Finnish Research Programme on Climate Change (FICCA) 2011-2014

Evaluation Report

ACADEMY OF FINLAND

Contents

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Preface

Climate change is a global, regional and local issue. The scientific understanding for action on climate change is crafted by natural and social sciences, humanities and technical sciences research. The relevant knowledge concerns both the climate system and its ongoing change as well as the challenges and possibilities related to mitigation and adaptation. There is also a range of synergies, as well as some possible goal conflicts, across the overall sustainable development agenda. Concerted efforts from research, both disciplinary and interdisciplinary, are needed for managing both the challenges and the possibilities with climate action. Mitigation and adaptation efforts require co-consideration, considering climate in development cooperation, in sub-national, transboundary and wider international contexts. Efficiently dealing with the interlinkages across many spatial scales requires co-learning by science, policy and practice. The urgency calls for effective dissemination of new research.

The four-year Finnish Research Programme on Climate Change (FICCA 2011–2014) was set up along these lines. Both during and after its active years, the FICCA programme developed and delivered new knowledge on topics related to climate change, which can support climate action both in Finland and provide contributions also to the global arena.

In spring 2021, the Academy of Finland invited an international panel of experts to evaluate how the programme had succeeded in attaining its objectives. In this report the panel presents the results of the evaluation of the FICCA programme, with an eye on its scientific outcomes, and impact as well as the collaboration within the projects and across disciplines, networking and capacity-building.

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1. Finnish Research Programme on Climate Change (FICCA)

1.1. Background

Climate change is under intensive research, since it is a known cause to a range of direct and indirect environmental effects and social developments. These may, in turn, be reflected back on climate change. The Finnish Research Programme on Climate Change (FICCA) launched in 2010 was a four-year funding programme to respond to the scientific challenges posed by climate change on a broad front. One of the principles underlying the FICCA programme was to support the type of multidisciplinary research that addresses the social and environmental spheres side by side – the objective being a systemic approach to research problems. Adapting to the effects of climate change is a technological, economic, cultural and infrastructure-related issue. Mitigation of climate change, in turn, is based on efforts to slow down global warming through the reduction of emissions from human activities. Multidisciplinary and interdisciplinary research based on a range of scientific traditions is needed in order to combine research in individual disciplines and promote a systemic understanding of climate change.

1.2. Objectives and framework of FICCA

The framework and thematic areas of the FICCA programme were selected with a view to covering a wide range of interactive processes between the environment and society in the context of climate change. Because of the extensive scope of the theme, all projects were required to adopt a multidisciplinary approach.

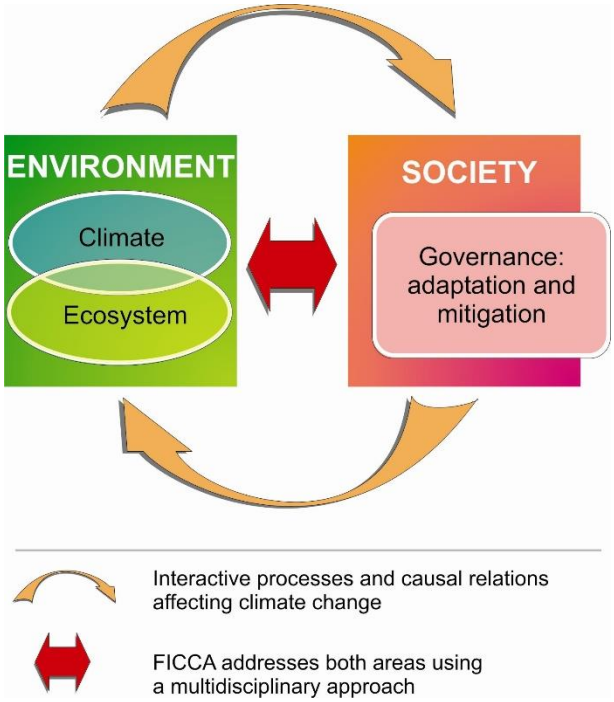

Figure 1. Framework for FICCA. The programme focuses on research that creates new knowledge concerning the interactive processes between the environment and society related to climate change. The multidisciplinary research projects address both society and the environment

In addition to producing high-level scientific results, the programme was expected to intensify the dialogue between scientific and social research and, in particular, promote the use of natural sciences as part of social research. Another objective was to increase interaction between researchers and knowledge users. The goal was to make use of new knowledge as quickly as possible. Additionally, the programme would support PhD training in the field and subsequent career development as well as promote international networking between researchers and multidisciplinary cooperation in Finland.

The FICCA programme had four cross-cutting themes:

- Environmental changes due to climate change
- Social implications and consequences of climate change
- Adaptation by society and the environment to climate change and its effects
- Social and technological concepts for mitigating climate change.

Research projects to be funded were required to attempt to respond to the scientific and social challenges and to be multidisciplinary or interdisciplinary.

1.3. Preparation and organisation

In autumn 2008, all research councils of the Academy of Finland submitted a proposal to the Academy Board for the preparation of a research programme on climate change. The theme had been discussed within the Academy earlier, and several programme initiatives had been received on the subject from outside the Academy in 2007 and 2008. In September 2008, the Board decided to grant authorisation to start the preparation of a research programme on the theme "Climate Change: Governance, Mitigation and Adaptation".

A preparatory working group was appointed in March 2009. It had members from all four Academy research councils: the Research Council for Biosciences and Environment; the Research Council for Natural Sciences and Engineering; the Research Council for Culture and Society; and the Research Council for Health. In the course of the preparations, the working group heard outside experts both directly at its meetings and by inviting comments on the programme text.

The group convened seven times, and an exploratory workshop was organised in June 2009 to support the preparation of the programme. A total of 130 members of the scientific community participated in the workshop to comment on the preparations and develop the themes. After the workshop, they had the opportunity to submit additional comments via the Academy website.

In November 2009, the Board of the Academy decided to launch the Finnish Research Programme on Climate Change (FICCA) and to allocate EUR 12 million to the four-year programme. The Board also considered allocating an additional EUR 4 million to a second call, primarily with a view to engaging in cooperation with foreign funding bodies.

1.4. Selection of projects

In January 2010, the FICCA steering group was appointed; it comprised members of the research councils and expert members (Appendix 1). The duties of the steering group were:

- to submit a proposal to the programme subcommittee on the projects to be funded
- to steer and monitor the programme
- to plan and organise the final evaluation
- to supervise and support programme coordination.

