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The Questions of Who, What, and How in the Science - Policy Dialogue: Experiences from the Pan - Canadian Framework on Clean Growth and Climate Change

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Abstract: The science-policy interface in climate change adaptation became better managed over the past decades. However, the scientists and other knowledge producers, as well as policy makers still need to take bolder steps to more effectively engage with others to apply science and shape up policies. This paper aims to provide practical recommendations, intended to promote conversations between science and policy sectors to address climate change issues. Here, I used two different approaches to synthesize experiences and identify recommendations: a literature review and a case study. The paper stress main findings: (1) The linear communication model is still commonly involved in the science - policy dialogue and proved to be useful to increase the relevance of science and data products to decision makers. (2) When a gap between knowledge producer and knowledge user or decision maker exists, the need for a third party to specialize in bridging the gap become essential. (3) Indigenous people and knowledge must be involved in adaptation policy making based on legitimation local and traditional knowledge, designing the consultation process to broadly engage local and indigenous people, facilitating meaningful dialogues between traditional knowledge and science, and developing initiatives to strengthen skills and capacity of indigenous communities.

Keywords: Science and policy - making; Environmental communication; Pan - Canadian Framework on Clean Growth and Climate Change

1. Introduction

The science-policy interface is very relevant to achieve better policy decisions that are implementable and relevant to make change on the ground. The science-policy interface in climate change adaptation became better managed over the past decades. There was significant growth of scientific researches as well as local knowledge on climate change, and a clearer picture on unprecedented impacts of global warming and agenda emerged. More scientific evidence and information is being provided to policy makers to push climate change adaptation policies forward. However, the scientists and other knowledge producers, as well as policy makers still need to take bolder steps to more effectively engage with others to apply science and shape up policies.

The key challenge is to provide constructive recommendations for actions that not only build on past experiences but also reflect a more nuanced understanding of the science-policy dialogue. This paper aims to provide practical recommendations, intended to promote conversations between science and policy sectors in the field of climate change adaptation. Here, I stress the need to: (i) include both scientific communities and local or indigenous knowledge producers; (ii) promote the contribution of scientific knowledge and lay knowledge; (iii) design suitable structures, mechanism and incentive schemes to support interactive dialogue in short and long-term. These changes are

needed considering climate change and its potential adverse for societal dependence on and benefits from nature.

In this paper, I used two different approaches to synthesize experiences and identify recommendations: a literature review and a case study. First, I carried out a literature review to identify the value of science-policy dialogue, existing recommendations on who and what kind of knowledge should be involved in the dialogue and how to design the dialogue. I focused on literature on climate change adaptation policy and governance and from science and policy interface studies. Then I drew up a single case study design, using the ideas and perception from the literature to analyze a science-policy dialogue in climate change adaptation policy making, the Pan - Canadian Framework on Clean growth and Climate Change.

The following sections will be organized as follows: Section 2 reviews the literature to provide background of science-policy dialogue, focusing on three main components of who, what and how; Section 3 presents the case study of the Pan - Canadian Framework on Clean growth and Climate Change including the case history, the main steps in the formulation process, as well as the spaces for science-policy dialogue; Section 4 is an analysis of the case study, shedding light on the linear model embedded, the role of working groups as a proactive mediator, and the opportunities for traditional or indigenous knowledge; The final section concludes and gives implications for practitioners and further research.

2. Insights from literature: Who, What, and How in Science-Policy dialogue

The characteristics of climate change and environmental issues, often referred to as ''wicked'' problems (Churchman, 1967; FitzGibbon. & Mensah, 2012), make them particularly problematic to understand, communicate and resolve due to uncertainty, complexity, diverse values and the involvement of many sectors (Laurance et al., 2012; Pielke, 2 007; Stirling, 2010). Stakeholders often have different interests (e.g. various policy actors), and understandings (e.g. different disciplines or knowledge source), resulting in different incentives for producing and using knowledge. Interdisciplinarity on the science side and multi-actor integration on the policy side have been recommended to improve science-policy communication, better understand and address these challenges arising from this complexity (Fairbrass and Jordan, 2004; Sarewitz, 2004; Young and Marzano, 2010). Notably, local communities and indigenous groups together with their lay/ local knowledge also need to be included into the science-policy dialogue for climate change adaptation (Ayer, 2010; Funtowicz & Ravetz, 1993).

