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Initiating Transdisciplinary Research in China: A Case Study

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Abstract

Transdisciplinary (TD) research is increasingly being applied to resolve various problems associated with real-world situations and complex socio-ecological problems. However, TD research remains challenging, particularly when practitioners and researchers collaborate in cross-border and cross-cultural settings. In this study, we examine the factors that facilitated and hindered the formation of a TD research project in China by synthesizing the experiences of a team of international and local researchers, practitioners and stakeholders working together to promote earthquake resilience through the "Earthquakes without Frontiers" research project. Our findings suggest that the development of a TD research project in China requires *guanxi*, or relationships, in the local context. The factors that are most important in sustaining commitment and achieving the project objectives are the potential for new insights and unique learning experiences and the opportunity to take part in salient activities and events that engage stakeholders. However, political considerations and cultural differences can hinder the development of a TD research project. Although there are areas that could be improved in operating the Earthquakes without Frontiers project in China, it has laid a solid foundation for the development of other TD research projects in China.

Keywords: Transdisciplinary (TD) research; China, Facilitators; Hindrances; Earthquake resilience

Highlights

a) Analyze practical factors that facilitated and hindered the formation of a transdisciplinary research project in the Chinese context.

b) Describe step by step how a transdisciplinary research project is set up in China involving international and local researchers, practitioners and stakeholders.

c) Provide practical recommendations for future transdisciplinary practices in China.

Introduction

Contemporary challenges such as climate change, disaster risk reduction and urban planning are characterized by complexity, ambiguity and uncertainty, which Rittel & Webber [1] described as "wicked problems" that have no immediate or ultimate solution. Transdisciplinary (TD) research has become a popular tool for identifying possible solutions to the challenges of wicked problems [2,3]. TD research is a broad and vibrant yet also highly contested field [4]; consensus has not even been reached on its definition. The implementation of a TD research project requires various strategies to combine research, development and implementation [5]. A distinct feature of this approach to solving complex real-world problems is its context-specific negotiation [6].

The situation-specific circumstances of TD research are important determinants of its success or failure. The examination of practical factors in performing transdisciplinary research within a specific socio-political context is essential to its iterative process. For example, understanding the motivations and processes of different stakeholder groups working together in a specific country allows foreign collaborators from different institutional and socio-cultural settings to be better prepared. Thoughtful consideration of the obstacles and challenges encountered in empirical studies could also facilitate researchers and practitioners in better understanding the ways in which a TD project can be shaped for a particular field and adapted in a specific social-ecological-cultural context [3,7].

Despite contingency being essential in TD research, it remains common for practitioners to expand their knowledge of TD practices by generalizing experience to provide insights, models and approaches relevant to other contextual settings after careful validation and adaptation [8]. These generalized experiences are closely tied to issues that cut across the TD process, such as research framing, methodology, management, organization and coordination and trust building [9-13].

However, generalizing TD practices is not always helpful because the knowledge derived can never be independent of the cases that structure the field [5]. Contingent details (including surprises) and practical actions and solutions need to be appropriate for the particular circumstances and parameters, fit with stakeholder interests and conform to political conditions so that practitioners can operate saliently in respect to different contexts using TD strategies [5]. However, little attention is paid to the examination of circumstantial problems and solutions, particularly in the context of China.

A previous TD study in China suggested that specific methods were required to respond to the country's specific cultural, social and political conditions [14]. It is imperative to clarify, however, that TD research is not common in China. We suggest that identifying the facilitators and hindrances in the initial stage of developing a TD research project in a particular context can provide critical insights for researchers on when and how to proceed with the TD research process. This could minimize the risk of "re-inventing the wheel" when applying TD projects in the country. In this paper, we synthesize the TD experience of an international and local team of researchers, practitioners and stakeholders working in China on the "Earthquakes without Frontiers" (EwF) project, which aims to increase the earthquake resilience of the region. To begin, we present the conceptual framework underlying our empirical study and then describe the materials and methods. Next, we focus on the factors that facilitate and hinder the development of a TD research project in the context of China and discuss the impact of the project. We believe that this study's findings could have wider scholarly and practice implications for the development of TD research in China and beyond, particularly in developing countries that are emerging and facing a host of "tricky" issues.

