

Scientific Diasporas, Knowledge Circulation, Development: Insights from the Study of Skilled Moldovans Abroad +

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Abstract

The world knowledge divide has led to demands for alternative ways of improving international cooperation in order to contribute to a reduction in the scientific disparity and inequalities in the availability of human capital between the North and the South. The human aspect has an essential role to play in determining ways of optimizing knowledge circulation within the current context in which the increased international mobility of skilled people offers new dimensions for scientific cooperation as a result of major global transformations. While science is ever more dependent on relationships and international exchanges, scientific collaboration has become an indispensable mechanism for the advancement of developing and transition countries. The efficient production and equitable use of knowledge requires international collective action, and this confirms the need for novel participatory approaches and a broadening of the beneficiaries and the empowerment of new relevant actors. Within this framework, today original ideas recognize the importance of scientific diasporas and promote their interventions as key players. The technological progress that has transformed the methods of production and the transmission of information enables scientists abroad to have an impact from a distance, without having to consider their definitive return as the only reasonable option. This situation also influences international cooperation as diasporas can function as bridges for the circulation of world knowledge and the transfer of technology. Highlighting their position as *knowledge communities*, this paper seeks to encourage scientific diasporas as agents of development and international cooperation by offering an innovative perspective of the exchange of knowledge that can optimize North-South cooperation. Focusing on an evidence-based analysis of research on the Moldovan scientific diaspora implemented by the Cooperation and Development Center (CODEV) at EPFL and the Academy of Sciences of Moldova (ASM) in a knowledge co-production effort, the paper argues that the recognition of knowledge as a global public good, the encouragement of decentralized collective organization and actions and the provision of enabling settings and opportunity structures, are key conditions for facilitating the initiatives and interventions of diasporas.

1. Introduction

Rationale and objectives

A new international agenda on cooperation and development is especially important in the current context in which the increased mobility of people, the importance of knowledge-based activities and the technological revolution have fundamentally altered some of the basic coordinates of the world we live in. Concerning the international mobility of human capital, this has been encouraged by globalization processes and the rapid changes in new technology, communication and transport systems, but it has also been influenced by the transformation of countries into knowledge-based economies. Associated with these trends, we find that growing poverty disparities intensify the gap between people who are able to move and those who are not, as well as between skilled people and those lacking formal education. Furthermore, the world knowledge divide is demanding alternative ways to improve international cooperation in such a way that it can contribute to diminishing the scientific disparity and the inequality of human capital availability between the North and the South¹.

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¹ The North-South divide is understood here in its conventional meaning and describes the opposition between the center and the periphery at a global level. The North implies development and refers to wealthy nations as opposed to belonging to the South which implies a lack of wealth and refers to poorer countries.

The UNESCO Science Report 2010 reveals that the disparities in the levels of development between world countries and regions are a sign of the differences in human capital investment as well as in the production and circulation of knowledge in the long term. The contrast in R&D investment shows that while industrialized countries invest on average 2.3% of their GNP, developing and least developed countries only invest 1% and 0.2 % respectively. The world share of researchers also shows dramatic inequalities insofar as 62.5% of world researchers are concentrated in industrialized countries (totaling 3,655.8 researchers per one million inhabitants –r/m), while the figure for developing countries is 37.4% (580.3 r/m) and the least developed countries only register 0.5% (43.4 r/m) (Hollanders and Soete 2010).

Knowledge has always been at the core of economic growth and the progressive increase in social well-being (Foray 2004) (Stiglitz 1999). In fact, the ability to innovate and create new ideas and knowledge has historically constituted “the fuel of development” (David and Foray 2002). Within this framework, two key issues can be highlighted from the current globalized world. First of all, the impetus of countries to reinforce their capacities to both generate and acquire innovative knowledge and technology in order to trigger socioeconomic progress. Science is ever more dependent on relationships and international exchanges and scientific cooperation has become an indispensable mechanism for the advancement of developing and transition countries. Secondly, new processes and dynamics reveal a significant structural change given that state entities are losing power as the main constitutive and acting units in the world order. The power of global networks (Castells 1997) illustrates the participation of new autonomous actors, modifying the predominance of states as the main organizers of collective life and creators of national identities (Castells 1996). In this context, scientific diasporas (Barré et al. 2003) (Tejada and Bolay 2010) as an example of transnational actors (Faist 2000) (Wickramasekara 2010) have gained relevance insofar as they have emerged as knowledge communities participating in the production and reproduction of knowledge through decentralized cooperation processes (Foray 2004).

Faced with the emergence of the challenges taking place in this context, we felt motivated to have a say in the discussion proposed by the UNESCO Tech4Dev Conference 2012 regarding the ways in which North-South knowledge circulation and scientific cooperation could be optimized to contribute to a reduction of poverty. We consider it necessary to bring the phenomenon of scientific diasporas into focus in their role as *knowledge communities* (Foray 2004), as they are actors pertaining to the production of knowledge and the promotion of its circulation in benefit of their home countries. Our arguments seek to encourage scientific diasporas as *agents of development and international cooperation* (Tejada forthcoming 2012). This view offers an original perspective of the circulation of world knowledge and the design of actions and policies to optimize international cooperation that can respond effectively to social needs. We do this by showing the experience of the Republic of Moldova, as an example of an Eastern European country that has faced major challenges as a market economy in transition and which has been hard-hit by the mass emigration of its scientific human capital, but also as a case in point for setting up strategies aimed at mobilizing scientific diasporas resources to benefit home country development. The article is based in the ongoing research that the Cooperation and Development Center (CODEV) at EPFL and the Academy of Sciences of Moldova (ASM) are carrying out in a knowledge co-production effort involving academic and non-academic actors working together. This approach could help us understand some of the basics implied in the discussion on international scientific cooperation, knowledge exchange, and knowledge co-production proposed by the Tech4Dev Conference, and it could also provide some points for reflection on its evolution towards more convincing models of North-South cooperation.

This article has several aims. First of all, it seeks to promote a focus on the scientific diaspora option in studies and discussions concerning the optimization of international cooperation and the promotion of knowledge circulation. Secondly, it explores the theoretical and conceptual implications of this option. Thirdly, it offers an evidence-based analysis of the perceptions of Moldovan scientists and skilled professionals who have emigrated in relation to their cooperation initiatives with the community in the country of origin. Fourthly, it evaluates the opportunities and risks of the interaction between scientists, policy makers and society in collaborations involving the co-production of knowledge. The content of the article is structured in the following way. The first part offers a general vision of the case of Moldova and introduces the phenomenon of the international mobility of human capital, emphasizing the importance of scientific cooperation in terms of strengthening the capacities of the countries of the South. The second part offers a theoretical framework which conceptualizes scientific diasporas as knowledge communities, and it proposes a model to make it possible for them to intervene as agents of development and international cooperation. The third part validates the theory with the study of Moldovan scientists and skilled professionals abroad. The last part concludes by offering specific recommendations with regard to optimizing international cooperation and drawing lessons from the co-production of knowledge in this project.

