

Miriades methodology guide

Multidimensional impact analysis
of research and resulting innovation
on development in the global South



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Traces in the sand (probably beetles) in Kumawa (Indonesia).
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Michel Cot, Laure Emperaire, Isabelle Henry, Laurent Laplaze,
François Roubaud, Florence Sylvestre, Ghislaine Thirion (coordinator),
Laurent Vidal, Jean-Daniel Zucker

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Introduction	7
Project Scoping.....	9
Objectives	9
Organization.....	9
Method selection	10
The <i>ex-post</i> case studies method	11
Guiding principles	12
Definition of case studies and their scope	12
Identification of actors and their contribution	12
Accounting for the diversity of impacts	13
Standardized tools for the assessment and presentation of results	13
Adaptation of assessment tools for IRD	14
Dimensions of impact selected.....	14
The choice of a qualitative approach	15
Case selection procedure	16
Composition of case study teams	17
Construction of the impact pathway	19
Case delimitation	20

The background and five phases of the impact pathway.....	21
Background.....	21
Actors' contribution to the research process.....	23
Products of research.....	24
Circulation of knowledge and intermediaries	26
Impacts: initial impacts and widespread impacts.....	27
Practical conduct of a case study	33
Stage 1: delimitation of case study scope and collection of internal data.....	34
Stage 2: collection of external data	36
Stage 3: report preparation	38
Stage 4: approval of report by persons interviewed	38
Appendices.....	39
Organization of the Miriades project	39
Contributions to the research process – actors and roles	42
Circulation of knowledge and intermediaries – actors and roles.....	44
Dimensions of impact and descriptors	47
Glossary.....	50
References (selected).....	51
Text boxes, figures and tables	52
Abbreviations and acronyms.....	53

Introduction

Describing and understanding the mechanisms by which research produces results, how it produces effects – and identifying them – is a principle that is now becoming more widely-shared. It is fully in line with IRD's strategy regarding the establishment of equitable partnerships with countries in the global South and its commitment to sustainability science. IRD resolved to embark on this journey in late 2016, with the launch of a pilot project on the societal impact of its research in the global South. This project was called: Multidimensional impact analysis of research and resulting innovation on development in the global South (Miriades) There were two main principles that guided the Miriades project: accountability and reflexivity.

Accountability: As a publicly-funded research institution, IRD is expected to “be accountable” for its research and for its “usefulness.” Understanding the pathways to research impact, and describing that impact, is an essential means of achieving this objective of accountability. It is an expectation that applies with even greater relevance and intensity, for IRD in particular, because it is also expected by the partner institutions of the “global South” with which the institute works. These institutions also call to be provided with information, descriptions, and “evidence” regarding the effects of research involving them.

Reflexivity: Constructing and documenting research impact pathways immediately requires a reexamination of the basic elements of an IRD researcher's work: were the partnerships entered at the appropriate time? With the right institutions? Do the questions that were asked reflect the partners' concerns? Was the methodology that was used the most appropriate one? Was the impact

on media and international discourse commensurate with the investment made? etc. Thus, to study the impact of our research means retracing the approach chosen and measures taken to achieve the specified objectives, showing our long-term process as a precondition for the proper organization of the research conducted in our partnerships.

The choice made was for a **case study analysis method** known as **ex-post** - i.e. after the fact - a method derived from those developed by the Centre for International Cooperation in Agricultural Research for Development (Cirad) and the National Research Institute for Agriculture, Food and the Environment (Inrae) and modified to suit IRD's context. Over the course of the exercise, the method was tested, discussed and adjusted by the methodological group leading this pilot project, so as to best integrate into the approach dimensions of assessment addressing development issues in the global South, the context in which research is conducted, the knowledge produced and disseminated, and the conditions for its appropriation and implementation. Experience shows that this method provides a generic analytical framework suited to the broad spectrum of disciplines and the diversity of thematic fields that characterize IRD's research, consistent with the principles of sustainability sciences.

The primary aim of this guide is to share the experience and results obtained by the Miriades approach. It then aims to provide methodological and practical support to researchers or groups wishing to undertake a study of the impacts of their work.

The guide is organized into four parts. The first summarizes the objectives, organization and approach of the Miriades project. The second presents key aspects of the method and their application. The last two parts present the work of the methodological group, integrating feedback from studies conducted during this stage. The third part thus describes the methodology for constructing the impact pathway, which is the method's primary tool used for identifying and characterizing research impacts. The fourth part details the realization of a case study in practice.

Project Scoping

At the end of 2016, the presiding directors of IRD tasked the Mission for research evaluation and programming (MEPR) with a research project seeking to identify and describe the impact of the institute's work in the global South.

Objectives

The objectives of this project were three-fold:

- to meet the expectations of IRD's supervisory authorities and of authorities in the global South countries where the institute works regarding the impact of the research conducted;
- improve knowledge of the actors, factors and processes likely to favor such impact;
- provide the teams with tools for analyzing and describing the potential societal benefits of their work beyond the academic sphere.

The objective of consequently developing a tool for the assessment of research or of researchers' activity was not included.

Organization

The project relied on a project team in charge of operational coordination, a methodological group in charge of ensuring the overall coherence of the project and its anchoring in the institution's scientific and partnership context, and scientific rapporteurs for each of the cases studied (see appendices).

The project team managed project coordination, formalized the methodological approach, and oversaw the realization of the pilot case studies.

The methodological group consisted of eight IRD researchers covering a wide spectrum of disciplines. It participated at all stages of the process: method selection and adaptation, pilot cases selection, monitoring and validation of studies, interim reports and recommendations.

Each case study was led by a scientific rapporteur responsible for the study and an advisor as point of contact for the project team, and had the support of one or two members of the methodological group.

Cases were documented based on interviews conducted amongst research partners from the global South and North, the actors who contributed to the dissemination of the results, and the impact recipients. The term recipients here refers to the actors (organizations or individuals) directly or indirectly affected - whether positively or negatively - by the impacts generated by the research and its results.

Method selection

After a review of the literature and a critical look at the different impact assessment methods, particularly for research impacts (*ex-post* vs. *in itinere*, i.e. whilst research is being conducted; quantitative vs. qualitative; evaluative vs. summative, etc.), the methodological group approved the choice of a method based on standardized *ex-post* case studies, inspired by those conducted by Cirad (Impress – Impact of Research in the South) and Inrae (Asirpa – public agronomic research impact assessment).

Prior to setting up the project, discussions were held with Cirad and Inrae concerning their respective methods for assessing the socioeconomic impacts of research in the agronomic field. These discussions and the publications addressing the corresponding methodological work (BARRET et al., 2017; COLINET et al., 2014; JOLY et al., 2015) greatly informed the approach implemented by IRD.

The approach taken is therefore qualitative, descriptive and replicable.

This pilot project is a first step towards describing the societal impacts of IRD's research. Its results open up prospects for an assessment of the generic elements that favor the achievement of impact. These remain to be explored and enriched over the course of the case studies.

The *ex-post* case studies method

The *ex-post* case studies impact assessment method is based on the assumption that the effects of research on society are the result of complex interactions between a plurality of actors, scientific or otherwise, who produce knowledge and disseminate, adapt, transform and use that knowledge. The impacts of research thus appear as the result of this network of actors taken as a whole. In this context, it is difficult to attribute an impact to a specific actor. The case study method seeks to document the actors' contributions to the generation of an impact (Text Box 1).

To do so, the method uses impact pathway analysis. This tool is a key element of the approach, which makes it possible to identify the actors, assess their contributions, and shed light on the processes by which the research performed manifests materially as impacts on society. These processes take place over the long term¹.

This chapter first discusses the guiding principles of the method, then turns to the manner of their implementation in the Miriades project.

1. The theoretical framework underlying this approach is presented in the final report of COLINET et al., 2014.

Text Box 1

Definition of impact and impact pathway

Impact: Research impacts can be defined as “the direct and indirect effects of the various components of research activity (production of knowledge, skill, expertise, know-how, infrastructure) on the economy, environment, health, etc. [...] Research impacts are generated by long-term processes and may be distributed over a very broad area. Hence the importance of the notion of impact generation mechanisms.”