Literature Review

Defining transdisciplinarity

The TD approach has become a basis of contemporary reflections on the forms of scientific research and organization, and on the nature of contemporary problems [15]. Transdisciplinarity was first termed by the Austrian astrophysicist Erich Jantsch as "the ultimate degree of co-ordination" and depends, *inter alia*, "on the mutual enhancement of epistemologies in certain areas" [16]. It emphasizes the articulation between disciplines rather than their relations to make it possible for researchers "to perform a transition to separate one types of knowledge from another while recognizing that part of this knowledge depends on models from other disciplines" [17]. The notion of articulation encourages researchers to interpret what they observe against the background of their own disciplines. Clarification of diverging definitions of values and measurements between disciplines becomes possible. For example, social scientists may misinterpret the term "uncertainty" in natural science debates as an indicator of scientific disagreement, not as an unavoidable data problem [18].

While transdisciplinarity integrates different bodies of knowledge, there is limited synthesis within the academic circle. Multiple sources of knowledge and ways of knowing are valued in TD research [19]. The notion of "transectorality" [20] underpins this problem-oriented approach. In a nutshell, the research process is both "horizontal and vertical" [6]. It is horizontal in the cooperation of disciplines at the *same* level during multi- and inter-disciplinary research, the involvement of different stakeholders in a local planning process and the cooperation of administrative bodies. It is vertical in the cooperation of disciplines at *different* levels, such as when scientific research is combined with best practices in the region and when NGOs and government agencies cooperate, and local communities interact [21]. It is understood that no interdisciplinary or TD researcher can be an expert in all fields [22]. In other words, the idea of an "expert" should be deemphasized as it impedes the integration and synthesis of the knowledge produced from different dimensions.

Multidisciplinarity (several disciplines working in parallel on a shared research interest but without interaction) and interdisciplinarity (different disciplines working together with the intention of integrating their results) may help us to obtain better and fuller answers to orthodox questions. Transdisciplinarity enables us to ask different questions [23] because it emphasizes transectorality, which distinguishes it from multidisciplinary and interdisciplinary thinking and practices [12,15,22-25]. However, it is imperative to note that multi-, inter- and trans-disciplinarity are complementary rather than mutually exclusive: without specialized disciplinary studies, there would be no in-depth knowledge and data [26] to serve as the foundation for transdisciplinarity.

Despite being broad and vibrant, TD research has been challenged [4]. There seems to be no complete history of the concept [27]. To date, there is still no consensus on the definition of transdisciplinarity, and the concept has shifted and expanded as it has developed. Jahn et al. [28] define transdisciplinarity as "a critical and self-reflexive research approach" (p.8) that emphasizes the importance of integration at epistemic, social-organizational and communicative levels with the aim of contributing to both societal and scientific progress.

This paper adopts Pohl & Hadorn's [29] conceptual definition of transdisciplinarity as a research approach that aims at identifying, structuring, analyzing and handling issues to

a) grasp the relevant complexity of a problem;

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b) take into account the diversity of life-worlds and scientific perceptions of problems;

c) link abstract and case-specific knowledge; and

d) develop knowledge and practices that promote what is perceived to be the "common good." It can be regarded as a comprehensive, multi-perspective, problem- and solution-oriented approach that transgresses the boundaries between disciplines and between science and practice [30].

This conceptualization is adopted because we believe that transdisciplinarity is an iterative process between abstract and case-specific knowledge. It is not an end in itself but a means for researchers and practitioners to explain a phenomenon and to address the complexity of a problem through the inclusion of descriptive, normative and practice-oriented knowledge [10]. It enables us to realize "*le tout est quelque chose de plus la somme des parties*" (the whole is greater than the sum of its parts) [31]. The "extra," or that which constitutes the whole, is made up of all of the articulations and interactions between the levels of reality established by disciplinary knowledge.

