



ORIGINAL ARTICLE

On the other end of research: exploring community-level knowledge exchanges in small-scale fisheries in Zanzibar

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Abstract

Sustainability science has increasingly adopted more action-oriented approaches in an attempt to mobilise and implement a broad knowledge base to sustain human wellbeing and promote sustainable development. There is an increasing recognition of the importance of knowledge exchange (KE) between scientists and end users of research for enhancing social, environmental and economic impacts of research. Here, we explore the process of KE through close observation of two cases of KE between external PhD researchers and local actors in small-scale fisheries at the community level in Zanzibar, Tanzania. First, we address context by examining perceptions of research held by actors at community level and patterns of interactions and flows of benefits between external researchers and local actors including fisheries managers, local research institute as well as fishers and traders. Second, we unpack experiences of actors engaged in the cases of KE. The study draws attention to KE processes in the Global South and actors outside decision-making processes in fisheries management. The study concludes that as KE is a complex and dynamic process and that (i) history and relationships between actors shape the outcomes of KE, (ii) KE includes more than knowledge-based processes and outcomes because multiple incentives of different actors shape KE and how it is experienced and (iii) knowledge-based outcomes of KE are complex and unpredictable as different actors create their own meaning from shared information. The results exemplify the inevitably complex and unpredictable nature of KE processes and their outcomes, and provide insight into how KE can contribute to science–society relationships.

Keywords Knowledge exchange · Science–society interaction · Knowledge systems · Small-scale fisheries · Zanzibar

Introduction

Sustainability science scholars have increasingly focused on bridging science and decision making, as this is considered key to sustainability (Cash et al. 2003; Clark et al. 2016;

Cornell et al. 2013; van Kerkhoff and Pilbeam 2017). This is based on the normative assumption that research should have impact in society. Sustainability science has even been described as “fundamentally interventionist” (van Kerkhoff and Pilbeam 2017) as it has adopted more action-oriented approaches to enhance the role of science in decision-making (Clark et al. 2016; West et al. 2019). Scientists are increasingly participating in activities beyond knowledge production such as multi-way interactions and knowledge co-production with decision makers and other beneficiaries of science (Fazey et al. 2013; Lemos et al. 2018; Singh et al. 2014). Folke et al. (2005) link the shift in researchers’ roles to rapid environmental changes, which demands researchers to deliver knowledge to managers instead of maintaining their position as objective and detached specialists.

Critical approaches to understanding the role of science in environmental decision making are concerned with power relations as well as desirability and efficiency of science in decision-making (van Kerkhoff and Pilbeam 2017). Western scientific knowledge has a multi-dimensional relationship

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with non-Western contexts, such as the East African fisheries investigated in this paper, playing out in complex and asymmetrical power relations and often in light of colonial history (Hoppers 2002). Accordingly, different kinds of scientific knowledge are situated in specific socio-political and cultural contexts and thus are value-laden in nature (Bäckstrand 2003; Hoppers 2002). Therefore, relationships between research-based knowledge and action are embedded within larger power structures that change over time (van Kerkhoff and Lebel 2006), and understanding these relationships requires examination of the socio-political context in which the generation and use of scientific knowledge are situated (van Kerkhoff and Pilbeam 2017).

These challenges have stimulated a growing literature examining how scientific knowledge bridges to policy arenas (e.g. Cornell et al. 2013; Cvitanovic et al. 2015a, b; Raymond et al. 2010; Roux et al. 2006). The gap between academia and the “real” world is widely recognised as the science-policy or science–practice gap, and discussed, for example in conservation science (e.g. Boreux et al. 2009; Gallo et al. 2009; Kirchhoff et al. 2013; Lemos et al. 2012). However, the metaphor of a science–practice gap has come to be considered as simplistic and problematic, as it ignores conflicting values, complex and dynamic relations and varying capacities that always exists when science and society interact (e.g. Cvitanovic et al. 2015a, b; Toomey 2016; van Kerkhoff and Lebel 2015). Thus, ideas of linear knowledge transfer are increasingly replaced by more complex understandings of knowledge exchange (KE) as a two-way exchange (Fazey et al. 2014, 2013; Roux et al. 2006) that needs to be studied as a process (Fazey et al. 2014). Consequently, a range of obstacles to efficient KE have been identified, including factors such as cultural differences between researchers and decision-makers, different worldviews and perceptions of knowledge and how it can be generated and transmitted, institutional barriers, and mismatches between societal knowledge needs and research design (Cvitanovic et al. 2016; Nguyen et al. 2018; Raymond et al. 2010). Proposed strategies for successful KE thus include engagement of stakeholders from early stages of research process, using third parties such as boundary organisations and knowledge brokers, and long-term knowledge management—often referred to as co-production of knowledge or participatory research (e.g. Cook et al. 2013; Cvitanovic et al. 2016; Philipson et al. 2012; Reed et al. 2014; West et al. 2019). Guidelines to help researchers navigate the knowledge–action landscape and KE in environmental management are emerging (Nguyen et al. 2017; Reed et al. 2014). They illustrate the need for both theoretically advancing understanding about KE processes and practically guiding researchers in the implementation of KE.

Addressing sustainability in fisheries requires researchers to implement appropriate KE so that a range of different

non-academic users are reached (Young et al. 2016b). Literature on KE in fisheries and marine resources has focussed on a narrow policy-science interface, largely in the Global North (Cvitanovic et al. 2015b). Recently, KE literature has expanded to include perceptions of end users of research, outside of formal decision-making processes, e.g. fisherfolk. Further, it draws on sociology of science to identify how normative expectations and knowledge claims may differ among authorities and other stakeholders (Young et al. 2016a). This opens up for further research to understand how KE in the context of fisheries management may play out in different geographical locations and under different conditions, for example in the Global South, where access to scientific knowledge may be limited and governance structures not so clearly defined (Cvitanovic et al. 2015b). Research by northern researchers in the Global South creates a particular setting for KE, which raises ethical considerations because of the exaggerated power relations and postcolonial contexts.

With this paper, we aim to contribute to sustainability science practice that makes scientific knowledge useable for broader sets of users, and creates conditions for shared learning among different actors, including researchers, in KE processes. More specifically, we add to the emerging literature addressing KE with local resource users in the Global South, by showing the effects of asymmetry between the actors involved in the exchange. We analyse two case studies of KE with local communities of fishers on the Unguja island of Zanzibar, East Africa, and address the context and different experiences and perceptions of the KE processes using a qualitative approach. This study provides empirical evidence of KE in a context in which, despite a vast number of fisheries related research projects, access to scientific knowledge is restricted—among local fishers as well as formal managers. We add to the KE literature by drawing focus on the contextual factors that shape outcomes of KE beyond the specific KE interventions.

