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Science diplomacy – looking towards 2030[1]

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The 2030 agenda is encapsulated within the 17 SDGs and their 169 targets. Some have been criticized the agenda as being too broad to be meaningful, unrealistic in scope and more aspirational rather than having the concrete, focused and very specific nature of their predecessor MDGs. Irrespective of such critiques, the SDGs are the critical framing device for progressing a global agenda. The question that is thus worth posing is to what extend does science underpin this agenda and in turn, given its global scope, what is the role of science diplomacy.

When I refer to science in this talk I am being all encompassing. In each of the SDGs, natural science, social science, data science, economic and political science and particularly implementation science will be needed. Technological developments will also be critical to many of the goals. The importance of robust social sciences to them cannot be overstated. But both the SDGs and the 4th industrial revolution speak to a critical juncture in human history. We are changing our environments and our human cultures and behaviours at a pace that makes the implications difficult to fully comprehend. The skills of historians, philosophers, ethicists and others are needed. It would be a mistake to assume a technologically deterministic approach to the challenges we face. The challenge is how to make deliberative and informed decisions about how technologies are deployed in our best interests.

This talk will be in five parts.

First: I will discuss the role of the sciences in addressing the 2030 agenda.

Second; we need to consider the role of new technologies and in particular to what extent progress on the goals will require discourse and social acceptance of many new technologies: digital, biological, medical and perhaps mechanical.

Third; I will discuss the role of evidence informed policy-making at different levels of government in progressing the agenda.

Fourthly because these are all global issues we will discuss the role of science diplomacy.

[1] Some components of this lecture are derived from my lecture at the University of Sheffied in October entitled *Will the Road to 2030 be Evdience Paved*. Others draw from work being undertaken with Vaughan Turekian on understanding science diplomacy.

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Finally I want to try and pull all of this together in thinking through whether we have the right organisational constructs in both international science and science diplomacy to get to where we want to be.

But first a few preliminary remarks to keep what I say in perspective.

It is sobering to remind ourselves of how many view science. Evidence to most people, including often policy-makers, does not mean robust science alone. It can refer to knowledge that comes from religion or tradition, to dogma that persists in a community, to local knowledge, or to personal observation, experience or anecdote or the view of social media network that has been selected by the individual precisely because it reinforces the views already held.

When we talk about science we need to remind ourselves that science is not a compilation of facts, rather it is a set of processes that aim to discover relatively reliable information about the world around and within us. There are many different definitions of science but virtually all of them focus on the processes, its inherently provisional nature and its essential value of institutionalised skepticism.

These issues are becoming more acute in the post-trust, post-expert world that now seems to be taking shape at least in the global north. While science appears to have been largely immune from the loss of institutional trust to date, we cannot take that for granted. It is not just the obvious issue of scientific malfeasance, it is more the enormous industry centered on bibliometrics rather than societal impact and the complexity of the changed relationships that follow from the utilitarian agenda that generate concern and can invite contestation.

So with this background let me turn now to the first of my questions: what scientific evidence is needed to map out and prepare for the road ahead? In 2015, the International Council for Science (ICSU) provided a pointed analysis of the SDG's targets. ICSU pointed out that there were some quite substantive knowledge gaps to be filled before a number of the goals could be reached. Yet others require the more systematic application of current knowledge and issues of knowledge and technology transfer are real and complicated. In 2017 ICSU returned to this question and dissected out in some detail four of the goals: goal 2–zero hunger; goal3-good health and well-being; goal7-affordable and clean energy; goal 14 - life below water. Their analysis identified a large number of knowledge gaps. We need a similar analysis across all 17 of the goals.

Last year's UN Global Sustainability Report opined that globally coordinated research roadmaps for most of the SDGs would help. ICSU also pointed out in that report the high level of interconnectivity between the goals and this has implications for filling these knowledge gaps and for policy decisions related to implementation.Thisgapanalysisneedsacoherenteffortratherthanbeinglefttothe somewhat capricious efforts of foundations and donor nations.