Impact pathway: Adapted from the Consultative Group on International Agricultural Research (CGIAR), the impact pathway is a graphical representation of the stages of impact generation that “describes the research work, the movement of the corresponding knowledge out of the academic sphere, and its transformation and use by socioeconomic actors.”

Source: COLINET et al., 2014.

Guiding principles

Definition of case studies and their scope

The method is based on the performance of *ex-post* case studies, i.e., assessing the impacts of research that has already been completed.

This is done by starting from a known impact (social, health, environmental, etc.), and then moving back in time, approaching any work² whose results are likely to have contributed to this impact. The work thus approached constitutes the scope of the case study.

The identification procedure for a case study selected in *Miriades*, moving from downstream to upstream, helps provide a sense of how the research has contributed to a given impact. This contribution is the result of multiple investments and is built over time, most often through several shorter-term scientific projects. Societal impact is therefore rarely the product of a single, time-limited project.

Identification of actors and their contribution

The method is based on an analysis of the role of the actors contributing to the impact pathway of the case under consideration, from the start of research to

2. The work addressed may include all or only part of the research projects developed by the research teams

the materialization of impacts. It identifies them and describes their material and immaterial contributions, as well as their respective roles in carrying out research, circulating knowledge or transforming research products. It thus highlights the interactions between actors, as well as the causal links between the different stages of the impact pathway.

This approach uncovers the network of actors who participated in building the impact and positions their contributions within the impact pathway.

Accounting for the diversity of impacts

The effects of research on society and its environment affect various different fields (economic, health, cultural, etc.). These may be positive or negative, direct or indirect, expected or unexpected, established or developing, in the short-, medium- or long-term. The *ex-post* case study method integrates the multidimensional nature of the impact into its standardized assessment tools.

Standardized tools for the assessment and presentation of results

For the performance of a case study and the presentation of its results three standardized assessment tools are used: the impact pathway diagram, the dimensions of impact, and the timeline.

These tools make it possible to report on the particularities of each case, put the cases into perspective, and thus to draw generic lessons. The results can thus be observed at different scales, from the laboratory to the institution.

– The **impact pathway diagram** is a chart that summarizes impact production in five phases: the actors in the research process and their contributions (actors' contributions), the products resulting from this research (research products), the actors that contributed to the circulation and adaptation of these products and the resources applied to such end (dissemination of knowledge and intermediaries), and lastly the impacts observed in the form of two phases (initial impacts and widespread impacts). The diagram also includes contextual elements.

– The **dimensions of impact** refer to the primary areas (environmental, social, economic, etc.) in which research impacts are likely to materialize. The tool promotes a systematic exploration of the nature of the impacts observed and facilitates their identification and characterization. These broad areas can be

broken down in various ways, in particular based on the different research institutions and their missions, their objectives, and the fields of application of their research work.

– The **timeline** presents a picture of the case under consideration in chronological terms, from the start of research to the impacts observed. It temporally situates the impact, the diversity of the actors, the salient elements of the case, and the key moments in the impact pathway: the contextual events (scientific, social, etc.) that influenced the progress of the research and the materialization of impact; engagement of actors; primary products of research; and materialization of the initial impact.

The use of these tools is detailed in the chapters on the construction of the impact pathway (diagram of impact pathway: see figure 1 and on the practical realization of a case study (timeline: see figure 2).

The case studies are informed by documentary information and interviews with stakeholders in the impact pathway. Identified impacts are documented and supported by factual evidence collected from impact pathway actors and impact recipients.

The study results in a report prepared according to a standard framework. This report is submitted to the interviewees for their opinion.

Adaptation of assessment tools for IRD

Based on these guiding principles, the methodological group made its choices in terms of impact characterization, established the criteria and procedure for case selection, and framed the conduct of the studies.

Dimensions of impact selected

In *Miriades*, six dimensions of impact were selected to characterize the societal impact to which the institute's research has contributed:

- Academic;
- Economic;
- Environmental;
- Institutional;
- Public policy;
- Sociocultural, health and educational.

The impact in terms of capacity development cuts across all these dimensions. Initially identified as an independent dimension, it ultimately seemed more coherent to report on it in the context of each of the six dimensions. This choice also makes it possible to better differentiate the capacity development process as a driver of impact generation from capacity development as impact.

The choice of this frame of reference results from a consideration of the criteria associated with IRD's missions and the contexts in which it pursues them. It thus takes into account:

- IRD's primary mission – to produce science focused on the intertropical and Mediterranean zone – based on an equitable scientific partnership with the higher education and research communities of the concerned countries and regions. This mission has a dual objective: to contribute to advances in scientific knowledge in matters of sustainable development, and to help give development policies a better grounding in scientific knowledge;
- the development challenges in the countries with which the institute works;
- the diversity and characteristics of the partnership contexts in which IRD research teams work;
- the potential areas of application of the impacts of the research conducted at the institute. These are structured around major themes addressing global challenges such as improving the health of populations, reducing inequalities, managing and conserving biodiversity, understanding global changes, quantifying hazards and risk reduction, or sustainable management of ocean resources.

The choice of a qualitative approach

Research impact analysis may be qualitative or quantitative.

Unlike the *Asirpa* and *Impress* methods, which combine both qualitative and quantitative analyses, the *Miriades* project opted instead to take a qualitative approach, for two reasons. The first is to avoid the risk that the tool would tend to be misunderstood by those who might see a quantification of impacts as a new research assessment metric. The second involved the complexity of building a tool to perform such assessment, which lends itself more to a qualitative than to a quantitative approach.

Case selection procedure

The choice of criteria and the selection process used for the chosen cases were guided by three requirements:

- the availability of a diversified set of research themes to test the method;
- involvement in the process by the scientific departments in charge of coordinating the institute's scientific policy;
- identification of volunteer researchers to lead the case studies.

A set of twenty-six subjects deemed likely to serve as case studies was compiled from several sources: a review of IRD scientific news sheets published between 1996 and 2010 (consisting of 360 news sheets), proposals from the scientific departments and proposals from the project's methodological group.

Cases were selected based on the following criteria:

- diversity and extent of the impacts observed;
- response to development challenges;
- significant contribution of IRD and its partners to the impact;
- academic results;
- representativeness of thematic and disciplinary fields;
- type of partnership established (higher education and research, businesses, non-governmental organizations [NGOs], community organizations, non-academic institutions, etc.);
- ways of disseminating results (patent, expertise, tool, method, etc.);
- diversity of geographical and cultural contexts;
- human resources available to conduct these studies.

After this initial selection, the selected cases were the subject of a feasibility analysis by the case's potential scientific rapporteur and project team. This resulted in the formulation of an impact hypothesis; an initial definition of the scope of the case; an assessment of the accessibility of the data necessary for case documentation; and a draft timeline and impact pathway diagram.

At the end of this selection process, nine cases were selected for the Miriades project (Figure 1).

Table 1
List of cases selected for the Miriades project

Case name	Abbreviated title
Mining activity in New Caledonia – Societal and environmental impacts	Mines
The Humboldt current, from ocean dynamics to Peruvian fisheries management	Humboldt
A statistical innovation: 1-2-3 surveys. A method for the measurement and assessment of informal economies (Madagascar, Peru, Vietnam)	Informal economy
Volcanic processes and hazards in Ecuador	Volcanoes
Access to antiretroviral treatment in Africa (Cameroon, Côte d'Ivoire, Senegal)	ARV
Discovery of a method for the early recognition of date palm sex and invention of a kit for agronomic use (Djibouti)	Palms
Heritage recognition for agrobiodiversity in Brazil	Agrobiodiversity
Road injuries in West Africa	Injuries
Impregnated mosquito nets in the fight against malaria	Mosquito net

Composition of case study teams

Each case study was led by a scientist, serving as scientific rapporteur and responsible for the study. This rapporteur had individual support in regard to methodological, editorial and documentary aspects from a consulting member of the project team trained in the method.

Each of these studies was also monitored, depending on the case, by one or two members of the methodological group, based on the themes addressed and the diversity of the impacts observed. They provide an external perspective and advice throughout the study.