Contextualizing a TD research project

While TD research has been thriving and gaining institutional momentum internationally, a large body of empirical literature has been generated on how TD research projects are designed, organized and adapted to address a particular research topic. In general, the conceptual model for evaluating or tracking the progress of a TD project is based on the TD research process, which consists of three phases:

a) Phase A: collaboratively framing the problem and building a collaborative research team;

b) Phase B: co-producing solution-oriented and transferable knowledge through collaborative research; and

c) Phase C: (re-) integrating and applying the produced knowledge in both scientific and societal practice [3,29].

The shared examples of TD case studies around the world [9] involve a thick description of TD research projects concerning three key areas:

a) the way the genesis of a real-world problem is addressed;

b) the method of identifying and involving heterogeneous actors; and

c) the way deliberate change is made to strategic planning based on contingencies. All of these areas contribute to grounding concepts, methods, tools and standards for TD research [32], which facilitates problem recognition and problem-solving efforts. Moreover, practice-oriented knowledge has significant implications for how to meet the knowledge requirements for problem solving in the lifeworld [32] and allows researchers to think more systematically about the insights gained, which could be useful for evaluation [33]. These findings help to develop recommendations for further research relevant to the specific field, such as disaster management.

Applying transdisciplinarity to promote earthquake resilience

Earthquakes, like many other natural disasters, do not respect national borders or privilege particular social groups. Over the last century, advances in the scientific understanding of earthquakes have been translated into impressive resilience in a few places where their occurrence is frequent and well understood. Developed countries have the resources to invest in building resilience (e.g., the United States, Japan and Chile). Comparable advances have not, however, taken place in most parts of continental interiors. One reason is that many nations at risk have a low frequency of earthquakes. These countries are often also poorer, and their distinctive scientific and societal responses to earthquake hazards are insufficient to translate into effective resilience. In addition, the risks become more significant when a population migrates to vulnerable and hazardous locations, as earthquakes can occur in regions where faults are often poorly identified.

The current problem is thus complex and multi-dimensional. While populations are growing and urbanization is occurring at a rapid pace, it is common to find people living in non-earthquake-resistant structures, and hazardous infrastructures are still being developed even though they are located in high-hazard impact areas. The human and economic impacts of earthquakes are therefore significant, particularly in developing countries such as China. To alleviate the negative impact, governments urgently need to implement an efficient disaster management plan in tandem with enhancing the scientific understanding of earthquake hazards.

Building earthquake resilience can be considered a "wicked problem" [1], as socio-economic-political contexts are rapidly changing and poorly understood and, in particular, because it is not yet possible to predict earthquakes. These contexts make the problem more difficult to define and delineate from other, bigger problems (e.g., climate change and sustainable development). In addition, it comprises several sub-problems that fall into the domains of different disciplines (e.g., physical and social sciences) and sectors (e.g., governmental and non-governmental organizations).

The immediate consequence of these obscuring contexts is that the design and application of earthquake-resilient strategies becomes acutely ill-formulated. The information is confusing, as it involves many stakeholders and decision makers with conflicting values, and the way the complex anti-seismic system works can be daunting. Often, practitioners and researchers do not seem to have the analytical tools or the measurement techniques to explain and address the complex and multi-dimensional problem.

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TD research in China

In the case of China, not only is TD research uncommon, but the environment that enables TD research collaborations between and within the government and society is challenging, and the existing socio-political structure is not conducive. For example, the contemporary governance structure between the central government and decentralized local government does not facilitate cross-agency collaborations [34]. Under the rhetorical *tiao-kuai* relationship, individual offices within these bureaucracies are no longer beholden to superiors within local governments (*kuai*); rather, they are directly controlled by their functional administrative superiors (*tiao*) and have only a consultative relationship with their former local government bosses, which brings as many problems to collaborations between different public agencies (Mertha, 2005) [35].

Furthermore, the nature of the political structure has bred a "love–hate relationship" between the party-state and the proliferation of NGOs in China for decades [36]. Although the state–NGO partnership is developing, there has been a lack of meaningful collaboration between the state and NGOs in China in the past [37]. This is reflected in the Chinese government's official NGO policy as "nourishment, development, supervision, and regulation" *(peiyu, fazhan, jiandu, guanli*), where there is greater emphasis on regulation and supervision than on nourishment and support [38]. All of these issues may also account for the fact that there is no widely recognized translation for transdisciplinarity in Chinese. Developing TD research projects against this background in China could be difficult given that the situation-specific circumstances of TD research are important determinants of success or failure [39].

