to Mr. Jackson:

“So I was involved in the United States trying to stop several dams and one of them was the Auburn dam, which is near Sacramento, the capital of California on the Auburn river, which is one of my favorite rivers and nearby there’s a big dam on the Feather river and that dam caused RIS, a small amount of damage just to building but no damage to the dam when it was being filled - Oroville dam... and we used RIS, and the fact that it damaged a few buildings at Oroville, to convince the government of California not to build the Auburn dam. It took a long, long time, like 20 years. The federal government agency, Army Corps of Engineers, really, really wanted to build the dam - that’s their job, building dams - and we did everything we could figure to stop that dam, we talked about environmental issues, we talked about water issues, all kinds of things and they managed to overcome all of those concerns except when we finally raised the specter that if the Auburn dam failed

due to RIS then Sacramento would get flooded and that was enough to scare them but only because of Oroville and the event there. Otherwise, I don't think we would have worked" (INT20131001)

After Wenchuan, the conditions of using RIS as an anti-dam argument are more or less the same as in the US context. Before Wenchuan, the letter sent to the government, with Yang Yong, Fan Xiao and others as signatories did not have much effect. Perhaps because a big earthquake had not yet occurred. This could be similar to the Auburn dam situation where the argument did not work until RIS had occurred at Oroville. If Zipingpu did cause Wenchuan, RIS would then be proven to have caused Wenchuan. Should this not have bolstered the RIS argument significantly in China?

The fact that RIS as an anti-dam argument did not work very well in China is perhaps not because the government is unwilling to listen, but because the government regards the risk of RIS in a different way. In listening to engineers, who it was shown 'compartmentalize' the risk of RIS as being outside the job of engineers, the government foregoes the policy option of *not* building dams in earthquake prone zones in China. This means that the risk of RIS becomes a risk that is contained by science and engineering. It does not matter if an earthquake is man-made or not, as long as dams are able to withstand them. Therefore, according to Zhang Boting, the discussion was concluded by Zipingpu and Wenchuan: "...then we had a 8.0 earthquake. So Zipingpu proved us right" (INT20130715).

Summing up

The intense debate about mass change on the surface of the earth under the Zipingpu dam, as discussed in Chapter 6, was an example of the way arguing about RIS in scientific journals went back and forth from 2008 to today. In the

present chapter we saw how this debate spread into mainstream media and turned the discussion about Zipingpu from the science towards the political consequences of dams triggering big earthquakes – thus intermingling with controversies over the political logic behind building dams in earthquake prone zones in China. Mixing with the scientific and public controversies were events prior to the Wenchuan earthquake: the history of Zipingpu (as described in Chapter 5) and technical bargaining over risk in major dam projects, exemplified by calculations of the risk of a major earthquake occurring at Zipingpu during the design of the dam, as analyzed in Chapter 7. Together the past four chapters make up a controversy study focused on whether the Zipingpu dam did, or did not, cause the Wenchuan earthquake. The chapters drew in perspectives from contemporary China studies and STS alike and showed that policy making around hydropower in China was not necessarily directly influenced by the scientific debate over Zipingpu but rather by how the scientific controversy intermingled with other contested issues in Chinese politics: issues of which experts to listen to and how to determine their credibility as well as risk calculation issues in relation to large construction projects. Ultimately, not much has changed with regard to China's determination to expand hydropower capacity and continue building dams. Hydropower is still at the top of the agenda in China in terms of securing green energy. Ultimately, the history of hydropower development in China, and the history of Zipingpu in particular, suggest that hydropower policy plans are not easily discarded. Hydropower as an option for stable energy supply in China can perhaps persevere in part due to this long-term perspective - regardless of how much scientific debate and how many new issue frames can be coined to counter such plans.