The linear model of science-policy communication assumes that policy makers pose well-defined questions, scientists provide objective, relevant and timely knowledge and policy specialists will develop solutions based on this knowledge (Bradshaw and Borchers, 2000; Demeritt, 2006; Pielke, 2007). The linear model has been criticized as inappropriate to describe actual science-policy processes and promote effective science-policy dialogue, especially for issues characterized by value conflict and uncertainty (Hoppe, 2005; Owens, 2005; Shaxson & Bielak, 2012; Spierenburg, 2012). Best & Holmes (2010), Lemos & Morehouse (2005), and Nutley et al. (2007) have shifted the science policy dialogue toward two-way interaction model. However, encouraging the two-way conversation requires a special effort.

John et al. (2009) and Rodari et al. (2012) have proposed the crucial role of mediators or intermediators, who work between policy makers and researchers. In some cases, the creation of science panels, public participation processes and stakeholder panels, or special communication materials can facilitate science communication, inform the need of decision makers, provide advice to decision makers, and enhance feedback mechanism (Winterfeldt, 2013). More highly skilled mediators will surely help researchers - policy maker communication to be more proactive whenever relevant policy decisions are being made, finding effective ways to convey scientific messages to policy makers and society at large while ensuring policy maker's demand is heard.

3. The Pan - Canadian Framework on Clean Growth and Climate Change

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In Canada and abroad, the negative influences of climate change are becoming undeniable which pose significant risks to human health, security, and economic growth. Severe weather events, in recent years, have cost Canadians billions of dollars, and would cost Canada $21-$43 billion per year by 2050, according to 2011 estimates from the National Round Table on the Environment and the Economy. Businesses and markets are increasingly considering climate risks. Indigenous Peoples, northern and coastal regions and communities in Canada are particularly vulnerable and disproportionately affected. Moreover, acting on climate change through transitions to a low-carbon economy, through innovation and clean technologies, will create new economic opportunities and good jobs for Canadians. There is already a global market for low-carbon goods and services worth over $5.8 trillion, which is projected to keep growing at a rate of 3 percent per year. Clean growth opportunities will benefit all sectors and regions in Canada and remain its global competitiveness (Government of Canada - GOC, 2016f, g).

The Pan - Canadian Framework was built based on a number of collaboration principles outlined in the Vancouver Declaration, including: (1) Recognizing the diversity of provincial and territorial economies and businesses related to the transition to a low-carbon economy in each jurisdiction; (2) Recognizing that growing economy and achieving carbon emissions targets will require an integrated approach that includes all sectors; (3) Recognizing that a collaborative approach between provincial, territorial, and federal governments is important to reduce emissions and enable sustainable economic growth; (4) Strengthening the collaboration between governments and Indigenous Peoples on mitigation and adaptation actions, based on recognition of rights, respect, cooperation, and partnership, consistent with the Government of Canada's support for the United Nations Declaration on the Rights of Indigenous Peoples; (5) Engaging with external experts to provide informed advice to First Ministers and decision makers, ensuring that the Pan - Canadian Framework actions are open to external, independent review, and are transparent and informed by science and evidence; (6) Recognizing the importance of traditional knowledge and experience, produced in holistic worldview and unique relationship with the land, in regard to understanding climate impacts and adaptation measures (GOC, 2016a, e, f).

The development of the Framework started with the Vancouver Declaration on March 3, 2016, when First Ministers launched a federal-provincial-territorial process to identify options for action in four areas: emission reduction; ideas for innovation, technology and job creation; pricing carbon pollution; and adapting to the impacts of climate change. Working groups were established and led by federal and provincial or territorial co-chairs, and composed of members from federal, provincial and territorial governments. First Ministers required that reports would identify options for taking action and assess the likely economic and environmental impacts of each option identified. Each of the groups included Indigenous peoples, experts, and other stakeholders as necessary to support their work. Their final reports were provided to the ministerial tables by September 2016. Ministers reviewed these reports and provide their recommendations to First Ministers by October 2016 (GOC, 2016 a, f, g).