Defining knowledge

We draw from constructive social science epistemology by defining knowledge as justified belief that is used to claim a truth and determined by acceptance of that truth in a particular context (Jacobson 2007; Nonaka et al. 2000; van Kerkhoff and Lebel 2006). Hence, in different contexts, knowledge takes different forms depending on the sets of criteria that the justification is based on (van Kerkhoff and Lebel 2006). According to Tàbara and Chabay (2013), information is turned into knowledge through meaning, which constitutes the possibility to “understand, intervene or resolve particular problems or address particular situations in meaningful or/and satisfactory ways”. Knowledge can thereby be recognized as multidimensional and context dependant, and it is

embodied in practices, tools, technologies and institutions used by different actors (Cote and Nightingale 2012; Tengö et al. 2017).

An analytic approach for studying interventions of knowledge exchange

We use three sets of literature in theorising knowledge processes to acknowledge complexity of knowledge processes: knowledge systems (KS), knowledge exchange (KE) and knowledge governance (KG).

Cornell et al (2013) conceptualise knowledge systems consisting of agents, practices and institutions, which construct the use, transfer and production of knowledge. Relationships within knowledge systems shape flows of knowledge, credibility and power (Cornell et al. 2013). Different actors can represent different knowledge systems, so that excluding certain actors can also mean excluding knowledge systems and kinds of knowledge (Tengö et al. 2017). Bridging and collaborating across different knowledge systems can support sustainable management of resources and improve governance (Agrawal 1995; Berkes 2009; Tàbara and Chabay 2013; Tengö et al. 2017). Simultaneously, coupling science with action and making better use of scientific knowledge in decision making is acknowledged as a key to sustainable development (Cash et al. 2003; Clark et al. 2016; Cornell et al. 2013; Fazey et al. 2007; Folke et al. 2005).

Knowledge exchange (KE) is a broad term that refers to “the process of sharing, using, and generating information through various methods appropriate to the context, audience and purpose of communication” (Fazey et al. 2013). KE includes concepts such as co-production, transfer, storage, transformation, integration and translation of knowledge and social learning (Fazey et al. 2014). KE as a research field is relatively new and it has often been presented as a tool rather than a complex and dynamic process with many uncertainties and interpretations (Cvitanovic et al. 2015a, b; Fazey et al. 2013). Such a perspective show how the ways knowledge is produced, shared and translated, as well as the social context where people learn about new knowledge determines if policy and practice are informed by science (Reed et al. 2014). Therefore, understanding habits and preferences of the actors turning knowledge into action is crucial for improving KE (Young et al. 2016b). Additionally, the concept of knowledge governance (KG) has been proposed to think critically about knowledge-based processes for sustainable development. KG is defined as “the formal and informal rules and conventions that shape the ways we conduct or engage in knowledge processes, such as creating new knowledge, sharing or protecting knowledge, accessing it and applying or using it” (van Kerkhoff 2014; van Kerkhoff and Pilbeam 2017). In this paper, we address this using an analytical approach bringing together conceptualisations

of knowledge processes in knowledge systems, knowledge exchange and knowledge governance literature.

According to Cash et al.’s (2003) work on KS, actors’ perceptions of the *credibility*, *legitimacy* and *saliency* of knowledge determine if knowledge will feed into action, particularly in interactions between science and policy. In other theoretical conceptualisations of KE, *relevance*, *legitimacy* and *accessibility* are named as factors that shape how knowledge translates into policy and action (Contandriopoulos et al. 2010; Reed et al. 2014). Table 1 presents how the three sets of literature talk about these central concepts. Examination of the different definitions reveals that the concepts are overlapping and not fixed across the KE and KS literatures. Legitimacy and credibility are similar in nature, particularly in the KE literature, and saliency and relevance are used as synonyms across literatures. KE has the additional focus on accessibility, which does not feature in the KS work. Kerkhoff and Pilbeam (2017) instead operationalise KG to study the socio-political context utilising Cash et al.’s conceptualisation of KS.

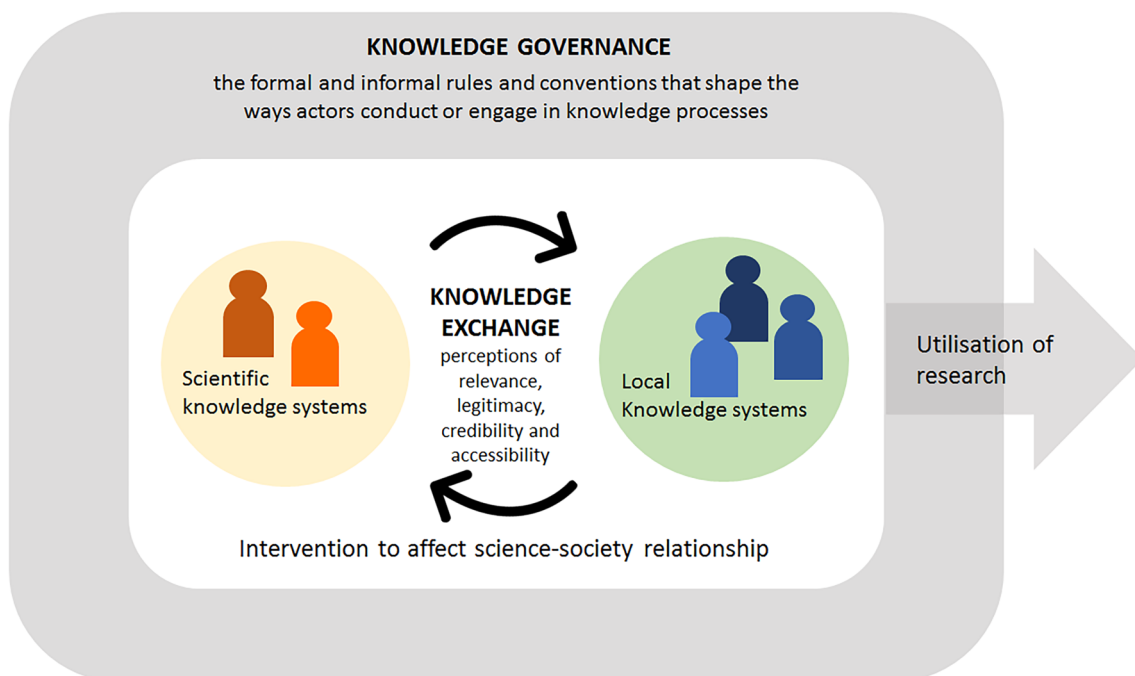
Figure 1 illustrates the analytic approach used in the study. Interactions between scientific and local knowledge systems in KE interventions are embedded in a KG context, and utilisation of research is determined by perceptions of *relevance* (as usefulness and actionability of information), *legitimacy* (as representativeness of different views), *credibility* (as trustworthiness of information) and *accessibility* (as availability and access to information) of new information. In this study, KG is used to emphasise the importance of contextual factors that shape KE and situate the interventions in greater institutional rules and norms. Based on KG literature, KE is conceptualised as an intervention, an attempt to affect science–society relationships.