Against these challenges, we aimed to examine the facilitators and hindrances in forming a TD research project in China by synthesizing the experiences of a team of international and local researchers, practitioners and stakeholders working together to promote earthquake resilience through the EwF research project. As TD research encourages researchers to progressively share their meanings, diagnoses, values, interests and views, should be considered from different perspectives and cultures [6], exposing the facilitators and hindrances of TD practices in a given context where TD research is uncommon may enable researchers to track the progress of the project and may thus yield practical insights into the application of TD research processes.

Case Study Background and Methods

The earthquakes without frontiers (EwF) case study

Project overview

The EwF project is funded by the United Kingdom's Natural Environment Research Council (and Economic and Social Research Council). It is a five-year research project (2012-2017) that brings together natural and social scientists from Cambridge, Durham, Hull, Leeds, Northumbria and Oxford Universities and from the Overseas Development Institute and British Geological Survey in addition to collaborators in China, Kazakhstan and Nepal.

The project aims to increase resilience to earthquake hazards worldwide with three overarching objectives:

a) to provide transformational increases in the knowledge of the distributions of primary and secondary earthquake hazards in the continental interiors;

b) to identify pathways to increased resilience in the populations exposed to these hazards; and

c) to secure these gains over the long term by establishing a well-networked, trans-disciplinary partnership for increasing resilience to earthquakes.

Specific objectives for each of the focused countries were developed and identified over the course of the project in its first year. The objectives emerged from interactions between the disciplines represented in the "country team" and through engagement with stakeholders in the focus countries and with local partners.

Origin and evolution of the project

EwF was initiated by several natural scientists who had previously collaborated on other projects. After deciding to use a TD approach to meet the project aims, they started by reaching out to social scientists via personal connections within the UK. With both natural and social scientists on board, they then invited a policy specialist to the project not only to maximize the uptake and impact of research but also to guide the TD research process. Although the project focuses on China, Kazakhstan and Nepal, its partnership generated a trans-national network that links with other countries at risk of earthquakes in the Alpine-Himalayan belt (e.g., Kyrgyzstan, India, Italy, Greece, Turkey, Iran etc.).

In recognizing the potential challenges in achieving effective TD research, the following principles underscored the TD processes:

a) understand and respect each other's disciplinary values and perspectives on the research issues and develop a shared conceptual framework of the problems, how they can be addressed and, consequently, what actions and activities are required;

b) refine the project's research agenda with local stakeholders in each target country through processes that enable participants to step beyond their own epistemic backgrounds; and

c) reflect on the development of effective transdisciplinarity as a routine element of the team's meetings and reports to drive the learning process over the course of the project.

To maximize the uptake and impact of the project, a systematic and iterative approach was adopted in each country to:

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a) map the social and political landscape, including identifying key stakeholders and their modes of influences;

b) identify how the status quo needs to change to enable the desired outcome;

c) develop and implement strategies to achieve those changes; and

d) monitor progress and update the understanding of key factors and adjust strategies accordingly.

The coordination, integration and promotion of transdisciplinarity within each country are overseen by a triumvirate comprising representatives from the social sciences, natural sciences and transdisciplinary streams. The triumvirate was established to ensure clear roles, responsibilities and management arrangements to develop and oversee the iterative approach outlined above within the project in each country. This ensured that fieldwork was organized wherever possible to enable mutual learning and cross-fertilization.