For the funding decisions, a subgroup comprised of research council members only was appointed.

The FICCA call for applications, following a two-stage procedure, was carried out in 2010. The deadline for letters of intent was 29 January and the deadline for full proposals was 16 April. The review criteria for applications at the letter of intent stage were how well the project tied in with the topic of programme, how the

programme objectives were to be realised and the project proposal's novelty and applicability. Sixty-four letters of intent were received, out of which 31 were invited to submit a full proposal. An international review panel convened in June 2010. Based on the scientific review by the panel and considering the objectives of the programme, the steering group ranked the applications and made recommendations for funding. In its meeting in August 2010, the subgroup decided on funding for eleven research consortia for 2011–2014 (Appendix 2).

1.5. Funding cooperation

FICCA's aim was to seek collaboration with international and national funding bodies. In April–May 2011, the FICCA programme organised three bilateral calls with two funding bodies from China and one from Russia: the Chinese Academy of Sciences (CAS), the Chinese Academy of Social Sciences (CASS), and the Russian Foundation for Humanities (RFH). The aim of the joint calls was to support long-term systematic research collaboration and to establish and strengthen research networks between the countries in the area of climate change research.

The three international joint calls with CAS, CASS, RFH to support research collaboration each also had specific research topics:

- CAS: Atmospheric composition and adaptation of the ecosystem to climate change
- CASS: Societal implications and consequences of climate change
- RFH: Societal implications and consequences of climate change, including climate policy

In the case of the CAS and RFH calls, both call parties used their own procedures for the review of applications. After the separate peer reviews, a joint meeting with the Academy of Finland was organised to discuss the final peer review ranking for the joint call. With CASS, the Academy organised a joint review. The applications were reviewed by foreign scientific experts agreed by both parties (neither Finnish nor Chinese). The parties made their funding decisions independently and according to their own procedures, but based on the scientific review and the consensus reached through discussions between the parties. Six three-year collaboration projects were funded for 2012–2014 (CASS, three projects; CAS, one project; RFH, two projects) (Appendix 2).

In 2012, the Academy of Finland and the Ministry for Foreign Affairs of Finland opened a joint call for development research in the field of climate change. The research projects funded in the joint call needed to strive for active collaboration with researchers and research institutes in developing countries.

Twenty-eight proposals were received. Based on the scientific review by the panel, the FICCA steering group, with additional members from the Ministry, ranked the applications and made recommendations for funding. Seven two-year projects were funded for 2013–2014 (Appendix 2).

All collaboration projects (CAS, CASS, RFH, Development) were fully integrated into the FICCA programme.

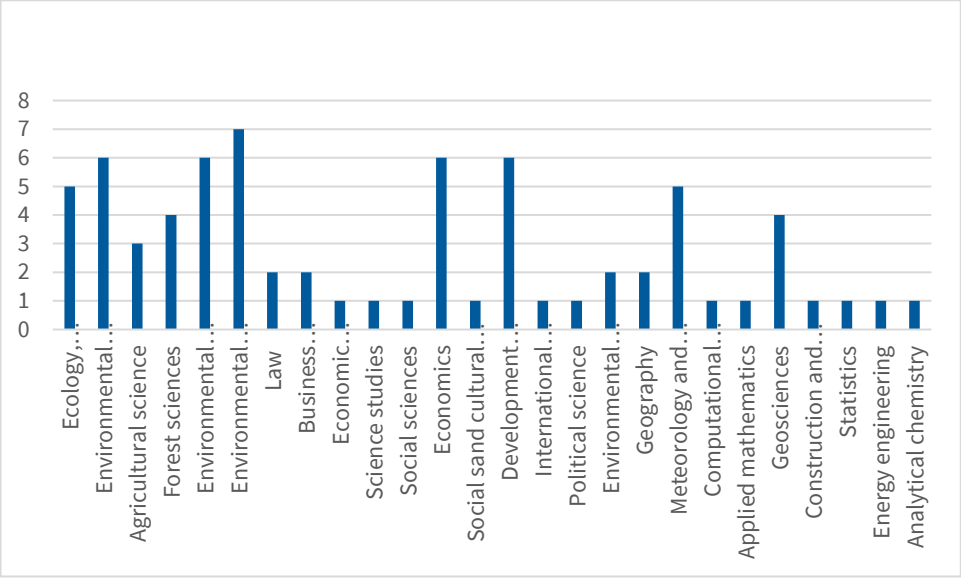

Figure 2. Research fields. Self-reported research fields of all 24 funded projects

1.6. FICCA Final evaluation

The implementation and results of the FICCA research programme were evaluated in May-June 2021 by an international panel of experts. The panel was chaired by Professor Markku Rummukainen (Lund University, Sweden). Other members of the panel were Doctor Elena Paoletti (National Research Council, Italy) and Professor Jouni Paavola (University of Leeds, UK).

The objective of the evaluation was to assess to what degree the FICCA programme succeeded in fulfilling the objectives originally set for it in the Programme Memorandum, including also the aims of the joint calls as part of FICCA. The main focus was on the performance of the programme as a whole as well as on the added value it generated. Of special interest were scientific performance, impact, interdisciplinarity, applicability of research and networking. Guiding questions for evaluation included, but were not restricted to:

- Scientific performance and quality: quality of outputs / new knowledge on climate change / contribution to enhancing interdisciplinarity and multidisciplinarity in climate research
- Impact: applicability of research and importance to users / enhancement of dialogue between scientific and social research / enhancement of interaction between research and stakeholders/end-users/ contribution to expert training
- Collaboration and networking: within FICCA programme / new national and international research networks

The material provided for evaluation included FICCA final reports of funded projects; researcher's self-evaluations in 2014 and in 2019 (including update of publications); compilations and summaries. The assignement for the panel can be seen in Appendix 3.

Programme Manager Tuula Aarnio from the Academy of Finland drafted the technical part of this report (Chapter 1).

2. Overall Evaluation

2.1. How the evaluation of FICCA programme was conducted

The scientific panel (below called the Panel) had specific competence in climate modelling, scenarios and impacts (Professor Markku Rummukainen), air pollution and climate impacts on the ecophysiology of terrestrial plant ecosystems (Doctor Elena Paoletti), and economics, governance, adaptation, biodiversity and ecosystem provision (Professor Jouni Paavola), and collectively a broad and far-reaching experience and understanding also on researcher education, scientific assessments, as well as outreach and impact. The evaluation was carried out remotely with electronic means of communication. A start-up meeting was held on 8 April 2021. The main Panel meeting took place on 12 May. The Panel also met on 24 May and 15 June. The Panel's evaluation report was finalised and submitted to the Academy of Finland on 19 June. The Academy provided logistics support such as hosting the virtual meetings and providing additional information as requested by the Panel.

