

# **Integration of traditional indigenous knowledge and western science knowledge for the co-management of freshwater resources**

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## **Abstract**

Integrated water resource management seeks to improve the relationship between human and environmental systems. The complexity of these systems requires the integration of western science and the holism of indigenous knowledge. This paper explores the importance of Indigenous knowledge and the intimate interconnection the Maaori (indigenous people of New Zealand) have with the environment. Data derived from two different focus groups (Maaori and Western Scientists) is analysed using the four components of a receptivity model: awareness, association, acquisition and application. The benefits and challenges of integrating both forms of knowledge for the co-management of freshwater and the applicability of the integration are then addressed. Finally, three recommendations are explored to bridge these two knowledge systems: 1) recognising the role of each other; 2) the need for a dialogue among cultures and; 3) the need to emphasize a cultural element in the IWRM approach.

## **Keywords**

Traditional Indigenous knowledge; Integrated Water Resource Management (IWRM); Knowledge Integration; Sustainability

## **1. Introduction**

Management of freshwater resources represents a challenge for sustainable development in many countries around the world. According to the UN-Water (2008), Integrated Water Resource Management (IWRM) is an efficient approach to achieve equitable and sustainable development and management of the world's water resources. IWRM also seeks to improve the relationship between human and environmental systems, achieving the triple bottom line of economic efficiency, environmental sustainability and equitable

benefits from natural resources (GWP 2000). Stakeholder engagement and participation are fundamental to IWRM as is scientific data. However, relying on western science to effectively manage complex environmental systems has so far not been particularly successful for achieving ecosystem sustainability in modern society (Berkes and Berkes 2009). Traditional ecological knowledge is increasingly recognised (Berkes and Berkes 2009; Mazzocchi 2006) as having the capacity to deal with complex systems, due to its holistic approach that represents centuries of wisdom. Indigenous peoples view the environment as integral to well-being, and its management as essential to preserving cultural identity (Mazzocchi 2006). While the literature posits the need for multi-stakeholder engagement, it does not ask how stakeholders perceive different views of the “other” knowledge system.

This paper examines the benefits, challenges and applicability of integrating the knowledge approaches of two different types of stakeholders for the co-management of the freshwater resources. We analyse data gathered from two focus groups (Maaori researchers and Western Scientists) using a receptivity framework comprising 4 components of 'awareness', 'association', 'acquisition' and 'application' (Trott, Cordey-Hayes, and Seaton 1995; Jeffrey and Seaton 2004; Brown and Keath 2008). We make three recommendations to assist in bridging these two forms of knowledge in IWRM. Firstly, creating a space where both systems are recognized as playing a role which can equally contribute to a solution. Secondly, starting a dialogue to overcome terminology differences. Finally, adding a cultural element to the IWRM approach will narrow the gap between different stakeholder perceptions while improving water governance.

## **2. Traditional Ecological Knowledge (TEK)**

### **2.1. TEK and Western Science**

Since 1980 the international community has seen the need to protect Indigenous traditional knowledge (Popova 2014; Chapman 2007). At the 1992 Conference on Environment and Development of the United Nations (Rio de Janeiro, Brazil), the Rio Declaration (Principle 22) and Agenda 21 (Chapter 26) and particularly the Convention on Biological Diversity (Popova 2014) strengthened a call to “...respect, preserve and maintain knowledge, innovations and practices of Indigenous and local communities embodying traditional lifestyles...”<sup>4</sup> (United Nations 1992). By 2007, the United Nations declared the rights of indigenous people affirming that they contribute to the diversity and richness of the common heritage of humanity and recognizing that their knowledge contributes to sustainable and equitable development and proper management of the environment.

We recognise that aspirations of Indigenous peoples are “... to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal systems.” (Martinez 1986).

The term Traditional Ecological Knowledge (TEK) refers to local knowledge, innovations and practices of ecological nature developed over many generations (Rinkevich 2008). Recognising that there is no agreed definition of TEK, we adopt a definition developed by the Traditional Knowledge Working Group of the Northwest Territories:

“Knowledge that derives from, or is rooted in the traditional way of life of Aboriginal people. Traditional knowledge is the accumulated knowledge and understanding of the human place in relation to the universe. This encompasses spiritual relationships, relationships with the natural environment and the use of natural resources, relationships between people; and, is reflected in language, social organization, values, institutions, and laws.” (Legat 1991)<sup>1</sup>

TEK’s understanding between human interrelationships and the environment provides a framework to understand complex systems (Chapman 2007). The advantages are:

- an ability deal with the inherent uncertainty and the unpredictability of the natural systems they are affiliated to;
- better processing of large amounts of information observed as a result of their interactions with the system (Mazzocchi 2006; Berkes and Berkes 2009);
- providing historical context on species and habitat management that is not generally captured within contemporary science (often due to the shorter timeframes for monitoring and observation);
- recovery planning fits Indigenous views about species protection and the maintenance of kinship relationships.