Construction of the impact pathway

The impact pathway constitutes the analytical framework of the study. It serves as a common thread for its realization, and acts as a guide for the presentation of its results in the form of a report, structured according to the logic of the impact pathway. It incorporates the contextual elements that influenced its development, and comprises five phases:

- the **actors' contribution**, identifying the research selected within the case study scope, the actors involved, and their respective contributions;
- the **products of research** resulting from the previous phase, which contributed to the generation of the impact observed;
- the **circulation of knowledge and intermediaries**, which describes the progress of these products, their transformation and their appropriation by the recipients; it identifies the actors (or mechanisms) that served as facilitators/intermediaries between the academic world and the impact recipients;
- the **initial impacts**, that is to say the direct or indirect impact observed on the first recipients of the products of research that had been transformed or adapted in the previous phase;
- **widespread impacts** that affect another sphere of recipients as a result of a change in the spatial scale of the impacts or their extension to other areas.

In the construction of the impact pathway, particular attention must be paid:

- to highlighting the **causal links** between the phases, in order to trace and shed light on the contribution of a given actor to the impacts observed;

- to the **role of the actors** involved in this impact pathway and the relationships they have with each other. One actor can both contribute to the research process and participate in the circulation of knowledge. The same actor may also benefit from the effects of the research ;
- to the **iterative nature of the approach**, within the same phase and between phases. The impact pathway is not linear. One research product may, for example, contribute to the production of another. It may also participate in the generation of impacts in multiple areas (social, economic, etc.) and in different time frames. Conversely, an impact may be the result of several research products.

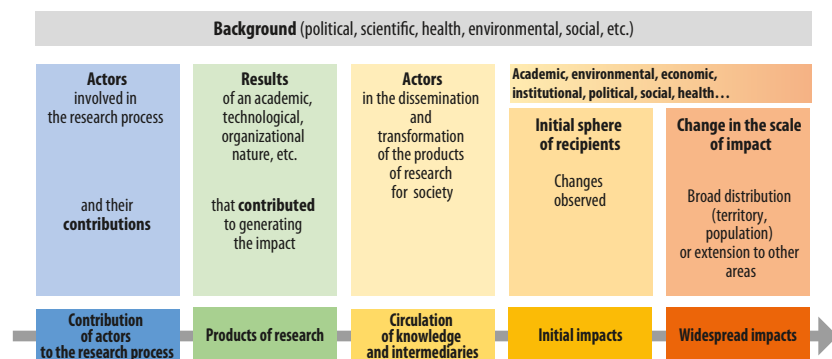


Figure 1
Impact pathway diagram.

This chapter first presents the methods used to delimit a case, and then details the content of the five phases of the impact pathway. The definitions proposed (in quotation marks in the text) originated in the Asirpa or Impress methods. Examples have been taken from the completed Miriades cases to illustrate these different phases; some include a mention of the studies concerned, referenced by their abbreviated titles (see Table 1).

Case delimitation

The scientific rapporteur plays a key role in this first step. By defining the scope of the research, they identify at the same time the primary elements of the impact pathway: the main research partners, results, methods used and actors involved in the circulation of knowledge, chronological reference points, geographical space, contextual events or other elements.

All the research constituting the scope of the case is identified by means of a process that starts from an observed impact and continues backwards, in the direction of the work of the organization leading the study that is likely to have contributed to it. This choice of scope must be relevant with regard to its skills, the positioning and expertise of its teams in the scientific fields concerned (originality, interest, approach, etc.), and the importance of its contribution and its partnerships. In other words, the aim is to determine the angle or scale of analysis that will best account for the organization's contribution to the observed impact. The scientific rapporteur thus constructs a plausible **hypothetical impact pathway**, to be compared with the points of view of the other actors in this pathway. Some example cases are shown in Text Box 2.

The initial scope is not permanently fixed and may change over the course of the study. The bibliographic work and the interviews conducted with the actors and recipients of the impacts can change the boundaries of the scope. Likewise, the study will lead to a validation, or not, of the initial hypotheses regarding impact on recipients, and may also lead to the identification of other impacts and potentially other recipients.

Points of concern: Delimiting the scope of the case involves an element of subjectivity. It is an exercise that may create bias, and the scientific rapporteur must be vigilant in this regard. A scope that is too restricted risks only partially elucidating the organization's contribution to the impact observed. Conversely, too broad a scope can render the study too complex and make the assessment of impact mechanisms a drawn-out, difficult process. It is thus advisable to refrain from selecting work that is too recent, the impact of which has not yet had time to fully unfold. The impact pathway is a **snapshot of the impact at a given time**.

The background and five phases of the impact pathway

Background

The objective is to highlight the societal issues and events that had a significant influence on the initiation of the research process or the development of the different stages of the impact pathway. This analysis is provided in the introduction to a case study report, and describes how such events were able to promote, slow down or orient the decisions of the actors. These contextual

elements may be of a highly diverse nature: political, scientific, environmental, economic, social, health, etc.

Text Box 2

Examples of Miriades project: case study scope

Mining activity in New Caledonia – Societal and environmental impacts

By 1999 the scientific community had been observed to have almost completely abandoned the environmental geosciences in New Caledonia, in regard to its “study of lateritic regoliths” component and in terms of operations. Nevertheless, on-site research had been growing over several years concerning the behavior of metals found in the soil, floral diversity in the mining zone, and mine site ecology. In terms of the scope, multiple approaches were possible, independently considering the different scientific themes that had been developed in the field. The choice was made to focus the study on the work of the “Supergene biogeodynamics and tropical geomorphology” team at Cerege in New Caledonia. This choice may appear reductive, but the team’s ability to combine the different approaches in the field and to draw on established knowledge reaffirmed the study managers’ confidence that the results considered would not leave aside any broad areas of impact.

A statistical innovation: 1-2-3 surveys

Essential challenges are associated with the measurement of the informal economy in light of the massive weight of the informal sector in the least developed economies and the fact that statistical data on the subject is incomplete. Designed in the late 1980s, the 1-2-3 survey system is a method for measuring and analyzing the informal economy. Consolidated over time, it is now implemented in many countries

In order to show the diversity of impacts to which the implementation of 1-2-3 surveys has contributed, the study focused on research work carried out in three countries, in partnership with national statistical institutes and research institutions: Madagascar (1995-2001), Peru (1993 to date) and Vietnam (2006-2011). This choice was motivated by several criteria: the location of these countries on three different continents, their highly contrastive economic and political situations, and the capacity differences between the national statistical institutes.

The studies addressed in the Miriades project include, in particular: access to a new treatment [ARV], economic, social and environmental issues associated with the exploitation of a resource [Mines, Humboldt, Palms] or with a category of economic actors [Informal economy], the development of legislative or regulatory frameworks or international agreements [Mines, Humboldt], natural risks and hazards [Volcanoes] or the establishment of a new international institution [ARV].

Actors' contribution to the research process

The objective of this first stage of the impact pathway is to document the specific contribution of the primary partners to the impacts observed, and thus to document the research activities that contributed to them.

The term contribution refers to “the investments of all kinds made by all the actors involved in collective research processes.” The approach takes into account “all the skills, infrastructures, partnerships, reputations and institutional arrangements leveraged for the production of scientific and technical knowledge.” Its analysis encompasses “the position of research in relation to the global pool of knowledge, the forms of organization and the interactions between the different actors involved: ‘the productive situation’” (COLINET et al., 2014).

This approach thus aims to take into account the diversity of the elements necessary for carrying out research work and producing knowledge. The contributions considered are those made before or during the research work included within the scope of the case study.

Beyond **research and higher education institutions**, the partners involved in the research process may be of a varied nature. The following groups also stakeholders to varying degrees in the studies in the Miriades project:

- representatives of civil society (non-profits, NGOs, community organizations, etc.), who serve as a relay between scientists and the communities concerned, or are directly involved in the projects [ARV, Volcanoes];
- actors in the **economic sector** (companies and professional organizations) who provide infrastructure, facilitate access to data or finance research [Humboldt, Mines];
- national, **regional or international organizations and agencies** that finance project-based research work and sometimes contribute to its definition [ARV, informal economy Humboldt, Palms];
- **public authorities**, which may sponsor or finance research, or may even be directly involved in carrying it out [ARV, Informal economy, Humboldt, Mines, Palms, Volcanoes];
- **non-academic public institutions** (national statistics institutes, health structures, etc.) involved in research activities or providing data [ARV, Informal economy, Humboldt];

– multi-actor networks that contribute to the organization, guidance or development of research [Palms].