Materials and methods

We use a case study approach (Yin 2014) and investigate the context and perceptions of KE in two cases from Zanzibar, Tanzania, East Africa. In both cases, the KE intervention was run by a Swedish-based researcher engaging with fishers in local communities to feed back the results from their research. The two interventions were of different kinds that we refer to as community dialogue and science outreach. We used qualitative semi-structured interviews and participant observation. Qualitative methods have been used to study different knowledge-related processes as they enable gaining an in-depth and rich picture of societal dynamics and decision-making processes (e.g. Ballard et al. 2008; Taylor and de Loë 2012). We applied an ethnographic approach in the qualitative data collection, in the sense that we also observed behaviour, listened to conversations between others and asked questions outside the set interviews, which

Table 1 Definitions and use of legitimacy, credibility, relevance, salience and accessibility in knowledge exchange, knowledge systems and knowledge governance literatures

Field of literature	Knowledge exchange (KE)	Knowledge systems (KS)	Knowledge Governance (KG)
Author	Contandriopoulos et al. (2010)	Cash et al. (2003)	Kerkhof and Pilbeam (2017) based on Cash et al. (2003)
Legitimacy	Legitimacy is defined as the <i>credibility</i> of information. Credibility is not included as an independent concept	Legitimacy is perception that the production of information and technology has been respectful of stakeholders' divergent values and beliefs, unbiased in its conduct and fair in its treatment of opposing views and interests	Where there are different concepts of public good or desired outcomes, whose dominates? Do science-based decision-making processes reinforce existing power relations, or challenge them? How do societal expectations of objectivity affect the role of science in decision making? Does science have a role in mediating conflicting societal views?
Credibility		Credibility refers to scientific adequacy of the technical evidence and arguments	Whose knowledge, or what kinds of knowledge, tends to be most readily accepted by decision-makers? What is the role of participation in supporting credibility? Does science-based knowledge have a role in formal accountability processes? Are there multiple accountabilities?
Relevance/Salience	Relevance is timeliness, <i>salience</i> and actionability of knowledge. Heavily context dependent	Salience is <i>relevance</i> of the assessment to the needs of decision makers	How visible are the knowledge-based needs of decision makers to researchers? What processes enable this visibility? Whose interests are included or excluded?
Accessibility	Includes dimensions such as formatting and availability of knowledge		

**Fig. 1** Theoretical framework. Interactions between scientific and local knowledge systems as a knowledge exchange intervention are embedded in knowledge governance and use of knowledge is deter-

mined by perceptions of relevance, legitimacy, credibility accessibility of new information. Not that each knowledge system is represented by persons that are the actors involved in the exchange

Table 2 Summary of the workshop types

Case	Case 1: Community dialogues	Case 2: Science outreach
Topic of presented research	Structure of the fisheries' value chain, including aspects of gender differences, actors' aspiration to change, the role of the tourism industry. Results from 8 sampling sites in Zanzibar and 15 villages in the Philippines	Perceptions of fishers, managers and researchers of different management options for seagrass-associated small-scale fisheries. Based on 108 semi-structured interviews and open and closed questioner questions with fishermen in 7 communities, 8 managers and 5 researchers in Zanzibar
Workshop design	A value chain 'map' depicting a typical fishery value chain in Zanzibar functioned as a base for the workshop. The researcher presented the information through data cards. Each participant got a paper figure that presented them. During the workshop, participants moved the figures in the value chain map for example in the nodes (e.g. fisher, trader, selling fish in urban/rural) they operate or would like to operate. Questions were asked throughout the workshop to hear participants' experiences and opinions. Participants could comment and ask questions at any moment	Workshop was based on presentation of a poster that presented the perceptions of different actors on different management options including measures such as education, temporary closures, no-take zones, mesh size and gear restrictions and minimum size of fish. Presentation was followed by an open discussion. Participants could comment and ask questions at any moment
Number of observed workshops and locations	7 Maruhubi, Mkokotoni, Nungwi, Uroa, Kizimkazi, Buyu and Kizingo	3 Mkokotoni, Fukuchani, Kendwa
Participants	11–20 participants Fishermen and fisherwomen and men and women traders (average ration ¼ women participants, varying from 0–50% of participants) Beach recorder present in 5/7 of the workshops	7–20 participants Only fishermen (no women interviewed in the study) Beach recorder present in all of the workshops

contributed to additional field notes and observation. We observed seven out of eight community dialogues and three out of seven science outreach workshops, since workshops were partly organised on the same days. Context interviews with range of actors were carried out before and after the workshops, and 1–3 participants were interviewed after each workshop. Thus, the sample per workshop is relatively small for inferring differences between workshops. Instead, results reflect the general experiences over the two different cases.

Study site

The two KE case studies concerned fisheries research and were conducted on Unguja Island in the administrative state of Zanzibar, located about 40 km off mainland Tanzania. In 1964, after over 70 years of British colonial rule, Zanzibar and mainland Tanganyika formed the United Republic of Tanzania. The population is mainly Kiswahili speaking and Muslim. Traditionally, the fisheries have provided an important livelihood and source of food and income to local communities (Lange and Jiddawi 2009). Expanding population, use of destructive gears and growth of the tourist industry have increased the pressure on marine resources, and management of fisheries has become more difficult (Jiddawi and Öhman 2003; Lange and Jiddawi 2009). The Department of Fisheries and Marine Resources (DFMR) is

responsible for maintaining and protecting small-scale fisheries, monitoring fish stocks and encouraging sustainable fishing activity. Their management strategies cover gear restrictions, marine protected areas and limitations on fishing techniques (de la Torre-Castro 2006). Beach recorders (*Bwana diko* in Kiswahili) are appointed in each village to monitor artisanal fishing and seaweed farming activities, record information on fishers such as gear use, enforce laws and serve as a communication channel for the DFMR (de la Torre-Castro 2006).