The evaluation was based on the material provided by the Academy of Finland. The Panel was also provided access to the FICCA call texts, original project proposals and additional information on FICCA activities. The Panel furthermore web-searched for some additional key information on publications and researcher careers, to the extent feasible, as such information was not contained in the materials.

The Panel noted that information had not been collected from stakeholders (for example with questionnaires) and that the publication data were not amenable to bibliometric or other quantitative analysis to explore, for example, author and institute connections. The availability of DOI identifiers would have helped the analysis of publishing in scientific journals, for example in terms of citations, author connections, etc. A use of a specific identifier in publication acknowledgements could also have allowed better use of publication databases.

2.2. Introduction

The Panel considered the following aspects in the evaluation of the FICCA research programme:

- scientific performance and quality

- impact
- collaboration and networking
- added value.

The assessment of each of these is outlined below. The concluding section offers an overall evaluation of the FICCA programme.

2.3. Scientific performance and quality

Overall, FICCA involved 24 projects during the programme period 2011–2014 (Appendix 2). The projects that started at the beginning of the programme lasted four years. Six projects were international collaborations funded bilaterally with China and Russia. These projects ran for three years each. The seven development research projects lasted for two years.

2.3.1. Contribution to enhancing interdisciplinarity and multidisciplinarity in research and enhancement of dialogue between scientific and social research

The research questions addressed in FICCA required perspectives from different disciplines. This was expected in the FICCA call, which stated that "in terms of approach and methodology, research projects must be clearly multidisciplinary or interdisciplinary". The research in FICCA involved many disciplines, and many projects were clearly multidisciplinary. Research areas included geosciences, environment, environmental policy, economics, law, ecology, evolution, environmental technology, ecotoxicology, geography, physics, education, sociology, social psychology, anthropology, ethnology, folklore, comparative religion, forest sciences, construction and engineering (Figure 2). Some projects combined different disciplines (specific fields from natural and social sciences), others hosted different closely-related fields within some specific discipline (such as different flavours of natural sciences). FICCA thus provided a fertile ground for interdisciplinarity and enhanced dialogue across disciplines. However, the documentation does not allow to determine to what extent real integration of concepts, methodologies or data across disciplines actually occurred.

The evaluation materials did not provide sufficient evidence of interdisciplinarity. The lack of a baseline (i.e, the situation before FICCA) also means that any evaluation of enhancement of interdisciplinarity, multidisciplinarity and dialogue between natural sciences and social sciences research is not possible. However, the Panel scanned the FICCA publications for entries in around 30 journals with significant interdisciplinary orientation, based on Clarivate's environmental science journal rankings. These journals had around 30 FICCA publications in them in all, which equals less than 10% of all scientific journal articles from FICCA. The results seemed to indicate that social and engineering sciences flavoured projects published more frequently in journals with an interdisciplinary orientation than natural sciences projects. However, the true number of truly interdisciplinary articles of those examined is smaller than the number quoted

above, as the entries included both single-author papers and papers authored by a PhD student and supervisor, without inter-organisational or interdisciplinary collaborations.

2.3.2. Quality of outputs, publications

The 24 FICCA projects produced more than 600 outputs, of which more than 400 or about 75% were international peer-reviewed journal articles (the other 25% included PhD theses, book chapters/conference papers, and other works). The longest FICCA projects all produced more than ten journal articles – many produced around 20–30 and one outlier project well over 100 articles. This is a substantial output even considering the resources committed to the FICCA programme. Of all outputs, around 150 were published after the end of the programme.

The Declaration on Research Assessment (DORA) advises not to use journal impact factor type of metrics as a proxy for the quality of research. Yet the broader reputation and esteem of journals does influence the academic impact of research published in them. In this regard, the FICCA projects have successfully published their research in key and distinguished publications of many fields, including Nature Communication, Philosophical Transactions of the Royal Society, Global Environmental Change and Atmospheric Chemistry and Physics. The Panel notes, however, that the publication types differ between disciplines, some being more active in publishing books and book chapters than others, and that top journals that cater for smaller research communities may not necessarily exhibit high impact factors.

About two-thirds of the scientific articles reported in projects' final reports (2015/2016) were open access, which is very positive and makes the results of FICCA more accessible to stakeholders and the research community. The publication and researcher education record of FICCA shows the successful science outcome of the whole programme. Some additional characterisation is provided below, with a closer look at a few selected scientific highlights.

2.4. Selected scientific highlights

2.4.1. Towards cleaner air in Finland

Air pollution and climate change are interlinked, because many air pollutants are also climate forcers. Air pollutants and greenhouse gases are in some cases generated by the same processes, they coexist in the atmosphere and have an impact on ecosystems. The project STARSHIP gathered a unique collection of data related to combustion emissions in Finland including emission factors for particulate matter and its components such as black carbon, organic carbon, polyaromatic hydrocarbons (PAH) and metals, as well as particle size distributions and particle morphology. This database can serve as a basis for further emission legislation, air quality monitoring and optimal energy solutions

that maximise the quality of air and citizens' health while also curbing climate change.

2.4.2. Exploring alternative methods to meet the temperature targets

Limiting the global mean temperature increase below 1.5–2°C is a target set by the Paris Agreement. Traditional analyses on optimal mitigation strategies focus on reducing carbon dioxide emissions. The project RICCS explored the potential of carbon capture and storage (CCS) technologies in Finland, and concluded that the costs were high and public trust low. One of the novelties was that the project also looked into uncertainties related to mineralisation. Large radiative forcing is also caused by particulate matter and black carbon, which furthermore have negative impacts on human health. The STARSHIP project explored the trade-off between health and climate impacts of bioenergy in household heating and concluded that advanced technologies would be required to reduce the air-pollutant emissions. The "Black and Brown Carbon Influence on Climate and Climate Change in India – from Local to Regional Scale" development project confirmed the downside of small-scale energy production by wood burning, in the form of emission of unhealthy PAH/metal-coated particles. The COOL project simulated climate mitigation of several geoengineering methods, including stratospheric sulphur injections, marine cloud whitening, artificial methane removal though addition of catalytic chemicals into the atmosphere, ozone-friendly organic aerosols, and solar radiation management. The research looked also into governance aspects. This knowledge is needed for the possible development of a political agenda concerning climate geoengineering.