But who should do the coordinating? The complexity of the UN itself means there is no truly comprehensive view of its various advisory inputs. The multiple agencies of the UN tend to work in silos and the full scope of sciences do not have a strong voice in many of the agencies that could be making great use of scientific advice. There is a need to get beyond capricious progress to address

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these knowledge gaps. Without an agreed roadmap, the vagaries of contestable research – which is increasingly managed and directed to areas of donor interest – may limit progress.

So the question then becomes: how should science address these knowledge gaps? There is no generalized global research funding system and never likely to be one. Governments mainly spend their research dollars almost entirely within their own borders and on issues of domestic relevance. Only occasionally as in the case of IIASA or some big science endeavours do they pool funds. Funding provided for development assistance is also often constrained to link to donor's objectives. And other funders such as foundations tend to have their own agendas and priorities.

While we will not have a global funding system should we be thinking about novel models for coordinated knowledge production? Can we learn from existing models that could address this challenge? One model is the Global Research Alliance on Agricultural Greenhouse Gases. This consortium emerged out of the Copenhagen climate change meeting in 2009 when NZ, supported by Canada and – at that time – the USA and several other countries, proposed a coordinated approach to agricultural emissions, given that 20% of GHG are associated with food production. In 2010 diplomats and scientists from some 30 countries developed the alliance model. The Alliance now has 49 member countries and a large number of agency partners. The members include all the major food-producing countries at all income levels. The secretariat consists essentially of two people and is based in Wellington. The secretariat supports a science-led effort in which scientists jointly identify the needs and then largely seek domestic funding to address these in a very coordinated fashion. There are other models of global research coordination without consolidated funding– the human genome project was one such example.

Now let me turn to the second set of issues. Irrespective of the knowledge gaps, we have a good idea of the general type of research and technologies that will be necessary. But is society willing to accept the technologies that could be most effective? We need to anticipate the issues of social license that will likely emerge. Let me focus briefly on four of these as areas for which the implications have not yet been fully imagined.

Firstly, there is data science. The last STI forum in New York was very much focused on the role of data and indeed throughout the SDG papers, data is repeatedly mentioned. But there are many issues. For one thing, data collection is not cost free and in many cases it is not simple. Many countries do not have effective national statistical centres, data curation requires a major investment, and big data analysis cannot be done simply by data analysts alone. It also needs domain expertise to define the models and interpret the data – and of course this is where IIASA has so much strength.

There are many caveats about big data but the one that needs consideration in the context of the SDGs is the issue of social acceptability of data use. Even where there is good data being collected, we must still consider who owns the data, who has access to the databases, and how it is interpreted. These issues are real in advanced economies, they will be equally large in LMICs. And globally, the issue of indigenous data sovereignty is another matter that mainstream data science has largely not begun to address. This is important because data science necessarily must set out a number of assumptions in developing its models.
If these assumptions are not culturally informed, the outcomes could be wrong.

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Secondly, digitalisation, AI, robotics and machine learning offer many opportunities but also threaten fundamental concepts of autonomy, democracy and national identity and indeed the post-enlightenment organisation of society and definition of values and human satisfaction. There are inevitable shifts underway in these dimensions as the pace of technology outstrips the capacity of society to adjust and policy structures do not seem to be able to canalize the shifts underway. We see the start of this in the rise of power of the platform companies and the effects of social media. Are we satisfied that the putative 'transparency' of these technologies can replace the 'accountability' of institutions? I could extend my discussion of this issue at length but that is not for today.

Thirdly the life science technologies from GM to GE to synthetic biology to whatever comes next offer enormous opportunities to deal with biosecurity, disease, food security, environmental management etc. But each of these technologies has real, perceived or unknown risks, creating for a complex discourse that can easily degrade into the entrenched views of one side or the other. Yet it seems inevitable that some of these technologies will have a role to play if we are to balance sustainability with the increased need for food production and against the background of climate and ecological change.

One role of effective science advisory ecosystems at national levels and enhanced science diplomacy would be to ensure adequate dialogue both with the public and with governments on such issues.

And this lets me segue to the third question– one that I believe has gone largely unnoticed in the various reports on how science can support the SDGs. This is the question of how will science practically engage with the policy-making *process* to progress the SDGs? An examination of the targets suggests that many of them require policy and/or regulatory development and all have policy implications.