Organizational structure of the EwF (China) team

The UK-based triumvirate that oversaw the project in China comprised eminent researchers and practitioners from different countries with varied cultural backgrounds. The leader of the natural science strand is a Professor of Geology in the Department of Earth Sciences at the University of Oxford. He works on several aspects of tectonics and has been involved in research in Greece, New Zealand, Italy, Turkey and Iran. The leader of the social science strand was born and raised in Canada and is a Professor in the Department of Applied Social Sciences at Durham University and Head of the Disaster Intervention Committee of the International Association of Schools of Social Work. The policy specialist who leads the work on maximizing the uptake of the research findings into policy and practice has lived and worked in Africa and Asia for most of his life. His experience working on a range of projects related to the application of knowledge to solve complex problems led to the development of the Research and Policy in Development program at the Overseas Development Institute, which aims to improve the integration of evidence and knowledge by policy-makers and practitioners. They are supported by five scholars from the UK with varied professional backgrounds. In addition, a social work academic at the Hong Kong Polytechnic University with vast experience working in the disaster management field in China has been engaged since the beginning to act as a conduit between the UK and Chinese scholars. When the project started, the first collaborator that EwF (China) identified in mainland China was the Director of the China Earthquake Administration Institute of Geology, who has on-going working relationships with the UK seismologists. A launch event and several field trips in Xi'an and Beijing were organized in early 2013 for the project to identify and engage local collaborators. Each meeting and field trip were attended by about 10 Chinese scholars from the China Earthquake Administration and Beijing Normal University, a sizeable group of officials from government organizations (e.g., Ministry of Civil Affairs), practitioners from non-government organizations (NGOs) and universities. In addition, the team actively engaged the other stakeholders such as residents from towns and villages in the study site of Shaanxi Province in China.

Methods

To document the TD experiences of the EwF team in China, this study adopted a descriptive qualitative approach using a semi-structured questionnaire to yield useful insights and an in-depth understanding [40].

A semi-structured questionnaire was designed by the investigators in the last quarter of 2015 to assess the EwF (China) project members' understanding of

a) the facilitators and hindrances in doing trans-disciplinary research in China; and

b) the impact of these practices and challenges on the TD team in achieving the common research objectives at the initial stage of TD research.

Data collection occurred from mid-December 2015 to early February 2016. The computer assisted qualitative analysis package NVivo was used to aid the content analysis of the survey data. Specifically, the coding process involved reading each collected questionnaire and assigning codes to sentences, paragraphs and sections of the responses by the research team. All of the codes were organized into themes related to specific questionnaire items according to the objectives of the initial phase of the project: to identify the facilitators of and hindrances to developing a TD research project in China.

The study and access to the sample were approved by the Human Subjects Research Ethics Committee of the Hong Kong Polytechnic University (No. HSEARS20150503001). Informed consent was obtained from the participants, and the confidentiality of their data was assured; in particular, the survey contents and data were not discussed with any of the members, and participants had the right to withdraw from the study without any negative consequences.

Table 1: Background of EwF (China) team members.

Participant	Gender	Discipline	Country
1	F	Social Scientist	China
2	M	Natural Scientist	UK
3	M	Natural Scientist	China

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4	M	Practitioner	China
5	F	Natural Scientist	China
6	M	Natural Scientist	UK
7	M	Practitioner	China
8	M	Natural Scientist	China
9	M	Practitioner	China
10	M	Practitioner	China
11	M	Social Scientist	UK
12	M	Practitioner	China
13	M	Practitioner	China
14	M	Practitioner	China

Results

In this section, we present the empirical observations from the EwF China team members. We sent out a total of 19 questionnaires to members of EwF (China). Eventually, 14 participants took part in the study, and all 14 questionnaires were usable for analysis. The response rate was about 74%. Table 1 presents the profile of the respondents who completed the semi-structured questionnaire.

Next, we outline the facilitators of conducting TD research in China, followed by the obstacles and challenges to developing the TD research project in this case study. Wherever possible, all observations are supported by quotes from the questionnaire.

Facilitating factors in developing a TD research project in China

Building a TD research team

TD collaboration is not common in China. When collaborations are engaged, "they are only formed under the pressure of the government" (Participant 7). There is usually little autonomy, and the collaboration is inorganic. "Few researchers in China are aware of the importance of the TD method" (Participant 12) and its potential to "generate outputs with real impact" (Participant 9). Given this background, what factors facilitated the formation of the EwF (China) team ?

A majority (43%) of the respondents expressed that having *shared interests and goals* for increasing earthquake resilience among members helped to form the EwF (China) team. *The composition of the team* (36%) with different backgrounds was also a facilitating factor that led to the team formation. Other factors included the attractiveness of *EwF resources and the project goals* (29%) and the *individual qualities of EwF members* (21%). Moreover, *collaboration opportunities* (14%) and *spending time together as a team* (14%) were considered constructive elements that brought the EwF (China) team together.

