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## Research for development in the 21<sup>st</sup> century

Rumpel, C.<sup>1</sup>, Ann, V.<sup>2</sup>, Bahri, H.<sup>3</sup>, Calabi Floody, M.<sup>4</sup>, Cheik, S.<sup>5</sup>, Doan, T.T.<sup>6</sup>, Harit, A.<sup>7</sup>, Janeau, J.L.<sup>1</sup>, Jouquet, P.<sup>1</sup>, Mora, M.L.<sup>4</sup>, Podwojewski, P.<sup>1</sup>, Minh, T.T.<sup>6</sup>, Ngo, Q.A.<sup>8</sup>, Rossi, P.L.<sup>1</sup>, Sanaullah, M.<sup>9</sup>

<sup>1</sup>CNRS, IRD, IEES, UMR (CNRS, IRD, Sorbonne University, UPEC), Paris, France

<sup>2</sup>Institute of Technology of Cambodia, Phnom Penh, Cambodia

<sup>3</sup>Institut National de Recherches en Génie Rural, Eaux et Forêts, Université de Carthage, Tunisie

<sup>4</sup>BIOREN, UFRO, Temuco, Chile

<sup>5</sup>Gachamaleh, lot 18,1095 Djibouti, Djibouti

<sup>6</sup>Soils and Fertilizers Research Institute, Hanoi, Vietnam

<sup>7</sup>School of Environmental Sciences, Mahatma Gandhi University, Kottayam, India

<sup>8</sup>Institute of Chemistry, VAST, Hanoi, Vietnam

<sup>9</sup>Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad Pakistan

A recent discussion in *Geoderma* dealt with the occurrence of helicopter research in soil science, an unethical practice, characterized by little involvement of local researchers and Indigenous populations, and small benefits to local scientific communities (Minasny et al., 2020). This topic is crucial and will, undoubtedly, cause vibrant discussions. In this paper, we provide a historical perspective on soil research for development, we critically assess the way in which countries tackle international research collaboration and provide a way forward to fruitful partnerships in the 21<sup>st</sup> century.

It has been pointed out that helicopter research can be identified by an international author list, including one or two local researchers at the end of the list (Minasny et al., 2020). Research papers are the most visible result of international research collaboration and may reveal the individualism of our societies. However, such a view may be quite limited, because publications are the outcomes of scientific exchanges, which are only possible after the formulation of scientific questions and hypotheses, acquisition and analyses of data, the utilization of infrastructures such as laboratories and experimental or observatory fields, often after obtaining funding from projects. Since international research projects mainly originate

from western countries (e.g. the European H2020 projects), a subtle dependency arises between soil scientists from the Global North (i.e., countries, whose gross domestic product (GDP) identifies them as developed) coming with their own research agenda and budgets and local scientists from the Global South (i.e., countries, whose GDP identifies them as developing countries) benefiting, directly or indirectly, from this cooperation. Inevitably, the risk of such a system is to create an unbalanced relationship, which may ignore local priorities. This typically occurs when tropical soils are used as models for doing fundamental research (e.g., the dynamics of carbon or the relationship between soil ecology and soil formation) by scientists from the Global North, while local scientists in developing countries could be more interested in applied aspects such as the relation between specific soil management practices and agricultural yield. Another mostly invisible aspect of helicopter research refers to the training of Master and PhD students from the Global South on topics which are undoubtedly priorities from the Global North but not necessarily those of their own countries. Similarly, the implementation of long term observatories (e.g., ecological field stations or Critical Zone Observatories) in developing countries, which are run with funds from developed countries are often not (yet) considered as a priority by local governments.

However, even if international cooperation is often unbalanced and helicopter research remains an issue, a historical perspective offers some reasons for optimism. An example is the evolution of the French Institute of Research for Development (IRD). This institute was formerly called ORSTOM and has colonial origins. It comprises >2000 staff working in over 40 countries in a variety of disciplines concerning environmental, health and societal subjects. The French researchers and technical staff are hired to do research in developing countries. Their role evolved from doing colonial research in the interest of France towards a collaborative oriented research approach intended to make a lasting contribution to the economic, social and cultural progress of developing countries. Soil science researchers from IRD nowadays develop inclusive approaches emphasizing interdisciplinary sustainability research aligned with the 2030 Agenda for Sustainable Development. Their mission is to do research, training and innovation in the Global South, with the Global South and for the Global South (IRD, 2018). Partnership with researchers from developing countries is viewed as key. How do these institutional principles translate into the practical work of the French researchers working in developing countries? Firstly, it is important to mention that the researchers sent overseas (29% of the staff, IRD, 2018) are placed within partner institutions and are thus in close contact with local researchers. However, due to the fact that their placement in countries is more dictated by the geopolitical interest of France than by the local