Background of case study: Development in Moldova and the emigration of its human capital

Moldova is a small landlocked country with a population of 3,600,000², which proclaimed its independence in 1991. Like other newly independent states which were wholly dependent on the economy of the Soviet Union in the past, Moldova was put under considerable pressure when entering a period of major transformations during its transition to a market economy. The result of this was a significant deterioration of economic and social indicators in the 1990s, with very limited access to basic public services with the consequence that the country has still not been able to equal its pre-1990 GDP levels. In addition to this, Moldova was confronted with the self declared *de facto* independence of the state of Transnistria due to

² The population totals 4,100,000 including Transnistria, which is officially a *de jure* part of Moldova.

ethnic tensions within the country and the geopolitical interests of Russia. Moldova has been unable to regain control over its entire territory until now. Furthermore, the internal process of democratization is still an ongoing issue.

According to the UNDP Human Development Index, Moldova ranked 111 worldwide among the 187 countries included in its 2011 classification³, (UNDP 2011a). With a GDP per capita of US\$2,900 and 64.7% of its population living below the poverty line, today Moldova is the poorest country in Europe. The National Human Development Report provides evidence of the enormous social, economic and political challenges faced by Moldova today, which have contributed to an increase in the magnitude of social exclusion experienced by a great number of Moldovan citizens (UNDP 2011b). According to this report, the employment rate in Moldova has declined from 54.8% in 2000 to 40.0% in 2009 showing the unsustainable nature of poverty reduction. In recent times, the international economic crisis has considerably slowed down the slight progress in poverty reduction in the country, as shown in the National Human Development Report (UNDP 2011b).

Diverse stages have characterized Moldovan emigration. A first stage corresponds to the period between 1991 and 1998 with small migration flows mostly for ethnical and political reasons as well as for family reunification particularly to Israel, the USA and Germany (Buga 2011). After 1998 the flows increased considerably due to the regional economic crisis which hit hardly Moldova. The lack of opportunities and a poor quality of life forced many Moldovans to leave their country in search of better prospects abroad in a variety of destination countries mostly in the Commonwealth of Independent States, primarily Russia, but also to Western Europe. According to IOM, the total number of emigrants grew from slightly less than 100,000 in 1999 to more than 400,000 by the end of 2005 (Lücke et al. 2007). While at the beginning of this stage migration flows involved mostly unskilled Moldovan labor workers, the trend has changed in the last years with increasing flows of scientists and skilled professionals as well as students either for continuing their education and training abroad or searching for better professional opportunities out of Moldova.

As a proportion of its population, today Moldova has one of the highest emigration rates in the world, with estimated 600,000 Moldovans living outside the country (some sources suggest the figure is closer to 1 million representing 25% of the country's labor force). UNDP estimates that the share of the population working abroad out of the total active population was 23.2% in 2009 (UNDP 2011b). Linked to this, financial remittances represent a remarkable 36% of Moldovan GDP (Lücke et al. 2007) making the country, together with Tajikistan, a world leader in terms of dependency on money from people working abroad. While one out of every four households in Moldova (26%) is dependent on financial monetary remittances sent from abroad, 15% of all households receive in-kind remittances. Their importance is enormous, since these are mainly used for the daily needs of their immediate relatives, such as buying food and clothes, paying rent and home improvements. Furthermore, as one IOM study showed (Orozco 2008), women account for two-thirds of the recipients of remittances.

As far as the science and technology sector in the country is concerned, the severe economic crisis, social conflicts and permanent political instability meant that science was left well down the list of national priorities for almost one and a half decades after Moldova's independence. Public investment in science and technology was drastically reduced between 1990 (0.73% of GDP) and 2000 (0.18% of GDP) (ASM 1990-2009). Without proper funding, up-to-date equipment and adequate wages, the scientific sector as well as research and innovation activities suffered major degradation. Furthermore, the methods of science organization remained conservative and the legislative framework had a regressive rather than a stimulating character. In spite of all these obstacles, the scientific excellence of Moldovan researchers and the reputation of the country's science schools remained quite high, but this alone could not prevent many scientists from leaving the country in search of better opportunities abroad (*brain drain*), or leaving the national research system to join other fields of activities in the country which were less qualified in most cases (*brain waste*). In fact, the scientific potential of Moldova was reduced by 83.4% in 15 years, diminishing from a total of some 30,000 scientific researchers in the 1990s to less than 5,000 in 2004 (ASM 1990-2009). It is clear to see, as Gaugas shows (2004), that the main determinants of the brain drain phenomenon in Moldova are economic factors such as limited employment and income prospects for scientists, as well as a lack of research infrastructure, materials and equipment, and that only radical socioeconomic transformations to improve the living standards of the population, together with political stability and governability will reduce and revert the loss of human capital.

The year 2004 marked a turning point in the reform of the science and technology system in Moldova with the ratification of the *Code on Science and Innovation* by the Parliament, and the adoption of the *Partnership Agreement between the government and the Academy of Sciences of Moldova (ASM)*⁴. As a result, the state investments in S&T increased systematically, reaching 0.74% of GDP in 2008, and further incentives have taken place. These are mainly aimed at both providing better conditions to Moldovan scientists and researchers, as well as encouraging Moldovans abroad to link to the scientific activities carried out in the country. In this line, a focused strategy led by the ASM and seeking to foster cooperation with the Moldovan scientific diaspora was launched in 2008. As part of this, the ASM in collaboration with CODEV at EPFL launched a joint research and action oriented project aimed at "Connecting the scientific diaspora of the Republic of Moldova to the scientific and socioeconomic development of the home country"⁵. In this study, we seek to

³ The HDI is a measure for assessing long-term progress in 3 basic dimensions of human development: a long and healthy life (measured by life expectancy), access to knowledge (educational attainment), and a decent standard of living (gross national income -GNI- per capita) (UNDP 2011a).

⁴ The Academy of Sciences of Moldova (ASM) is the highest scientific forum of the country managing and coordinating S&T activities at a national level.

