

EVALUATION REPORT OF THE UNIT
IAM - Interactions Arbres Micro-organismes

UNDER THE SUPERVISION OF THE
FOLLOWING ESTABLISHMENTS AND
ORGANISMS:

Université de Lorraine

Institut national de recherche pour l'agriculture,
l'alimentation et l'environnement - INRAE

EVALUATION CAMPAIGN 2022-2023
GROUP C

Report published on March, 17 2023



In the name of the expert committee¹ :

Christina Hazard, Chairwoman of the committee

For the Hcéres² :

Thierry Coulhon, President

Under the decree n° 2021-1536 of 29th November 2021:

¹ The evaluation reports "are signed by the chairperson of the expert committee". (Article 11, paragraph 2);

² The president of the Hcéres "countersigns the evaluation reports established by the expert committee and signed by their chairperson." (Article 8, paragraph 5).

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

MEMBERS OF THE EXPERT COMMITTEE

Chairperson: Ms Christina Hazard, École centrale de Lyon

Experts: Mr Gilles Bena, IRD, Montpellier (representative of Inrae CSS)
Ms Sylvie Blangy, CNRS, Montpellier
Ms Véronique Gruber, Université Paris Diderot (representative of CNU)
Mr Olivier Puel, Inrae, Toulouse, (representative of supporting personnel)
Mr Thierry Rouxel, Inrae, Thiverval-Grignon
Ms Daniele Werck, Professeur émérite, CNRS

HCÉRES REPRESENTATIVE

M. Serge Delrot

CHARACTERISATION OF THE UNIT

- Name: Interactions Arbres-Microorganismes
- Acronym: IAM
- Label and number: UMR 1136
- Number of teams: 3
- Composition of the executive team: M. Sébastien Duplessis

SCIENTIFIC PANELS OF THE UNIT

SVE2 Productions végétales et animales (agronomie), biologie végétale et animale, biotechnologie et ingénierie des biosystèmes

THEMES OF THE UNIT

The IAM unit (Tree-Microbe Interactions) deciphers the molecular, ecological and environmental mechanisms controlling the interactions between trees and microorganisms. It is structured into three "historic" research teams and a more recent team dedicated to participatory sciences. The Stress Response and Redox Regulation (RSRR) team works on the biochemistry of proteins, cellular and molecular biology in plants and fungi. The Ecogenomics of Interactions (EGI) team studies the biology and ecology of tree-associated microorganisms in forest ecosystems, and the Ecology of Forest Pathogenic Fungi (ECPF) team is studying the ecology, epidemiology and evolutionary biology of emerging forest tree diseases. During the period of 2016-2021, a new and small team (TC, Tous Chercheurs) involved in science and participatory research was founded. The RSRR, EGI and ECPF teams share two cross-cutting projects, one on the mechanisms and evolution of the poplar-poplar rust interaction, and another on the microbiology of wood degradation.

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

The IAM research unit was established in 2001, joining INRAE Forest Microbiology Laboratory and part of the Forest Biology Laboratory of the Université Henri Poincaré (Nancy I). In 2005, the INRAE Pathology unit also joined IAM. The IAM unit resides at two different sites, the Faculty of Science and Technology at the University of Lorraine (Vandoeuvre-lés-Nancy) and the INRAE Grand Est Center – Nancy (Champenoux). The two sites are located 20 km apart. The RSRR team is stationed at the University of Lorraine and the EGI, ECPF and TC teams at INRAE Grand Est Center – Nancy.

RESEARCH ENVIRONMENT OF THE UNIT

The unit is attached to the INRAE Ecology and Biodiversity Division (ECODIV) and to the University of Lorraine's Scientific Pôle A2F (Agronomy, Agroalimentary, Forest). Unit members participate in the scientific council and preparation of the ECODIV Strategic Plan. The A2F pole has been directed by a member of the RSRR team since 2022, with participation in the Pôle Council, and with involvement in the Ecosystèmes Forestiers, Agroressources, Bioprocédés et Alimentation (EFABA) Research Federative Structure.