The present chapter showed that ideas of the impersonal ethos of science in many ways permeated the way experts were positioned in the public controversy over

Zipingpu and the debate over dam building in earthquake prone zones more generally. The separation of one's person from one's science was found important in relation to which experts were relied on by the Chinese government. Zhang Boting was one such expert whose affiliation bolstered his credibility. However, his insistence on mixing in what Yang Yong deemed 'political' issues – such as China's economic development – into 'pure' science arguments, discredited Zhang Boting with the 'non-establishment' e.g. NGOs. On the other hand, Dr. Klose and Yang Yong had their persons drawn into the public debate – effectively tying them personally to their science. Dr. Klose unwillingly, by the way he was discredited in the news, Yang Yong perhaps more willingly, in the sense that his personal independence bolstered his credibility to the 'non establishment' and some media. One of the points of Chapter 7 was that the trust in science by establishment scientists – who in this chapter has been exemplified by Zhang Boting – is so firm that it overshadows the fact that dams can cause earthquakes in and of themselves. In other words, dams designed and constructed according to scientific methods will remain safe. Having analyzed the public debate around Zipingpu, this chapter in many ways supports this argument as the public controversy over RIS at Zipingpu even after Wenchuan has occurred – contrary to an outcome in the US where a dam was cancelled – did not convince the 'establishment scientists', that the government primarily draw on, to reconsider building dams in earthquake prone areas. On the contrary, the soundness of their scientific dam building methods was only confirmed by Wenchuan.

Conclusion

This thesis was initially motivated by the idea of studying a controversy in China involving emerging science in a highly politicized context. The choice settled on taking the controversy over the Zipingpu dam as the empirical point of entry. This in turn, meant that the thesis spanned two disciplines: that of contemporary China area studies and that of the constructivist tradition of Science and Technology Studies (STS) - particularly controversy studies as developed within STS. Part I of the thesis, comprising Chapters 1 and 2, served the aim of describing how the thesis came about, outlining the methods employed, and positioning the two disciplinary traditions relative to each other. Part I thus outlined in which ways contemporary China studies and controversy studies in STS could contribute to each other conceptually. It was my contention that contemporary China studies, and particularly the notion of Fragmented Authoritarianism (FA), need STS concepts for more context sensitive analyses of the role of expertise in policy making. I thus argued that FA does not possess the conceptual vocabulary to explain the role of scientists and scientific expertise in technical disputes such as controversies and that drawing on STS could fill this gap. Conversely I argued that controversy studies in STS need contemporary China studies in order to study controversies in a non-democratic context such as the Chinese. This due to the fact that most studies in STS have taken the ('Western') democratic state as a given in their investigations of how scientific knowledge and political systems interact. Moreover, as China is becoming a significant player when it comes to scientific knowledge and technological development, I argued that the STS of tomorrow must be able to investigate the complex interweaving of science, technology and society into a non-democratic setting such as the Chinese.

So how did conducting a controversy study in a Chinese context fare?

Based on the contextualization of the controversy in Part II and the analysis of the controversy over Zipingpu in Part III of the thesis, it can be concluded that the controversy study approach as developed in the constructivist STS tradition fared quite well in combination with contemporary China studies. How so? First, because the notion of a controversy study is open and flexible enough to be ‘applied’ in a non-democratic context such as the Chinese in the sense that additional perspectives from contemporary China studies can be drawn into the analysis. Second, because the analysis of the controversy over Zipingpu has benefitted from drawing on concepts such as the inherent reflexivity about the researcher’s own role, about the fluidity of categorizations, and about how to approach the analysis of a scientific controversy. These have been important points to help open up the typical categorizations in FA to more detailed analysis of expertise in policy making in China.