EwF comprises a consortium of eminent local and international researchers and practitioners in their respective fields. This represents a resource that is "complementary in that there are different areas of professional knowledge and research skills" (Participant 9). It also has a pool of attractive talents and qualities, including coordination capabilities and energy and passion for increasing earthquake resilience. Moreover, EwF brings opportunities that are new in China. For instance, one of our participants revealed that being involved in EwF as a young scholar was possible because one of the project's aims is to promote the development of young scholars. For others, EwF offered the opportunity to enhance their individual skills and career development. Some of the participants indicated that one of the factors that facilitated the TD team formation was the opportunity for collaboration across sectors, i.e., between the government and tertiary institutions and NGOs.

Initiating TD collaboration

There were three ways that EwF (China) team members became involved in the project. The most common was through *personal ties with EwF principal investigators and team members* (50%), followed by *receiving an official invitation from the EwF* (29%).

Facilitation through personal ties meant that these members were engaged in the research project either due to direct association or through referral by a collaborator in China. For instance, one of the participants expressed that:

Through participating in the seminars organized by EwF in 2014, I met an EwF team member together with our Director. We then learned more about EwF. Owing to my professional needs, I then joined the EwF (China) team and was engaged in a wide range of EwF activities. (Participant 10).

It is noteworthy that approaching a higher level of government officials in China at the initial stage of the project facilitated the building of networks and engaging different stakeholders as the project developed. The personal connection with the director of the China Earthquake Administration Institute of Geology enabled EwF to develop smoothly in China, although the environment is less open to international non-governmental organizations and there are tight regulations on foreigners working in China [41,42]. By working closely with a national governmental

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body, EwF gained more "legitimacy" to work with the local government at provincial levels and with NGOs.

Mechanisms for TD integration

Eighty-two percent of respondents indicated that the field trips helped them to get to know the others better. Field trips required members from different sectors, fields and regions to come together as a team to learn. It also provided a common reference point for discussion and facilitated cross-disciplinary dialogue. The field trips allowed formal and informal discussions to take place between members. Traveling together "allowed the team to spend a lot of time in each other's company, so much was learned from our interactions" (Participant 2).

Some respondents specifically mentioned the Writeshop (36%), which was a three-day event at which government, NGOs and tertiary institutes came together to produce a publication focusing on the pathways to promote earthquake resilience [43]. Others also found annual meetings in different countries and workshops (36%) helpful, such as one conducted on "How to apply participatory action research." Informal events, such as socializing through visiting places of interest (18%), were also found to help team members get to know one another.

Hindering factors in developing a TD research project in China

The heterogeneities of the team (27%), inadequate communication (27%) and inadequate adherence to the TD principles of working together (27%) were considered to be the three main obstacles to building the team. Eighteen percent of respondents suggested that personality clashes were an impediment to the project. In addition, an external factor of political constraints (9%) in China was pointed out by a participant as an impediment to the formation of the EwF (China) team.

Cultural differences between team members in terms of language and ethnicity were considered to "impede mutual understanding" (Participant 1). At the same time, the involvement of different disciplines and professional orientations (research versus practice) were also described as hindrances for reaching mutual agreement.

A majority of participants indicated that there was inadequate communication within the TD team. This meant that some of the researchers were unaware of the latest developments in the project. One of the participants stated that "the division of labor is not clear, and there is little mutual understanding of each other's expectations, roles and responsibilities, as they were not clearly defined when the team was formed" (Participant 7).

Moreover, as EwF (China) is a cross-border research project, the different work styles and systems exacerbated the organizational and coordination challenges. For example, one participant reflected that there were different administrative and financial procedures between partners that could be challenging to comply with.

The volatile dynamics of a diverse group cannot be taken for granted, as our project shows that personality conflicts compound the complexities. One expressed that:

There are bound to be challenges because of the different disciplines and people making different assumptions and speaking different languages, but this has been compounded by differences in personality. (Participant 6).