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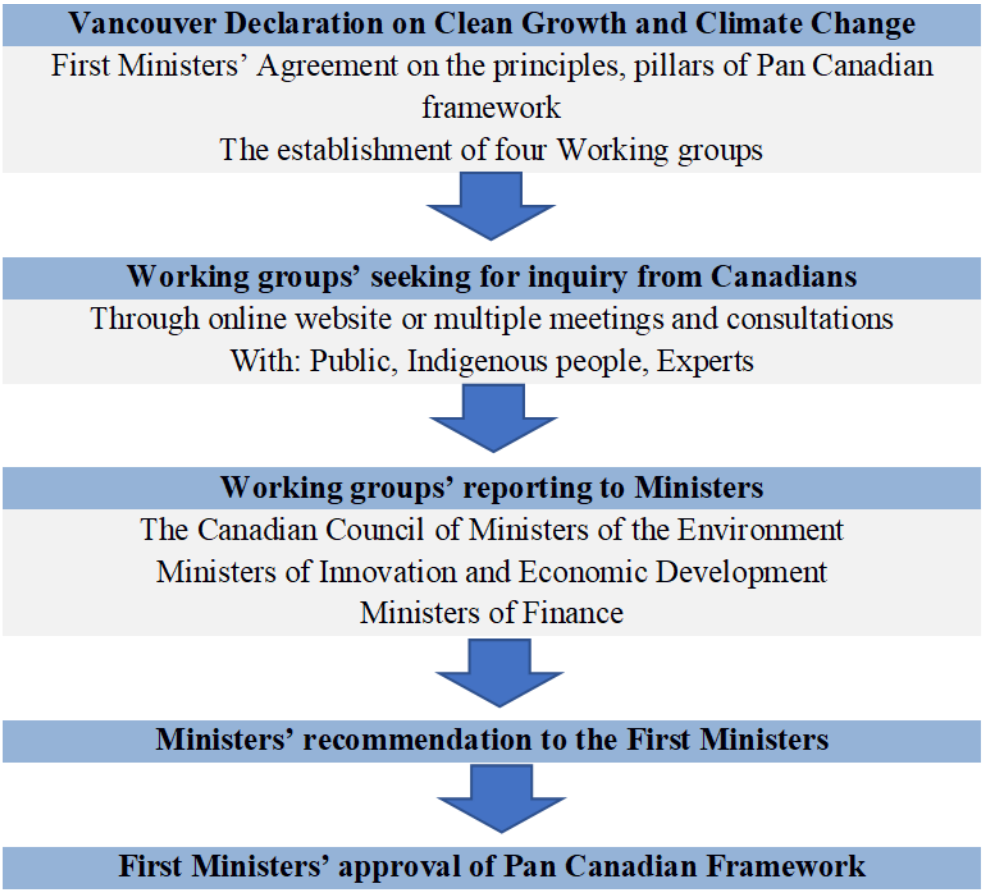

Figure 1: Key steps in the formulation of Pan - Canadian Framework (synthesized from GOC, 2016a, f)

The Pan - Canadian framework formulation process created spaces for science - policy dialogue. The first is the dialogue between First Ministers and the working groups. First Minister established four working groups with the mandates as developing different policy options to achieve the target of carbon reducing, economic growth, and adaptation. The second is the dialogue between the working groups and different knowledge producers. The working groups facilitated a series of workshops, meetings, roundtables, consultations with multiple stakeholders by posing questions most relevant to the policy priorities, such as: The barriers and the opportunities in a sector, different policy options to shift the sector toward clean growth and sustainable adaptation, the pros and cons of each policy options, the proposed solution (GOC, 2016b, e). Scientist as well as other knowledge generators were encouraged to be involved in to inform the policy process. Finally, the traditional knowledge from Indigenous people, lay knowledge from local people, and scientific knowledge from experts were integrated and reflected in the final reports submitted to the Ministers who gave recommendation directly to the First Ministers for considerations.