Two cases of knowledge exchange

The two studied cases of KE were organised and conducted by two European doctoral students (Table 2). The objective in both cases was to share research findings with the communities where the researchers had conducted research for their Ph.D. projects approximately three years earlier. The motive for the KE intervention was mainly ethical—a will to thank the communities and give something back to the participants in the research.

The two researchers used different approaches for their KE intervention. Case 1 used community dialogues approach. The workshops were implemented in an interactive manner where participants could share and validate their perceptions of shared information as part of the activities

Table 3 Overview of the different data types and sample sizes

Type of data	Clarification
Semi-structured interviews	With local academics ($n = 2$), who work with fisheries research and external researchers, beach recorders ($n = 6$), key informants in the small-scale fisheries (included 3 fishers, secretary of beach recorder/fisher, chair of fisheries committee/fisher, secretary of traders' cooperative/trader, $n = 7$), were identified with help of beach recorder, workshop participants (community dialogues $n = 12$, science out each $n = 4$) who volunteered after the workshops, external researchers ($n = 2$) conducting fisheries related research in Zanzibar
Observation	10 different KE workshops (7 community dialogues, 3 science outreach workshops) and one meeting with managers were observed as an outside observer. Participant observation was conducted throughout the whole process of planning and implementing KE, including the fieldwork period but also time before and after fieldwork
Group discussions	Two times with managers, first with 3 participants and then with 2. One manager participated in both discussions
Informal follow-ups	Some landing sites (Uroa, Kizimkazi, Maruhubi, Nungwi and Mkokotoni) were visited three months after the workshops. Visits included discussions with some workshop participants such as beach recorders, fishers and traders when they were reached

(Table 2). The aim of the intervention was to share the overall view of the fish value chain, as it had emerged in the research, to the fishers and traders. The researcher did not expect the results to be of direct practical use for the participants, as the research was designed for academia rather than end users, and no direct recommendations were presented. Case 2 can be described as science outreach workshops. In each workshop, a presentation of the researcher was followed by an open discussion (Table 2). The aim of this intervention was to provide the fishing communities that contributed to the research with a quantitative overview of what fishers thought about existing and other management options, as revealed in the research. The researchers in this case considered the research findings being more useful for the management level.

In both cases, the researchers designed and facilitated a workshop to reach community-level members who would not otherwise have easy access to scientific information such as scientific reports or publications. Participants were invited by the beach recorder of the respective landing site. The beach recorders were instructed either on phone or in a meeting in person to target the fishers and fish traders who had been interviewed for the Ph.D. projects. However, workshops were open for other fishers and traders to participate, and most participants had not participated in the research projects. For the community dialogues, the researcher asked beach recorders to encourage women fishers and traders to participate as the researcher knew that they would be harder to be reached. Women participated to varying degrees in community dialogues with half of the workshop participants being women at the highest and no women present at the lowest (Table 2). One of the observed community dialogue workshops included only traders and one only fishers. Otherwise the participants represented a mix of traders and fishers, and the exact division between occupations was not recorded. All the participants in science outreach

workshops were fishermen since only that actor group had been included in the research project (Table 2).

In each workshop, up to 20 invited participants were given 2000 Tanzanian Shillings (0.9 USD) as a compensation for their participation. In community dialogues, they were also served snacks and soft drinks. However, the workshop was organised in public places such as on beaches, and were open for other curious people to come and leave freely during the workshops and, therefore, workshops reached actors beyond invited participants. The studied cases included communities where many researchers are advised by the local research institute to conduct their fisheries-related research.

Qualitative data collection

The majority of the data collection took place during a one-month field trip in Unguja Island November–December 2017. The first author conducted participant observation (Bernard 2006) in the KE workshops (7 Community Dialogues; 3 Science Outreach workshops) to capture the interactions between researchers and participants and among participants. She also observed the two researchers in each case, in their planning and execution of the KE process before and during the fieldwork period.

Semi-structured interviews were carried out in different sets: (i) two sets of semi-structured interviews, before and after the implementation of the workshops, with the external researchers; and (ii) context interviews with key informants, including local academics, beach recorders, fishers and traders, local officials and managers; (iii) post-workshop interviews with workshop participants (see more details in Table 3). Furthermore, there was an opportunity to visit some of the communities three months after workshops, which provided some additional informal observation of people's perceptions of the community dialogue workshops.

For the semi-structured interviews, we used purposive sampling (Bernard 2006). In the context interviews, our purpose was to capture informants from important stakeholder groups, including beach recorders, local academics and management officials. In the workshop participant interviews, we interviewed participants who volunteered, and we could only reach people who stayed around after the workshops. We aimed at interviewing both women and men, and fishers and traders participating in each workshop (see supplementary material 1 for detailed information of sampling of interviewees).

We conducted interviews with local community members in Kiswahili with the help of translators. Interview guides were designed by the research team around the themes presented in the theoretical background of KE, KS and KG including topics such as legitimacy and trustworthiness of scientific information, information sources used in decision making and use of scientific knowledge in decision making (see Supplementary Material 2 for the different interview guides). The interview guide used after workshops was piloted with local students and with a participant of the first observed workshop. Other interview guides were modified according to important emerging topics during the fieldwork period.

Data analysis

We transcribed recorded interviews and digitalised notes from hand-written interviews, then thematically coded interviews with different code sets for the different research questions using qualitative data analysis software MAXQDA. The coding process was open to emerging themes not necessarily supported by the theoretical background (see Supplementary Material 3 for the coding structure). This can be referred to as abductive reasoning as the data analysis based on finding surprising empirical results against a background of existing theories (Timmermans and Tavory 2012). In addition to prominent themes, we focussed on more rare perspectives to map a wide range of experiences. Using data from different sources (interviews, observation and other field notes) helped to ensure validity of findings by triangulation (Bernard 2006) and diminished the risk for deference effect and social desirability bias (Bernard 2006; Denzin and Lincoln 2011). Hence, observation and informal discussions offered some more critical perspectives, which are also reflected in the results. The focal point of our analysis in this paper was interactions between external researchers and local actors. However, we acknowledge that interactions between local actors as well are essential in influencing KE and how it is experienced and, therefore, occasionally refer to these actor relationships.