⁵ The project is funded by the SCOPES Programme of the Swiss National Science Foundation (SNF) and the Swiss Development Cooperation Agency (SDC).

advance knowledge on Moldovan scientists and skilled professionals who have emigrated from their home country and thereby provide specific policy recommendations as to how to leverage their potential to benefit Moldova.

2. Theoretical reflections on knowledge circulation and the role of scientific diasporas

Knowledge as a global public good

Knowledge is undoubtedly a key to poverty reduction. Based on the belief that a society has the ability and capacity to generate and capture new knowledge and to access, share and use it efficiently, knowledge is viewed as a global public good (Stiglitz 1999) (Foray 2004). Likewise, given that education and scientific research represent core catalysts for economic, social and technological progress, the positive externalities of enhancing the availability of knowledge are countless. Correa (2012) argues that non-appropriable public goods are “typically created through scientific research thus avoiding tensions and possible rivalry” (p.13). In fact, knowledge as a global public good “provides a central rationale for international collective action” (Stiglitz 1999: 320), impelling cooperation for development. Following Stiglitz (1999), the concept of knowledge as a global public good “helps us think through the special responsibilities of the international community” (p. 320) and requires support at the global level. Considering that the efficient production and equitable use of knowledge requires countries to collaborate among themselves, as this viewpoint suggests, we are faced with a need for novel participatory approaches that improve the accessibility to knowledge and which empower new relevant actors.

Considering knowledge as a global public good and given that knowledge-based economies are at the forefront of the international debate on development today, collective action aimed at enhancing availability and the equitable use of knowledge for the benefit of the more disadvantaged countries is increasingly relevant. We can see how economies of knowledge are organized to generate growth through the use of knowledge and technology, the production of new know-how and its codification and diffusion (Foray 2004) (David and Foray 2002). In this context, as argued by David and Foray (2002), the need to innovate becomes stronger since it tends to be almost the only way for advancing in strongly competitive and globalized knowledge-based economies. The proliferation of new information and communication technologies, as well as the increase in the knowledge world bank symbolized by these technologies offer countries in the South possibilities to reach higher levels of prosperity and productivity than ever before. Still, limited access to scientific knowledge and the slow advancement in technological innovation of these countries represent a great challenge today. In this perspective, we can now observe the expansion of new forms of transnational organizations and communities (Faist 2000) (Wickramasekara 2010) dedicated to the production and reproduction of knowledge through decentralized forms of cooperation (Foray 2004) and an intensive use of the new information and communication technologies.

Scientific diasporas as knowledge communities

The concept of *knowledge communities* is useful here as it refers to “networks of individuals striving, first and foremost, to produce and circulate new knowledge” (Foray 2004: 182). Their forms of organization and ways of functioning as new structures supporting world knowledge openness have gained importance of late. A case in point is *scientific diasporas* (Barré et al. 2003) (Tejada and Bolay 2010) or *knowledge diasporas* (Kuznetsov 2006), which makes reference to groups of emigrated scientists, engineers and skilled professionals who act collectively to create cooperation opportunities aimed at boosting the development of their home countries, mainly in the areas of science, technology and education.

Recognizing the importance of community-based activities as enabling organizational systems to exploit the benefits of knowledge (Foray 2004), here we propose a consideration of *scientific diasporas as knowledge communities* (Tejada forthcoming 2012), bearing in mind that they aim to produce new knowledge and encourage its circulation to the benefit of their home country. The collective action of scientific diasporas entails both solidarity and the expression of a common transnational identity by members (Bordes-Benayour and Schnapper 2006), enabling group influence in the home country. As Foray argues (2004), when the members of a knowledge community put their capacity to mobilize in place and launch communitarian initiatives, they facilitate collective influence in the home country and become agents of change.

In recent years both the growing recognition of the significance of knowledge-based activities in the development processes, as well as the rising flows of scientists and skilled professionals from the South to the North have contributed to the *scientific diaspora option* (Barré et al. 2003) (Tejada and Bolay 2010) being considered as an alternative to addressing the phenomenon of international scientific emigration. This option stresses the fact that scientists abroad can stay interconnected and contribute from a distance influencing economic and social transformations in their home countries if adequate enabling strategies and mechanisms are put in place to channel back their knowledge and skills.

A model for enabling scientific diasporas as agents of development and international cooperation

To promote world knowledge exchange and circulation through the participation of scientific diasporas, here we argue the approach of open knowledge systems proposed by Foray (2004), in which the principle of rapid disclosure of new knowledge prevails and diverse processes facilitate and reinforce its circulation. Given that these systems are related “to public or semipublic spaces in which knowledge circulates” (Foray 2004: 165), knowledge communities are oriented

towards the creation and reproduction of knowledge through decentralized processes of cooperation. Foray distinguishes the community “as an organized system allowing the exploitation of the virtuous properties of knowledge” (Foray 2004; 182). The new information and communication technologies which increase the power of production and circulation of knowledge offering opportunities for collective action are considered here as “adequate tools for the creation and expansion of virtual communities” (Foray 2004: 130). An example of this are scientific diaspora networks, or diaspora knowledge networks (Meyer 2011) which function as effective mechanism of knowledge and skills transfer through the associated activities of skilled migrants willing to contribute to home country development. As highlighted by Meyer (2011), the action of scientific diaspora networks is based on the logic of connectivity and the multiplier effect of individual interest to participate in a common project. We can see that over the last two decades diverse country case studies have shown evidence of the active involvement of these networks in science and technology advancements in the home countries through specialist knowledge transfer, exchange of information, training and mentoring “from a distance”, joint research projects, as well as circulation or temporary return for technology and/or academic assessment.

Foray identifies four key constituents of knowledge communities: 1) multiple capacities for knowledge creation and reproduction; 2) mechanisms promoting the creation of public or collective spaces for knowledge exchange and circulation; 3) adequate norms and instruments for the creation of trust; 4) intensive use of new technologies of information and communication as tools for collective creation, codification and transmission of knowledge. We argue here that these four characteristics are important factors in the study of the conditions for scientific diasporas to become agents of change. To go deeper in this view, we propose a conceptual model for analyzing how the agency of scientific diasporas in the benefit of development and international cooperation could be enabled. As illustrated in Fig. 1, this model involves three essential components which are considered as the key conditions that facilitate scientific diasporas’ initiatives and help interventions to arise: recognition of knowledge as a global public good; decentralized collective organization and actions; and enabling settings and opportunity structures.