The unit is attached to the INRAE Grand Est – Nancy Center, where three of the four teams reside, and participate in the council of the center. The unit is a member of the Laboratory of Excellence (labex) ARBRE (Advanced Research on the Biology of Tree and Forest Ecosystems), directed by a member of the unit and with other members from the unit participating in the Executive Board and Scientific Council. IAM is involved in directing the i-SITE Lorraine University of Excellence project - BioMolécules (network of laboratories and companies with the aim of developing biomolécules for the marketplace). IAM belongs to the Doctoral School ED SiReNa 607 (Science and Engineering of Natural Resources) and serves on the ED Council. The unit also participates in various local or national platforms [SILVATECH (INRAE) – dedicated to analysis of forest ecosystems and wood; Infra+, StAR-LUE – Functional and Structural Approaches to Cellular Interactions (ASIA); Infra+, PEPLor – Experimental Phytotronics of Lorraine), and is involved with the Lorraine Incubator, an association that supports the development of start-up companies.

UNIT WORKFORCE: in physical persons at 31/12/2021

Permanent personnel in active employment	
Professors and associate professors	3
Lecturer and associate lecturer	6

Senior scientist (Directeur de recherche, DR) and associate	8
Scientist (Chargé de recherche, CR) and associate	2
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	28
Subtotal permanent personnel in active employment	47
Non-permanent teacher-researchers, researchers and associates	4
Non-permanent research supporting personnel (PAR)	10
Post-docs	3
PhD Students	15
Subtotal non-permanent personnel	32
Total	79

DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: NON-TUTORSHIP EMPLOYERS ARE GROUPED UNDER THE HEADING "OTHERS".

Employer	EC	C	PAR
INRAE	0	10	22
Université de Lorraine	9	0	6
Total	9	10	28

UNIT BUDGET

Recurrent budget excluding wage bill allocated by parent institutions (total over 6 years)	1 250
Own resources obtained from regional calls for projects (total over 6 years of sums obtained from AAP idex, i-site, CPER, territorial authorities, etc.)	2 656
Own resources obtained from national calls for projects (total over 6 years of sums obtained on AAP ONR, PIA, ANR, FRM, INCa, etc.)	4 611
Own resources obtained from international call for projects (total over 6 years of sums obtained)	1 000
Own resources issued from the valorisation, transfer and industrial collaboration (total over 6 years of sums obtained through contracts, patents, service activities, services, etc.)	865
Total in euros (k€)	10 382

GLOBAL ASSESSMENT

For the IAM unit, several strengths in the 4 main assessment domains were identified. In terms of unit resources, there is a significant critical mass of permanent staff members (45 positions currently), and which has been stable since 2008, to drive forward their scientific mission. There is a healthy ratio of 0.89 technicians per researcher, although this varies greatly within the different teams of the unit. The unit is also very successful in obtaining funding, with an annual budget of 1.3 – 2 M€ (18.5 €/person/year). The strategic scientific policy of the unit is to focus on the development of innovative and fundamental research within their research themes in which they have excellent expertise. The mission of the unit being to bridge knowledge gaps in the integrative biology and ecology of tree, fungi and bacteria associations and the influence of these associations on forest ecosystem functioning. The research scales from the level of genes to organisms and from individuals to the community

scale. Three teams of the unit drive forward the main scientific axes of the unit consisting of investigation into the molecular, ecological and environmental mechanisms of tree-microbe associations (team RSRR), identification and understanding of microbial interactions in relation to forest functioning (team EGI), and identification of processes driving evolution and adaptation of tree- pathogen associations (team ECPF). A fourth team (TC) is dedicated to participatory science. These research axes are in line with the thematic fields of the supervisory bodies and answer to societal, economic and environmental issues. Team RSRR continues to successfully develop and expand upon an original and increasingly promising research on sulfur and redox metabolism in plants and fungi, and EGI continues strong research in fungal genomics and tree-fungal interactions, and ECPF in the field of forest tree diseases with strong collaboration with DSF. Strengths in attractiveness of the unit include international recognition, demonstrated by award distinctions, invitations to conferences, and establishment of strong collaborations (60% of publications include international partners as co-authors). The unit is reputable in their staff recruitments and hosting outside researchers, and in the success of obtaining external sources of funding and support. The unit has integrated most of its technical platforms into large scale local labeled facilities for improving management, recruitment of dedicated personnel and visibility. Scientific production of the unit in terms of quantity (319 primary articles & reviews) and quality (23% and 43% in exceptional and excellent journals (*Noria*)) of publications is impressive and includes publications from transversal projects between the teams. The unit's contribution of research to society is excellent, demonstrated through translational and outreach activities, and those of team TC. Partnerships with the non-academic and economic sectors are numerous and diversified.