research agenda and demand, independent IRD researchers are in danger of becoming free-riders working on subjects of their own interest with funding from the North. This can indeed lead to helicopter research (e.g. Rumpel et al., 2006). However, due to their placement within the countries' partner institutes instead of IRD owned research stations, **this** research most often **still** had an impact on the local research environment, as it focused on capacity building through training of Master and PhD students, and technical staff from their host institutions. **In order to further equal the relationship between scientists from France and from developing countries**, since a few years IRD has established new programs favoring co-construction of research projects giving funding and autonomy to associated young research teams (JEAI), Mixed International Laboratories (LMI), Mixed International Units (UMI), and International Research Laboratory Networks (GDRI) involving South-South collaborations. As a result of **this** new policy, **co-authorship** of scientific articles by authors from IRD and scientists from developing countries increased. For example, **a bibliometric analysis showed that over 90% of the 62 IRD-involved articles published in Geoderma since 2005 with fieldwork in developing countries** have also a co-author from the local country. This percentage increased to 95% in 2012, and **to** 100% in the last 4 years. The IRD has an open access policy for developing countries (Rossi, 2019) with 7821 studies referring to soil **science, largely** accessed by researchers from the Global South. The IRD instruments and IRD interventions in developing countries have positive as well as negative aspects. Positive aspects relate to the funding of research and involvement of local groups and, in recent years, to the encouragement of South-South collaboration. But depending on the context, negative aspects in terms of loss of sovereignty and even competition with local groups are also **occurring**, especially in countries where language barriers **exist** and IRD researchers therefore are not completely integrated into the local research environment. In such a situation, little benefit of the research is to be expected for local stakeholders, who in the end do not care if published papers are “helicopter research” or “non-helicopter research”. When doing research for development intended to address **local needs as well as** global challenges, stakeholder involvement may thus be crucial (Giller et al., 2020).

Initiatives to establish international collaboration are not limited to Northern Countries. An excellent example for successful establishment of South-North collaboration comes from Chile, which until recently was a developing country and could not afford to establish sophisticated soil research laboratories all over the nation. To overcome this limitation, the National Foundation for Science and Technology (CONICYT) launched several governmental funding programs to encourage South-North collaboration. One of their

strategies is based on funding of research leaves for Chilean PhD students to spend several months overseas in international laboratories (CONICYT/Internship scholarships abroad). To favor international collaboration and exchange, Chilean research projects usually involve funding for one international expert per year, who is invited to visit a Chilean lab and to contribute to the science (FONDECYT/REGURAL/INICIACION). To further enhance international cooperation, CONICYT in 2000 developed the International Cooperation Program (PCI), to encourage establishment of global research networks. This program has specific funding opportunities to identify Northern partners to promote local research. An example of this is the ECOS-CONICYT program for Chilean-French collaboration established in 2005. Last year a joint call with the German Max Planck institutes, which also promotes South-North interactions, was launched. Through supporting such actions, the country makes sure that the foreign contribution is benefitting the local research agenda. Similarly, PERIDOT is the Franco-Pakistani collaborative Program, providing opportunities to Pakistani and French researchers to carry out joint research activities. The main agenda of this program is to develop new scientific and technological cooperation between French and Pakistani higher education institutions and research laboratories by supporting the mobility of researchers from both sides. Drawbacks of such programs include the fact that they provide travel support instead of research money, which would be necessary to ensure equality when common research projects are developed.

International research collaboration is thus strongly context dependent. Sovereignty should be one of the guiding principles. It is therefore important to respect (1) ethical rules in terms of interest of local research communities and Indigenous people, and (2) regulations, such as the protocol of Nagoya on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (UN, 2011) and others for the sampling and sending soil samples to a laboratory in the North when there are no analytical possibilities in their country of origin. This is especially important in developing countries with a colonial history.

The grand challenges of our time require rapid, profound transformations in soil management practices and in our approach to research and training. The Covid-19 crisis has proven to be a pressure cooker for more inclusive approaches to teaching and international exchange through virtual lecturing, webinars and even free conferences including participants from developed and developing countries. We should take advantage of this crisis to adopt such technologies for more inclusiveness in global research collaboration.

As radical transformations are needed to adapt to global threats, lessons are also to be learned from developing countries. A typically example is the highly efficient management of the Covid-19 epidemic crisis in Asia as compared to Europe and America. Therefore, international collaborations, in particular South-South collaboration and South-North collaboration are extremely important (Lal, 2019). Researchers from the Global North should acknowledge that since the establishment of the Sustainable Development Goals (SDGs), all nations can be considered as developing countries, as a country may be rich in terms of GDP, but may fail to reach environment-related SDGs (Gore, 2015). In the 21<sup>st</sup> century, a global focus on development is tempting as it offers opportunities for addressing universal issues such as climate change, food security, etc. holistically (Horner, 2019). For soils, which are important for multiple development issues, international collaboration is required, which needs to take into account locally specific pedoclimatic and socio-economic conditions. To guarantee equality in the relationship between researchers from North and South, and to encourage sovereignty of South-South collaboration, global funding programs are urgently needed.

Finally, helicopter research may be universal, unintended and related to human nature with American researchers publishing results from France without French contributors (Hupy and Schaetzl, 2008) or researchers from developing countries publishing research carried out with researchers from developed countries but without including them as co-authors. Regulations such as the Nagoya protocol and publication ethics are thus necessary and need to be respected in soil science research to make sure that research is a source of global solutions, equal collaboration and sharing of common findings rather than creating tension and exclusion.

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