Bearing knowledge as a global public good in mind, the starting point of the model takes is the recognition of scientific diasporas as knowledge communities participating in the production of world science and research, functioning as bridges for the exchange and circulation of knowledge and influencing international scientific cooperation. The ability to mobilize (Westcott and Brinkerhoff 2006) through collective organization and actions is a crucial factor enabling the agency of diasporas to function. While scientists abroad, as individuals, are considered as agents of change, their collective action is what mostly enables them to influence their home country. As a point of fact, the collective projects of scientific diasporas show evidence of their move beyond personal interest towards a common impetus to affect change. In another study we have shown how the participation of emigrated scientists and skilled professionals in associations, organizations or networks, is crucial for a collective harnessing of their social capital that can leverage their contributions to the home country (Tejada and Bolay 2010). A further study illustrates how the success of long-distance collaboration requires the establishment of community groups, associations and networks of skilled professionals to act jointly for their home country (Saxenian 2006). Furthermore, scientific diasporas facilitate their operation using the new information and communication technologies through decentralized and collective actions which are considered to be essential to reinforce their capacity to create an influence. Finally but equally important, enabling institutional settings and opportunity structures both in the countries of destination and in the home country is needed to allow the agency of scientific diasporas to function.

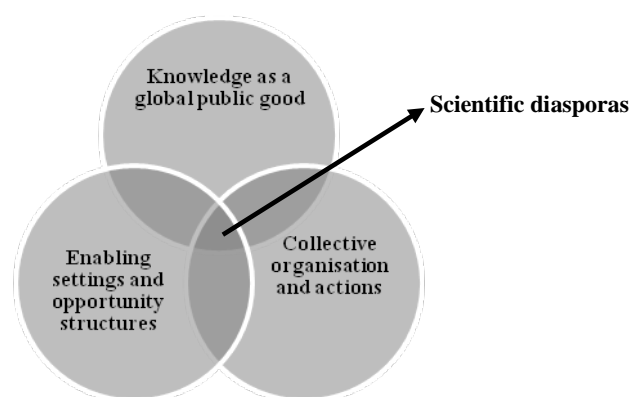


Fig. 1: Model for enabling the agency of scientific diasporas in benefit of development and international cooperation.

In order to identify adequate opportunity structures and enabling conditions to allow the agency of scientific diasporas to function, we will now try to adapt this conceptual framework and model to the study of emigrated Moldovan scientists and skilled professionals.

3. Empirical study

Methodology of the study of the Moldovan scientific diaspora

This research and policy oriented project pays special attention to the generation of first hand data aimed at broadening the knowledge base on Moldovan skilled migrants in order to be able to provide specific policy recommendations as to how to leverage their potential for the benefit of Moldova. This collaboration has brought together scientists and policy makers who in a knowledge co-production effort are contributing to bridging the gap between the scientific requirements and the needs of society. The concept of knowledge co-production is understood as a collaborative work between academic and non-academic actors (Jasanoff 2004) (Van den Hove 2007) (Regeer and Bunders 2009) (Pohl et al. 2010). It is also known as transdisciplinary research (Klein et al. 2001), or science-policy-society research collaboration in which *science and society interactions* (Robinson and Tansey 2006) come together to ask questions and search jointly for responses to enrich decision making and ensure a social impact.

Both in the literature and in practice, it is recognized that the joint co-production of knowledge by scientists and professionals has greater political relevance and offers greater possibilities of the recommendations being implemented, and provides a benefit for the society. In addition to the academic and institutional partners, our project includes the vision of other relevant social, individual and collective actors during the various stages of the research. Working in this way offers us a chance to explore the advantages of the interaction between scientists, policy makers and society in scientific cooperation and the promotion of knowledge circulation. This collective method of approaching science is not a new one, but it has increased in importance over time. Within the areas of international migration and international cooperation for development as well as in many other arenas, institutional decisions must be based on trustworthy scientific results sustained by analysis-based empirical evidence of the social actors that are directly involved. This type of collaboration ensures that the scientific reflection has a more efficient practical social application to the purpose of the research, based on specific recommendations for decision makers.

However, it should be pointed out that the link between these two worlds –science and policy- is not straightforward and the efforts to stimulate interactions between them in the knowledge co-production endeavor tend to face important challenges, which are mainly due to the different, and sometimes even contradictory, perspectives both might have in terms of the ambitions, work schedules and task completion, goals and priorities of the institutions they represent, culture and ideologies, and structures of reward. Pohl et al. (2010) refer to some of the risks that can be experienced during the research into science-policy-society collaboration. For example, they mention that science can be considered as something “politicized” and the collaboration can end up as a simple process of political strategy without any real intention to make a social contribution. This undermines credibility in terms of scientific rigor or else the legitimacy, in terms of respect for the divergent values and opinions of all the actors, is incompatible with scientific rigor.

Our study promotes the focus of development advancement through the reinforcement of knowledge communities. We aim to identify cooperation practices and mechanisms between Moldovan scientists abroad and those who are based in Moldova. Here we want to encourage and facilitate a systematic collaboration between both groups. During our field work, primary information was sought in two comprehensive surveys designed by the research team and applied on-line. The first survey was for Moldovan scientists, skilled professionals and students abroad, and the second was for the scientific and professional community in the home country. In the first survey, skilled Moldovans abroad were asked about their motivations for emigrating, experiences abroad, their links with the home country, their future plans and their perceptions of their potential to contribute to the development of Moldova. In the second survey, Moldovan scientists and professionals based in the home country were asked about their perceptions of their current professional and socio-economic situation, their links with skilled Moldovans abroad and their prospects of collaborating with them, their future plans and perceptions of the role of scientists and professionals abroad in the development of the home country. To complement the data gathered, a few questionnaires were applied on a face-to-face basis and we also conducted some interviews with key informants.

Our target group in the destination countries has been defined as “members of the Moldovan scientific diaspora”, referring to scientists, researchers and skilled professionals from Moldova living abroad, as well as postgraduate students (MA and Ph.D. students) in all disciplines, professional areas and sectors. For the survey carried out in Moldova, the target population was professionally active scientists and skilled professionals in any discipline and sector. The surveys were answered by 101 members of the Moldovan scientific community and 197 members from the Moldovan scientific diaspora. The following sections present some of the qualitative observations of both surveys. Excerpts of the testimonies of Moldovan scientists are presented throughout the paper.

Contributions from a distance, cooperation opportunities and the impact on development

In this section we provide an overall vision of the intervention of emigrated Moldovan scientists and skilled professionals in activities for the transfer of knowledge that seek to influence the country of origin. We can see that the literature on the matter requires some specific determinants of effective interventions of diasporas in the development process of the country of origin, such as for example: the reasons for emigrating, the time spent abroad, their level of success in the country of

destination and the conditions and policies in the country of origin. Although our research will attempt to analyze the influence of these explanatory variables in the contributions to the country of origin at a future stage, here we focus on an analysis of the perceptions of the Moldovan scientists and skilled professionals in terms of collaboration opportunities and their contributions to Moldova from a distance.