Chapter 6 showed how this combination worked in practice in analyzing the scientific debate over Zipingpu. First, the analysis highlighted a classic point in controversy studies, namely that often actors in a controversy are in fact not arguing about the same thing. In analyzing the scientific debate in detail, it was found that the way scientific actors argued was more related to the *scientific field* they belonged to (e.g. engineering or seismology) than where they were working or which country they belonged to. This effectively broke up the categorization in FA based on the bureaucratic logic of “where you stand depends on where you sit” (Allison 1971 as quoted in Brødsgaard 2013). This meant that the logic of the FA categorization of the CEA as a government entity belonging to the ‘establishment’ could not account for the way CEA scientists argued in the scientific debate. Drawing on STS helped open up this categorization issue in showing that scientists at the CEA argued both sides of the debate. However, where FA made a contribution to the combination with controversy studies was in the understanding

of bureaucratic politics in China more generally. The analysis of the scientific debate in Chapter 6 also showed that arguing for Zipingpu having triggered Wenchuan could serve the additional purpose of ‘disciplining’ hydropower companies into complying with CEA regulations. This point was substantiated by Chapters 3 and 4. These chapters accounted for the historical conditions for the use of scientific and expert knowledge in political decision making in China and particularly how these historical conditions had influenced hydropower policy making in China over time. When the findings from chapters 3 and 4 were drawn on the analysis in Chapter 6, it was shown how bureaucratic ranking could make it difficult for the CEA to discipline hydropower companies into complying with regulations set by the CEA - particularly, as these companies’ ranking most likely only differed slightly from the CEA’s. Thus, FA contributed to STS in the sense that the deeper context of bureaucratic turf-wars helped unpack the scientific controversy further than STS would have been able to on its own.

Bureaucratic rank as a factor in pre-construction negotiations about earthquake risk at Zipingpu was examined closer in Chapter 7. Here the potential risk of a large natural earthquake occurring at, or near, the Zipingpu dam once built, was agreed on in a debate between the CEA and the Zipingpu Company. At this point in time the Zipingpu dam had not been built. The account of historical conditions leading up to the controversy over Zipingpu analyzed in Chapter 5 showed that the dam plan for Zipingpu was not only a project inspired by Mao, it was also inscribed in the high-priority central government reform program ‘the great western development campaign’ as one of ten key projects. In sum, the analysis of the historical conditions showed that Zipingpu was a project that the Chinese central government and Sichuan Province needed to have built. The stakes in the negotiation analyzed in Chapter 7 were therefore high. The analysis in this chapter showed that the Zipingpu Company was most likely in a favorable position to

influence the negotiation with the CEA so that a lower number for the ‘maximum possible earthquake’ than the CEA had initially suggested was settled on. Bureaucratic ranking was once again highlighted as a way the negotiation could have tipped in favor of the Zipingpu Company against the provincial branch of the CEA, regardless of the scientific evidence presented by seismologists on each side.

Chapter 7 and Chapter 8 in different ways showed that the risk of large dams causing earthquakes once built was, on the part of engineers, considered a risk that could be contained by engineering science. Chapter 7 showed that engineers played a key role as experts in assessing the risk of Chinese major dam projects. The chapter also uncovered how engineers made what was tentatively called a ‘compartmentalization move’ where the risk of earthquakes was divided into separate domains effectively dividing risk into what was the task of engineers and – perhaps more importantly – what was *not* the task of engineers. The science of building earthquake proof dams could then be taken care of within engineering science. This ‘compartmentalization move’ meant that it did not matter if an earthquake was man-made or not, as long as the dams built were able to withstand them. In this way, the risk of RIS was ‘compartmentalized’ as being outside of the discussion as it was not a task for engineers.

This point was substantiated in Chapter 8, analyzing how the scientific and public debate around man-made earthquakes affected hydropower policy making in China. First, Chapter 8 showed that the strategies used by different experts to gain credibility and legitimacy were important for their possibility to influence hydropower policy making. Particularly affiliation to well reputed universities or research institutes and being able to publish peer-reviewed scientific output were important measures for getting the ear of policy makers. Thus, the analysis of the public debate showed that experts in the form of engineers with affiliations to the IWHR and the CSHE were more likely to be listened to than experts possessing

other kinds of knowledge. The reason being, that engineers were able to contain the risk of RIS within their field of expertise. Thus the analysis in Chapter 8 showed how the ‘compartmentalization move’ on the part of engineers could be affecting policy making around hydropower in China. Thus, the fact that dams can cause earthquakes, as an anti-dam argument, did not work very well in China was perhaps not because the government was unwilling to listen, but because the government, in listening to engineers, forego the policy option of *not* building dams in earthquake prone zones in China.