A description of the role of the actors who contributed to the research process in the case studies of the Miriades project is included in appendices.

Points of concern: The aim is to identify the actors in the research process, i.e. those without whom the research work could not have been performed, and not to create an exhaustive mapping of all contributors to this process. Care must also be taken to clearly define the case scope within the continuum of research being conducted on the theme concerned, and to set time restrictions for the work. Previously produced knowledge is part of the “knowledge pool” that can be leveraged.

Products of research

The objective of this second stage of the impact pathway is to present the products of research resulting from the previous phase, which contributed to the generation of the impact observed.

These products are diversified. They may be: “academic (publications, conferences, etc.), technical (incorporated in software, marketable products, etc. or intangible like processes, know-how, training, expertise, etc.), or organizational (database, collections).” They “may or may not be subject to intellectual protections, such as filings to protect patents, know-how, trademarks or software” (COLINET et al., 2014).

The examples of products listed in Table 2 (excluding academic publications, conferences and scientific seminars) illustrate this diversity.

Points of concern: Causality is the decisive criterion in choosing the results to be mentioned in this section. The aim is not to appraise all the production resulting from the research, but more precisely that which actually contributed to the occurrence of the impact. For scientific publications, for example, it is advisable to cite only those that underpin the results.

Table 2
A few examples of the products of research: Miriades case studies

Type of research products	Examples The short title of the relevant case study is given in square brackets
Tools, methods and models	Volcanic hazard maps [Volcanoes] Tools and methods for observing the marine system [Humboldt] Mining impact monitoring stations [Mines] Statistical method for measuring and analyzing the informal economy [Informal economy] Digital models [Humboldt]
Patents, trademarks	Molecular markers and methods for early sex identification in date palms [Palms]
Standards, guides, procedures	Standards and guides on mineral exploration and extraction, restoration of degraded environments [Mines]
Databases, collections	National database of statistics on the informal economy [Informal economy] Organizing a structured mushroom collection [Mines] Prospective observational cohort of people living with HIV [ARV]
Creation/structuring of organizations, networks, research collectives	Creation of a mycological society [Mines] Youth team associated with IRD, international joint laboratory [Volcanoes]
Expertise for public authorities or socio-economic actors	Collective expertise, consultancy [Humboldt, Mines]
Recommendations, opinions	Development of a policy brief [Informal economy] Recommendations for the White Paper on research in the humanities and social sciences in New Caledonia [Mines]
Education/training designed or provided	Design of training modules with or without a diploma [ARV, Informal economy, Humboldt] Training in research through research (supervision of masters, doctorates) [all studies]
Actions and tools for dissemination of knowledge between science and society	Reports and film on the issues and research methods accompanying the mining activity [Mines]

Circulation of knowledge and intermediaries

The objective of this third stage is to describe how the products of research circulate and are adapted or transformed and used.

Intermediaries may include, for example, “technical systems, professional organizations, consulting, training or mediation organizations, licensing or contracting systems, human resources, technical centers, incubators, administrations or media.” (COLINET et al., 2014).

The actors involved in this stage may also have contributed to the research process upstream, or may be recipients of the impacts. The way in which they leverage the knowledge produced may vary based on their area of expertise and the context.

Thus, in the studies conducted within the Miriades project, contributions can be observed from:

- **research and higher education establishments**, whose involvement took various forms (development of advocacy campaigns, bringing different actors together, training, carrying out expertise, information and dissemination of scientific knowledge to society, contribution to the public debate, establishment of incubators, operating licenses, etc.); the commitment of researchers acting as facilitators was seen in all cases;
- **public authorities**, who served both as requestors of expertise and scientific knowledge and stakeholders in their adaptation, use or dissemination through various instruments (integration into public policy guidelines; enactment of laws and regulations; changes in the organization of public resources; funding of mechanisms to promote the dissemination of knowledge, etc. [ARV, Humboldt, Mines, Palms, Volcanoes]);
- **non-academic public institutions**, which contribute to creating the conditions for the appropriation of the knowledge and innovations produced, to making them operational and sustaining them [ARV, Informal economy, Volcanoes];
- actors in the **economic sector** that enlist scientific expertise and appropriate or adapt new technologies, standards or practices [Humboldt, Mines, Palms];
- representatives of **civil society** (NGOs, non-profits, community organizations, etc.) who contribute to capacity development in communities or institutions (funding, training, awareness-raising actions, etc.), giving an issue grounding in

public debate, ensuring the interface between science, politics or other actors in society, etc.; this category of actors was present in all the studies conducted;

- **non-academic public institutions**, which contribute to creating the conditions for the appropriation of the knowledge and innovations produced, to making them operational and sustaining them [ARV, Informal economy, Volcanoes];
- **national, regional or international organizations and agencies**, through the funding of mediation mechanisms, contributions to the operational implementation of research results, adaptation of their instruments, etc. [Informal economy, Palms, Volcanoes];
- **multi-stakeholder networks** [Informal economy, Humboldt, Mines]. This diversity of actors can form networks that contribute in various ways to the dissemination of knowledge or the raising of new issues.

A description of the role of the intermediary actors identified in the case studies of the Miriades project is included in appendices.

Points of concern: The boundary between the production of research and the circulation of knowledge is often a tenuous and porous one. Depending on the case, an element may be considered either as a product of the research stage or of the knowledge circulation stage. The logic behind the unfolding of the impact generation and the interactions between the actors are what determine its positioning in the impact pathway.

Impacts: initial impacts and widespread impacts

These last two stages of the pathway describe the confirmed societal impacts, the nature and intensity of the changes observed, the limits encountered, and the recipients of these impacts. The recipient describes the impact as positive or negative. Depending on the categories of recipients questioned, the effects of a change may be deemed positive or negative.

The analysis distinguishes two levels of impact: initial impacts and widespread impacts. Initial impacts involve effects on the direct users of research products. Widespread impacts are “associated with the widespread adoption of the innovation over a large part of the target space or by a large part of the target population, beyond the sphere of the initial users (impact 1)” (COLINET et al., 2014). The distinction between initial impacts and extended impacts is based on a change in scale. Extended impact may also result from changes in nature. The case study on access to ARVs in Africa illustrates these two levels.

Text Box 3

Example of extended impact: case study on access to ARVs in Africa

The first impacts of research on access to ARVs involved the three countries (Cameroon, Côte d'Ivoire, Senegal) where the work took place (health policy, health, social, economic, and capacity development impacts). Beyond these three countries, research results helped promote access to ARV treatment in Africa, thanks to their demonstrative value and the visibility of their results (widespread impacts corresponding to a change of scale). Lessons learned from this research also inspired public health programs addressing other pathologies in Cameroon, Côte d'Ivoire and Senegal (widespread impacts corresponding to a change in nature).

The impacts contributed to by research performed by IRD in collaboration with its partners are described based on the six dimensions defined in the previous chapter (Adaptation of assessment tools for IRD): academic; economic; environmental; institutional; public policy; sociocultural, health and educational.

Note that capacity development is integrated into each of these dimensions. These dimensions of impact can be observed at different geographical scales (local, national, international, etc.) and concern both initial impacts and extended impacts.

Some elements characterizing the six dimensions of impact are proposed below, accompanied by examples drawn from completed case studies of the Miriades project. The studies concerned are referred to by their abbreviated title (see Table 1).

Academic impact

In the context of the Miriades method, academic impact refers to the sphere of higher education and research (Table 3). This impact may materialize as capacity development in academic institutions, or in the form of effects on the organization, functioning or structuring of the research and higher education system. It may also result in openness to new scientific issues and research questions, or even in the emergence of new fields to be addressed by the scientific community. It was agreed that the impact of knowledge production on the world of research as such, as well as on habitual iterations of research, would be excluded from the scope of this dimension of impact.