2.4.3. Changing the paradigm of forest management in Finland

The forest sector is important to the Finnish economy. Even-aged monoculture stands of Scots pine, Norway spruce and Silver birch dominate Finnish silviculture. The ECONADA project combined economic and ecological analyses for predicting the long-term impacts of old and new forest management approaches under climate change scenarios. A major result is the potential of uneven-aged management for forest adaptation to climate change. Uneven-aged models for Norway spruce, Scots pine and Silver birch single-species and mixed-species forests were developed, which at the time was new for the Nordic countries and also had a direct impact on the Finnish forest legislation change in 2014.

2.4.4. Protecting Finnish animal biodiversity under climate change

Disentangling the complex interlinkages between species diversity and climate change is essential for biodiversity protection. The A-LA-CARTE project assessed limits of adaptation to climate change and opportunities for resilience, finding for example that the Finnish protected areas alleviate climate change impacts on northern bird species of conservation concern and that grassland management would promote butterfly conservation. The project found that major efforts are needed to expand the protected area network in the southern and central boreal zones and to improve the capacity of the Finnish legal system to support

biodiversity adaptation measures such as assisted migration, species translocation, dispersal corridors or ecosystem restoration.

2.4.5. Arctic research for Finland

The Arctic is warming at twice the global average rate. The project CLICHE examined the impacts of climate change on Arctic ecosystems, vegetation, biodiversity, tree-line, water resources, peatlands, snow and ice, as well as consequence on reindeer herding, fisheries, forestry, tourism industry and local communities. The project estimated that up to 35% of the present subarctic plants of Finnish Lapland could disappear if the atmospheric concentration of carbon dioxide doubled, and that a warming of 1.5–2°C would cause the loss of permafrost and an invasion of new fish species. Multiple opposing feedbacks between land surface and atmosphere are expected because of changes in albedo, heat fluxes and biogeochemical cycles. Information on species extinction risks, peatlands as carbon sinks, invasive species and climate impacts on traditional and local livelihoods is critical for local adaptation planning.

2.4.6. How local populations and communities in developing countries are involved in mitigation and adaptation

Participation of local populations and communities, how they are affected and mobilising their knowledge are important topics, but they have not been central in climate change mitigation and adaptation action. The “Private Agricultural Investments and Land-Use-Change Impacts on the Adaptive Capacity of Local Communities to Climate Change in Mozambique” project characterised the geographical distribution of investments in the country, finding both negative and positive impacts on local communities. The “Towards Responsive Governance in Climate Change Adaptation and Mitigation? Comparative Case Study in Tanzania and Nepal” project investigated the roles of local communities and external actors, finding that external actors such as national governments and donor organisations significantly influence the design of locally implemented climate adaptation and mitigation initiatives. The “Redefining Energy and Climate Policies in Least Developed Countries: Analysing Institutions and Initiatives in the Mekong Region” project found that local governance has less influence than donors and external actors and concluded that integrative policy narratives such as climate compatible development may create more problems than they solve.

2.5. Impact

2.5.1. Outreach methods and audiences, enhancement of interaction between research and stakeholders/end-users

FICCA conducted both overarching and specific activities in order to communicate the research to stakeholders at introductory, midway and final events, focused briefings to specific audiences, and in some cases by engaging stakeholders in research. The overarching programme-level meetings at the

start, during and at the end of the programme periods likely benefited both the research and the uptake of results. The number of these events is in good proportion in relation to the relatively short programme period.

Several projects involved stakeholders in research (for example A-LA-CARTE, RICCS, LAICA, ClimWater, MARISPLAN). FICCA also joined forces with the NordForsk Top Level Research initiative (TFI) in the organisation of a Nordic Climate Change Adaptation Conference in 2012, which provided an arena for disseminating and discussing research within FICCA. FICCA also organised two foresight workshops, leveraging the programme for sounding future needs and activities, which has since contributed to new research initiatives.

Some projects placed the problem within the European context (e.g. RICSS) or were a part of larger global studies (e.g. FLUX), while the majority focused on Finland. The results thus served the Finnish society's needs well. However, often the combination of global and local perspectives was not obvious. In the international development projects, the main focus was on the effects of climate change on economies and ecosystem services in other countries. Direct links to the Finnish society were limited to the role of Finland as a donor country. Such a role, however, is strategic as it may positively affect both local democracy and economic development, thus improving the approach to climate change drivers that are global by nature.

2.5.2. Contribution to expert training, researcher training and the advancement of research careers

Substantial capacity building was achieved by FICCA projects through doctoral training and training of early-career researchers. FICCA provided a platform for researcher training totalling 25 PhD theses and seven MSc theses during the programme period, after which an additional seven PhD theses based on FICCA have been reported.

According to the results of the 2019 questionnaire, most of the personnel involved in FICCA were, five years after the end of the programme, employed in academia. Others were employed in public administration and consultancies, and a few in industry. Most resided in Finland, but a number of people were abroad at the time of the survey. The questionnaire did not explicitly ask the whereabouts of the students involved in FICCA. Further discussion on researcher training can be found in the section 'Capacity building'.

2.5.3. Scientific impact

Scientific results, development of methodologies and teaching were mentioned as significant outcomes of the programme by the project leaders and sub-project leaders (PIs). The scientific impact is most readily documented in the FICCA's publication records (see the section 2.3.2 'Quality of outputs, publications'). It can also be expected that the FICCA-related results will achieve additional impact via continued research and development based on the generated findings, methodologies, databases and the early-career researchers trained within FICCA.

A wealth of new information was generated in the FICCA programme on the impacts of climate change on Finnish ecosystems and sectors, as well as on adaptation and mitigation. Options for and barriers to enhancing ecosystem resilience were identified. FICCA projects also improved the volume and quality of Finnish modelling capacity to simulate climate change, ecosystem responses and adaptation scenarios. The collected databases will ensure the future use of FICCA results. The projects highlighted key regulatory gaps and proposed approaches and strategies for the policy agenda and for implementing adaptation measures. The inclusion of natural, technical and social sciences perspectives was an especially valuable aspect of the FICCA programme.