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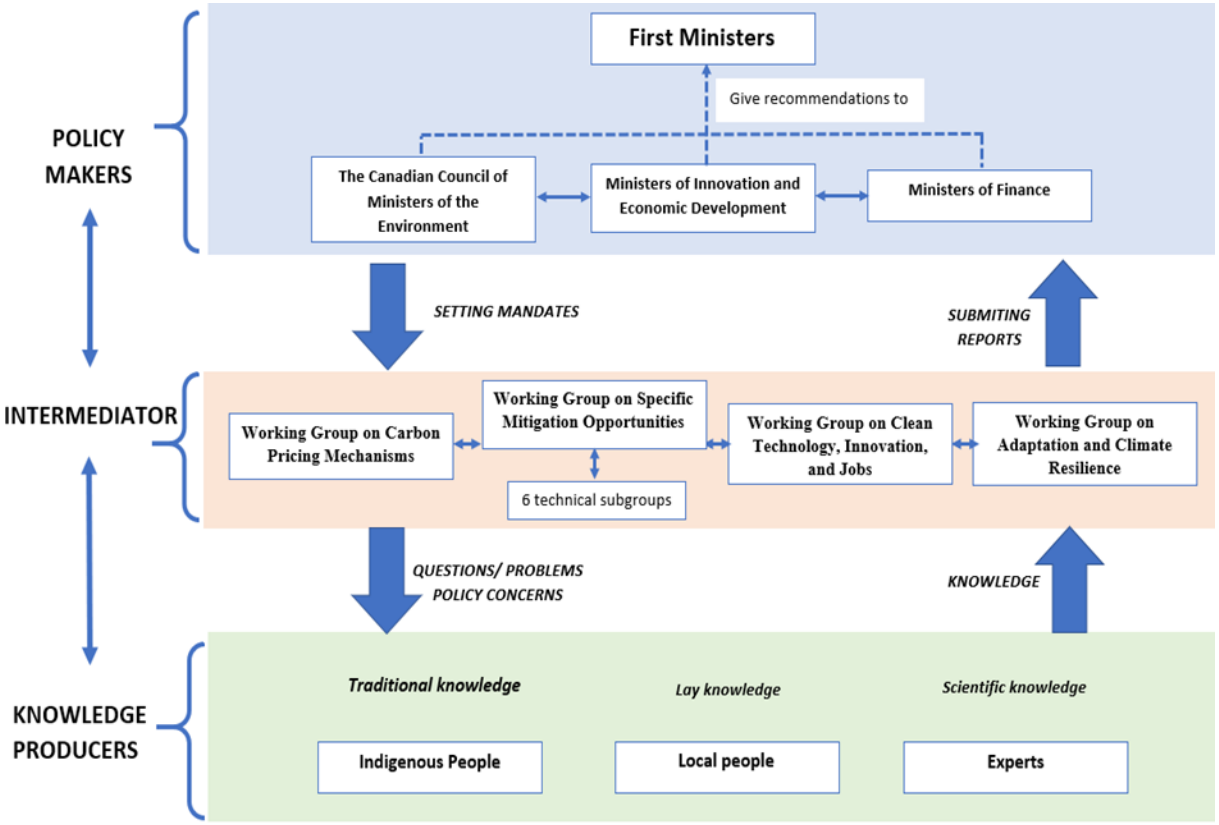

Figure 2: Science - Policy Dialogue in Pan - Canadian Framework Formulation (synthesized from GOC, 2016a, b, c, d, e, f)

4. Discussion

4.1. A typical example of the linear model in science – policy communication

Although the literature on science policy communication has long highlighted the need to engage in two-way interaction, the design of many dialogues is still thought to be influenced by the linear model (Koetz et al., 2011; Young et al., 2014). The science - policy dialogue to formulate the Pan - Canadian Framework is a typical example of linear communication model in which (i) the policy makers, as the knowledge users, pose the questions or demand the knowledge; (ii) the scientists, as the knowledge producers, answer the questions or supply the policy-relevant knowledge; and (iii) the policy makers use the information provided by scientists to support their decision-making process. This model apprears obviously advantageous since it directly informs the producers what the users need and what challenges they are facing and seeks to increase the relevance of science and data products to decision makers. Thus, the scientific questions and the format, resolution, and scale of date output could effectively deal with the challenges that are at the forefront of policy concerns. Policy makers are likely to be more successful in achieving the scientific foundations they originally intended as well as improve the understanding of processes, relationships and products in climate change science. The Pan - Canadian Framework favored a simplistic but effective practices of policymaker uptake of knowledge being a product of the linear interaction between science - policy.

However, the linear model frames knowledge producers as inactive actor in policy making process. They answer the research questions that have been already determined by the policy makers. In the case of Pan - Canadian framework, they only can focus on the four pillars of carbon pricing, other mitigation opportunities, innovation and job creation, and climate change adaptation. They cannot suggest the other themes despite of their relevance and strong effectiveness to achieve the target of carbon reduction and resilience improvement, for example: the ideas of changing customers behavior toward low carbon and energy saving products. Out of three functions: defining

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a problem in a particular fashion, defining and selecting one or more solutions over any other, and putting together definitions and proposed solutions (Mukherjee & Howlett, 2015, p. 66), the knowledge producers during the formulation of Pan - Canadian Framework just focus on articulating solutions for pre-determined problems. Besides, the scientists and other knowledge producers have no opportunities to give feedback on the way policy makers use information and evidence in decision making process even if there are misunderstandings or mismatches.

The case of Pan - Canadian Framework reveals the trade-off between one-way, simple, time-saving approach and two-way, more complex, time-consuming approach to design science - policy interface during policy making process. In this policy making process, research starts as a direct response to a policy need. In the other words, knowledge producers have a better understanding of which type of outputs will be more useful for policy makers, in term of high relevance, right format, understandable language, and timely way. This approach can be considered as an effective strategy to move beyond silos in science and policy and delivering research outputs matching policy expectations and needs (Young et al, 2014, p. 395). However, this approach provides a very narrow space for joint framing of the research problem and questions by science and policy as well as an open mechanism for feedback.