Table 3
Examples of academic impact

Domains	Example descriptors The short title of the relevant case study is given in square brackets
Related to capacity development	Development of an ecosystem approach to the marine environment in Peru [Humboldt] Reinforcement/diversification of scientific skills [ARV, Humboldt, Palms, Volcanoes] Creation/reinforcement of research structures, technical resources for research [ARV, Humboldt] Increased ability to obtain funding for research [Mines, Palms, Volcanoes] Sustainability of a training pathway [Mines]
Initiating new issues in science	Initiating new analytical fields for research by providing access to new statistical data [Informal Economy] Development of a research sector in the humanities and social sciences related to the subject of "mines and society" [Mines]

Economic impact

Economic impacts can be observed through their effects on economic actors (households, companies, State, institutions, etc.). These changes may affect different sectors, such as employment (creation, preservation, reduction, qualification, new trades, etc.), the production of goods and services (productivity, profitability, quality, diversification, cost reduction, etc.), resources/ income (increase, decrease, preservation), innovation or trade (Table 4).

Table 4
Examples of economic impact

Domains	Example descriptors The short title of the relevant case study is given in square brackets
Employment	Job creation through the creation of start-ups and satellite nurseries [Mines] Revision of public policies addressing employment and training [Informal economy]
Production of goods and services	Reduction of production costs for mining companies [Mines] Controlling fuel use in industrial fishing [Humboldt]
Resources/ income	Increase in the income of families managing the nurseries [Mines] Reduction of household health expenditure thanks to free ARV treatments [ARV]
Commerce/ distribution	Access of fishing industry to new markets [Humboldt]

Environmental impact

Here we review the definitions proposed in the Asirpa method. The following are considered environmental impacts on the emergence and sustainability of socio-technical systems of production or consumption and on environmental compartments bearing upon national or international public policy issues: biodiversity, change climate change, pollution and destruction of environments, consumption of resources (Table 5).

Table 5
Examples of environmental impact

Domains	Example descriptors The short title of the relevant case study is given in square brackets
Implementation of environmental regulations	Implementation of environmental codes for the North and South provinces of New Caledonia, integrating regulations on mining [Mines]
Improved natural resource management	Natural resource management optimization via the implementation of real-time ecosystem monitoring for fisheries in Peru [Humboldt] Adoption of cultural practices better adapted to environmental conditions and to the preservation/enhancement of local biodiversity [Palms]
Improved environmental monitoring	Establishment of an environmental monitoring observatory in New Caledonia [Mines]

Institutional impact

This dimension of impact encompasses effects on public or private institutions other than higher education and research establishments, as well as on formal or informal social organizations. These impacts may concern the structure, the organization, skills, policy/strategy, or the functioning of these institutions or social organizations (Table 6).

Public policy impact

This can be analyzed by looking at how knowledge and ideas are leveraged and appropriated by different actors in public debate and how they are used in public policies (Table 7). These effects can concern all or part of the life cycle of a public policy (agenda setting, policy formulation/decision-making, policy implementation, evaluation) and manifest themselves at different scales (local, national, international).

Table 6
Examples of Institutional impact

Domains	Example descriptors The short title of the relevant case study is given in square brackets
Creation/development of instruments, tools	Creation of an environmental observatory [Mines]
Development of the strategy or institutional organization	Reinforcing the national volcanic risks prevention and management system [Volcanoes]
Related to capacity development	Construction of a body of domestic expertise in informal sector production and statistical analysis [Informal economy] Reinforcement of national health structures [ARV]

Table 7
Examples of public policy impact

Domains	Example descriptors The short title of the relevant case study is given in square brackets
Introduction/grounding of an issue in public discourse	Consideration of the artisanal fishing sector as a political and economic issue [Humboldt]
Integration of a principle/provision into policy	Introduction of free ARV treatment (Senegal, Côte d'Ivoire, Cameroon) [ARV] Reorientations of public policies with regard to the informal sector [Informal economy] Implementation of provincial environmental codes integrating regulations for mining (polluting processes, soil restoration) [Mines]
Strategic document in support of a public policy	Development/adaptation of climate change and risk strategies, risk prevention plans and crisis management [Humboldt]

Sociocultural, health and educational impact

This very broad dimension of impact may for example encompass effects on quality of life, well-being, behaviors and practices, the social fabric, representations, or public discourse (Table 8).

Appendices show, by dimensions of impact, a description of the impacts identified via Miriades project case studies.

Table 8
Examples of sociocultural, health and educational impact

Domains	Example descriptors The short title of the relevant case study is given in square brackets
Improvements to health and quality of life	Improving the quality of life of people living with HIV (PLHIV) [ARV]
Changing attitudes in a community	Social recognition of a category of actors: informal workers [Informal economy] Reduction of stigmatization and social marginalization of PLHIV [ARV] Appropriation of preventive measures and volcanic risk management by communities [Volcanoes]
Insight into public discourse	Introduction of the issue of informal economy into public discourse [Informal economy]
Reduction of health risks	Improving the protection of mine workers exposed to asbestos dust in New Caledonia [Mines]
Reduction of morbidity and mortality	Reduction of morbidity, mortality and the quantity of new HIV infections in Cameroon, Côte d'Ivoire and Senegal [ARV]
Improving health systems	Improving the quality of care for PLHIV in Cameroon, Côte d'Ivoire and Senegal [ARV]
Related to capacity development	Development of the capacity of Kanak communities to cultivate endemic species for soil restoration [Mines]

Points of concern: The same impact may potentially be included under two different dimensions. For example, the creation of new jobs is likely to have economic effects as well as sociocultural, health or educational effects. Once documented, these effects can be identified simultaneously in the relevant dimensions. The objective is to highlight the different facets of the societal benefits of research.

Practical conduct of a case study

Each Miriades project case study is led by a researcher, who is the scientific rapporteur and responsible for the study, and an advisor. This pair was then accompanied by one or two researchers from the methodological group.

The performance of a study is based on documentary research (articles, reports, regulatory texts, etc.) and the conduct of semi-structured interviews with stakeholders on the impact pathway, within and outside of the organization leading the study (research partners, intermediaries, research users, impact recipients). In the case studies from the pilot phase of the Miriades project, the lead organization for the study is IRD.

The case studies in the Miriades project take place over four stages:

- Stage 1: delimitation of case study scope and collection of data available within the organization;
- Stage 2: collection of data from outside the organization;
- Stage 3: report preparation;
- Stage 4: approval of report by persons interviewed during the study.

This chapter describes the practical development of these four stages as well as the deliverables expected at the end of each of them.

Stage 1: delimitation of case study scope and collection of internal data

The delimitation of the scope of the case as defined in the previous chapter marks the starting point of the study (Table 9).

The scientific rapporteur formulates a hypothesis on the contribution of the organization's work in relation to an observed impact. This will serve as a common thread to delimit and refine the scope of the case and guide the collection of data.

Once the scope has been defined, this first stage is organized in two stages: documenting the study based on the data available on the entire impact path; and conducting interviews with the actors internal to the organization.

Table 9
Stage 1

Stage 1.1 Data collection within the organization	Identification of research units, laboratories and scientists involved within the organization Identification of direct partners, contextual elements and actors Identification of major academic publications on the case, those that have contributed to the generation of impacts Listing available information and data sources First draft of impact pathway diagram and timeline
Stage 1.2 Interviewing contributors from the organization	Establishment of the list of persons to be interviewed Preparation of an interview guide Conducting semi-structured interviews with contributors: scientists from the units involved and, where applicable, representatives of the other structures involved The questions may relate to all the stages and actors of the impact pathway as well as impact recipients

At the end of this first stage, the following are identified:

- the scope of the case and its feasibility;
- the organization's contribution to the research process (structures and teams concerned; the primary research that contributed to the impact hypothesis as formulated, and the start date of the first work done on the subject by the organization; the material and immaterial resources involved; skills and disciplines implemented; infrastructure mobilized; position of the institution's teams on the theme relative to the state of the art, etc.); the scientific

rapporteur identifies the start date of the research work selected within the scope of the case;

- the role of the organization and its teams, on an institutional or individual basis, in the circulation, adaptation or transformation of research results in order to facilitate their appropriation by actors in society;
- the organization's primary partners in the research process, those without whom the research could not have been carried out, as well as the actors in the knowledge circulation stage of the impact pathway;
- the pool of knowledge being leveraged;
- contextual elements;
- research products that contributed to impacts;
- where applicable, an initial identification of the impact recipients;
- a first draft of the impact pathway diagram and impact hypotheses;
- a first draft of the timeline.

