Gaps in science and policy formulation of climate change: perspective from university

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Abstract. In relation to climate change, policy formulation based on science is needed to determine further strategic actions. Unfortunately, there have been several gaps that hampered the implementation. This paper explores these gaps from a stand point of university, one of strategic partner of the government as the policy maker and regulator of climate change. The identified major gaps are: (1) no specific courses dealing with climate change, although research centers have been established; (2) insufficient number of lecturers who specialized in climate change; (3) research in climate change are long-term that requires big funding, except for carbon estimation; and (4) need to use sophisticated math modelling that requires specific skills. Climate change science is extremely complex, encompass various knowledge disciplines, developed very fast, and covering a global scale. Besides as strategic pools of expert, university lecturers also have important roles to educate students who might involve in future research and policy formulation. Therefore, these gaps need to be addressed, to produce effective policies formulation and then translating them into action programs. In addition, Indonesia needs to have a likelihood science group in climate change who will provide a regular scientific assessment to be translated into policy by the government.

1. Introduction
Climate change is a complex issue and humans have never been in the situation of confronting the planet such as it is happening now [1]. As a process and impact that have been happening very slowly compared to human life, long term past data need to be collected, analyzed, and used for future prediction, of which all these processes required a strong science and knowledge. Having collected and interpreted scientific facts, policy need to be formulated in order to take necessary actions in national, regional, and global context. Following the policy formulation, series of action programs – which are essentially involving everybody and every country – need to be created as well.

Based on the above process, gaps might exist in every stage: gaps in research and science are needed to produce necessary policy, gaps in delivering knowledge and science to the policy makers, gaps in transferring the knowledge and science of the policy makers into policy formulation, as well as gaps in creating real actions based on the policy that has already been formulated by policy makers. Gaps in the implementation of actions surely also might exist.

This paper emphasizes on first gap only, namely gaps related to human resource development and capacity building related to climate change from a stand-point of university, one of strategic partner of
the government as the policy maker and regulator of climate change. After the gaps are identified, recommendations will be provided to fill up the second gap, namely gaps in delivering the knowledge and science compiled by university to the policy makers.

Accumulation of knowledge related to this issue bases on personal experience as a lecturer for at least 15 years. During those periods, various activities have been conducted by the Author, including attending several UNCFCCF Conference of Parties, writing some reports related to climate change, joining meetings conducted by ministries and other government institutions, as well as lecturing topics related to climate change (undergraduate and graduate level). Desk study is also performed to enhance and strengthen the analysis.

2. University as a Capacity Building Institution

Universities offer higher-degree education for students who has a passion and a need to pursue further education, after finishing high school. Based on the latest educational system in Indonesia called KKNI (Kerangka Kualifikasi Nasional Indonesia; Indonesian National Qualification Scheme), Indonesian universities - including Bogor Agricultural University (‘IPB University’) - provide an education of level 6 (Bachelor), 8 (Master’s), and 9 (Doctor, the highest level). As already standardized in Indonesia, ASEAN, and global education system, normally it takes 4 years to complete Bachelor degree, 2 years for Master’s, and 4 years for Doctor.

The main product of a university would be graduates, who will be alumni when the graduates finished their study. In addition to conduct lecturing for students, the lecturers also required to conduct research and some community service. Lecturers are expected to continuously improve knowledge, science, skills and experienced within his/her own field of specialties. This lifelong self-education will create high quality lecturers, and in turn, also impacting the high quality of the university.

Some university alumni might work as government official, who also might involve in the policy making. Although the alumni’s knowledge could originated from his/her own effort after they graduated from university, clearly education in the university (Bachelor, Master’s and Doctor degrees) would greatly help the alumni in providing the basic science and knowledge to eventually produce appropriate decisions or policies.

3. Gaps in climate change science as a basis to develop policy

In order to have a good policy formulation in climate change, background of knowledge and science as the basis of decision-making process has to be in strong, accurate and solid. For Indonesian university, four major gaps related to climate change have been identified. These gaps are related to three major ‘products’ of university, namely lecturers (the pool of expertise), alumni (graduated students), and advancement of knowledge, science, and technology derived from researches (field research and desk study) conducted by lecturers and students. Summary of the gaps is shown in Figure 1, and the explanation of each gap is elaborated below.

3.1. Lack of courses related to climate change

No specific courses dealing with climate change, although research centers have been established

Until now there has been not any universities offering program in climate change. In fact, even course on climate change has been extremely limited and probably close to none. The fixed curricula often have been blamed as the logic reason.

University curricula are re-visited, re-new and revised – if necessary – every five years. Adding a new course, especially undergraduate course, is not always easy because it most likely have to replace another existing course. For graduate program, new additional course can be easily placed under the elective course, although the new course will need to ‘compete’ with another existing course.
3.3. Insufficient number of lecturers who specialized in climate change
Among the lecturers in a university, climate change is most probably not the only topic (or course) that should be taught. Hence, the time dedicated to concord the science and political decision related to climate change may be limited and most probably be driven by personal interest and curiosity rather than fulfilling a task as lecturers. In fact, following and updating issues emerged in the UNFCCCs’ COP and their related meetings are not easy. New information overwhelmingly ubiquitous, as if they constantly pouring down with a fast speed.

3.3. Research in climate change are long-term that requires big funding
Finding topic for research on climate change mitigation and adaptation is always dilemmatic for lecturers, although the lecturer has sufficient background and knowledge on a specific topic related to climate change. The topic that can be done in a relatively short time probably would be biomass and carbon estimation of various tree species, tree stand, or possibly forest/ecosystem types.