There is not one goal that does not involve policy development and indeed goal 16 is essentially about building robust governance systems. Policy-making is fundamentally about making choices between options that involve different trade-offs affecting different stakeholders in different ways. More effective policies may be made and implemented if they are informed by scientifically derived evidence. This latter statement should not be contentious, and it should be true both globally and nationally, regardless of the policy context and even though the policy processes and considerations at global and national levels differ.

And indeed a small but increasing number and diversity of countries are establishing more formal science advisory mechanisms within their own domestic ecosystems. Comprehensive domestic advisory systems have some key components: those dealing with knowledge generation, with knowledge synthesis and with knowledge brokerage. Knowledge brokerage is the actual process of transferring policy needs to the science community and transferring an understanding of what we know and the limits on that understanding to the policy community to better inform their options; a decision that will always have a large values component.

My view is that all countries irrespective of their state of development need a multi-dimensional

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ecosystem – in some case this could have a regional component. There is a need within the government for knowledge brokerage, often informal, throughout the policy process. There is a need for structured input of the scientific community–by means of more deliberative advice – for example via an academy. These internal and external sources have different functions and operational modes but between them and other components I do not have time to discuss, it allows for the full breadth of advisory needs.

In addition to these diverse and complementary components, I believe that a single focal point speaking to the chief executive of government can help that office make sense of it all. But whatever structures are used they rely on sufficient institutional development – of government, of academia, of policy making. It is noteworthy that a conclusion of the 10 member group to the Technology facilitation mechanism in 2016, reinforced by conclusions of the STI forum in New York earlier this year, was that all countries need a science advisory ecosystem and that single point of focus.

But how do domestic advisory mechanisms link to decisions made at a global level? Largely they don't and that is a huge problem I shall soon return to. But before I do so let me say something about science diplomacy.

International science engagement can be viewed through two overlapping lenses; a lens that sees international collaboration in science as having the goal of advancing knowledge and ensuring scientific capacity and capability, and a lens that sees scientific engagement across national boundaries to advance broader national interests. It is the latter that is primarily encompassed within the evolving concept of science diplomacy. While there is no sharp distinction, these two perspectives are often administered through different agencies and through different funding streams, which can be a source of potential conflict between, and confusion within, agencies.

The concept of science diplomacy was given contemporary emphasis and currency by a meeting held in in 2009 at the Wilton House, UK. The most influential outcome of that meeting was the development of a taxonomy for science diplomacy that has come to be widely used:

- **Science in diplomacy:** Science can provide advice to inform and support foreign policy objectives.
- **Diplomacy for science:** Diplomacy can facilitate international scientific cooperation.
- **Science for diplomacy:** Scientific cooperation can improve international relations.

From the perspective of the foreign ministries, the traditional taxonomy is seen as academic and of limited practical application. Further there are important elements of science diplomacy that do not sit easily in this tripartite framing – such as the governance of non-jurisdictional spaces such as Antarctica, the role of science in development assistance or in resolving trade disputes.

Vaughan Turekian and I have proposed a more utilitarian framing that focuses on the rationale for why a country might invest effort and resources in science diplomacy and international science provides an alternative perspective that resonates better with government agencies. For a country to make any investment that supports science diplomacy, the actions must be seen to either directly or indirectly

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advance the national interest but that national interest can be parsed according to the motivations and intervention logic. In this alternate framing, science diplomacy can be considered in three categories:

- **Actions that are designed to directly advance a country's national needs,**
- **Actions that are designed to address cross-border interests,**
- **Actions that are primarily designed to meet global needs and challenges.**

So let me parse each of these categories briefly – first those science diplomacy actions that are designed to directly advance a nation's national needs.

Countries use science diplomacy to project their culture and influence beyond their boundaries. This was originally largely a function of large countries projecting soft power. But smaller countries have also found that science is a way they can project their potential and role effectively. Israel for example has used its strengths and demonstrated success in developing start-up and innovation economy to great effect in building relationships with many countries and in these getting beyond issues arising from the long-standing tensions in the Middle-East. Many nations are now looking to become more strategic in identifying how science can build relationships with target countries, reduce tensions, and promote trade and to advance broader diplomatic interests.