Some participants suggested that there was room for improvement in the frequency of interaction, process of implementation and the approach to work in forming the team. They reflected that *more regular interaction* (62%), *greater solidarity within the team* (31%) and *better implementation of the project* (23%) may have enabled better team building.

Impact of EwF in China

Despite the difficulties and challenges, EwF has achieved much more than expected in the face of all of the contingency challenges in the Chinese context. First of all, the project enabled people in China to explore the potential of transdisciplinarity. The experience of working in EwF facilitated a better understanding of the possibilities and ways in which transdisciplinarity could be contextualized in China. One of our collaborators in China defined the concept as follows:

[Transdisciplinarity is an approach that] could account for the strength of each member. It bridges the gap between research and practice. At the same time, it integrates different methodologies and analytical approaches. This rendered [the process and the output] to be more comprehensive ... and more convincing. (Participant 14).

Our participants also reflected that there were no apparent restrictions on its application because the TD approach is still new and not commonly adopted in China. Due to its rare adoption, "Chinese people find it interesting and are willing to take part in it" (Participant 9). Meanwhile, Chinese stakeholders can refer to the established practical experiences and skills from the West and, given time, the Chinese will be able to share their experiences and practices once they have built a good number of cases.

Furthermore, our participants identified three areas where a TD approach could plug the gaps of at least three issues related to TD practices in China. First, the majority of participants expressed that the TD approach is effective in integrating resources and knowledge in China. As transdisciplinarity exemplifies heterogeneity and multidimensionality, it has the ability to bring various disciplines and stakeholders together, such as through workshops and seminars, which is uncommon in China. TD can thus effectively integrate information and knowledge by creating a platform for the cross-fertilization of ideas across disciplines and sectors, particularly among NGOs, government departments and academic institutions. The enhanced knowledge gained from mutual learning could, for instance, serve to improve the quality of social services in China.

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Second, the participants suggested that the practice of TD allows knowledge gaps to be mitigated in China. On the policy level, TD could "address the [implementation] gap between top-down and bottom-up levels in China" (Participant 1). The gaps between disciplines could also be narrowed through the initiation of cross-disciplinary dialogue, which facilitates researchers to explore and cultivate commonalities on a common topic. In turn, researchers may "understand a problem from a different perspective and seek solutions for a social problem based on a different angle" (Participant 12).

Third, TD research facilitates the focus on practice at the local level in China. This emphasis on locality allows local government and the China Earthquake Administration to take on the ownership of research rather than it being determined by the authority or outside agencies. At the same time, the agenda and concerns of local actors and stakeholders, in this case NGOs, local governments and the China Earthquake Administration, could be attended to and addressed in a straightforward manner. In addition, having a clear focus on the local level enables researchers to "decide whether the knowledge is effective in mitigating a local hazard" (Participant 2).

The EwF (China) project has laid the foundation for the development of at least one other TD project in China: Pan-participatory Assessment and Governance of Earthquake Risks in the Ordos Area (PAGER-O). This is a three-year (2016 to 2019) project that is co-funded by both the Chinese and British governments to bring together natural and social scientists with policy makers, practitioners and local communities using a pan-participatory approach to identify and fill knowledge gaps and co-produce evidence-based approaches to reduce risk and increase resilience to earthquake hazards. It will extend the reach, depth and impact of EwF and expand the research beyond the rural setting to the urban setting, involving more stakeholders both locally and internationally. This new project also provides us with the opportunity to apply the TD lessons learned in EwF (China) when it ends in the third quarter of 2017.

Discussion and Practical Recommendations

Our study aimed at identifying the factors that facilitated and hindered a TD research project in China. The results provide several key lessons.

First, it is necessary to recognize the key cultural element that underpins all practices in China. *Guanxi* is a unique form of social capital common in Chinese societies. A *guanxi* network is defined as a group of people connected by particularistic interpersonal ties, which are cultivated and maintained through trust, obligation and reciprocity [44]. It is the key element that facilitated the formation and maintenance of our TD research team. While *guanxi* could help in identifying and bringing in potential collaborators, it requires time and effort to develop and cultivate, formally and informally, through different platforms.