The main weaknesses identified with resources and organisation of the unit consists of disparity between the sizes of the four teams (ECPF and TC relatively small to that of RSRR and EGI), and with staff departures that may jeopardise the functioning of teams and loss of essential skills. However, the proposed merger with the mycology unit of ANSES could provide an avenue for increasing staff resources and productivity of the ECPF team. Also, with the profile for a CR on the theme of the role of microbiome on tree health could provide the means for another transversal project for the unit. There are challenges with the management of geographically distant teams. The RSRR team is hosted at UL and composed mostly of UL personnel unlike the other teams (INRAE), making it challenging for synchronisation of human resource management between supervisory bodies, and with a lack of integration actions/events to bring members of the unit together. Funding is predominantly from national sources, and exploitation of EU funding is not maximised, particularly for team ECPF which is in good position to respond to EU calls for expanding their emerging tree disease research beyond France and contributing to international visibility and research impact. Also, funding from industrial partnerships is low. The attractiveness of the unit suffers from little involvement in leading major European projects and steering international networks. Several aspects are unbalanced between teams, such as the hosting of international researchers, with EGI leading in this respect, but which is particularly driven by a single researcher of this team. Also, scientific production is greater with RSRR and EGI, who utilise approaches which enable valorization in relatively shorter time spans than that of ECPF. Team EGI and TC are also unit leaders in the communication of research to society. While TC is excellent in this regard, the team is understaffed and underfunded, requiring a strategic plan for its future and development of scientific projects.

DETAILED EVALUATION OF THE UNIT

A - CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

The previous evaluation recommended that efforts be made to become involved in international projects, particularly for certain teams. This point has not been reached, as out of 16 international projects, 13 are only carried out by EGI, with the other two teams carrying one each and one project being carried out jointly by RSRR and EGI. International collaborations are however present in the publications of all the teams with their co-authorships.

A request was formulated to improve their results in terms of publications with however disparities according to the teams. However, these figures should be put into perspective, as Team RSRR is made up exclusively of research professors who have teaching duties to fulfil. If we consider the research activity of a professor as equivalent to 50% of that of a full-time researcher, then this ratio of publications per year is also at a very good level for the RSRR team.

On the aspects of transversality, there are 21 publications common to teams RSRR and EGI but only 3 common to teams EGI and ECPF. Only one publication is common to all three teams, the latter corresponding to the *Melampsora* transverse project.

There has been no reduction in biological models, as suggested by the committee, but this has not affected the dynamics of the unit.

The unit maintains a very good dynamic of attractiveness and international collaborations. The recommendations concerned opening up to young researchers, and not relying on a small number of older researchers for these relationships. A start has been made on transfer, but this needs to be intensified, particularly in the EGI team.

The committee recommended a strategy for developing links with its economic environment and promoting the research conducted in the unit. This recommendation was only marginally followed up, as the unit claims to focus on the fundamental aspects of its research. The unit does not deny the possibilities of social and economic outlets, and contacts are apparently made with structures such as SATT, but this remains at a very modest level today.

There is mention of a Biocode start-up incubated in the unit, but no detailed information on its real activity is provided in the report. However, this information was provided in responses to the Committee's questions.

The evaluation of the organisation and life of the unit did not highlight any crucial points. The complexity of living in a unit on two sites is recognised by the unit. Efforts have been made to promote communication between the sites (via the resources resulting from the covid crisis).

Finally, with regard to the strategy and the five-year plan, the unit has continued, as requested, its efforts to invest in the animation within the LUE i-site, essentially in the direction of the ARBRE labex. In their response, they mention "strategic choices in terms of recruitment and the opening of new scientific posts" without this being explained.

B – EVALUATION AREAS

EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

Assessment on the unit's resources

Overall, the unit's resources are very good. The teams have the critical size to achieve their scientific objectives. and they are very dynamic in their search for funding, The financial and material resources of IAM to achieve its scientific objectives are excellent. However, the unit will deal with a dramatic decrease of the support staff due to the retirement departures. This issue regards three teams and risk jeopardizing the functioning of the unit. The size of the infrastructure is appropriate for the size of the unit and adapted to its activity except for the building housing the team EGI, which displays numerous defects.

Assessment on the scientific objectives of the unit

Overall, the scientific objectives are very good. They are set by the unit in order to maintain successfully the leadership and the excellence of its different teams. These objectives are in agreement with the thematic fields of the supervisory bodies and answer to societal, economic and environmental issues. However, the unit is lacking a strong and distinctive identity as a whole. A visionary exercise to define a stronger scientific identity is recommended. Position of TC in the Unit and supervising bodies (INRAE) needs to be clarified. The scientific objectives of teams 1 and 3 are too ambitious with regard to the number of staff in these teams.