Increasingly development assistance is also seen to have important critical scientific as well as diplomatic dimensions. Core to the development of LMICs is the enhancement of science literacy and capacity through the promotion of STEM education, the development of scientific expertise to inform policy, to address crises and to promote economic, human and environmental development. Science must also inform development assistance more directly. Much aid has a technological dimension – whether to address water and other environmental and resource issues, to address issues in public health, to promote food and energy security or to grow and diversify the economy. However, well-intended efforts can be counterproductive if not evidence-based. Increasingly there is a need for both the science of development assistance and for scientific input into the evaluation and design of proposed programmes.

Science impinges on national security needs at a number of levels. Most obviously it is to reduce tensions and build understandings as was the case when IIASA was founded or in the promotion of arms treaty verification science. But it has other security dimensions: for example in the need for trans-national scientific assistance in the face of a natural or technological emergency or disaster. For example considerable international science collaboration was needed to resolve each nation's response to the Iceland volcanic ash episodes.

Equally, while cybersecurity at one level is a global concern, the growth of state and non-state cyber-espionage drives an increasing interest and need for states to seek and develop bilateral and international cybersecurity protocols. The rapid development of new and emerging technologies, such as gene editing, artificial intelligence and machine learning, also are presenting rapidly evolving challenges to the foreign policy and national security systems at national and global scales.

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In the 21st century, trade and diplomacy are intimately linked and in many countries the two are organizationally linked within the same ministries. The World Trade Organisation (WTO) system – particularly in areas related to food and agriculture – is heavily dependent on science and the international trade system is underpinned by an array of agreements on phyto-sanitary and related issues. Many disputes handled through the WTO system are based on scientific argument and frequently the issue is whether the science is being properly applied or is it being misused to create a non-tariff barrier.

Increasingly, trade is in advanced technologies and technology based services. The global value chains of intellectual property, data and manufacturing mean that multiple countries may be involved in the development of one product. In this, innovative countries seek to partner with other innovative countries looking for synergies. At the same time countries are looking for advantage to protect and sell products that have a high intellectual component. Thus recent trade negotiations have been heavily invested in debate and negotiation about intellectual property, copyright, software and advanced biologics. Scientific input into such negotiations is critical to protect national positions.

As technologies develop in parallel across the world, successful export (or import) depends on common technical standards and definitions. Different definitions may create potential non-tariff barriers. For example if genetic modification excludes gene editing in some jurisdictions but includes it in others there is quite some potential for disruption as these techniques become more widely used in agriculture and medicine.

Many countries are seeking to build their science, technology and innovation capacities. Diplomacy is used in multiple ways to assist in this endeavor, whether it is by opening doors to capacities in other countries, by building relationships through partnership agreements at national, university or company level and by reaching out to their diaspora. These are all activities that engage foreign ministries, often in partnership with their science and innovation agencies.

For many countries partnership in big science projects that cross national borders has a primary goal of assisting national development. For example some of the countries investing the square kilometer array (SKA) project are doing so primarily because of the impact it will have on national development.

There are other actions where the national interest is served by using science to assist in specifically addressing bilateral or cross boundary issues. An obvious example is in the management of ecosystems and resources than span jurisdictional borders. An example where science is assisting is in the management of the Rift Valley region between Jordan and Israel where, despite other tensions, there is a growing understandings of the science needed to sustain the agricultural potential of the valley and where efforts continue bilaterally and multilaterally to consider the issue of the reducing size of the Dead Sea. And science based management plans agreed between Rwanda, Uganda and Congo have been critical to protecting the vulnerable mountain gorilla and the associated tourist industry. Clearly matters of trans-border shared resources like aquifers, fish stocks and rivers all have large scientific components, meaning that diplomatic efforts without adequate science can be ill-directed.

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As the success of the European Commission demonstrates, there are many technical services that can be shared between nations such as food safety assessment or pharmaceutical regulation or industrial standards. Regional groupings can play a role in promoting trade, resolving matters of standards and definitions and in emergency planning and crisis management. The major focus of the Asia-Pacific Economic Cooperation (APEC) science advisors and equivalents group has in enhancing cooperation in crisis and emergency management.