Results

Context for KE: patterns of interaction and flows of benefits

This section describes the context in which KE processes took place in terms of interactions between researchers and different local actors, previous experiences of these interactions and perceptions of scientific knowledge.

We identified key actor groups and a set of interactions that form the context for KE. An overview is given in Fig. 2, which highlights parts of KG by presenting some of interactions between these actors manifested in flows of benefits. The knowledge governance context for fisheries research in Zanzibar depicts the flows of benefits between 6 key actor groups (a–f), and particularly to/from the external researchers (a). Key benefits flowing from external researchers to local actors include money, external contact and status (g–h). Key benefits flowing to external researchers include access for and facilitation of research and local knowledge and time participating in e.g. surveys (i–j). The flow of scientific knowledge to benefit management and to feedback to local actors has been limited (k). These relationships create the fundamental base for foreign researchers conducting research projects in Zanzibar.

Benefits are closely related to power relationships. Table 4 presents benefits exchanged and aspects of power in the relationship between external researchers and local stakeholders. Ultimately, researchers directly benefit through gaining degrees, publications, and creating an academic career based on knowledge extracted from local actors. As shown in Table 4, we also highlight the benefits local stakeholders may gain from interaction with external researchers in the researched context. Few of these benefits are knowledge based. The local actors in turn shape the research process and thus have some power—yet maybe marginal—over the processes.

Exploring perceptions of scientific knowledge and researchers at the community level

Beach recorders and other key informant interviewees stated that they generally trusted researchers and their knowledge since they can validate researchers' information by what they see in the environment, or because the changes they see in the environment are explained by researchers [BD2, KI2, KI3, KI4, KI5¹]. Also, research was perceived

¹ Citation to the interviews. KI=Key Informant, M=Managers, LA=Local academic, E=External researcher, BD=Beach recorder (Bwana Diko), IWS=Workshop type 1 participant, 2WS=Workshop type 2 participant (see supplementary material 4).

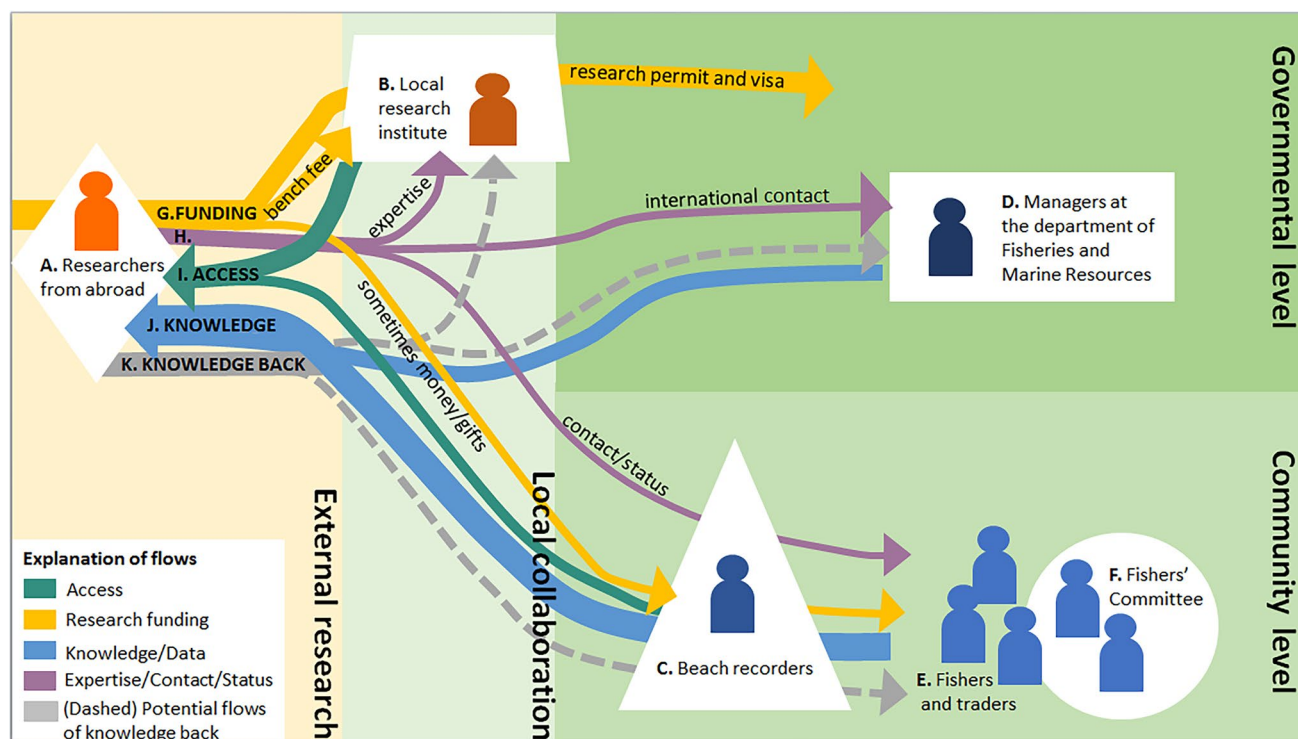


Fig. 2 Flows of benefits between external researchers and local actors. Funding for research projects is exchanged for access to research subjects. Sharing research findings with local actors is mostly missing. The figure was created based on interviews and field observation

trustworthy if it could be applied and was useful [BD4, KI4, KI5]. As noted by a few interviewees, this requires researchers sharing their results [BD1, BD6, KI1]. Research-based knowledge was considered useful in describing the system, increasing awareness, and providing knowledge about the environment and better ways to do fishing or trading activities [BD1, BD3, BD4, BD5, KI1, KI4]. Science was seen as having modern and technological aspects, which can offer more efficient or environmentally friendly ways to support livelihoods, compared to the local ways of practising activities [BD4, KI7, 1WS2, 1WS11]. Researchers were linked to possibilities for learning, creating solutions and exchanging ideas [BD1, BD2]. Some of the interviewees even hoped to have more contact or training with researchers [BD2, KI1, KI3, KI5, KI7]. Researchers were also seen to function as a link between local and other actors such as managers or NGOs which could lead to benefits to communities [KI3, KI7].