Both TEK and Western Science knowledge systems share the similarity of constant evolution and have developed strategies to generate and transmit their particular observations and knowing (Chapman 2007; Mazzocchi 2006). However, there are distinct differences between TEK and Western Science identified in literature, remarked in the following points (summarized in Table 1):

(1) Western Science relies on quantitative and objective evidence (i.e. statistics); as opposed to TEK, which is subjective and qualitative, due to the processes of observation and knowing (Chapman 2007; Mazzocchi 2006; Berkes & Berkes 2009).

(2) Indigenous people tend to hold long-term mental information which makes TEK intuitive rather than analytical like Western Science, which requires scientific researchers to rely on large amounts of data collection (Chapman 2007).

(3) Western Science usually practices reductionist methods rather than a holistic view, which is a key characteristic in traditional knowledge (Chapman 2007; Mazzocchi 2006; Berkes & Berkes 2009).

(4) Western Science is materialist (tangible) as opposed to TEK which is spiritual (Mazzocchi 2006).

(5) TEK relies on the oral knowledge transmission across generations; whereas WS is

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<sup>1</sup> Legat, Alice. 1991. Report of the Traditional Knowledge Working Group. Yellowknife: Government of the Northwest Territories, Department of Culture and Communications.

based on written data (i.e. academic literature) which must meet criteria for robust scientific critique (Mazzocchi 2006).

(6) The environment is an essential part of indigenous' culture, as such they depend and consider themselves part of it (also known as 'subjectivity').

**Table 1**

Differences between Traditional Ecological Knowledge and Western Science (Chapman 2007; Mazzocchi 2006; Berkes & Berkes 2009)

<b>Traditional Ecological Knowledge</b>	<b>Western Science</b>
Qualitative	Quantitative
Subjective	Objective
Intuitive	Analytical
Holistic	Reductionist
Spiritual	Materialist
Oral	Written
Humans part of the environment	Humans distinct from the environment
A way of life	Compartmentalized knowledge

## **2.2. Maaori knowledge (Matauranga Maaori)**

The word Maaori, is a universally used label to describe the ethnicity and culture of Indigenous people of New Zealand, nevertheless, historically this term has a deeper meaning (Royal 2012). Maaori are intimately interconnected with the environment and it is argued that neither can exist independently of the other (Awatere 2010). Whakapapa (genealogy) helps to explain this holism, as it represents the interrelation between Maaori, the animate (environment) and the inanimate (cosmological or spiritual entities) (Awatere 2010; Smith et al. 2013). Based on this belief, Maaori have an intergenerational responsibility and obligation to give, receive from and safeguard nature (kaitiakitanga) in order to sustain and maintain the well-being and equilibrium of people and their environment for present and future generations (Awatere 2010). Thus, matauranga Maaori (Maaori knowledge) is the knowledge system that receives and transmits this complex learning system (Smith et al. 2013).

## **3. Methods**

Spiller and others (2012) recognize the importance of understanding the receptivity of any individual or group towards a change (i.e. integrated knowledge) to support policy and decision-making in the water sector. To contribute to this understanding, we used an action research approach drawing on qualitative methodologies. Key informant interviews and focus group discussions were conducted to assessed knowledge, practices and perceptions about the value of each knowledge. The analysis of the data draws on Trott's (1995) model of receptivity further adapted by other studies.

We base our analysis of the results on a receptivity model originally used in assessing the inward technology transfer mechanisms of commercial organisations. Trott's (1995) conceptual model focuses on the concept of 'receptivity' toward new ideas or innovations. Understanding the perceptions and attitudes (i.e. responses and behaviours) towards proposed change or the 'need for a change' provides insights into where potential supporting policies or actions should be directed (Spiller et al. 2012; Roma et al. 2013). We adopted the receptivity model to analyse the perception of two types of (freshwater) knowledge: traditional Maaori knowledge and Western Science knowledge with the aim of understanding how an integration of both knowledge systems may be effected.

The Model of Receptivity (Table 2) includes four key attributes: awareness; association; acquisition; and application. It has been adapted for the analysis of individual's receptivity toward water management alternatives in policy and decision-making (Jeffrey and Seaton 2004; Brown and Keath 2008).