Box 1: Example of linear communication model: Consultations with Invited Experts
The Carbon Pricing Mechanisms Working Group invited a number of experts (professors and researchers) to meet with the working group to discuss issues and considerations related to the role that carbon pricing should play in the pan-Canadian Framework. The experts were asked to consider a series of questions, related to the importance of carbon pricing, policy options and designs for carbon pricing, the economic impacts of carbon pricing on consumers and industry, the potential outcomes of carbon pricing on Canadian efforts to reduce GHG emissions and to support a transition to a low-carbon economy. (GOC 2016b, p. 56)

4.2. The significant roles of intermediator

Policy makers have experienced the difficulties in identifying and judging the value of research outcomes, that has led to the suggestion that there may be a need for a third party to specialize in bridging the gap between academia and policy (Newman, 2014, p. 616). In this respect, the intermediators can help to find the relevant scientific background, review scientific materials, value the research results, explain and interpret for the purpose of policy formation. Too much information creates confusion and must be synthetized, categorized, and explained in an easy and most relevant faction. In this case, the flow of information between the knowledge generators and proximate decision-makers benefits from a skilled third party involved within the communication processes, to ensure that the message gets across and engender interest of the decision makers. The mediator role is therefore apparently twofold: (i) to 'interpret' the scientific content and ensure it is appealing to the recipient and (ii) repackaging data and information into usable form (Howlett, 2011. John et al., 2009; Young, 2010).

The Pan - Canadian Framework on Clean Growth and Climate Change is a comprehensive plan with multiple and very ambitious objectives to grow the economy while reducing emissions and building resilience to adapt to a changing climate. The development of the Pan - Canadian Framework was informed by input from Canadians across the country, Indigenous Peoples, the public, businesses, academics and civil society. Thus, the flow of information was characterized by the abundance of information and the diversified form of communication. For example, over 13,000 ideas and comments from Canadians about how Canada should address climate change were received through the Let's Talk Climate Action website (GOC, 2016f, p.2). In addition, consultations by governments and working groups on clean growth and climate change held across Canada also resulted in thousands of written submissions as well as thousands of oral analysis and suggestion contributed to meetings, roundtables, groups discussions, consultations, that summarized in form of

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minutes, reports, or briefs (GOC, 2016 c, f). The Working Group reviewed all materials to identify common themes and concerns, uncover new and innovative ideas and developing policy options with sufficient detail to support their practical and implementable ability. Where needed, the Working Group followed up with bilateral meetings with individual stakeholders and industry associations to clarify or expand suggestions, seek additional feedback and verify the core messages. These policy options were organized as a broad menu or toolbox, from which Ministers can choose and adapt the most relevant options for future. The report did not rank or prioritize policy options, as the development of recommendations falls under the purview of Ministers. However, it provided relevant analysis and considerations to support Ministerial discussions on policy options (GOC, 2016 b, c, d, e).

Box 2: Examples of policy options, relevant analysis and considerations

The report from the Working Group on Specific Mitigation Opportunities offers a large spectrum of potential options for ambitious emissions reductions across all economic sectors. For each option, the Working Groups have provided detailed information and analysis, including:

(1) Policy Goal

(2) Policy Tool and Detail

(3) Economic and Consumer Impacts

(4) Considerations: Stakeholder perspectives; Co-benefits/negative impacts; Linkages with other working group areas and other proposed policies; Regional impacts including northern and remote communities; Implementation, feasibility, technological and enabling infrastructure issues.

4.3. Opportunities for traditional knowledge

Adger et al. (2003) propose the concept of a "paradox" in climate change adaptation policy-making, implying the clearly existing discrepancy between the conclusions of a global assessment and the experience of societies living with environmental change (p.181). Including local and indigenous people to engage their lay or traditional knowledge is important for understand and effectively adapt to climate change. Few et al. (2007) suggest the factors that determine vulnerability are context-specific and understanding the local contexts of vulnerability requires a different kind of knowledge and expertise, therefore, designing adaptation interventions requires a knowledge base that is tailored to local settings. In the framework of post-normal science, Funtowicz and Ravetz (1993) argue that the application of routine scientific techniques is not enough when the uncertainties get higher, and the skills and judgement of new participants need to be consulted and 'experts' may need to share enquiries with lay or indigenous knowledge generators.

Government of Canada has highly recognized that indigenous or traditional Knowledge has a critical role in managing and addressing climate-related challenges, but also in developing climate policies and related programs (GOC, 2016a, f). Although Indigenous peoples are among the most vulnerable to a changing climate due to their close relationship with the environment and its resources, they are not merely passive recipients of climate change impacts. Rather, they are active drivers and agents of change who contribute vital knowledge, experience, and leadership to adaptation efforts across the country. With sufficient support, they contribute to the development of new and innovative solutions that benefit all Canadians and act as way finders on the path to resilience (GOC, 2016e).