2.5.4. Societal impact

FICCA projects engaged in a range of impact activities from communicating with the general public to engaging with key stakeholders in Finland and internationally. In the FICCA researchers' responses in the 2014 questionnaire, 20 respondents out of 50 considered that there had been social impact. Other respondents expected such impact to emerge in the future (Question 13). The 2019 questionnaire highlighted many examples of societal impact, including contacts with stakeholders such as cities and municipalities, uptake of results in water resources planning and environmental management, forest legislation and development of narratives related to public discussion on climate change.

There are many examples of significant impacts such as a better evidence base for decision-making on climate change adaptation and mitigation in different sectors, and new international collaborations. However, the way in which societal impact is addressed in different project reports varies substantially: some give it little if any attention whilst the best project reports provide good, plausible and verifiable accounts of impact. This likely to some extent reflects the fact that FICCA projects were implemented at a time when the impact agenda was rather new and standards of practice had not yet solidified. Reflections have not either been collected from stakeholders.

Many projects dedicated time and effort to participating in public arenas (e.g. TV, newspapers and social media), and several projects contributed information to the climateguide.fi website to circulate and popularise scientific results. It is possible that the projects practised outreach also via professional media or popular science publications, but this is not clearly discernible from the publication statistics.

The Panel highlights below three examples of impact of FICCA projects, as a non-exhaustive sample. The choice is based on the information provided on the projects, not from stakeholders as such information is not available:

Economically optimal adaptation of forest management in changing climate (ECONADA)

ECONADA's results have been widely used nationally and internationally. The project research on uneven-aged forestry informed the 2014 forest legislation change in Finland, which officially accepted uneven-aged forestry. The team also

participated in the design of new silvicultural recommendations for uneven-aged forestry in cooperation with the forest extension service. An important contribution was made also on the role of different tree species and mixed stands in climate change mitigation, by demonstrating that admixture of deciduous and coniferous tree species has a positive impact on forest growth and carbon sequestration. The project thus directly influenced forest legislation and forest management recommendations with possible consequences for determine the climate change adaptation and mitigation potential of Finnish forests.

Assessing limits of adaptation to climate change and opportunities for resilience to be enhanced (A-LA-CARTE)

The project studied the implications of high-end climate change projections for agrifood systems and biodiversity in Finland, focusing on potential adaptive responses to enhance resilience. The findings informed the development of Finland's National Climate Change Adaptation Plan 2022 (approved in 2014), which replaced the earlier National Climate Change Adaptation Strategy. The Deputy Chair of the Finnish National Climate Panel in 2012–2015 was one of the principal investigators in the project, which provided a significant channel and forum for disseminating and communicating results to relevant experts, public authorities, stakeholders and end-users.

Local adaptation and innovation-in-practice in energy efficiency and carbon neutrality (LAICA)

The LAICA project fostered practical interventions to disseminate the results of the project. The interventions included: (I) Six open homes walk events in three municipalities and involving nearly 200 residents were organised to disseminate user experiences of renewable energy and energy efficiency investments (II) Development of a successful joint procurement process for solar power as a demonstrator leading to follow-up and modification in other localities (III) Systematic analysis of self-build courses which led to the development of new courses in three municipalities (IV) Diffusion of innovative renewable energy practices via local banks (V) Organisation of village competitions in two municipalities, creating energy maps to stimulate local activism around renewable energy.

2.6. Collaboration and networking

2.6.1. Within FICCA

The FICCA consortia involved seven Finnish universities and eight Finnish research institutes, and international partners from China and Russia. The University of Helsinki, the largest Finnish university, was the most frequent partner across the projects (15) and was involved in seven out of the eleven FICCA projects from the first FICCA call, and in quite a few of the bilateral and the development projects. The Finnish Environment Institute (SYKE) and the Finnish Meteorological Institute (FMI) were also very active. They participated in eight FICCA projects each, as well as in some of the international projects. In general,

the participation reflected the size of the organisation, with the University of Helsinki, FMI and SYKE, Aalto University and the University of Eastern Finland being most frequently involved in the projects. More specialised research institutes were involved in fewer projects. The requirement of FICCA projects to involve a consortium likely promoted the design of medium-to-large networks (2–8 partners per project), which provided a frame for collaboration and cross-fertilisation across institutions. Indeed, seven of the four-year projects brought together both universities and research institutions.

It is not possible to quantitatively assess to what extent FICCA enhanced collaboration, multidisciplinarity or interdisciplinarity. The self-evaluations indicate that the involved consortium leaders and subproject PIs gained added value from FICCA, including enhanced multidisciplinarity and competitiveness. There was focus on a systemic understanding, which likely translated into an improved knowledge on the past, present and future dynamics of climate change. Most of the projects had a comprehensive approach integrating different scales (over space and time), approaches (experimental, modelling, monitoring) and sectors.

The available information does not suggest that the programme led to many new collaborations. The self-evaluation questionnaire from 2014 indicates fairly neutral experiences regarding benefits from participating at programme level (such as in terms of collaboration, but especially mobility and visibility), whereas the experienced collaboration within the projects was rated higher. Benefits within the projects were considered positive and productive. The involvement of stakeholders also appears to have been fairly limited, not least when it comes to consumer groups, industry, policymakers and the media. The 2014 self-evaluation indicates fairly limited enhancement effect on communication and collaboration thanks to the programme, both between projects and with stakeholders and end-users.

2.6.2. International collaboration

As the focus of the national projects was on Finland, international collaborations were somewhat limited and mostly based on pre-existing collaborations (e.g. within EU projects). Some projects organised international conferences (e.g. the 2nd Nordic International Conference on Climate Change Adaptation, with 250 participants from 30 countries; the 17th IBFRA Conference on Forest Science in Boreal Region, which resulted in more than 20 newspaper articles; and the Sustainable Futures in a Changing Climate with Chinese partners), which increased the visibility and impacts of FICCA within the global scientific community.

International visits to and from Finland were numerous (FICCA scientists spent 85 month-equivalents abroad in long visits and hosted 142 month-equivalents of visits to Finland. The visits were unevenly distributed across the consortia (114 of the 142 month-equivalents to Finland were within one consortium of eight subprojects, CLICHE), which reasonably reflected the needs of the research

projects with visits. Shorter visits amounted to 16 and 3 month-equivalents, respectively.

Collaboration was a requirement in the international calls. The self-evaluations indicate that most of these collaborations will continue. In particular, the calls with the Chinese Academy of Sciences and the Ministry for Foreign Affairs of Finland on development-related research led to new international collaborations that are manifested in the co-authorships of articles and other research outputs with international collaborators.