3.4. Need to use sophisticated math modelling that requires specific skills
Impact of climate change are slow and almost undetected in the short term period. Only a long term data would prove that climate change does exist. Forecasting to the future based on long-term past data (e.g., impact of climate change on insect/wildlife population, resiliency and tolerance level of climatic irregularity, rate ex species extinction, etc.), as well as prediction of success in implementing an action program mainly for climate change adaptation (e.g. species/cultivar selection, ability to decrease local/regional/global greenhouse gasses or global temperature due to specific action program, etc.) will need a sophisticated math and meticulous modelling. Basis long-term data necessary for modelling could be unavailable. Even carbon estimation research requires at least a background of allometric equation and some knowledge on mathematical modeling.

4. Increasing roles of higher education system in policy formulation of climate change
Institution that is responsible to the climate change policy formulation in Indonesia is the Ministry of Environment and Forestry (MoEF). The MoEF - as the leading agency and national focal point of UNFCCC - has been developing its unit related to climate change very rapidly. Currently the Directorate General of PPI (Pengendalian Perubahan Iklim; Directorate General of Climate Change) is the highest level of institution unit within this Ministry. This Directorate General has been undergone a rapid development, from a small sub-directorate within the Planning Agency, then moved under the Forestry Research and Development Agency (FORDA) due to its intensive scientific content at that time, and now has been placed under a directorate general.

Higher education system (i.e. university) should be perceived as a strategic partner of the MoEF. Resources within the university, including the lecturers, alumni, and the accumulation of science and knowledge, could be shared with the MoEF in formulating appropriate policy. In return, the MoEF could also share the policy (existing and draft/planned) global/regional/national policy, considering that the university could possess some limited access to the policy and the process.

University can also assist public awareness program. Based on study [2], climate change is relatively popular among Indonesian respondents (teachers and students of SD/elementary school, SMP/middle school and SMA/high school), and the major information sources are mass media (mostly public television and radio), followed by newspapers, and non-universities. Furthermore, the same study also reveals that the capacity building opportunities for students (SD, SMP, SMA) and their teachers are mostly provided by NGOs, rather than by government education offices and universities. This means that universities currently are not considered as good sources for capacity building in Indonesia. Most capacity building opportunities in Indonesia are mostly NGOs and international development agencies [3].

5. Conclusion and recommendations
University has been experiencing some gaps in relation to climate change science. The gaps are embedded within lecturers, alumni/graduates, curricula, and pool of knowledge, science and technology derived by the lecturers and graduates. In the context of policy making, unless universities take immediate actions to reduce or eliminate these four identified gaps, university will not able to participate in the policy formulation of Indonesian country.

When these gaps can be eliminated, universities will be able to serve as strategic partners of the policy makers and other stakeholders (for example NGOs, local community, private sectors) in translating policy into action program in the field. Some recommendations to reduce the gaps, both internal within university and external, are presented in Appendix A.
In addition, pools of scientific knowledge and a group of scientists can be established in Indonesia to assist policy makers (i.e. Ministry of Environment and Forestry) in formulating scientifically sound policy and the related action program. If UNFCCC has IPCC, the Government of Indonesia can also have this likelihood science group in the future.

References
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[2] Republic of Indonesia 2010 Indonesia Second National Communication under the United Nations Framework Convention on Climate Change (UNFCCC) Jakarta: Ministry of Environment.
[3] Putrawidjaja M 2008 Mapping climate education in Indonesia: Opportunities for development. Climate Education Research Jakarta: British Council.

Appendix A. Some recommendations to eliminate the internal gaps and external gaps of a university in relation to the advancement of climate change knowledge, science, and technology.

| Clusters | Recommended Actions |
|----------|---------------------|
| **Internal within a university** |
| Curricula and beyond | • Develop a course dedicated to climate change, or at least include the climate change topic within existing course(s)  
| | • Provide training, seminar, workshops, discussion, or other scientific meeting for lecturers and students  
| | • Integrating education pillars (to know, to do, to be, to live together) into the extra-curricular program for students  
| | • Provide examples of best practices within campus life  
| | • Practice the climate change friendly activities within the daily habit in university |
| Lecturers | • Prepare for life-long learning to update current science and policy  
| | • Write scientific and semi-scientific papers (journals, lecture notes, textbook, magazine, even in personal blogs)  
| | • Actively involved in national and international meeting  
| | • Conduct research under the umbrella topic of climate change  
| | • Create a better link with NGOs to learn more about best practices in the field  
| | • Make a better collaboration with other researchers worldwide (who has been working in climate change)  
| | • Strengthen cooperation with university research centers within and outside university |
| Long term research | • Asses funding (mostly international) to conduct long-term studies related to various aspects of climate change  
| | • Create join research with other colleagues in other universities or research center, within and outside Indonesia |
| Methodology | • Start or strengthen collaboration with experts in certain methods (for example collaboration between ecologist and mathematician)  
| | • Spend sufficient time to learn more about standardized approach/method from journals and textbook |
| **External (other institutions)** |
| MoEF and other ministries/institution | • Provide opportunities for universities and other stakeholders to be involved in the decision-making process |
• Conduct sharing sessions with universities and other stakeholders, especially in dissemination of international policies
• Assign university to conduct some assessment as a basis for policy formulation

Other universities
• Create a collaborative program in research and lecturing (e.g. guest lectures)
• Create mechanism to exchange knowledge and research results

Research centers
• Conduct join research on climate change
• Create mechanism to exchange knowledge and research results

NGO
• Strengthen partnership to mutually learn more about field program and best practices
• Provide opportunities for students to conduct internship on climate change program/activities

Private sector
• Provide funding for research related to climate change, especially research leading to practical activities needed by the private sectors
• Provide opportunities for students to conduct internship on climate change program/activities

Local community
• Provide input on problems and challenges linked to climate changes that have been faced by the local community
• Provide field sites for research and testing the findings/theories
• Initiate collaboration in testing/developing awareness program