The Pan - Canadian Framework has opened opportunities for local and indigenous knowledge. First, local and traditional knowledge was legitimated as an important part of policy-science dialogue as equal to scientific knowledge. Involving local and indigenous knowledge is one principle of Pan - Canadian Framework (GOC, 2016a, f) and the mandate of all working group during the formulation process (GOC, 2016b, c, d, e). Second, the consultation process was designed to broadly engage local and indigenous people into policy making process. National Indigenous

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Organizations consulted broadly with Indigenous communities and provided their perspectives and priorities to working groups or ministers (the Assembly of First Nations, the Métis National Council, The Inuit Tapiriit Kanatami (GOC, 2016b, c, d, e). The Working Group held three in person meetings with them as well as weekly telephone calls during the consultation process. Third, a meaningful dialogue was established between traditional knowledge and science so that traditional and scientific knowledge can be integrated to work out the policy options (GOC, 2016f, p. 28). Finally, the working groups and other relevant Ministers developed initiatives to strengthen skills and capacity of indigenous communities in generating and linking their unique knowledge into policy making process, developing pathways for the adoption and adaptation for Indigenous Peoples (GOC 2016c, f).

Box 3: Some examples of Indigenous knowledge proposed by Indigenous People and included in Pan- Canadian Framework on Clean Growth and Climate Change:

1. Incorporate Traditional Knowledge and culture into building designs (GOC 2016f, p. 16).
2. The traditional ecosystem-based forest management practices include increasing protected areas and using lower-impact harvesting techniques to retains more carbon in the forest (Cheakamus Community Forest carbon offset project) (GOC 2016f, p. 23).
3. The federal government will provide support for the Indigenous people to monitor climate change in their communities and to connect Traditional Knowledge and science to build a better understanding of impacts and inform adaptation actions (GOC 2016f, p. 33).

5. Conclusions

This paper provides a brief review on science - policy communications and presented a framework of three dimensions of science - policy dialogue, including who should be included, what should be covered, and how to design science-policy communication. Referred to as "wicked" problems, climate change and other environmental issues give challenges to the science – policy dialogue due to the uncertainty in scientific attempt to access the vulnerability, diverse value, as well as the participations of many stakeholders. To achieve more inclusive and effective climate change adaptation, the science – policy dialogue should reconsider its traditional frame, open the dialogue to both scientists and other knowledge producers, especially local and indigenous people. Local knowledge together with indigenous knowledge is the valuable source should be treated as equal as other specific knowledge. The literature also suggests the different mechanisms to foster science-policy communication, for example, linear model versa non-linear model, direct communication versa communication via intermediaries.

The case study has been analyzed to discover how science-policy dialogue happened in the context of clean growth and climate adaptation policy making. However, the implications of the case study can be applied in many other sectors of different contexts as well.

(i) The linear communication model is still commonly involved in the science - policy dialogue and proved to be useful to increase the relevance of science and data products to decision makers. Policy makers are more successful in achieving the scientific foundations they need, especially when they are looking for a huge and complex knowledge background to support the decision making of comprehensive or master plans, programs or policies.

(ii) When a gap between knowledge producer and knowledge user or decision maker exists, the need for a third party to specialize in bridging the gap become essential. Two significant roles of intermediaries are: to interpret the scientific content, ensuring it is appealing to the recipient and repackaging data and information into usable form. These roles are complementary to each other since the former helps policy maker understand the scientific materials and the latter presents them the way to use this in the decision-making process.

(iii) I believe that indigenous people and knowledge must be involved in adaptation policy making, the case study has provided practical recommendations on how to do it. A wide range of

actions should be implemented including: Legitimation local and traditional knowledge as an important part of policy-science dialogue as equal to scientific knowledge; Designing the consultation process to broadly engage local and indigenous people into policy making process; Facilitating meaningful dialogues between traditional knowledge and science so that traditional and scientific knowledge can be integrated to work out the policy options; Developing initiatives to strengthen skills and capacity of indigenous communities to generate and involve their unique knowledge into policy making process.