Signs of research fatigue

Signs of research fatigue became evident through interviews. In most of the communities, fishers, traders and beach recorders generally recalled no researchers or only a few ever coming back to share their results in spite of “too many” researchers conducting research in their villages. Hence,

some of the interviewed fishers and beach recorders felt that fishers did not get anything back from the interaction [BD3, BD6, KI6, KI7]. Simultaneously, students and researchers were considered to benefit from the interaction as they could collect data for their degrees [BD6, KI6].

External researchers and a local academic reported that in some communities researchers need to pay for the participation in research projects, or research cannot be conducted at all [E1, E2, L2]. One of the interviewed beach recorders described a change in people’s attitudes with regard to payment:

They [fishers] are not tired [of participating in research projects]. They are really interested to have contact with the researchers. But nowadays, something has changed. They need something, like to get money. So, they become very happy that researchers are here with them.—Beach recorder [BD5]

The comment reflects a typical narrative regarding possible research fatigue: many times, interviewees insisted that people like to have contact with researchers but this was often conditional on getting something in return. Expectations of benefits were often expressed indirectly: frequently after interviews, interviewees asked for favours, or contact with “donors” or NGOs, rather than for direct compensation for the interview.

Table 4 Selected benefit and power relationships between the identified actor groups

Actor	Possible benefits from research/KE	Provided benefits to the researcher	Power-related aspects
European academic researchers	Publications, degrees, career development, field-work experience	–	Funding and initiation of research allows researcher to set the research agenda, knowledge about and access to academic research
Managers/Governmental level	International contact, knowledge, status, fees for research visas and permits (governmental level)	Participation in the research projects (managers), research permits and visas	Power to deny permissions for research, power to operationalise knowledge
Local research institute	Funding, projects, expertise, training of staff, authorship of international publications, status	Access to the researched context, research permits	As a key gatekeeper the institute can dictate some aspects of how research and KE is conducted, requirement of bench fees
Beach recorders	Compensation/payment, status and social capital	Access to research subjects, own knowledge of the research topic, practical knowledge of the research context	Beach recorders are empowered to control which community members have opportunity to take part in research and KE
Locals at the community level	Sometimes money or material benefits, contact-based benefits, status, knowledge and training	Participation in the research projects, practical assistance and welcome	Refusing to participate or expecting payment

Actor relationships shaping implementation of knowledge exchange

The practise of KE was negotiated with, and shaped by, local actors with whom researchers had collaborative relationship such as the local research institute and beach recorders and their interests. This limited researchers' influence on the process. For example, accepting local research institute's guidelines regarding a compensation for participation in the workshops was necessary not to risk the collaborative relationships at the institutional level. Thus, both researchers did provide a small payment for participants, despite their initially negative views toward compensation. Hence, it is impossible to separate gaining material benefits from participants' experiences in the observed KE workshops.

The external researchers organised workshops with help from beach recorders. Beach recorders selected relevant participants to the workshops in exchange for payment. Therefore, beach recorders had a great role in deciding who has access to the information and other benefits. Often participants said that they came to the workshop because a beach recorder told them to participate or it was their "job" as fishers or traders. Access to the workshops had in some cases a social and political nature. For example, one fisherman explained he never gets information about events as he does not support the ruling political party, while a woman trader admitted that she had been invited due to her close relationships to a beach recorder.

In the studied cases, accessibility of knowledge becomes a key issue for the context of KE and in turn for perceptions of it in three ways (i) the lack of general feedback from different previous research encounters, (ii) feeling of not getting anything back from constant participation in research projects and (iii) where access to research findings and other benefits was possible, it was mediated by social and political relations.

Experiences about the two cases of knowledge exchange

Based on the lack of sharing research findings back to the researched context described above, the novelty of a researcher coming back and sharing research findings was evident in both types of workshops. Many times, interviewed workshop participants mentioned they either learned that researchers can come back or that researchers can come back was the most surprising information in the workshops [1WS: 3, 8, 9, 11; 2WS3]. The researchers described how they felt gratefulness from the communities for coming back, and they were surprised that in most of the cases people were keen on participating. The following sections shed light on perceptions of relevance, legitimacy and credibility of the observed KE processes.

Relevance and learning

Relevance and learning in the community dialogue

KE There was a variation in what participation in the workshops meant to the participants. It was seen to provide learning and results but also contact with researchers [1WS: 1, 2, 3, 5, 7, 8, 11, 12], as well as assurance that other people outside Zanzibar know about the fisherfolks' situation [1WS: 9, 12]. Receiving material benefits was also mentioned once [1WS12]. A trader's comment combines many of these aspects:

I think that now there is some kind of connection. Because researchers came to see us... it is very very important to us. And learning about other people like in other countries, doing the same activities, is very useful for us. And also, we can take the information and tell each other: "We are very important because other people know about us", and even when other researchers come here sit together like this, it is very important.—Male trader, Maruhubi [1WS11]

The content of the comment shows that KE can make participants feel acknowledged, hinting towards empowerment, as participants see that people from outside Zanzibar are interested in their situation. This can be subtle and surprising from a researcher perspective—probably often underestimated or not understood. Also, an interesting aspect for many interviewed participants was to learn about small-scale fisheries in the Philippines as compared to Zanzibari context [1WS: 4, 6, 7, 9, 11, 12]. For example, a female trader described how hearing that women in the Philippines do deep-sea fishing made her aware that it is also possible for women. However, it was difficult for some interviewees to describe learning or new and surprising information from the workshop. For example, a male trader described the output of the workshop vaguely as "*learning about how to trade and fish*", and when asked about reasons to participate he explained how he is one of those who like to participate in the events and to be close to visitors. KE is thus not linked only to sharing knowledge but there are other interests playing out within interactions with researchers. These can be financial or even simply having a good feeling from the interaction or being curious about visitors.