We observed that the Moldovan scientists and skilled professionals have a high level of attachment to their country of origin and they are interested in its progress. 65.7% of the Moldovans (or 111 persons) say that the regional and national development of Moldova is “very important” to them, while 30.2% (or 51 persons) consider it to be “somewhat important”. Furthermore, 85.5% (or 151 persons) think that they themselves can play a significant role in the socioeconomic development of Moldova. In this respect, we can observe their interest to participate directly in specific initiatives. A Moldovan woman, with a managerial position in a multinational company in France mentioned: *“I am open to participating in any projects that are linked to Moldova's development in the future. (...) I am open to any proposal that might help improve Moldova's situation”*. The ways in which skilled Moldovans abroad see how they could get engaged from a distance in development activities for the home country include the following: temporary visits and circular migration, participation in joint research projects, contributing to the design of public policies, establishing links with local executives and the private sector, acting as cultural ambassadors improving the image of Moldova abroad, as well as through technology transfer and investments. We can observe that in the Moldovan case, settling permanently in destination countries does not necessarily mean a decrease over time in the intensity of their ties with family and community in the home country.

We have identified some brain gain initiatives in which Moldovan scientists and skilled professionals abroad have already participated (Table 1.). These initiatives have taken place in the form of knowledge sharing or technology transfer projects, scientific or academic exchange projects, investment and business activities, as well as through philanthropic and communitarian activities. It is worth mentioning that 41 persons said they had carried out research projects in cooperation with Moldovan partners in the past. This is very relevant given that cooperation is considered to be one of the most effective forms of knowledge transfer. In fact, systematic scientific collaboration progressively enables advances in research and development in Moldova, and it can address critical issues for its socioeconomic advancement. Furthermore, this can also help Moldova to reinforce both the individual and institutional competences of its scientific community, and it can also lead to scientific publications.

Table 1: Initiatives in benefit of Moldova	
Type of initiatives	Description
Knowledge sharing	
	Knowledge support to local think tanks
	Participation in seminars and /or international conferences
	Sharing scientific knowledge with colleagues working in the same field/topics
	Better understanding of Moldovans problems through PhD topics chosen
	Publication of scientific work in Moldova
	Sharing experiences and skills
	Providing technical advice on key development issues
	Encouragement of R&D activities
	Information on scholarship opportunities abroad
	Sharing of information and scientific papers
Joint research projects	
	Involvement of Moldovan partners in international research projects
	Joint publications in collaboration with Moldovan scientists
	Helping Moldovan scientists to get international grants
Scientific/academic exchange project	
	Temporary visits to research centers and universities
	Share of supporting materials for university courses
	Giving lectures in Moldova
	Contributing to advising on new teaching techniques and syllabus design
	Participation in the creation of academic programmes in universities
Investment and business	
	Investment promotion projects
Philanthropic and communitarian activities	
	Sending books to Moldovan elementary schools
Other	
	Interventions in public administration reform

Source: Based on information collected during the research into the Moldovan scientific diaspora (2010-2012).

With regard to migration plans, we can observe that the majority of skilled Moldovans intend to return to their home country in the near future if there are clear opportunities for them there. Those Moldovans who do not intend to return to the home country gave their reasons for this: a lack of employment opportunities and professional prospects, a lack of social and professional networks beyond family ties, the low quality of life as well as political, social and economic instability. They feel they have a brighter future waiting for them somewhere other than Moldova. Consequently, they are ready to take opportunities in the host country or even in third countries, but they do not believe these opportunities will be offered to

them in their homeland soon. These observations reveal the need for adequate policies in attracting and retaining scientists related to the improvement of infrastructure, job opportunities as well as a better quality of life in general.

We will now take a closer look at the specific brain gain practices of the Moldovan researchers abroad, as well as at their perceptions in relation to the difficulties that they face when carrying out these practices. With this aim in mind, we have broken down the information in our survey to consider only those people from the sample with a researcher profile and who are employed in an academic and/or research institution in the country of destination. In all, we considered 45 researchers in this group and most of these live in the following countries: USA, Germany, Russia, Sweden, Switzerland, France, Ukraine, Denmark, and Canada.

We saw that personal motivation had been the most important factor behind the decision to leave Moldova for three out of every four Moldovan researchers (75% or 33 persons). The impetus to learn new research methodologies and to have access to the latest research infrastructure was highlighted by one Moldovan scientist: *“Until 1991 researchers from Moldova had no access to international publications, or to international scientific events, or international research projects, and when the opportunity opened up for me to apply for a research grant I applied and went to Germany”*. In order of importance the three main reasons for emigrating are: scientific advancement; to gain professional experience; to have better employment opportunities and income prospects than those available in Moldova. The relevance of the international exposure for a scientific career is something the skilled Moldovans are aware of; for them, international mobility is intrinsic to the scientific world. One Moldovan scientist based in France stressed: *“Science doesn’t have any borders. (...) If you wish to achieve international standards in research and international recognition for your work, you should travel a lot and interact with researchers from scientific centers abroad”*.

Based on the perceptions that were examined, we can see that the destination countries take advantage of the capacities of the skilled Moldovans and we do not find any situations of brain waste to the detriment of the potential of the Moldovan scientists, as all of them (100% or 45 scientists) work within their area of specialization and the majority (89.7% or 35 persons) think that their qualifications correspond to the level of the position that they hold. The vast majority (97.5% or 39 persons) occupy researcher positions or else they work as lecturers or teachers. This has significant implications for the collaboration opportunities with the country of origin given the fact that favorable conditions in the country of destination increase the social capital of the Moldovan scientists, strengthening their mobilization capacities and stimulating their transnational actions (Faist 2000, 2010).