FICCA-related scientists made substantial contributions to international assessments (mostly IPCC, Intergovernmental Panel on Climate Change) and to national processes (e.g. National Climate Change Adaptation Plan 2022, National Climate Panel 2012–2015, Arctic Advisory Board, Carbon and Climate Law Review, Forest Legislation 2012). Some projects were linked to international networks. For example, the FLUX project was part of ICOS (Integrated Carbon Observation System), and the Chinese partner affiliated to CLIMES contributed in IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services). Contacts existed also with the CLRTAP working group on effects (United Nations Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution) and AMAP (Arctic Monitoring and Assessment Programme).

The “Lakes in Trouble: Understanding the Effect of Climate Change on Threatened Ecosystem Services of Eutrophicated Aquatic Systems” project reports that the Ministry of Agriculture and Forestry of Finland and the Ministry of Water Resources in China signed a Memorandum of Understanding in aquatic resource management, which strengthens continued collaboration.

2.7. Added value of FICCA

FICCA brought together a number of talented research groups from Finnish universities and research institutes. Yet there is little explicit evidence of new lasting collaborations. Project PIs in the international calls, however, assessed that they expected continued collaboration that had started thanks to FICCA.

It is clear that many of the research questions could not have been addressed without multidisciplinarity or interdisciplinarity. FICCA research generated a wealth of new science, clear impacts and helped new early-career researchers to start. Whether FICCA made a difference and led to increased interdisciplinarity rather than the more common multidisciplinarity cannot be assessed based on the evaluation materials. A thematic synthesis of the all-programme findings could have been useful.

2.8. Capacity-building

FICCA projects have made a substantial contribution to the enhancement of research capacity through doctoral training and training of early career researchers. The 2019 survey suggests that most of the personnel involved in FICCA projects were, five years after the end of the programme, employed in

academia, with the rest pursuing careers in public administration, consultancies or in industry. Most former FICCA personnel resided in Finland, although as a result of the international collaboration projects there were also FICCA personnel based outside Finland at the time of the survey.

According to the projects' final reports, a total of 25 PhD and a few MSc degrees were completed as part of the FICCA projects by the end of the programme. The overall programme statistics, which also contain degrees completed after the FICCA period, suggest that the numbers were slightly different. Results on web searches made by the Panel, some two-thirds of the new PhDs have remained in academia and are pursuing an active research career. Some of them have already attained senior academic roles. Many in the remaining third also engaged in research after FICCA, having expert roles in business, government organisations or consultancies.

Over half of the MSc students trained as part of the FICCA projects engaged in further research training and progressed their research careers. The FICCA-trained researchers have found employment in key Finnish research organisations in the environmental field – both at universities and in research institutes.

In addition to early career and research training, which is quantified in terms of degrees obtained, FICCA projects also supported postdoctoral capacity-building. The latter is more elusive to assess. Overall, in terms of funded person-months across the programme, the investment in postdoctoral researchers was 75% of that made in PhD students. The gender balance favoured males in all personnel categories, the difference being the largest among professors (16% female, 84% male) and smallest in the "assisting staff" category. At the doctoral training stage, about two-thirds of the person-months were accounted for by male PhD students and about one-third of person-months by female doctoral students. In the researcher, postdoctoral and assisting staff categories, the gender ratio was close to even.

3. Discussion and Conclusion

3.1. Attainment of programme goals and objectives

FICCA had the ambition to cover a wide range of interactive processes between the environment and society in the context of climate change. The projects were required to adopt a multidisciplinary approach and produce results of wide applicability. A high level of scientific performance, intensification of the dialogue between scientific and social research and promotion of the use of natural sciences as part of social research were prominent goals. Increased interaction between researchers and stakeholders/users, as well as effective dissemination of results of the basic research was also expected. Overall, the new knowledge would be efficiently and expediently put to use. PhD training, career development and international networking were aims of the funders of FICCA.

Below, the Panel comments on the attainment of the primary programme objectives.

It was clear to the Panel how the evaluation of FICCA had been planned – several years after the end of the programme – and why it had been planned that way. Some strengths and weakness of this choice became evident during the evaluation. On the positive side is the potential for greater clarity about impacts, a more complete account of scientific and other outputs, and a possibility to follow up new collaborations and careers. On the other hand, it is more difficult to assess the novelty retrospectively, as the research front has shifted in the meanwhile, thus requiring trying to "recall how it was".

The Panel noted that additional information would have been useful in assessing the success of FICCA with respect to its set objectives, including structured collection of evidence of interdisciplinarity and development of new collaborations, collection of publication data that would enable bibliometric and other systematic analyses, or shared keywords in publications allowing publication database searches, interviews with stakeholders on impacts, definition of innovation and tracking new research careers.

3.1.1. Generate knowledge of climate change – its effects and management

Overall, FICCA contributed critical scientific knowledge for climate policy planning in Finland, as well as other countries, not least in China, Russia and Mozambique, as well as the global level. FICCA highlighted regulatory gaps and contributed to the political agendas and to adaptation measures. The new databases and publications will ensure the future use of FICCA results, and a number of new research careers have been launched. The further development of quality and quantity of the Finnish research capacity to simulate climate change, assess ecosystem responses and prepare adaptation scenarios is a significant source of new scientific knowledge related to climate change.

FICCA contributed to a novel understanding of climate change impacts and management. In particular, options for and barriers to enhancing ecosystem resilience were identified including (i) interventions through policies and strategies from local to national level and (ii) impacts on traditional livelihoods, industries and communities. Results were relevant to the agricultural, grassland, forest, wetland, lake, marine, urban, fishing, tourism, water-use and (bio)energy sectors. Outcomes may be further useful for regional development and for understanding the elements influencing the adaptation strategies. Combating climate change by new technological advancements was also addressed.

Overall, FICCA was successful in generating new scientific knowledge of climate change effects and management. Most of the evidence on this resides in the documented publications from the programme period, and from the later follow-up by the Academy of Finland.

3.1.2. Promote multidisciplinary expertise and research environments in order to intensify research into climate change and achieve synergy benefits

Climate change research encompasses many disciplines. FICCA projects brought together a wealth of different disciplines and provided a frame for conducting multidisciplinary research and a platform for exploring interdisciplinary research and a more systemic understanding of the research questions and societal needs of knowledge related to climate change. While strong multidisciplinarity characterised the programme, there is less clear evidence of interdisciplinarity in or thanks to FICCA.