Interviewees often related presented information to ways to do business, such as learning that there are possibilities to export fish or connect to the tourism industry, suggesting that some participants had a limited understanding of the value chain beyond their own node of operation. The researcher did not provide advice about more profitable or sustainable business models. Nevertheless, we found that participants often created an action-oriented meaning for themselves, saying that they had learned different ways of doing business that could be better or more profitable [1WS:1, 2, 5, 6, 7,

8, 12]. For example, a fisherman described how he is now excited about trying to sell his catch outside the landing site:

Earlier I thought of selling fish to anyone in the village but now I am happy to sell my fish to someone else through deals and trust throughout the action. [...] The thing that entered to my brain is to sell our fish through someone else, not here to local consumers like I did. I got excited to sell fish outside [the village].—Fisherman, Buyu [1WS8]

This perception about how to sell fish emerged from the exchange between participants as they discussed a lot about the topic in the workshop. Sometimes these unpredictable 'created meanings' (how information was discussed between participants) were even conflicting with what the researcher wanted to communicate, which was frustrating for the researcher [E1]. Nevertheless, changing the way to do daily activities was seen as impossible by many of the interviewees due to lack of money and resources although the gained information was described as useful [1WS:1, 2, 6, 7, 8, 9]. The lack of material or other assets to act upon information created a barrier to apply new knowledge or perceived meanings into action, which led two fishermen in one workshop to question the purpose of KE. In one landings site, a change based on shared knowledge was detected three months after workshops in the form of a new trade connection to the mainland. According to the beach recorder of the site, information presented in the workshop about different trade connections in Unguja had given the idea for the new way of selling fish.

Relevance and learning in the science outreach KE The science outreach workshops presented information about fishers' perceptions of management options, and the researcher made it clear to participants that she would communicate the same results to the fisheries managers. Hence, participants' perceptions of the workshops and the information were related to the role of the researcher as a knowledge broker between communities and managers. The usefulness of the knowledge was perceived as indirect, through management. The contact with the researcher also created an impression that fishers' voices were heard. For example, a fisherman described how he got a chance to share his ideas with somebody who could take his views to the decision-makers [2WS3]. The perceived connection to managers was actively used in the workshops as fishers asked the researcher to communicate material needs such as boats or gears to the management level. This was uncomfortable for the researcher, who had hoped to focus more on the presented information [E2].

Linking to the management level through a researcher was seen as a way to hold decision-makers accountable [2WS 2, 3, 4] and affect the power relations between them.

For example, one fisherman described how fishers are like bosses to the managers, while another said:

It is very important for the department to know [about the research findings], because this will influence their accountability. Because now everybody knows, because after research [has been conducted] we [fishers] have results. So, we have evidence, we have reference. The researcher has done research and these are the results and they are sent to the department. “Why did you not implement according to these results”, fishers can ask. “We agreed that. The results are correct and you received it from the researcher, and other experts.” So, this will influence the accountability of the staff at the Department, because we know. Even fishers, we know results. Managers think: “If I don’t implement this I will be in trouble.”—Fisherman, Kendwa [2WS4]

Credibility and legitimacy

Perceptions of credibility of information were investigated for both KE processes through a sense of trustworthiness. Most interviewed participants said they trusted the presented information, and nothing was misunderstood by the researchers. However, one woman trader expressed reservations that the information could not be into action. Perhaps because the research was based on interviews, hardly any information conflicted with what the participants already knew, which may have contributed to legitimacy and credibility. Perceiving information as legitimate and having a feeling of ownership over it may contribute to sharing it with others, as a trader commented “*there is no problems in sharing this information [with others] as it comes from traders*” [1WS11].

Discussion

The two case studies of KE processes illustrate three broad findings about KE. Firstly, the process, outcomes and perception of KE are determined by the context, including the pre-existing relationships and structures between a range of actors. Secondly, the incentives and outcomes of KE are not solely about knowledge; they also involve the exchange of material and other intangible resources and can influence power relations. Finally, and perhaps as a consequence of the first two, the outcomes of KE are unpredictable and external researchers have limited control over them. This reflects the complex nature of KE recognised in the literature (Cvitanovic et al. 2015b; Fazey et al. 2014). There is a growing notion of the complex sets of engagements and relationships that are a part of KE processes. These develop over time in

science–society interactions, emphasising the interdependency and interrelatedness of actors, who operate in the contexts of institutional norms and values (Contandriopoulos et al. 2010; Cvitanovic et al. 2015b; Roux et al. 2006; Vogel et al. 2007). Complexity of outcomes of KE reflects the nature of the context, where different knowledge systems, multiple actors and incentives shape the way that research is conducted, shared and used. Therefore, understanding the KG context becomes crucial also in unpacking KE.

Science–society relationship embedded in previous research encounters and actor relationships

Our results highlight the influence of previous research encounters on KE through both the lack of flows of knowledge back to communities and general research fatigue among fishers and traders in Zanzibar. As Toomey (2016) shows, the impact researchers have on their field sites is not linear but embedded in different encounters between researchers and stakeholders before, during and after the fieldwork, where different power relations shape the interactions. The two cases of KE were welcomed at the community level due to limited feedback from previous research. The presence of researchers in wider socio-political context, such as community meetings, can build trust and help communicating knowledge (Young et al. 2016b). Similarly, here, the primary effects of KE can be seen as improving science–society relationships by counteracting research fatigue. Feelings of being over-researched can stem from a lack of perceived improvements, indifference toward engagement or practical issues such as cost, time and organisation, or extractive nature of research or lack of feeling an ownership over the project (Clark 2008). Thus, while sharing findings with researched communities may address the perceived lack of feedback, it cannot address long-term feelings of over-research if findings are not perceived as actionable for example due to lack of resources or because they do not lead to improvements.

Institutional relationships related to organising KE workshops were particularly influential in KE at the community level. Collaboration with the local research institute and beach recorders directly shaped the workshop design (e.g. participants were paid) or actors’ access to the presented information (who was invited by the beach recorders and how well communities were informed about the workshops), restricting researchers’ authority over the process. The local research institute and beach recorders were gatekeepers to the field, who gave access to logistical, human, institutional or informational resources in the field, a common phenomenon in fieldwork as discussed by Campbell et al. (2010). Understanding how different types of relationships support or constrain KE could inform more efficient KE implementation.

Knowledge-based outcomes

Our study demonstrates tensions in knowledge-based outcomes between what was expected by the researchers and how shared knowledge was perceived by the local actors. Neither researcher expected the knowledge to be directly usable at the community level nor for changes in practice or understandings to result. However, KE, particularly in the community dialogues, led to general enlightenment (conceptual use of research). Such enlightenment included for example seeing new possibilities in fish trading such as learning that fish can be exported outside Zanzibar or considering that selling fish through a trader would be more beneficial for one's business. Conceptual use of research can lead to action indirectly and less specifically than if information was used instrumentally (Beyer 1997). The encounters of KE were not tailored to fit to specific needs in the specific situations, and thus according to Beyer (1997), the instrumental use of information by stakeholders cannot be expected. However, Rudd (2011) argues that due to the pervasive nature of conceptual use of research, instrumental impacts are dependent on conceptual impacts. Conceptual impacts can turn into instrumental use of research at later stages, for example if resources become available (Wall et al. 2017). In our cases, researchers did not share knowledge in an instrumental form, but it was instrumentalised by participants based on their existing knowledge and worldviews. Hence, recommendations for business strategies were created by participants through their meaning-making out of information.