The **timeline** limits the time frame of the case. It must be concise in order to ensure that it remains readable. It shows: 1) major contextual events; 2) events in which the organization is involved. Key points in the impact pathway should be included, including the date when research began at the organization, the date of the first product of the research, and the date of the first impact. Depending on the case, this timeline may begin at the time research began, or may begin with previous contextual elements that shed light on the issues it addresses. These chronological reference points must also appear in the text of the report.

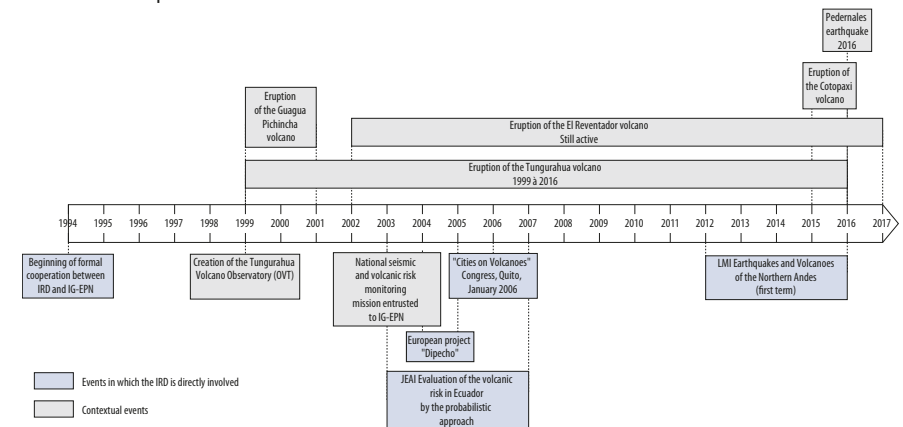


Figure 2
Example of timeline for the case study on volcanic processes and hazards in Ecuador.

As the construction of the impact pathway is an iterative process, the impact pathway diagram and timeline will be supplemented and adjusted as the study unfolds, based on interviews conducted and information gathered.

Stage 2: collection of external data

This second stage is devoted to interviews with: 1) the main actors who contributed to the research process; 2) the intermediary actors involved in the circulation and adaptation of research products stage; 3) the impact recipients. It has three phases. The first is devoted to the preparation of interviews, the second to their realization with the research partners and intermediary actors, and the third to the conduct of the interviews with recipients. It is advisable to follow this sequence in order, because actors from the research phase and intermediaries may make it possible to identify recipients not identified in the first stage (Table 10).

In addition to collecting data, these interviews make it possible to compare the hypotheses of the impact pathway initially formulated with the analysis of the other actors. The objective is to build a shared vision with regard to the roles and contributions of the different actors, the nature and methods of their interactions, and the key elements and moments of this impact pathway.

These interviews also make it possible to confirm the impacts described by recipients. They may also bring to light unexpected impacts.

Cross-referencing of these interviews among the different categories of actors and cross-checking the information help validate the data collected by means of triangulation.

It is advisable that interviews be carried out in pairs to the extent possible, so as to limit bias in the formulation of questions, the collection of answers and their understanding or interpretation.

The number of interviews to be conducted depends on the complexity of the case. Each actor met is at the heart of his story, which may lead him to extend the interview to fields other than those of the study, whose impacts the actor feels are equally significant. The study leads are responsible for ensuring its coherence and consistency with the central theme.

Table 10
Stage 2

<p>Stage 2.1 Preparation of interviews</p>	<p>Establishment of the list of persons to be interviewed Identification of the data to be collected Development of an interview guide to be adjusted to suit the categories of actors and recipients Questions may address all stages of the impact pathway</p>
<p>Stage 2.2 Interviews with research partners and intermediaries</p>	<p>Confirmation or additional insight into their roles (as research partners or intermediaries) or even, where applicable, into persons effected by the research Contribution, positioning in the impact pathway, interactions with other stakeholders in the impact pathway Identification of impact recipients</p>
<p>Stage 2.3 Interviews with recipients</p>	<p>Collection of impact descriptors as formulated by the recipients: nature of the change observed, populations concerned, intensity, scale (local, regional, etc.), difficulties encountered, possible discrepancies in the perception and assessment of these impacts Collection of evidence of impact (bibliography or any other element corroborating the impact)</p>

At the end of this second stage, the following will be identified and described:

- the primary actors who contributed to the research phase, their type (higher education and research, economic sector, representatives of civil society, public authorities, etc.),and their role in and contribution to the research process (discipline/know-how/expertise, financial or human resources, infrastructure, etc.);
- the primary intermediaries, their type (academic, institutional, economic sector, representatives of civil society, etc.), their role in and contribution to the circulation and transformation of the knowledge obtained;
- the dimensions of impact (social, health, economic, etc.) and the recipients (society, public institutions, economic sector, higher education and research, etc.) concerned;
- impacts and descriptors collected from recipients.

Stage 3: report preparation

The study takes the form of a report, prepared according to a standard format consistent with the structure of the impact pathway:

1. Summary
2. Background
3. Actors' contributions
4. Products of research
5. Timeline
6. Circulation of knowledge and intermediaries
7. Initial impacts
8. Widespread impacts
9. Impact pathway diagram
10. Appendices
 - Interviews conducted
 - Documents cited (documents cited in the report, evidence of impacts substantiating the impact reported)

The impact pathway diagram and the timeline form an integral part of the report.

The report must reflect all the contributions of research partners and intermediaries. The contributions of the establishment leading the study should be subject to an analysis more detailed than that to which the other stakeholders are subject, in order to clearly describe its contributions. Furthermore, some specific information, defined upstream of the study, must be systematically collected, in order to facilitate a subsequent cross-sectional analysis of cases.

Stage 4: approval of report by persons interviewed

The report tells the story of a collective experience. The actors who contributed to its writing and provided proof of the existence of the impacts must recognize themselves in this story. The report will therefore be sent to the persons interviewed during the study to collect any factual corrections and comments they may wish to make regarding the text.

The study is then finalized based on this feedback.

Appendices

Organization of the Miriades project

Project management

The Miriades project was led by the Mission for research evaluation and programming.

It was coordinated by a project team within the MEPR, made up of:

Isabelle Henry, director of MEPR (2015-2018)

Éric Martin, director of MEPR (2020-2022)

Sylvie-Anne Mériot, project manager

Ghislaine Thirion, project manager (project coordinator)

Case study advisors

The following project managers from MEPR provided support to the scientific rapporteurs for conducting the studies (methodology, documentation, writing):

Ouidir Benabderrahmane, advisor for the study on a method for the early recognition of date palm sex and invention of a kit for agronomic use

Anne Geslin, advisor for the study on road injuries in West Africa

Perine Sanglier, advisor for the study on heritage recognition of agrobiodiversity in Brazil

Sabine Tostain, advisor for the study on the Humboldt current, from ocean dynamics to Peruvian fisheries management

Methodological group

The Miriades project relied on a methodological group to build the method, select the case studies, perform the role of methodological point of contact for individual follow-up of the studies, contribute to the assessment of the exploratory stage and issue recommendations. This methodological group consisted of eight research directors:

Michel Cot, epidemiologist with the UMR [joint research unit] Mothers and children in tropical environments: pathogens, health systems, and epidemiologic transition (Merit)

Laure Emperaire, ethnobotanist with the UMR Local Heritage, Environment and Globalization (Paloc)

Laurent Laplaze, plant biologist with the UMR Diversity-Adaptation-Development of Plants (Diade)

Isabelle Henry, geneticist, representative of IRD in Senegal

François Roubaud, economist and statistician with the UMR Dauphine economics laboratory (Leda), Development, institutions and globalization (Dial)

Florence Sylvestre, paleoclimatologist with the UMR European Center for Research and Education in Environmental Geosciences (Cerege), point of contact for IRD in Chad