Assessment on the functioning of the unit

The organisation and the life of the unit are very good, independently of the difficulties linked to the location of its teams on two geographically distinct sites. Physical disconnection between the sites challenges communication between teams, and there is no mixing between members of the two institutes. Some communication issues have been raised by PhD students, who want more interactions.

1/ The unit has resources that are suited to its activity profile and research environment.

Strengths and possibilities linked to the context

Despite several departures over the period 2016-2021, the size of the unit has increased slightly with a total of 88 people, 48 of whom are permanent as of 31/12/2021. The RSRR team located on the campus of the Faculty of Science and Technology of the University of Lorraine is essentially composed of teacher-researchers (3 PR, 2 PREM and 5 MCF), one DR INRAE, one IR, one IE, 1TR and 1AT. The IR is in charge of the ASIA platform and the 2 technical agents share their time between research and teaching support activities. The EGI team located on the INRAE site of Champenoux is composed today almost exclusively of INRAE personnel (5 DR, 1 DR EM, 1 CR, 3 IR, 1 IE, 2AI, 3TR and 1AT). With the PhD students, the post-doctoral fellows, the fixed-term contracts, the foreign visitors, the two teams are composed of about thirty people, which is a respectable number for a research team. The ECPF team is composed of 2 senior DRs, 1 CR, 1 newly recruited IR (2020), 1 IE supported by a technical staff consisting of 1 AI and 4 TR. The ratio ITA/researcher is excellent compared to the other teams of the unit. The global annual budget of the unit is 1730 K€, mainly supplemented by its own resources obtained through contracts. The recurrent allocations from the supervisory bodies represent only about 12% of the overall budget, and the unit shows real dynamism in its quest for additional financial resources. The sources of financing differ between the teams, but the own resources are quite balanced between teams with an average value of 18.5 K€/person/year, which is quite sufficient to achieve the scientific objectives set. The EGI team is able to mobilise resources of various kinds (financial, sequencing services) through the establishment of a regularly renewed contract with the Oak Ridge National Laboratory and from a permanent collaboration with the Joint Genome Institute of the DOE. The TC team, in relation to its small size, has shown an excellent capacity to acquire financial resources thanks to a lot of public relations. They have been very successful in raising funds for the renovation of the old building and the equipment.

The unit has nearly 2,400 m² on both sites, of which nearly 40% is administrative space. The ratio of surface/people is 10.80 m²/person and 11.40 m²/person for office and technical space respectively. Overall, the premises housing the different teams are adapted to their size.

In line with the importance of genomics in the activity of EGI, its members have access to the JGI annotation pipeline.

Weaknesses and risks linked to the context

This workforce is unevenly distributed in three teams located on 2 sites geographically distant of about 20 km. While two teams (RSRR and EGI) are of equal size in terms of permanent staff, two others (ECPF and TC) [1] [2] are much smaller.

The unit will be facing five retirements, including an AI in charge of financial management in the next two years.

By the end of 2023, the team EGI will be impacted by 3 retirements, mechanically decreasing the ITA/researcher ratio. Regarding the team ECPF, its excellent ratio ITA/researcher should be eroded with the imminent departure of 1 TR specialised in the management of field experiments.

These departures, if they are not compensated, risk jeopardizing the proper functioning of the unit, losing certain essential skills, adding an additional burden to the remaining agents and consequently becoming a source of conflict and psycho-social risk.

With the exception of the TC team, the other teams are almost mono-headed in terms of the affiliation of their different members. For RSSR, only 1 DR INRAE and no technical staff INRAE are hosted in the team. Part of the surface area allocated to the RSSR team has been used to house the ASIA platform (90 m²). This has imposed constraints on a team whose size grew during the same period.

EGI does not host any UL staff since the migration of a MC toward another university and the change of supervising body of another one to become DR INRAE. The ECPF team is entirely composed of INRAE staff.

Since 2012, the EGI team has been housed in a newly constructed building with numerous defects. This situation generates numerous costs substantially affecting the financial resources of the unit.

The TC team is still struggling to secure a couple of positions and relies so far mainly on short-term contracts.

2/ The unit has set itself scientific objectives, including the forward-looking aspect of its policy.