**Table 2**

The Model of Receptivity

Attribute	Definition
Awareness	Being aware of a problem or need, and the (knowledge) capability to search for an alternative/innovative option.
Association	Associate these options with an objective and recognition of the potential benefit of this knowledge in association with needs and capabilities.
Acquisition	Being able to acquire new skills and systems or learn new models of behaviour which support exploitation of knowledge, and learn from behaviours in order to apply the innovation.
Application	Motivation, incentives and ability to practically apply and implement the new approach to achieve a benefit.

#### 4. Results and Discussion

##### What does each Knowledge represent?

Similarities and differences between traditional Maaori knowledge and Western knowledge were easily outlined by all participants and literature review. Concisely, both forms of knowledge found their knowledge based on observations and both give a solution to a problem (Berkes & Berkes 2009). As for the differences, traditional Maaori knowledge is perceived as holistic, where human beings are part of the environment, without focusing on quantitative data or repeatability samples as Western Science tends to concentrate (Berkes & Berkes 2009). It is important to highlight that half of the Western Scientist participants have acknowledge Maaori knowledge as a science that fully understands the relationship between human and nature. While, although the other half recognise the

importance of Maaori knowledge, they are yet to acknowledge it as science, as they feel a need to validate it by using Western/Modern Science.

### **Benefits for Integration**

Traditional Maaori knowledge can provide vast data on environmental health based on many years of observation of health fluctuations within the ecosystem. As reported by (Berkes & Berkes 2009), this data is significant due to large amounts of information; it is collected continuously; and changes are incorporated into the 'collective mental model' as new information is collected. In addition, the authors also agree that the holistic perspective that is inherent within Indigenous knowledge, captures a range of indicators (e.g. reading animal behaviours which can reflect the animal health) not normally studied by Western Science. Within the focus groups and literature there is a strong case for the valuable contribution that matauranga knowledge can offer to support Western Science and modern society.

Similarly, Western Science knowledge is important for understanding causations within the field of study. Moller et al. (2003) states that science can offer research on larger spatial scales; provide precise and quantitative data, including the design of it at an appropriate scale and an analytical evaluation. The author points out that quantitative data generated by Western Scientists focuses on objectives which may help to better understand cause-effect relationships. Even though some authors (Kellenberger 2004; van Regenmortel 2004) and some participants of the focus group suggested that traditional indigenous knowledge may no longer be sufficient to understand the modern complexity to the extent that Western Science does. There are many authors (Moller et al. 2004; Mazzocchi 2006; Berkes and Berkes 2009; Memon and Kirk 2012; Watene-Rawiri and Fitzgerald 2012) and members of the focus groups that have integrated both forms of knowledge into their research work and have found it essential to improving outcomes.

### **Challenges for Integration**

History underlines significant shifts in the meaning of words occurring during the translation of documents from Maaori to English (Muru-lanning 2012), the use of different terminology by both forms of knowledge remains a substantial challenge. According to Popova (2014) local or Indigenous terms usually use metaphors to express a social or environmental reality, nevertheless, this should not imply that their concepts are less 'sophisticated' or valid in comparison to western scientific ones. Thus, both sides need to strengthen their communication skills; however, this would only be possible if the following challenges are overcome.

The group members come from different experiences and have offered to the focus groups a variety of encounters with the applicants of the other knowledge. Dealing with discrepancies due to oversimplified perceptions towards Maaori or 'pakeha' (Western

Scientist) has represented a challenge for the participants in their work. The perception of the Western Scientist revealed that some Maaori were reluctant to share their knowledge, this observation has been supported by Maaori stating that usually this happens for fear of being misunderstood or not recognized. However, this behaviour is totally understood if further analysis into Maaori history is examined. Dominant regimes during colonization over indigenous lands and lives may have affected Maaori perception towards non-Maaori people (Mahuika 2009). In addition, the misinterpretation by non-indigenous of the 'privileged knowledge' has led indigenous people to overprotect their knowledge (Popova 2014). Hence, to facilitate the sharing of Indigenous knowledge in a way that avoids any oversimplified perceptions, Popova (2014) suggests the use of international mechanisms to protect Indigenous knowledge. In addition, a trust-based relationship needs to be reinforced between the new Maaori and non-Maaori generation.

Cultural aspects of water may represent a cultural difference, particularly when this wisdom is intangible and non-visible. Nonetheless, the challenge should not be the acceptance of another culture but as Berkes and Berkes (2009, pg. 11) states, the challenge is to bridge Western Science and Indigenous knowledge "without absorbing the diversity of knowledge traditions into one dominant science".

### **Applicability of Integration**

The integration of traditional Maaori knowledge and Western Scientist knowledge has been successfully integrated within several projects that the research participants have been involved in. To demonstrate the applicability of this integration, the participants shared some examples of their work developed in areas such as: fishing activities, habitat restoration and a water quality monitoring tool.