A different set of issues emerge when one considers problems that are primarily global in nature such as climate change, protecting global biodiversity or avoiding micro-plastic contamination of the oceans. Here near-term national interest may drive in a direction other than desirable. Indeed this has been obvious in the difficulties in for example achieving effective commitments and action to address greenhouse gas emissions.

About 70% of the planet's surface is not jurisdictionally controlled; these are our oceans outside of exclusive economic zones and the polar-regions. The Antarctic in many ways represents the apex of post-WW2 science diplomacy with the original signatories to the Antarctic treaty in 1957 agreeing to suspend territorial claims, reject resource extraction and promote Antarctic for scientific research. There are now 53 treaty signatories and partners and the Antarctic is effectively governed by a series of scientific committees working closely with diplomatic partners.

Science is increasingly important to manage our other ungoverned spaces; the oceans and space. To a large extent science has already played a major role in space governance but the oceans represent a global commons where a growing number of threats emerge. Cyberspace was born as a scientific endeavour and scientific tool –and it is from this and many other scientific developments that the digital world has grown to become so dominant. However, while science initially had a pseudo-governing role over cyberspace, that role has now been largely displaced by platform technology companies. Given the manifest opportunities on one hand, and the threats to national authority, security and impacts on social organisation and behaviours on the other it is inevitable that issues of the digital world will increasingly engage both diplomats and their technical advisors in coming years.

In situations of direct national interest, decision-making is structured through the executive branch of government and increasingly informed by domestic science advisory ecosystems. But international decision-making and scientific input is more obtuse. UN agencies and the UN itself are not autonomous but depend on decision making by the votes of member states. These votes are generally made via ministries of foreign affairs. However the scientific input to UN bodies generally comes from UN agency staff or advisory committees to those agencies and is largely disconnected from whatever advice the national representative may or may not have. If progress is to be made on many of these issues it is important that there is stronger linkage between domestic science advisory mechanism and international agencies on one hand and between domestic science advisory systems and ministries of foreign affairs on the other.

Progress will require that domestic science advisory and diplomatic systems agree that their national interests are indeed served by a global solution being reached. For example it is disappointing that the last United Nations Secretary General's Science Advisory Board made no effort to reach out to

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domestic science advisory systems. This deficit is not unique to the UN system – other parts of the international science policy system also are not inclusive – for example many of the influential policy discussions on Open Science have not been inclusive.

And this brings me to my final point: findings a solution. There are two components;

First domestic science advisory mechanisms and foreign ministries must be better linked. In the last year there has been a growing effort to do so. In 2016, the United States, New Zealand, the United Kingdom and Japan joined to formalize a Foreign Ministers Science and Technology Advisers Network (FMSTAN) to elevate the inputs of science and technology to diplomacy. This network that I chair has now expanded to nearly 20 countries of diverse characteristics

Second, the UN system is largely built in silos, agencies have their own science inputs that are largely inchoate, and yet science and technology are obviously key to progress across the whole agenda. Logic says some scientific coordinating group close to the centre of the UN system is needed. Does the recent disestablishment of the last UN Secretary General's science advisory board offer an opportunity to think about what might replace it?

Following the STI forum in May this year, it was proposed that a UN Scientific Advisory Board should be re-established but that its membership should be carefully drawn from distinguished scientists with a clear vision of the role of science, technology and innovation in supportingAgenda2030 and deep experience at the science-policy interface. Its chair should be from within that group and it must report to New York. The board's mandate should be to: ensure better coordination across UN agencies and programmes in the development of scientific input into UN policy development and implementation framework; promote effective linkages between the UN system and international scientific bodies; contribute to coordinated science roadmap development for the SDGs; encourage the development of domestic science advisory systems and their coordination with UN agencies and advisory mechanisms; and assist the Secretary General's office as appropriate through the promotion of science diplomacy. This recommendation is highlighted in the consultative document INGSA has just released on science advice and the global goals (www.ingsa.org/manifesto/) – please engage in the consultation.

The 2030 agenda has multiple dimensions, some require domestic action, some global action. All require sciences to support policy development and actions by civil society. There is a lack of structures to ensure the effective use of science. This requires attention to strengthening domestic advisory ecosystems and then linking them via the mechanisms of science diplomacy to global policy making. Science diplomacy is evolving from being a marginal activity to being at the centre of the global agenda.

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