Strengths and possibilities linked to the context

The scientific project of the unit is to improve the understanding of the interactions between trees and microorganisms (fungi and bacteria) and their respective contributions to the functioning of forest ecosystems. The objectives are defined in agreement with the strategic plans of the two supervisory bodies (INRAE ECODIV department and University of Lorraine's scientific pole A2F (Agronomy, Food and Forest). Concerning ECODIV, the scientific themes addressed by IAM fall within the thematic fields of "interactions between species within ecosystems" and "adaptation of organisms and populations".

The unit is very well established in the local and national academic environment where it plays a driving role (presence in the strategic and scientific councils of PA2F and ECODIV, council of the INRAE centre Grand-Est Nancy, council of SIRENa doctoral school and pedagogical council of the UL masters training). It actively participates in strategic measures resulting from the program "investissement d'avenir" (PIA) such as the labex Arbre, whose scientific direction is ensured by a member of IAM since its creation. The unit is attentive to all the incentive, transversal and federative programs of the INRAE type METAPROGRAMME, both in the coordination of some of them and in the response to certain calls for projects.

The strategic scientific orientations are taken in consultation by the board of directors or the scientific council. There is a consensus among the members of the unit to develop only original and innovative fundamental research in the themes in which the unit is a leader (*Integration biology of plant-microorganisms* (Bacteria and Fungi) and *Ecology of associations between trees, fungi and bacteria*). IAM unit refuses to have opportunistic behaviour by responding to the calls for projects at the margin of its activity.

The unit regularly analyses the impact of its research both in terms of societal issues (participatory research on ticks (CITIQUÉ) and on the ash dieback) and economic issues (finalised research on truffles, wood degradation or poplar varietal selection).

These have led to the creation of two start-ups: WeTruf and Biocode.

Weaknesses and risks linked to the context

The scientific objectives of the 3+ 1 teams are clear and well defined. However, the whole unit is lacking a strong and distinctive identity as a whole.

3/ The functioning of the unit complies with the regulations on human resources management, safety, the environment and the protection of scientific assets.

Strengths and possibilities linked to the context

The unit's management has opted for a classical organisation, with an executive board consisting of a DU and two deputy DU (1 INRAE, 1 UL), the holding of unit councils (service and scientific) and the holding of a yearly general assembly. A gender balance has naturally been created through the recruitment of permanent and non-permanent staff.

As IAM welcomes many foreign visitors, a special effort has been made to integrate non-French speaking visitors into the life of the unit (seminars are almost systematically held in English, minutes of meetings are written in French and English). The effort is extended to help with the administrative procedures inherent in their installation in France. The unit is particularly attentive to the support of permanent and non-permanent staff. This is reflected in the monitoring of training needs, assistance in preparing for internal competitive promotion exams and the establishment of a skills passport for temporary staff.

The unit is also sensitive to the future of its doctoral students with support for the preparation of the post-thesis period with, for example, help in writing a scientific CV.

The IAM's main concern is to ensure the safety of all its agents. To do this, it scrupulously follows the official directives and procedures related to the safety and protection of agents. All teams have an agent in charge of prevention (ACP). A sum of money is made available by the teams in order to improve points relating to health and safety. The new arrivals get acquainted with their new environment during the welcome by a referent and the accompaniment of the ACP of the team, the handing-over of the regulation of the unit.

Having been a pilot in 2017 for a survey on psycho-social risks, IAM is aware of and sensitive to this type of risk.

The unit ensures a policy of sensitivity to the prevention of economic intelligence risks. This is reflected in the centralised archiving of all users' computer data on one server of the unit. Sensitive data is also stored on INRAE servers dedicated to long-term storage. This also translates into the establishment of a digital charter.

IAM unit has decided to cease all activities involving the manipulation of radioactive elements. Regarding the regulations concerning GMOs, the unit has renewed its approvals in 2021 (1 approval for each site (INRAE and UL).

In anticipation of the March 2020 lockdown, the unit set up an Activity Continuity Plan (PCA) approved by the supervisory bodies and the successive confinements have tested its robustness.

The setting up of scientific seminars on both sites, attended by members of the other site via video communication tools, partially alleviates the obstacles to inter-site exchanges.

Weaknesses and risks linked to the context

One of the weaknesses of the functioning of this unit is inherent to its constitution and its co-supervision. One of the teams is almost composed of UL personnel, housed at the UL, managed by the UL, while the others depend on INRAE. In addition to the difficulty of managing geographically distant teams, it is impossible to harmonise certain practices linked to the difference in human resources management between the supervisory bodies, which prevents the agents from being put on equal footing.

Given the large volumes of data acquired by the unit, the lack of a functioning data management plan is detrimental.