## **5. Recommendations - Creating the Bridge**

Analysing, understanding and using the criteria of another tradition (be it Maaori or Western influence), may represent a difficulty for the integration of both forms of knowledge (Mazzocchi 2006). A shift in approaches toward environmental management requires very few physical resources and is more dependent on the willingness of individuals and supporting institutions. Three recommendations will be explored below that if applied, could assist in creating a necessary bridge between these two forms of knowledge: 1) recognising the role of each other; 2) the need for a dialogue among cultures and; 3) the need of emphasizing culture in the IWRM approach.

### **1) Recognising the role of each other**

Water serves as a unifying element between human cultures and the environment (UNESCO-IHP 2012). Humans cannot deny the inherent need to understand this bond, evident in both Indigenous and Western Science knowledge. Western Science knowledge has played a central role in developed societies; in contrast indigenous knowledge has

not. Nevertheless, other knowledge systems (i.e. matoranga) need to be acknowledged (Mazzocchi 2006), understood, valued and used in order to understand in a sustainable way the human/environment relationship (UNESCO-IHP 2012). Recognizing the value of traditional indigenous knowledge should be regarded as equal; using both forms of knowledge to validate each other. Therefore the use of Western Science to only validate Indigenous knowledge should be used tentatively as it implies Western Science to be the dominant form of knowledge (Mazzocchi 2006). Moreover, Huntington et.al. (2004) states that recognizing the strengths of each system and comparing both sources of information, aids the process of using them to complement one another. Once a shift in perceptions toward both forms of knowledge is accomplished, the integration of these forms of knowledge will come naturally.

## **2) Dialogue among cultures**

Culture can be expressed as patterns of behaviour that have allowed humans to interact, engage, and adapt to changes in the environment (UNESCO-IHP 2012). Ways to express an individual's cultural background may vary from one individual to another, creating space for confusion when it comes to understanding what someone from a different culture is trying to express. Terminology represents a challenge when it comes to either Maaori or Western Scientist to communicate their thoughts. In this context, a 'dialogue among cultures' could represent a tool to overcome these obstacles. Mazzocchi (2006) has previously identified the scenario in which this dialogue can take place. He mentions that the involved individuals (each knowledge system) should acknowledge the uniqueness of each approach, be open to share ideas and to experience the others' knowledge system without compromising his/her knowledge values. As stated by Berkes & Berkes (2009) many researchers have applied to their work an ever-expanding cultural understanding of the environment, capturing and integrating both forms of knowledge. Therefore, regardless of the terminology used or the way individuals present their thoughts, if the dialogue is not delivered in an open-minded (free of stereotypical views) space, no progress towards a sustainable environment will be achieved.

## **3) Emphasis on culture in IWRM approach**

Besides achieving a balance between social, environmental and economic goals and improving water resource management, the IWRM approach seeks to improve good governance (GWP 2006). On this last point, the GWP (2006) report suggested that a "more holistic water governance" is needed. In this context, many authors (Hofstede and Hofstede 2015; Matz 2008; Jønch-Clausen 2004) have mentioned how intrinsically related culture and governance are and the extent that this relationship has an important impact on water management. Thus, cultural characteristics should have a higher consideration in water management.

According to Matz (2008), IWRM approaches have not concentrated enough on the role of governments and cultural mechanisms in water management; rather it has focused on

stakeholder participation that is normally related to democratization processes. In addition, (Jønch-Clausen 2004) identifies this weakness in the IWRM framework by recognizing that most water managers do not understand water holistically. Therefore, cultural reality (of the home country) should be a determinant conductor for good water governance. IWRM is already an approach known worldwide, in this regard if an effective cultural assessment system is further studied and included in this approach, the spread of this important policy approach will be more effective.

## 6. Conclusions

The results indicate that both groups strongly recognised the benefits of integrating both forms of knowledge. For instance, Maaori participants acknowledged how projects with this type of partnership were more successful. Also, western scientists noted that projects that include Maaori knowledge save project research time and incorporate a holistic perspective. The Maaori focus group concede that their values and traditional knowledge are progressively being included in current New Zealand's freshwater policies; however, further work to allow a significant role in decision-making is needed. Members of the western science focus group grasped the opportunities the project results represents for both groups. We concur with the participants' opinion that the inclusion of both sets of knowledge would advance holistic and effective environmental regulations.

This research supports current literature in highlighting the importance of treating both forms of knowledge (Maaori and western science) as equally important and complementary to each other. Both forms of knowledge have different relative strengths and weaknesses and our method provides a tool to improve understanding and co-management of freshwater resources.

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