According to Nonaka et al. (2000), “information becomes knowledge when it is interpreted by individuals and given a context and anchored in the beliefs and commitments of individuals”. The knowledge creation process is thus context specific as it depends on who participates and how they participate (Nonaka et al. 2000). This demonstrates the difficulties in KE between different knowledge systems, as knowledge is embedded in individuals' perceptions and worldviews (Evely et al. 2011), and use of new knowledge depends on how well new information fits for the needs of users (Lemos and Morehouse 2005). Knowledge itself and unpredictability of its creation are a part of the complexity of the phenomenon. Therefore, viewing knowledge as an open, socially and ecological embodied system (Tàbara and Chabay 2013) can also support understanding dynamics of KE as it acknowledges and embraces the complexity, compared to more reductionist worldviews on knowledge. Consequently, sustainability scientists should expect unpredictable meaning-making as an outcome of KE. As pointed out by Evely et al. (2011), increased communication between actors and KE is not a simple “panacea” to reach sustainable outcomes. Combining different knowledge systems is a difficult process (Berkes 2009), and different understandings of presented

information and what was wanted to be communicated could create varying, possibly socially or environmentally undesirable outcomes.

On the contrary, although the presented information was described as useful by many interviewees, and even though it met principles of relevance, legitimacy, credibility and accessibility, it was not necessarily actually usable due to constraints or barriers. This finding calls for more attention to understanding actionability in community-level contexts where actors can lack social, material or political assets to act upon the knowledge, and hence usability of knowledge is limited. Actionability is not only linked to the type of knowledge but to conditions where knowledge is received, as the case study shows: Often in the community dialogues, the possible action stemming from interpretation of information was prohibited by a lack of material assets. However, focusing only on usable knowledge for sustainable development (e.g. Clark et al. 2016) can lead to missing the possible importance of non-actionable information for the stakeholders. For example, information about the Philippines was described as interesting and useful, which reflects that knowledge for the sake of gaining new perspectives can be equally or even more valuable than directly usable knowledge.

Researcher as knowledge provider, facilitator or broker?

The multiple and varying roles of researchers are increasingly recognised in sustainability science (e.g. Wittmayer and Schöpke 2014). Our findings show how researchers adopted different roles during the KE processes. One of the observed effects of KE in the community dialogues was the creation of a setting for exchange between local participants, where fishers and traders interacted and discussed about their livelihoods. The role of the researcher was then a facilitator of a dialogue that enabled a space for learning. Instead, in the science outreach workshops, fishers hoped that receiving research findings could contribute to the involvement of fishers' views in management. The researcher was thus perceived rather as a broker of knowledge to mediate different views between fishers and managers. The roles can even be adopted unintentionally and different actors in KE process can have different perceptions on researchers' positions, which in turn have implication on how KE is perceived. Hence, in both cases, researchers found themselves stretched beyond their expected roles of knowledge providers. Therefore, awareness of the socio-political context as proposed in the literature about KG (van Kekhof and Pilbeam 2017) enables designing KE strategies which acknowledge the roles and spaces that researchers possibly fill and create when they engage in KE.

Beyond knowledge-based outcomes: multidimensional interactions with researchers

Participation in research-related projects is led by multiple interests that impact the possible outcomes of encounters. Previous literature about KE has not taken into account non-knowledge-based aspects and assets, which were an important part of these KE cases and their outcomes (Fig. 2). Focusing only on usable knowledge can lead to simplifications of the context and a naïve understanding of the motivations of actors in the KE and research spheres. At the community level, researchers provided (i) knowledge and training, (ii) material benefits, (iii) contact and assistance to reach other actors and (iv) status in the community. They also exchange in reciprocal relationships with national institutions and local gatekeepers, exchanging money, status and international connectivity for access and practical research opportunities (Table 4). Therefore, KE researchers, themselves have multiple incentives for implementation of KE, ranging, in the case study, from ethical responsibilities and personal obligation toward people encountered in the field to an aim to have a real-world impact.

This study focused on one aspect of KE in the form of sharing of research findings. Our case studies covered relatively conventionally designed research processes where KE was included in the end of the projects. Although KE is advocated in the early phases of a research project through co-productive approaches (e.g. Phillipson et al. 2012), in practice research projects often lack formalised plans to engaging end-users throughout the research process (Wall et al. 2017). Therefore, this article can provide useful insights into many research processes that do not involve longer-term stakeholder engagement throughout a research project.

Our explorative approach to data collection would have benefitted from a longer fieldwork period that would have enabled a more detailed mapping of local actors' relationships and a more profound understanding of power dynamics. Benefits and patterns of interactions manifested in KE are related to power relations, which could be further explored through an explicit power analysis. We suggest power analysis as key for future studies of KE, particularly in the Global South but also in the Global North.

Conclusions

Our analysis of the two KE processes between foreign researchers in Zanzibari fisheries highlights some key aspects of KE. Firstly, KE is shaped by previous experiences of research and the pre-existing relationships between research actors. In these cases, research fatigue and a lack of feedback meant that KE was welcomed as a departure

from typical practises, while institutional relations created constraints on where, with whom and how KE occurred. Secondly, the process by which knowledge becomes instrumentalised as a result of KE is unpredictable and sometimes uncomfortable for researchers. For example it may facilitate new forms of exploitation of natural resources. Thirdly, KE involves researchers playing multiple roles including knowledge broker, facilitator of interactions between local actors as well as knowledge producer. Lastly, KE involves exchange of benefits between researchers, local institutions and community members. These include non-knowledge assets such as material benefits, prestige and strengthening of voices to authorities. These exchanges are based on pre-existing relationships, in which different stakeholders negotiate their interests according to different sources of power. In conclusion, a better understanding of the relationships between researchers, local institutions, research subjects and potential knowledge users, including their interests in non-knowledge assets and relative power exchanges can help can help to navigate the complexity of KE.

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