Laurent Vidal, anthropologist with the UMR Economic and Social Sciences, Health Systems and Medical Informatics (Sesstim), representative of IRD in Mali

Jean-Daniel Zucker, AI modeling and bioinformatics specialist with the UMI [international joint research unit] for Mathematical and Computer Modeling of Complex Systems (Ummisco)

Scientific rapporteurs

Scientific rapporteurs, in charge of case studies in the Miriades project:

Frédérique Aberlenc – study on a method for the early recognition of date palm sex and invention of a kit for agronomic use, UMR Diade

Arnaud Bertrand – study on the Humboldt current, from ocean dynamics to Peruvian fisheries management, UMR Biodiversité marine, exploitation et conservation (Marbec)

Emmanuel Bonnet – study on road injuries in West Africa, UMR Pôle de recherche pour l'organisation et la diffusion de l'information géographique (Prodig)

Fabrice Colin – Study on mining activity in New Caledonia, Societal and environmental impacts, UMR Cerege

Laure Emperaire – Study on heritage recognition for agrobiodiversity in Brazil, UMR Paloc

Christian Laurent – Study on access to antiretroviral treatment in Africa (Cameroon, Côte d'Ivoire, Senegal), UMR Recherches translationnelles sur le VIH et les maladies infectieuses endémiques et émergentes (TransVIHMI)

Mireille Razafindrakoto – Study on a statistical innovation: 1-2-3 surveys. Method for measuring and analyzing the informal economy (Madagascar, Peru, Vietnam), UMR Leda (Dial)

Pablo Samaniego – Study on volcanic processes and hazards in Ecuador, UMR Laboratoire magmas et volcans (LMV)

Contributions to the research process – actors and roles

The table below identifies the categories of actors who contributed to the research process in the case studies of Miriades project. It describes the roles they played in this first phase of the impact pathway. This list of descriptors is for illustrative purposes only. It is a tool to assist in an analysis of the impact pathway, and is not intended to be exhaustive.

Categories of actors	Examples of roles of actors involved in the research process
Higher education and research	<ul style="list-style-type: none"> Jointly building research projects with local actors (interacting, building together) Contributing to the knowledge pool (data, publications, methods, etc.) Bringing together and leading scientific networks and communities Funding research Providing training in and through research (researchers, technicians, engineers, etc.) Providing infrastructure for research Providing skills, expertise, know-how Conducting research
Non-academic public institutions	<ul style="list-style-type: none"> Coordinating a national initiative Jointly building research projects Funding research (projects, grants, etc.) Making data available for research Providing specialized infrastructure (Health structures, observatories, etc.) Providing skills, expertise, know-how Contributing to the orientation and programming of research
National, regional or international organizations and agencies	<ul style="list-style-type: none"> Commissioning the evaluation of pilot programs (in public health, for example) Contributing to the orientation of research objectives Contributing to bringing together and leading networks and scientific communities (conferences, seminars, etc.) Funding research (projects, grants, etc.) Financing training courses Launching and rolling out national or international initiatives or projects
Public authorities	<ul style="list-style-type: none"> Funding research and higher education Acting as a sponsor for the evaluation of public policy pilot programs Mobilizing donors for research funding Applying for international initiatives (from the political sphere) Making personnel available for research

Categories of actors	Examples of roles of actors involved in the research process
Multi-actor networks	Developing, structuring or directing research in a given field
Economic sector	<ul style="list-style-type: none"> Funding research (thesis grants, research contracts or expert investigations, etc.) Funding conferences, training Providing infrastructure for research Making data available for research
Civil society	<ul style="list-style-type: none"> Jointly build projects with research actors (project development, human resources, funding) Supporting the implementation of pilot trials (supporting patients, interfacing between patients and healthcare and scientific staff) Contributing to the maintenance of observatory equipment Contributing to observation and data collection activities

Circulation of knowledge and intermediaries – actors and roles

The table below identifies the categories of actors who contributed to the circulation of the products of research from the academic sphere to society in the case studies of the Miriades project. For each of these categories, it describes the types of roles played by these actors in the dissemination or adaptation of research products. This list is for illustrative purposes only. It is a tool to assist in an analysis of the impact pathway, and is not intended to be exhaustive.

Categories of actors	Examples of roles of intermediary actors
Higher education and research	<ul style="list-style-type: none"> Performing scientific mediation Participating in public bodies/committees as an expert, carrying out expert investigations Making reliable data available to the public Designing, organizing or providing training for professionals, leading to a degree or otherwise Designing and organizing a core training course leading to a degree Supporting students at the end of their training (access to employment) Contributing to the development of a regulatory text Contributing to the development of an action plan, of a national sectoral program Contributing to the development of national and international norms and standards Providing public service missions (observation, surveillance, provision of data, etc.) Contributing to crisis prevention and management (awareness, information, training of the public concerned, implementation of systems and procedures, etc.) Contributing to the implementation or financing of innovative systems Prospecting companies, negotiating patent licensing agreements Studying the feasibility of major public instrument projects Seeking funding for development actions Acting in an intermediary role between start-ups and professionals in a given sector Contributing to the development of national or international recommendations (guides and methods) Building and disseminating advocacy on public policy issues Contributing to the construction of influence strategies to guide public policy Designing and implementing strategies to communicate and disseminate research results Raising awareness of the ecosystem approach (political, economic, social actors) Promoting South-South exchanges and collaborations

Categories of actors	Examples of roles of intermediary actors
Non-academic public institutions	<ul style="list-style-type: none"> Serving as an interface between research, public authorities and economic actors (connection, dialogue) Designing and implementing strategies to communicate and disseminate research results Building and disseminating advocacy on public policy issues Contributing to the construction of influence strategies to guide public policies Deploying a nationwide pilot program (in health, for example) Ensuring the operational implementation of risk prevention and management systems and measures Institutionalizing and sustaining a method or instrument within a national system Contributing to the development of national or international recommendations (guides and methods) Leveraging knowledge and data to respond to requests (public authorities, national/regional/international organizations, etc.) Making reliable data available Designing, organizing or providing training, with or without a diploma, for professionals
National, regional or international organizations and agencies	<ul style="list-style-type: none"> Financing development actions Funding risk prevention and mitigation programs Organizing, promoting exchanges and interactions between member countries of an organization on common issues Developing national or international guides/standards (commission, funding, coordination) Managing or financing regional or international operational programs
Public authorities	<ul style="list-style-type: none"> Building and disseminating advocacy on public policy issues nationally or internationally Adapting, developing a public policy, integrating a principle, a concept, an innovation Developing and implementing regulations or a legislative framework or monitoring their application Monitoring the concerns of socioeconomic actors with a view to the development of regulations Developing and financing multi-year national programs Organizing and coordinating risk prevention and management systems Promoting a policy of raising awareness among socioeconomic actors on national issues Participating in the creation or management of public/private institutions

Categories of actors	Examples of roles of intermediary actors
Multi-actor networks	<ul style="list-style-type: none"> Leading or coordinating discussions/expert investigations Developing a new scientific field Promoting consultations between public authorities, public institutions and scientific institutions Contributing to the development of international concepts, norms and standards Promoting new methods and tools
Economic sector	<ul style="list-style-type: none"> Adapting or implementing research products (recommendations, opinions, guides, standards, procedures, tools, methods or models) Ensuring scientific monitoring in regard to the acculturation of actors in the sector to new knowledge Setting up a scientific body within a professional organization Participating in consultations with public authorities for the development/implementation of regulations Participating in the creation or management of public/private research programming and funding institutions Transferring research results to serve the provision of innovative services (via start-ups originating from laboratories) Ordering scientific expert investigations
Civil society	<ul style="list-style-type: none"> Leveraging research results to inform actions with regard to public authorities, socioeconomic actors and populations Building influence strategies to guide public policy Conducting awareness-raising actions with socioeconomic actors, public authorities and populations on societal issues Training socioeconomic actors in sustainable practices Designing, financing or supporting development programs Serving as a mediator between a given target population category and other actors to promote new practices

Dimensions of impact and descriptors

The table below recapitulates, by dimensions of impact, the generic impact descriptors identified via Miriades project case studies. This list is for illustrative purposes, for use as a tool to help describe impacts. It is not intended to be exhaustive.