In conclusion, this study gained some ground in showing that contemporary China studies can benefit from the reflexive analytical vocabulary of STS found in controversy studies. Nevertheless, controversy studies in STS could not stand alone in studying an actual controversy in a Chinese context. The study of the controversy over Zipingpu showed that STS could not account for the deeper context when analyzing a scientific controversy in China. Issues such as bureaucratic turf-wars, the importance of specific political reforms, projects and persons intermingling with the scientific controversy point to the importance for STS – and perhaps other fields of study focusing on China – to draw more on the area studies scholarship contemporary China studies provides in analyzing societal developments and heated debates involving scientific and technical issues in China.

As someone originally coming from China studies, STS has been the subtle wrench that has turned the way I see the world upside down. This has meant questioning my assumptions, embarking on fieldwork and following actors to places I never thought I would go. It has been an interesting, fun, frustrating and extremely educational ride. I would never have been able to conduct this study without knowing the Chinese language and many of the subtle things that come with it. Were someone to be inspired to conduct a controversy study on a new

techno-scientific controversy unfolding in China, my advice would be to start with the language. Learning Mandarin, as any other language, brings with it a broad cultural and historical understanding which is in many ways necessary to follow both the historical and presently unfolding conditions of controversies. Equally important, however, are technical and scientific languages and terminology as they lead into the heart of techno-scientific controversies. Thus, in studying controversies, cultural and scientific languages are intertwined and I find that it is the knowledge of them that helps untangle the ways in which controversies may come to shape policy decisions.

If I were to continue down this road and do more research on techno-scientific controversies in China, I would particularly want to engage with the *digital* approach to mapping out controversies. A whole branch of scholarship in STS focuses on systematically mapping controversies online and this approach could be an ideal supplement to the kind of fieldwork and archival research I have undertaken in this study. A logical next step for me would thus be to engage with this digital side of controversy studies more systematically and make an effort at learning the skills and the language(s) required to undertake such studies. In an age of ‘big data’ and an increasing reliance on all things online, understanding the interconnections between this way of representing physical phenomena offers additional perspectives to fieldwork and traditional research that may open more avenues into understanding the way science, technology, expertise and political decision making are interconnected. This study showed that you cannot apply a controversy study framework in China without drawing in, and taking account of, the deeper historical and cultural context. In the same way, this kind of work lies ahead for a digital mapping of controversies in non-democratic contexts such as the Chinese where online communities are tightly regulated.

Today, discussions of science and expertise fill the news daily. Much in line with many STS inspired studies, this study has shown that the way science, politics and expertise co-produce in China has deep roots in the Chinese historical and cultural context. This knowledge, combined with the controversy study notion that actors are seldom in agreement as to the nature of the controversy they take part in, can perhaps be extended into another theme for further research. When Chinese leaders say that science is of utmost importance for the future of the Chinese society what does that mean? Does it mean the same as when our prime minister in Denmark, or a European Commission spokesperson, utters the same words? Or are they in fact talking about different things? The implications of the findings of the thesis on, for instance, science policy could indicate that we do well in being more attentive as to which scientific fields are favored in making policy decisions. If different disciplines have different ways of arguing, are some disciplines better at communicating their science in such a way that policy makers tend to favor these perspectives when making decisions? What does that mean for the way for instance our science policies, environmental policies or our energy policies are made nationally and internationally? And what does that in turn mean for the way we order our societies?

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