With regard to the collective initiatives channeled through associative activities, we see that the majority of the Moldovan scientists participate in associations and networks established abroad. These can be divided into two specific types. The first are associations and/or professional or scientific networks of an exclusive nature, insofar as they are focused on specific areas or disciplines, but open to participation from members of specific geographical areas or from any part of the world. Their participation in these organizations helps them to establish transnational connections with scientists throughout the world and to form part of collaboration opportunities, which the country of origin can also benefit from. Some of these are: Biomedical Romanian Association in Boston Area, Royal Institute of Technology, Swedish Engineers Organisation, International Association for Food Protection, and the French Society of Radioprotection. The second type are transnational networks or associations that bring together the Moldovan community in general, and they stimulate collective initiatives in favor of the country of origin. These organizations are less exclusive than the previous ones, but they also have important implications because of their capacity to forge links among the diaspora. Some examples are: the Association of Moldovans in Nordic Countries, the Association IMPACT in Paris, Moldaviens, Asociatia Moldovenilor din tarile Mordice, and Casa Mare in Washington DC. The aims of all these are similar: to connect with each other and with the country of origin and to promote an exchange of experiences and collective participation through projects focused on Moldova. Unlike the first type, the collective impact of these associations in the scientific and professional collaborations and in the transfer of knowledge is not clear and future research is necessary to reveal these elements. We can also observe how skilled Moldovan scientists and professionals abroad also participate in scientific and professional associations based in Moldova, which has substantial implications for the scientific and professional community in the country of origin, since these associations link them to the international scientific world and they open up cooperation opportunities which they can benefit from in terms of the strengthening of capacities. Those mentioned include the Institute of Chemistry of the ASM and the Moldovan Society of Biochemistry and Molecular Biology.

In other research, we have observed that the organized initiatives of the scientific diasporas are spurred on by a feeling of community and collective identity, which reinforces their ability for mobilization and group actions and this encourages their participation in associations (Tejada 2010). It is important to point out that in the case of Moldova, questioning the existence of a collective identity challenges the very use of the diaspora concept (Bugă 2011). This problem has historical roots given the fact that the national identity crisis divided society into two major groups after independence in 1991: those of Russian origin and those of Rumanian origin, giving rise to a skepticism regarding the existence of a Moldovan national identity, *“which has commonly strong political connotations”* (Bugă 2011 : 330). For Bugă, the Moldovan diaspora needs to be considered as an “emerging diaspora” defined especially as small informal networks created by emigrated Moldovans who live in the same region of the country of destination. The appearance of the first associations of the diaspora, which focused mainly on cultural activities *“are a sample of the evolution of the process of structuring the Moldovan diaspora towards a desire to affirm themselves as a group”* (p. 331), promoting the values of the country of origin but also

channeling the community efforts towards collective projects for the benefit of the host country. When this has been consolidated, it is hoped that a greater impact in the country of destination will ensue.

Despite their weak associative structure, the Moldovan researchers do cultivate their transnational links with Moldova. Most of them keep themselves informed of events in their country of origin on a regular basis. Slightly more than half of the Moldovans (52.4% or 22 persons) return to Moldova once a year, and a third (31% or 13 persons) said that they visit their country of origin several times a year. The main reason for these visits, which have an average duration of between 2 and 3 weeks, is to meet family and friends, with interchanges or scientific or academic collaborations being the second reason. More than half of the Moldovan researchers (53.7% or 22 persons) consider the regional and national development of Moldova to be “very important”, while 39% (16 persons) regard it as “somewhat important”. Only one person indicated that it was not important to him at all. The vast majority of Moldovan researchers (90.7% or 39 persons) believe that scientists and skilled professionals abroad might have a pertaining role in home country development, and they have some ideas as to where this possibility could be crystallized through specific initiatives and projects. A researcher living in France mentioned: *“I believe that Moldovan professionals have a great deal to contribute to the development of Moldova as a whole, which can take the form of various collaboration projects, the transfer of social remittances and facilitating and promoting the collaboration of other professionals from Moldova with counterparts in Europe”*. Another researcher said that his position in the country of destination *“can offer new opportunities in scientific collaboration projects for scientists based in Moldova”*.

Moldovan researchers feel that they can benefit the country of origin through their professional and scientific activities abroad. The specific forms of impact that are considered possible include: improving public policies, increasing investments, improving education and research systems, improving the quality of scientific publications, promoting technology transfer, encouraging S&T and R&D activities, increasing Moldavia’s rate of participation in international research projects, increasing prospects for joint research projects, stimulating Moldova’s insertion in the global economy, and improving the image of Moldova abroad. The main mechanisms or specific actions through which the Moldovan researchers consider that it is possible to promote the development of the country of origin are: knowledge sharing, the transfer of technology, academic curricula design, temporary visits, policy setting, cultural promotion, investment activities, and philanthropy. We can observe that some of them have already carried out specific initiatives to benefit Moldova. Table 2 shows a selection of brain gain practices of Moldovan researchers and it provides evidence of their perceptions of the obstacles that limit these initiatives.

Type of project	Description	Profile of researcher involved	Moldovan institutions involved	Obstacles limiting brain gain initiatives
Knowledge sharing / technology transfer project	Involved in a 5-year project to investigate the genetic and biochemical basis of environmental stress and disease resistance in fruit crops. Assisted in conception and implementation of 5-year research proposal to address the needs of Moldova’s agriculture”.	PhD in Life Sciences; researcher in Agriculture; employed in a research institution based in the USA (holds a temporary position).	Institute of Genetics and Plant Physiology	Lack of funding; lack of political interest; lack of interest of skilled Moldovans abroad to collaborate with Moldova.
Research project in cooperation with Moldovan partners	Scientific project for designing and producing gamma and X-ray energy detectors in Moldova, then testing them in France	PhD in Physical Sciences; researcher in Atomic Energy; employed in a research institution based in France (holds a permanent position).	State University of Moldova	Lack of recognition of scientific diasporas’ value; lack of funding; lack of political interest.
Knowledge sharing/ technology transfer project	Participated in the IOM-ASM grant program and involved research and teaching activities with academic institution from Moldova	MA in Medicine; researcher in Energy and Biosciences; employed in a research institution based in the USA (holds a temporary position).	Academy of Sciences of Moldova	
Knowledge sharing/ technology transfer project	Viral Hepatitis Study/ TA/VH Surveillance & Lab Capacity Building	PhD in Medicine; researcher in Public Health; employed in an academic and research institution based in the USA (holds a permanent position).	National Center for Preventive Medicine	Lack of funding; political instability in Moldova; Lack of recognition of scientific diasporas’ value.
Knowledge sharing/ technology transfer project; scientific / academic exchange project; research project in cooperation with Moldovan partners	Close collaboration with scientists based in Moldova. Helping them to get international grants for research and involving them in research grants. Giving lectures during temporary visits.	PhD in Physical Sciences and PhD in Computer and System Sciences, Full Professor; employed in a research institution based in Israel (holds a permanent position).	Institute of Applied Physics, ASM	Lack of funding; lack of opportunity structures; lack of political interest.
Knowledge sharing/ technology transfer project; scientific / academic exchange project; research project in cooperation with Moldovan partners.	SCOPES Project	PhD in Physical Sciences; researcher in Photonics; employed in an academic and research institution based in Switzerland (holds a temporary position).	Technical University of Moldova	Lack of opportunity structures; lack of recognition of scientific diasporas’ value; lack of interest of skilled Moldovans abroad to collaborate with Moldova.