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References

1. Adger, W., Huq, S., Brown, K., Conway, D. & Hulme, M. Adaptation to climate change in the developing world. *Progress in Development Studies* **2003**, *3(3)*, 179-195. doi: 10.1191/1464993403ps060oa
2. Ayers, J. (2010). Understanding the Adaptation Paradox: Can Global Climate Change Adaptation Policy be Locally Inclusive? Retrieved from http://etheses.lse.ac.uk/393/1/Ayers_Understanding the Adaptation Paradox.pdf
3. Best, A. & Holmes, B. Systems thinking, knowledge and action: towards better models and methods. *Evidence & Policy* **2010**, *6(2)*, 145–159. doi: 10.1332/174426410X502284
4. Bradshaw, G. A. & Borchers, J. G. Uncertainty as information: narrowing the science–policy gap. *Ecology and Society* **2000**, *4(1):7*. Retrieved from: https://www.ecologyandsociety.org/vol4/iss1/art7/
5. Churchman, C. Wicked problems. *Management Science* **1967**, *4(14)*, 141–142. Retrieved from: https://punkrockor.files.wordpress.com/2014/10/wicked-problems-churchman-1967.pdf
6. Demeritt, D. Science studies, climate change and the prospects for constructivist critique. *Economy & Society* **2006**, *35(3)*, 453–479. doi: 10.1080/03085140600845024
7. Fairbrass, J. & Jordan, A. Multi-level governance and environmental policy. In: I. Bache, M. V. Flinders (eds), *Multi-level governance*. Oxford University Press, Oxford, GB, 2004; pp. 147 -164.
8. Few, R., Brown, K. and Tompkins, E. Public participation and climate change adaptation: avoiding the illusion of inclusion. *Climate Policy* **2007**, *7*, 46-59. doi: 10.1080/14693062.2007.9685637
9. FitzGibbon, J. & Mensah. O. K. Climate Change as a Wicked Problem: An Evaluation of the Institutional Context for Rural Water Management. *SAGE Open* **2012**, *April-June*, 1–14. doi: 10.1177/2158244012448487
10. Funtowicz, S. & Ravetz, J. Science for the post-normal age. *Futures* **1993**, *25(7)*, 735–755. Retrieved from: https://ac.els-cdn.com/001632879390022L/1-s2.0-001632879390022L-main.pdf?_tid=9305cfe0-a1e0-4556-b8fa-87526d62c2ed&acdnat=1524167290_8a21ec5cc74824679c4a54cb78304fc3
11. Government of Canada. Vancouver Declaration on Clean Growth and Climate Change, 2016a. Retrieved from: https://itk.ca/wp-content/uploads/2016/04/Vancouver_Declaration_clean_Growth_Climate_Change.pdf
12. Government of Canada. Working Group on Carbon Pricing Mechanisms - Final report, 2016b. Retrieved from: https://www.canada.ca/content/dam/eccc/migration/cc/content/6/4/7/64778dd5-e2d9-4930-be59-d6db7db5cbc0/wg_report_carbon-20pricing_e_v4.pdf
13. Government of Canada. Working Group on Specific Mitigation Opportunities - Final report (2016c). Retrieved from: https://www.canada.ca/content/dam/eccc/migration/cc/content/6/4/7/64778dd5-e2d9-4930-be59-d6db7db5cbc0/wg_report_specific_mitigation_opportunities_en_v04.pdf
14. Government of Canada. Working Group on Clean Technology, Innovation, and Jobs - Final report 2016d. Retrieved from: https://www.canada.ca/content/dam/eccc/migration/cc/content/6/4/7/64778dd5-e2d9-4930-be59-d6db7db5cbc0/wg_report_specific_mitigation_opportunities_en_v04.pdf
15. Government of Canada. Working Group on Adaptation and Climate Resilience - Final Report 2016e. Retrieved from: https://www.canada.ca/content/dam/eccc/migration/cc/content/6/4/7/64778dd5-e2d9-4930-be59-d6db7db5cbc0/wg_report_acr_e_v5.pdf.