The willingness of members and collaborators to spend time together and be patient with each other during the preparation phase were also crucial factors in determining the success of a TD project in China. Other recommendations include providing the team with dedicated time to spend on strategic planning; starting an open dialogue between disciplines during the early stages to help them understand each other's approaches; and ensuring that practitioners and researchers get to know one another. Dedicated time during the preparatory stage enables team members to better appreciate each other's differences and hence make better use of each other's strengths.

Consistent and regular communication within the team throughout the TD process is also an essential part of an effective team. Various forms of interactions, both formal and informal, were recommended by our participants, including research training workshops, writing together, team meetings using social media such as Skype and using email to establish a project communication platform. In addition, in a TD setting, communication must be intense and ongoing if it is meant to achieve integration or exchange among different viewpoints, interests, convictions and scientific paradigms [45]. Within a team, formal and informal discussions between members are important. In relation to TD study, it is in line with Farrell's [46] argument that while interactions within groups are essential, the one-to-one relationships between members may exert the most important effect upon creativity, and this kind of exchange between dyads or sub-group of members of a group provides an "instrumental intimacy" in which "each begins to use the mind of the other as if it were the mind of his own" [46]. It is therefore suggested that organizing meetings with each stakeholder at an early stage to attract their interest and recognize the value of getting together with others is the first step in making a TD project happen.

Effective management, iterative enhancement and cultivation of TD capacity and skills are deemed useful. At any stage of the project, there is a need for regular activities to facilitate mutual learning, the definition of shared goals, the creation of rules and boundaries for collaboration and integration, the management of complexity and heterogeneity, strategic planning and a balance between the personal attitudes and conflicts among researchers [39,47-49]. Having a local facilitator who is able to mediate discussions and cultural nuisances could serve to channel some of the doubts and worries of collaborators. Rhetorical and hermeneutical skills are needed to deal with the dynamics of communication in teamwork [6]. In a TD team, differences in epistemologies, research methodologies and approaches to questions must be bridged to achieve mutual understanding and to arrive at common resolutions, particularly when the team members work in different sectors (e.g., government versus non-government).

The beauty of transdisciplinarity lies in its heterogeneity and complexity. It pulls together various attitudes of researchers from different disciplines and sectors, who speak different languages

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and with different cognitive systems, to address a common research problem. There is a general consensus that diversity rather than conformity is more likely to produce novelty and quality in the form of outcomes [50]. However, diversity could also be the biggest cause of conflict and destabilization of a TD team, and it has implications for the sustainability and applicability of transdisciplinarity in a particular context (Table 2) [51-53].

Table 2: Practical recommendations for future TD practices in China.

Building a TD Team in China
Appoint a local facilitator to mediate discussion and cultural nuisances
Make use of existing personal contacts to establish networks in local areas
Organize individual meetings with each stakeholder initially to attract their interest in the project
Start a dialogue between different disciplines and professions at an early stage
Approach higher-level government officials at the initial stage of the project
Sustaining a TD Team in China
Mitigate conflict constellations
Maintain consistent and regular communication
Enhance and cultivate TD skills and capacities
Organize seminars and workshops to make visits worthwhile for local stakeholders

Conclusion

This paper contributes to the literature on transdisciplinarity by examining the factors that facilitate and hinder the adoption of a TD approach in the context of China. With the aim of filling the gap in TD research in China, we used the EwF project as a case study to synthesize the TD experiences of a team of international and local researchers, practitioners and stakeholders working collaboratively to enhance earthquake resilience in China. We believe that our findings will provide scholarly insights for the development of TD research in other countries, particularly in the developing world, where it is still in the earliest stages of development.

TD is understood simultaneously as an attitude and a form of action [6]. In this paper, we argue that the development of a TD research project in China requires the presence of *guanxi*. The ability to offer something new and unique and the organization of activities and events that make it worthwhile for stakeholders to engage are important factors in sustaining a TD project. However, political constraints and cultural differences may compound the complex management of such projects. Despite the challenges, the EwF project has laid the foundation for the development of other TD projects in China. The iterative learning process produced recommendations for future projects, which will ensure better preparation and the dedication of time and patience when adopting TD in a country where the practice is uncommon.

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