Descriptors followed by an asterisk (*) refer to an impact associated with capacity development in the dimension of impact concerned.

Dimensions of Impact	Example impact descriptors
Dimensions of Impact	<ul style="list-style-type: none"> Creation/structuring/reinforcement of research and training centers/networks, and of technical resources for research (*) Increased ability to mobilize financing Development/diversification of scientific skills and expertise (*) Development of a culture of scientific publication Broadening of career paths, better visibility of trained agents (*) Increased notoriety, legitimacy, regional or international scientific influence Introducing/grounding/structuring new approaches and scientific themes Reinforcement of organizations (process, governance, operation, strategy, etc.) (*) Structuring/development/reinforcement of a scientific community in a given field of research (*)
Economic	<ul style="list-style-type: none"> Adapting production techniques and processes to suit eco-responsible practices Improving the profitability of an activity (improving production processes, reducing costs, etc.) Improving national instruments for measuring, analyzing and monitoring the economy Increasing/maintaining household income Access to new markets Change, evolution of perception of public opinion, or of policies in relation to an economic issue Creation of companies (start-ups, SMEs, services, etc.) Job creation/preservation Development of a resource management forecasting tool Sector development Diversification of the economic fabric Introduction of new professions Integration of a principle or a provision into a public economic policy (broad guidelines, law, regulation, action plan or program, etc.) Preservation of human capital Capacity development in regard to knowledge transfer (*)

Dimensions of Impact	Example impact descriptors
Environmental	<p>Improvement of environmental monitoring (implementation of monitoring, alert, or observation tools)</p> <p>Improvement of the management of natural resources (adaptation of resource exploitation techniques, resilience of degraded environments, adaptation of production techniques and processes to suit eco-responsible practices, etc.)</p> <p>Biodiversity conservation</p> <p>Development and optimization of the ecosystem approach</p> <p>Implementation of environmental regulations</p> <p>Preservation of agrobiodiversity</p> <p>Training of populations in the use of environmental impact monitoring indicators (*)</p>
Institutional	<p>Improvement/reinforcement of skillsets (*)</p> <p>Improvement/reinforcement of organizations (process, operation, governance, strategy, etc.)(*)</p> <p>Improvement/reinforcement of instruments</p> <p>Improving the renown, the credibility or the legitimacy of an institution (*)</p> <p>Broadening of career paths, better visibility of trained agents (*)</p> <p>Implementation/improvement of crisis prevention and management plans and systems (climate events, natural hazard, etc.)</p> <p>Building trust between an institution and its users</p> <p>Capacity development in regard to knowledge transfer (*)</p>
Public policy	<p>Change, evolution of perception of public opinion, or of policies in relation to an economic issue</p> <p>Introduction and grounding of a public issue in the public discourse</p> <p>Financing of a public policy</p> <p>Integration/recognition of new actors in the formulation of a policy and its decision-making process</p> <p>Integration of a principle or a provision into a public policy (broad guidelines, law, regulation, action plan or program, etc.)</p>

Dimensions of Impact	Example impact descriptors
Sociocultural, health and educational	<p>Acculturation of a category of actors to scientific research, its approaches and its results</p> <p>Adaptation of lifestyles to reflect risks (health, natural, etc.) (*)</p> <p>Improvements to health and quality of life</p> <p>Improving patient care and management (*)</p> <p>Changing attitudes in a community</p> <p>Developing a risk culture (health, natural disaster, etc.) (*)</p> <p>Introduction/development of new professions</p> <p>Introduction and grounding of an issue in the public discourse</p> <p>Training populations in sustainable practices, appropriation of these practices (*)</p> <p>Recognition/social integration of a category of actors</p> <p>Reduction of health risks</p> <p>Reduction of morbidity and mortality</p> <p>Reinforcement of the science-society dialogue</p> <p>Capacity development in regard to knowledge transfer (*)</p>

Glossary

Actors' Contribution (input): Investments of all kinds made by all the actors involved in collective research processes. The approach takes into account all the skills, infrastructures, partnerships, reputations and institutional arrangements leveraged for the production of scientific and technical knowledge. To the classic course of analysis are added investments and partnerships built over time, as well as the position of research in relation to the global pool of knowledge, the forms of organization and the interactions between the different actors involved: "the productive situation".

Capacity development: The UNDP defines capacity development as the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time.

Dimension of Impact: Major areas of impact. In the Miriades method, six dimensions were selected: academic; economic; environmental; institutional; public policy; sociocultural, health and educational. Added to these six dimensions is a dimension that cuts across them all: capacity development.

Impact: Research impacts can be defined as the direct and indirect effects of the various components of research activity (production of knowledge, skill, expertise, know-how, infrastructure) on the economy, environment, health, etc. Research impacts are generated by long-term processes and may be distributed over a very broad area, and may include unexpected areas. Hence the importance of the notion of "impact generation mechanisms".

Impact pathway: Adapted from the Consultative Group on International Agricultural Research (CGIAR), the impact pathway is a graphical representation of the stages of impact generation that describes the research work, the movement of the corresponding knowledge out of the academic sphere, and its transformation and use by socioeconomic actors.

Initial impacts (impact 1): Observed impacts on the direct users of research products. They manifest themselves in the dimensions of impact considered.

Intermediaries: Actors and systems playing a role in transformation, dissemination, adaptation of regulations, or coordination of actors... this may consist of technical systems, professional organizations, consulting, training or mediation organizations, licensing or contracting systems, human resources, technical centers, incubators, administrations, media, etc.

Research products (outputs): These may be academic, technical (incorporated in technical or methodological objects), or organizational.

Widespread impacts (impact 2): Impacts related to a widespread adoption of the innovation over a large part of the target space or by a large part of the target population, beyond the sphere of the initial users (initial impacts). The distinction between the two levels of impact is based on a change in scale.

Sources: COLINET et al., 2014 ; UNDP, 2008.

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Text boxes, figures and tables

Text Boxes

Text Box 1	Definition of impact and impact pathway	12
Text Box 2	Examples of case study scope: <i>Miriades</i> project	22
Text Box 3	Example of widespread impact: case study on access to ARVs in Africa	28

Figures

Figure 1	Impact pathway diagram	20
Figure 2	Example timeline for the case study on volcanic processes and hazards in Ecuador	35

Tables

Table 1	List of cases selected for the <i>Miriades</i> project	17
Table 2	A few examples of the products of research: <i>Miriades case studies</i>	25
Table 3	Examples of academic impact	29
Table 4	Examples of economic impact	29
Table 5	Examples of environmental impact	30
Table 6	Examples of institutional impact	31
Table 7	Examples of public policy impact	31
Table 8	Examples of sociocultural, health and educational impact	32
Table 9	Stage 1	34
Table 10	Stage 2	37

Abbreviations and acronyms

ARV: Antiretroviral

Asirpa: Public agronomic research impact analysis

Cirad: Centre for International Cooperation in Agronomic Research for Development

Cerege: European Centre for Research and Teaching in Environmental Geosciences

CGIAR: Consultative Group on International Agricultural Research

Diade: Diversity-Adaptation-Development of Plants

HIV: Human Immunodeficiency Virus. The virus that causes AIDS.

Impress: Impact of Research in the South

Inrae: Institut national de recherche pour l'agriculture, l'alimentation et l'environnement

IRD: French National Research Institute for Sustainable Development

Leda: Dauphine economics laboratory, Development, institutions and globalization - Dial

LMV: Laboratoire magmas et volcans

MEPR: Mission for Research Evaluation and Programming

Merit: Mothers and children in tropical environments: pathogens, health systems, and epidemiologic transition

Miriades: Multidimensional impact assessment of research and resulting innovation on development in the global South

NGO: Non-governmental organization

Paloc: Local Heritage, Environment and Globalization

UNDP: United Nations Development Program

Prodig: Pôle de recherche pour l'organisation et la diffusion de l'information géographique

PLHIV: Person Living With HIV

Sesstim: Economic and Social Sciences, Health Systems and Medical Informatics

UMI: International Joint Research Unit

Ummisco: Mathematical Modeling and Complex Systems Informatics Unit

UMR: Joint Research Unit



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