3.1.3. Serve the Finnish society by combining global and local perspectives and Increase knowledge and awareness of climate change in society

FICCA engaged in outreach both as a programme and within the projects. Some projects involved close interaction with stakeholders. Outreach to the public at large also took place. In some cases, OpEds and suchlike are detailed. In general, the information in the projects' final reports is rather condensed (such as number of media interviews without any additional information). Thus, the extent, nature and reach of outreach cannot be assessed more fully.

FICCA-affiliated researchers contributed to national-scale climate-related efforts and played prominent roles in climate-related national fora and processes (e.g. National Climate Change Adaptation Plan 2022, National Climate Panel 2012–2015, Arctic Advisory Board, Carbon and Climate Law Review, Forest Legislation 2012).

3.1.4. Create new Finnish and international collaborative research networks

FICCA channelled Academy of Finland funding to a specific set of research questions. Some projects were partially funded from further sources, which evidences leveraging one pool of research funding with another one, thus further strengthening the addressing of specific research questions. The leveraged in-kind funding (EUR 5 million) came from participants themselves and funding from Chinese and Russian sources. FICCA also provided a platform for the development research projects on climate change, which led to a call in 2012.

3.1.5. Increase the mobility of PhD students and researchers

FICCA fostered several new PhDs and MSc students. Most of them have continued their research or researcher training in Finland. One-third have moved on, for example to expert roles in business, government organisations or consultancies. It is not very clear from the record whether there was mobility between the projects or among the partners within the projects (such as national visits or stays), or what the purpose of visits was in each case. A number of international visits were reported either to or from Finland. About half of the 24 FICCA projects had international visits of at least three months. Most visits took place within only a few projects.

3.1.6. Enhance coordination and cooperation with other Finnish (e.g. sectoral research) and international actors (e.g. IPCC)

FICCA involved 15 Finnish universities and research institutes, often both types of actors participating in joint projects. The bilateral and development projects involved by definition and in practice international collaboration with either research partners or stakeholders. Some of the latter collaborations are expected to last.

It is not feasible to assess to what extent the research output of FICCA contributed to international assessments, such as by the IPCC. It is a reasonable assumption, however, that this would be the case, given the timeliness and quality of the research in the programme. It is particularly clear that FICCA-related scientists contributed to the working groups of the IPCC.

Some of the projects connected -one way or another - to prominent international networks, for example ICOS (Integrated Carbon Observation System), IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services), CLRTAP (UNECE Convention on Long-Range Transboundary Air Pollution) and AMAP (Arctic Monitoring and Assessment Programme).

3.1.7. Generate knowledge in support of innovation

In the projects' final reports, the sections 'inventions' and 'patents' were empty without exception, suggesting that FICCA did not or was not successful in generating this kind of innovation in the field of climate change research. The final reports did not in some other manner either suggest significant developments in this aspect.

Appendices

Appendix 1: Members of Steering Group

FICCA Steering Group 7.1.2010 - 31.12.2012

Chair Professor **Paavo Pelkonen**, Research Council for Biosciences and Environment
Vice Chair Professor **Tuija Pulkkinen**, Research Council for Natural Sciences and Engineering
Members
Professor **Pauli Niemelä**, Research Council for Culture and Society
Professori **Ilmo Keskimäki**, Research for Council for Health
Professori **Hannele Hakola**, Research Council for Biosciences and Environment
experts
Director **Kimmo Kanto**, Tekes (Finnish Funding Agency for Technology and Innovation)
Environmental Councellor **Antero Honkasalo**, Ministry of Environment
Project Manager **Pirkko Heikinheimo**, Prime Minister's Office

FICCA Steering Group 5.3.2013 - 31.12.2015

Chair Professor **Hannele Hakola**, Research Council for Biosciences and Environment
Vice Chair Professor **Juha Pekka Lunkka**, Research Council for Natural Sciences and Engineering
Members
Professor **Liisa Laakso**, Research Council for Culture and Society
Professori **Ilmo Keskimäki**, Research for Council for Health
experts
Head of Unit **Kimmo Kanto**, Tekes (Finnish Funding Agency for Technology and Innovation)
Senior Officer **Pirkko Heikinheimo**, Ministry of Environment
Ministerial Advicer **Anne Vehviläinen**, Ministry of Agriculture and Forestry
Senior Advicer **Johanna Kirkinen**, the Finnish Innovation Fund (Sitra)

Appendix 2: List of Research Projects and their Funding

Academy of Finland Research Programme FICCA 2011–2014

A-LA-CARTE: Assessing limits of adaptation to climate change and opportunities for resilience to be enhanced (funding € 1 059 999)

- Timothy Carter, Finnish Environment Institute
- Marja Järvelä, University of Jyväskylä
- Helena Kahiluoto, MTT Agrifood Research Finland
- Reijo Miettinen, University of Helsinki
- Tapio Määttä, University of Eastern Finland

RICCS: Risk governance of carbon dioxide capture and storage (funding € 709 998)

- Janne Hukkinen, University of Helsinki
- Carl-Johan Fogelholm, Aalto University

DECADE: Decadal climate prediction in adaptation to climate change (funding € 809 998)

- Heikki Järvinen, Finnish Meteorological Institute
- Matti Liski, Aalto University
- Eero Nikinmaa, University of Helsinki

CLICHE: Impacts of climate change on Arctic environment, ecosystem services and society (funding € 2 100 005)

- Atte Korhola, University of Helsinki
- Hannu I. Heikkinen, University of Oulu
- Kimmo Kahilainen, University of Helsinki
- Matti Leppäranta, University of Helsinki
- Miska Luoto, University of Helsinki
- Jarkko Saarinen, University of Oulu
- Heikki Seppä, University of Helsinki
- Eeva-Stiina Tuittila, University of Helsinki

COOL: Aerosol intervention technologies to cool the climate: costs, benefits, side effects and governance (funding € 1 446 001)

- Ari Laaksonen, Finnish Meteorological Institute
- Mikael Hildén, Finnish Environment Institute
- Hannele Korhonen, Finnish Meteorological Institute
- Markku Kulmala, University of Helsinki
- Tapio Määttä, University of Eastern Finland
- Sami Romakkaniemi, University of Eastern Finland

LAICA: Local adaptation and innovation-in-practice in energy efficiency and carbon neutrality (funding € 840 003)

- Raimo Lovio, Aalto University
- Ari Nissinen, Finnish Environment Institute

ECONADA: Economically optimal adaptation of forest management in changing climate (funding € 949 997)