We can observe that Moldovan scientists consider their initiatives to be mostly limited by a lack of recognition of scientific diasporas' value, and a lack of political interest and opportunity structures. Some also stressed the lack of financial resources as the main hindrance to cooperation activities. A skilled Moldovan elaborated on this issue *"The first barrier is probably the financial one. Even if you come (to the home country) to do something concrete and you know how and with whom you can do this, you miss the finance. Financial support moves everything forward, including research"*. Another scientist referred to the better conditions enjoyed by scientists outside Moldova compared to their colleagues in the country of origin, and to the limitations resulting from a lack of time: *"Scientists who have settled in richer countries are available for various projects, because their situation is very different from those following a scientific career in Moldova. Here there is more time devoted to research than in Moldova where teaching absorbs a great part of their time"*. One Moldovan scientist based in Austria mentioned he does not see any obstacles to collaborating with colleagues from Moldova apart from the need to have joint interests and motivation. A scientist based in the USA referred to this saying: *"to achieve an impact we need to work together. One half of the work should be done in Moldova and the other half in the US, through a scheme that could be covered financially"*.

The Moldovans gave their opinion concerning the most efficient forms of capitalizing on their knowledge and experiences, highlighting the following: participation in public settings, evaluation and monitoring; establishment of a scientific diaspora steering committee, organization of short-term working visits to Moldova, launching of joint research projects, launching a website for cooperation, offering support to enhance cooperation between the host institutions of Moldovan scientists abroad and Moldovan institutions, and encouraging participation in scientific events and conferences organized in Moldova. This information can be useful for Moldovan institutions with regard to shaping their plans and strategies and these ideas can be given important consideration.

Perceptions of enabling conditions and opportunity structures

Our research tried to tease out the perceptions that skilled Moldovans have of both policies and enabling conditions that might boost their flow of knowledge and skills. We have shown in previous research that an enabling environment favorable to diasporas' resources and to pursuing positive endeavors for the home country is mainly based on the structures and infrastructure available, as well as on the existing opportunities encouraging such an environment (Tejada 2010). In the Moldovan case, we can observe, as argued by Kapur and McHale (2005) that policies and conditions in the home country continue to mediate the nature of the interplay between the diaspora and its country of origin. These might include for example: support from public institutions both in the country of destination and the country of origin, encouraging science and technology policies, supportive institutional programmes, a stable political system, access to resources and infrastructure, as well as adequate socioeconomic conditions in the home country.

We can observe that supportive public policies and opportunity structures are perceived as crucial, both in the form of systematic support and encouragement of bottom-up collaboration initiatives from the scientific diaspora, as well as in the form of the implementation of top-down incentive programmes. Within this framework, Moldovan researchers were asked their opinion about the programmes that the government of Moldova has recently put in place to engage skilled Moldovans abroad⁶. We can see that most of the respondents knew very little about their existence. Around one third said they were not familiar with these initiatives and more than half say they have never participated in them, citing a lack of time, as well as lack of interest to support the current government and a lack of trust towards its initiatives as the main reasons. Some Moldovans referred to the operational weaknesses of these programmes. One professor based in France mentioned that *"the application formalities are demanding too much effort to be filled up"*. A senior researcher based in the USA indicated: *"I am very interested in participating, but the majority of them were not advertised properly"*. The conclusion here is that while the top-down policies implemented by the Moldovan government supported by international organizations and development cooperation agencies include valuable initiatives that have tapped into the resources of Moldovan scientists and skilled professionals abroad through both recovery and return schemes, the scientific diaspora appear to lack the ownership of these initiatives that is considered necessary in order to catalyze their bottom-up practices. This urges the need to improve ways of promoting the visibility of, and participation in such institutional programmes.

Perceptions of the Moldovan scientific community in the home country

Our research also examined the perceptions of the Moldovan scientific community with regard to collaboration perspectives with Moldovan scientists and professionals abroad. Accordingly, our observations reveal that the scientific community in Moldova maintains contacts with its colleagues who are based abroad on a sporadic and occasional basis, using diverse means of communication and different occasions to exchange ideas, information and to discuss cooperation prospects. They believe that the latter should have an important and recognized role in the development process of Moldova through specific contributions "at a distance", relating to the transfer of knowledge, sharing new ideas, visions, implementing common projects, exchanging experiences, establishing connections with the international scientific community, promoting the

⁶ These programmes are: the initiative "Developing cooperation with the scientific diaspora of the ASM", the temporary return program of the ASM and IOM, the creation of the council of scientists of Moldovans abroad, the PARE 1+1 program promoting the use of remittances for investment activities and the Moldovan Diaspora Fair.

involvement of young researchers in international scientific activities, discussing scientific achievements from Moldova and promoting them abroad.

We observed that one out of every three scientists based in Moldova has already carried out specific collaboration initiatives with their colleagues abroad, such as the launching of joint projects, the drafting of joint scientific publications, inviting experts to participate in scientific events in Moldova, as well as the promotion of the achievements of their colleagues abroad in Moldova. Our observations also reveal the Moldovan scientific community to be generally optimistic about the prospects of collaborating with their colleagues abroad, and it recognizes the potential benefits. However, they deem that this endeavor presents some obstacles due to a lack of time or the difficulties in matching common research topics and working agendas, as well as a lack of established contacts and specific mechanisms and opportunities to collaborate. They believe all these constraints have postponed their decisions to try to reinforce the linkages with the scientific diaspora.

Some Moldovan scientists mentioned specific ways in which they could imagine a collaboration with their colleagues abroad, such as: launching joint research projects and activities, carrying out joint publications, joint organization of scientific gatherings, and engaging scientists abroad as experts for the evaluation of research projects in Moldova. The Moldovan scientific community expects scientists abroad to be more open to cooperation, more engaged in promoting young Moldovan researchers in international scientific activities, as well as more dynamic in helping Moldovan research groups to engage in international research projects. The more pessimistic voices say that the personal interest of the scientific diaspora, the limited scientific development in Moldova, the focus on short-term and non-productive projects, as well as economic and political instability in the country are some of the main obstacles to the establishment of cooperation with the scientific diaspora. While a few even believe that they do not need such collaboration, the majority of Moldovans would like to increase their cooperation with their colleagues abroad, and they think that continuous information about each others' activities as well as systematic support from Moldovan institutions are some of the first steps in this regard. The implication here is the need to encourage the establishment of contacts to promote cooperation activities in Moldova. In fact, Moldovans believe that public institutions should support more joint scientific activities by allocating additional financial funds to joint scientific activities.