16. Government of Canada. Pan - Canadian framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy, 2016f. Retrieved from: https://www.canada.ca/content/dam/themes/environment/documents/weather1/20170125-en.pdf
17. Government of Canada. Federal Actions for a Clean Growth delivering on the Pan - Canadian Framework on Clean Growth and Climate Change, 2016g. Retrieved from: https://www.canada.ca/content/dam/themes/environment/documents/weather1/20170119-en.pdf
18. Government of Canada. Pan - Canadian framework on Clean Growth and Climate Change: First Annual Synthesis Report on the Status of Implementation, 2017. Retrieved from: https://www.canada.ca/content/dam/themes/environment/weather/climatechange/PCF-FirstSynthesis_ENG.pdf
19. Howlett, M. *Designing public policies, principles and instruments*. Routledge, New York, USA, 2011.
20. Hoppe, R. Rethinking the science-policy nexus: from knowledge utilization and science technology studies to types of boundary arrangements. *Poiesis & Praxis* **2005**, *3(3)*, 199–215. Retrieved from: https://link.springer.com/article/10.1007/s10202-005-0074-0
21. Jones, H., jones, N., Walker, D. & Walsh, C. Strengthening science–policy dialogue in developing countries: a priority for climate change adaptation. Overseas Development Institute (ODI) Background Note 2009. Retrieved from: https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/5710.pdf
22. Koetz T., Farrell K.N., Bridgewater P. Building better science-policy interfaces for international environmental governance: assessing potential within the Intergovernmental Platform for biodiversity and Ecosystem Services. *International Environment Agreements: politics, Law, and Economics* **2011**,*12(1)*, 1–21. doi: 10.1007/s10784-011-9152-z
23. Laurance, W. F., Koster, H., Grooten, M., Anderson, A. B., Zidem, P. A., Zwick, S., Zagt, R. J., Lynam, A. J., Linkie, M. & Anten, N. P. R. Making conservation research more relevant for conservation practitioners. *Biological Conservation* **2012**, *153*, 164–168. doi: 10.1016/j.biocon.2012.05.012
24. Lemos, M.C. & Morehouse, B.J. The co-production of science and policy in integrated climate assessments. *Global Environment Change* **2005**, *15*, 57–68. doi: 10.1016/j.gloenvcha.2004.09.004
25. Mukherjee, I., & Howlett, M. Who is a stream? Epistemic communities, instrument constituencies and advocacy coalitions in public policy-making. *Politics and Governance* **2015**, *3(2)*, 65-75. doi: 10.17645/pag.v3i2.290
26. Newman, J. Revisiting the "two communities" metaphor of research utilisation. *International Journal of Public Sector Management* **2014**, *27(7)*, 614–627. doi: 10.1108/IJPSM-04-2014-0056
27. Nutley, S.M., Walter, I. & Davies, H.T.O. *Using evidence: how research can inform public services.* Policy Press, Bristol, GB, 2007.
28. Owens, S. Making a difference? Some perspectives on environmental research and policy. *The Transactions of the Institute of British Geographers* **2005**, *30*, 287–292. doi: 10.1111/j.1475-5661.2005.00171.x
29. Pielke, RA. Jr. *The honest broker. Making sense of science in policy and politics*. University Press, Cambridge, GB, 2007.
30. Rodari, P., Bultitude, K., & Desborough, K. Science communication between researchers and policy makers. Reflections from a European project. *Journal of Science Communication* **2012**, *11(3)*. Retrieved from: https://jcom.sissa.it/sites/default/files/documents/Jcom1103%282012%29C07.pdf
31. Sarewitz, D. How Science Makes Environmental Controversies Worse. *Environmental Science & Policy* **2004**, *7*, 385-403. doi: 10.1016/j.envsci.2004.06.001
32. Shaxson, L. & Bielak, T. Expanding our understanding of K* (KT, KE, KTT, KMb, KB, KM, etc.). *A concept paper emerging from the K* conference* held in UNU-INWEH Hamilton, ON, April 2012, Hamilton. Retrieved from: http://inweh.unu.edu/wp-content/uploads/2015/05/KStar_ConceptPaperSummary_Final_SinglePaged_Web.pdf
33. Spierenburg, M. Getting the message across. Biodiversity science and policy interfaces - A review. *GAIA - Ecological Perspectives for Science and Society* **2012**, *21(2)*, 125–134. doi: 10.14512/gaia.21.2.11
34. Stirling, A. Keep it complex. *Nature* **2010**, *468*, 1029–1031. doi: 10.1038/4681029a
35. Winterfeldt, D. Bridging the gap between science and decision making. *PNAS* **2013**, *110 (3)*, 14055 - 14061. doi: 10.1073/pnas.1213532110

36. Young, J. & Marzano, M. Embodied interdisciplinarity: what is the role of polymaths in environmental research? *Environmental Conservation* **2010**, *37(4)*, 373–375. doi: doi.org/10.1017/S0376892910000524
37. Young, J., Waylen, K., Sarkki, S., Albon, S., Bainbridge, I., Balian, E., Davidson, J., Edwards, D., Fairley, R., Margerison, C., McCracken, D., Owen, R., Quine, C., Stewart-Roper, C., Thompson, D., Tinch, R., Van den, Hove, S. & Watt, A. Improving the science-policy dialogue to meet the challenges of biodiversity conservation: having conversations rather than talking at one -another, *Biodiversity Conservation* **2014**, *23*, 387–404. doi: 10.1007/s10531-013-0607-0S.