- Raisa Mäkipää, Finnish Forest Research Institute
- Olli Tahvonen, University of Helsinki

RECAST: Reviewing Climate change simulations for enhanced adaptation in sectors and technical infrastructure: implications of growing weather variability and uncertainty for weather sensitive capital intensive systems (funding € 973 999)

- Adriaan Perrels, Finnish Meteorological Institute
- Lasse Makkonen, VTT Technical Research Centre of Finland
- Jouni Räisänen, University of Helsinki

ClimWater: Climate change and water cycle: effect to water resources and their utilization in Finland (funding € 640 003)

- Jouni Pulliainen, Finnish Meteorological Institute
- Bertel Vehviläinen, Finnish Environment Institute

STARSHIP: Synergy and trade-off analysis on the reduction strategies for climate and health impacts from particulate matter and greenhouse gases (funding € 950 001)

- Ilkka Savolainen, VTT Technical Research Centre of Finland (Sampo Soimakallio)
- Jorma Jokiniemi, University of Eastern Finland
- Kari Lehtinen, Finnish Meteorological Institute

MARISPLAN: Marine spatial planning in a changing climate (funding € 1 520 002)

- Markku Viitasalo, Finnish Environment Institute
- Jari Haapala, Finnish Meteorological Institute
- Mikael Hildén, Finnish Environment Institute
- Heikki Lehtonen, MTT Agrifood Research Finland
- Lauri Urho, Finnish Game and Fisheries Research Institute
- Bertel Vehviläinen, Finnish Environment Institute

International joint projects with CAS, CASS and RFH for 2012–2014 (Academy funded partner)

China and EU in the context of global climate change - Analysis of changing economic structures and related policies (funding € 585 836)
(jointly funded by Academy of Finland and Chinese Academy of Social Sciences CASS)

- Jyrki Luukkanen, University of Turku
- Prof. Ying Chen, CASS Research Center for Sustainable Development

Economic effects of climate change across Russian regions (funding € 477 342)
(jointly funded by Academy of Finland and Russian Foundation for Humanities RFH)

- Riitta Kosonen, Aalto University
- Dr. Pavel Druzhinin, Karelian Research Centre

Adaptation of the food sector and socio-economic impacts of climate change in North-East Europe (funding € 630 164)
(jointly funded by Academy of Finland and Russian Foundation for Humanities RFH)

- Heikki Lehtonen, MTT Agrifood Research Finland
- Dr. Vladimir Surovtsev, Russian Academy of Agricultural Sciences

CLIMES: Impacts of climate change on multiple ecosystem services: processes and adaptation options at landscape scales (funding € 699 288)
(jointly funded by Academy of Finland and Chinese Academy of Sciences CAS)

- Martin Forsius, Finnish Environment Institute (SYKE)
- Prof. Bojie Fu, CAS Research Center for Eco-Environmental Sciences

Lakes in trouble: Understanding the effect of climate change on threatened ecosystem services of eutrophicated aquatic systems (funding € 415 059)

(jointly funded by Academy of Finland and Chinese Academy of Sciences CAS)

- Anne-Mari Ventelä, Pyhäjärvi Institute
- Leena Nurminen, University of Helsinki
- Prof. Boqiang Qin, CAS Nanjing Institute of Geography and Limnology

FLUX: Flux measurements of greenhouse gases for agricultural, lake and wetland ecosystems and process modelling of wetland methane production systems (funding € 323 438)
(jointly funded by Academy of Finland and Chinese Academy of Sciences CAS)

- Timo Vesala, University of Helsinki
- Prof. Xunhua Zheng, CAS Institute of Atmospheric Physics

Development research projects for 2013–2014 (funded by Ministry for Foreign Affairs and Academy of Finland)

Black and brown carbon influence on climate and climate change in India – from local to regional scale (funding € 283 000)

- Antti Arola, Finnish Meteorological Institute.

Private agricultural investments and land use change impact on the adaptive capacity of local communities to climate change in Mozambique (funding € 354 000)

- Yirdaw Eshetu, University of Helsinki; Paula Horne, Pellervo Economic Research PTT.

Towards responsive governance in climate change adaptation and mitigation? Comparative case study in Tanzania and Nepal (funding € 267 000)

- Irmeli Mustalahti, University of Eastern Finland.

Impact of climate change on water quality: a Himalayan case study (funding € 217 000)

- Mika Sillanpää, Lappeenranta University of Technology.

Aquatic ecosystems in a changing climate – introducing a cost-effective tool to guide management options in poorly developed countries (funding € 169 000)

- Janne Soininen, University of Helsinki.

Redefining energy and climate policies in least developed countries: Analysing institutions and initiatives in the Mekong region (funding € 363 000)

- Jarmo Vehmas, University of Turku.

Study on risk management of extreme weather related disasters and climate change adaptation in Malawi and Zambia (funding € 339 000)

- Ari Venäläinen, Finnish Meteorological Institute.

Appendix 3: Assignment for the Evaluation Panel

Evaluation Panel Members

Professor **Markku Rummukainen**, Chair, Lund University, Sweden
Professor **Jouni Paavola**, University of Leeds, UK
Doctor **Elena Paoletti**, National Research Council, Italy

Rationale

The aims of the scientific evaluation is to estimate to which degree the FICCA Research Programme has succeeded in fulfilling the objectives that have been listed in the Programme Memorandum, including also the objectives of the joint international calls as part of the FICCA.

The aims of FICCA are to cover a wide range of interactive processes between the environment and society in the context of climate change. In addition to achieving a high level of scientific performance, the programme is expected to intensify the dialogue between natural sciences and social sciences research and, in particular, to promote the use of natural sciences research as part of social sciences research.

Task

The panel is expected to assess the programme as a whole and reflect issues such as attainment of the programme's goals and objectives; scientific quality of the programme output; added value of the programme; results and impact; interdisciplinarity; integration of the results and synthesis on the programme level; evidence of the scientific, social and economic impacts pursued by the programme; researcher training and the advancement of research careers; national and international cooperation.

The work will include examination of the projects' final reports, outcome of two Webropol questionnaires, compilations of publications and other products of the programme. The panel meeting takes place online and the preparation and drafting of the evaluation report is done remotely.

Preliminary schedule for the evaluation process:

- End of March 2021 - material available to the Panel members
- April 2021– homework by the Panel members
- Early May 2021 - the panel meeting (remotely, the date to be agreed)
- Beginning of June 2021 - the panel Evaluation Report completed