4. Conclusions and lessons learnt

The increased international mobility of human capital encouraged by the processes of globalization and the relevance of knowledge-based economies offers new opportunities and dimensions of international scientific cooperation of which developing and transition countries could and should take benefit. Notwithstanding the contradictions caused by this mobility related to the tensions of the brain drain-brain gain controversy, we argue here that the technological progress that has transformed the methods of production and the transmission of information together with the rise of new transnational actors challenging the state dominance in the world order have motivated the understanding that the emigrated scientists and skilled professionals who have successfully settled in host countries can contribute to the development of their home country. This is especially relevant since the growing world knowledge gap means that it is necessary to promote alternative forms of North-South cooperation. In this context, an efficient production and equitable use of knowledge demands international collective action and confirms the need for novel participatory approaches enlarging the beneficiaries and empowering new relevant actors.

These confirmations motivated us to participate in the discussion proposed by the UNESCO Tech4Dev Conference 2012 concerning the ways in which the world production and circulation of knowledge can be optimized in such a way that it is more effective in terms of helping to reduce poverty and improve the scientific and socioeconomic advancement of less advanced countries. Our proposal is to make a contribution, not only in terms of an analytical discussion based on empirical evidence and case studies that can guide political decisions, but also in normative terms, by offering reflection insights as to how we ought to move forward. How can the various social actors contribute to reducing the scientific disparities and the inequality in the availability of human capital between the North and the South? What and how should we do to take advantage of scientific mobility and optimize international cooperation for the benefit of the most vulnerable sectors of the population? With these questions we move into a territory –cooperation for development- in which we could enter an endless debate about the role of the main actors and the responsibilities of each one, as well as about the most relevant determinants of success before the main world challenge represented by poverty. This challenge is a major one.

Knowledge is unquestionably a key catalyzer of development. Within the current context in which scientific and technological innovation are considered not only as forces driving progress but also as essential tools that are necessary to prosper in the strongly competitive and globalized economies, the increase in the world bank of knowledge, symbolized by the new information and communication technologies, offers developing countries more possibilities of reaching greater levels of productivity and prosperity than in the past. However, limited access to scientific knowledge, a scarcity of human capital and the slow advance of technological innovation in the countries of the South are current signs that the international efforts of cooperation for development still have a long way to go.

This paper promotes the focus of development advancement through the empowerment of scientific diasporas as knowledge communities. Accordingly, we propose to encourage scientific diasporas as agents of development and

international cooperation by providing an original perspective of the circulation of world knowledge and the design of actions and policies to optimize scientific cooperation that can respond effectively to social needs and help reduce the scientific disparities and the unequal availability of human capital between the North and the South. We do this by showing the example of the Republic of Moldova, which has been hard hit by the mass emigration of its skilled human capital, and which has recently launched an institutional strategy aimed at fostering cooperation with its scientific diaspora. Accordingly, by using an analysis-based on evidence of the experiences of skilled Moldovan scientists and skilled professionals in the countries of destination, as well as their cooperation initiatives and mechanisms with the scientific community based in Moldova, the article shows that scientific diasporas participate actively in the production of knowledge and they promote its circulation for the purposes of strengthening the capacities of the country of origin.

When the members of a knowledge community put their capacity to mobilize and launch common initiatives in place, they facilitate collective influence in the home country and become agents of change. Three interdependent factors are necessary to activate the agency of scientific diasporas and to generate a positive impact: the recognition of knowledge as a global public good, support for organizations and decentralized collective action, and the provision of a suitable environment and opportunity structures.

With the example of the implementation of this research and policy oriented project through a knowledge *co-production* effort by academic and non-academic actors working together, this paper brings also into focus the relevance of collective research collaboration, ensuring a more effective and practical social application of scientific reflection upon completion of the study. This method is particularly relevant in international migration and international cooperation for development, which are two areas in which policy decisions should be informed by reliable research findings and supported by evidence-based analysis. It is essential that both the academic and non-academic actors learn from each other in order to develop a common working understanding regarding the project and to integrate their specialized knowledge through their participation in the different stages of the research.

Our experience illustrates both the advantages and the risks that might be experienced during knowledge co-production in research. We were faced with two main challenges. The first of these was the skepticism the Moldovans showed towards our project due to the lack of recognition of institutional “top-down” pro-diaspora initiatives. The second was the lack of credibility and trust in terms of scientific rigor given that some Moldovan scientists referred to our study as a “purely political initiative”. However, we are satisfied that our research has been innovative in the sense that it counts on both important scientific value for the new information uncovered and it also enables ownership of the results by the relevant group of social actors involved. We expect that the different actors involved will ensure the application of research insights in a collaborative way and that they will provide policy makers with high-quality information on which to base their decisions.

Our reflection on scientific diasporas, the circulation of knowledge and development has led us to conclude that the following five determinants are necessary to guarantee a systematic and inclusive circulation of knowledge that the countries of the South can benefit from, with scientific diasporas as the main focus point:

1. International action of a collective nature (bilateral, regional, worldwide) must ensure the efficient production and more equitable use of knowledge, through support for innovative and efficient approaches, and by strengthening the active participation of new relevant actors.
2. The mobilization and organization capacity of scientific diasporas through the creation of networks and associations must be supported in order to facilitate their community initiatives and to allow them to act as agents of development and international cooperation.
3. The appropriation and trust of institutional top-down collaboration initiatives with diasporas must be promoted, while simultaneously favoring bottom-up initiatives.
4. The systematic dissemination of the value of scientific diasporas and their best practices will encourage further collaborations with new actors, thereby broadening their field of action.
5. Favorable institutional environments and an adequate infrastructure in the countries of origin of the South as well as in the destination countries of the North will allow the initiatives of the scientific diasporas to be transformed into specific cooperation projects that have a significant impact.

This article represents a small but necessary step towards establishing an agenda with priorities that can guide the processes and mechanisms that are required to guarantee a sustainable and inclusive circulation of knowledge. The circulation of knowledge involves human interaction and scientific collaboration is one of the most promising mechanisms for an effective exchange of knowledge. The promotion of scientific diasporas as agents of change is an essential part of this perspective, which considers human capital as the focal point in the generation of knowledge, technological innovation and scientific cooperation.

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