There is a lack of periodic forward-looking scientific seminars and integration events aimed to bring together people from different geographic locations and to cultivate belonging to the entity that is the unit.

Future retirements may lower the technician/scientist ratio and the increasing number of tasks to be achieved may weaken the scientific output.

EVALUATION AREA 2: ATTRACTIVENESS

Assessment on the attractiveness of the unit

Overall, the unit has an excellent level of attractiveness, enabling it to attract foreign researchers of very high calibre as well as post-docs. At the national level, all the teams manage to attract young recruits. At the international level, two teams have a better attractiveness, the third one should make efforts on this point. The unit should be more involved in responding to European calls for proposals in order to set up networks in which it could be the leader.

1/ The unit has an attractive scientific reputation and contributes to the construction of the European research area.

Strengths and possibilities linked to the context

The IAM unit presents several criteria justifying a real international recognition of its activities. Although it is a small unit (25 researchers), four of them have received WoS Highly Cited researchers awards. These distinctions underline the impact and audience of the unit's publications. Other distinctions (Académie des Sciences de Turin, Chevalier de l'Ordre National de la Légion d'Honneur) are also held by two members of the unit. The work of the researchers is disseminated abroad, with invitations to conferences (12, such as at the 9th International Conference on Mycorrhiza, the Society for Experimental Biology annual meeting or the 2nd International

Conference on Wild Plant Pathosystems) but also invited seminars (29), which again reflects strong links and connections with other non-French laboratories. Within this framework of collaboration and recognition at the European level, the unit has created a unique partnership with the Max Planck Institute for Terrestrial Microbiology over the last 10 years, which forms a relevant embryo of a European network. The international audience goes beyond Europe, with one of the researchers being appointed Professor at the Beijing Forestry University.

Participation in terms of organisation of international conferences (4 over the period) remains modest partly due to the disruptions caused by the health crisis, while the involvement of staff in editorial activities (10 staff members involved) represents a normal number in relation to the size of the unit.

From an editorial point of view, it is notable that several researchers are involved in the new PCI journal, which should be intensified while reducing participation in predatory or for-profit journals if the time commitment is limited.

Weaknesses and risks linked to the context

The unit has little involvement in international steering networks, particularly European ones, which means that it is not possible to relay information to the decision-making bodies and to set up calls for tender for which the unit could apply. Similarly, the vast majority of research steering activities are national, and there are no figures for international project evaluations.

A major risk, raised in the self-evaluation report, concerns the age of a researcher who is responsible for a large part of the laboratory's international reputation. Without presuming a possible emeritus status, a transfer of networks and collaborations must be undertaken (if not yet completed, but this is not clear from the report) so that this audience and these partnerships do not stop with his departure.

2/ The unit is attractive for the quality of its staff hosting policy.

Strengths and possibilities linked to the context

The unit implements an active policy to favour a good integration of doctoral students, whether in terms of working environment, personalised welcome of doctoral and post-doctoral students, meetings in English for non-French speakers. The number of HDRs in the unit is significant, with 22 HDRs for a total of 33 CH/EC/IRs, which allows it to ensure a good level of reception and supervision capacity. The dynamics of HDR defence is regular with 3 HDR defended during the period.

There were 38 doctoral students present over the period, giving a theoretical supervision rate of 1.7 doc/HDR, which remains quite reasonable. These thesis are going well, with only one abandonment, an average duration of 37.8 months and an average number of publications per PhD student of 2.1.

Over the period, the unit has been able to recruit three assistant professors (MCF), one Research Director and two IR, which demonstrates a good recruitment and renewal dynamic of the unit's researchers. However, that even though the unit is very attractive, the policy of opening positions for recruitment is not within its remit

The unit is also attractive in welcoming researchers from outside (15 over the period according to the text, although only 11 are indicated in the table). The sources of funding are not mentioned, but the possibility of hosting researchers with the help of European funding (Marie Curie Skłodowska fellowships) should be developed.

The unit is committed to a virtuous approach, whether in the deposit of articles in HAL, the implementation of a data management plan at the level of the unit, or a reinforcement in the awareness of ethics and scientific integrity.

Weaknesses and risks linked to the context

While the average supervision rate of doctoral students per HDR is relatively low, there are strong disparities. Of the 22 HDRs listed in the unit, several were not in position to supervise a Ph.D student for various reasons (emeritis status, visiting scientist, detachment on a platform, arrival in 2021...). In the end, 12 HDRs actually supervised a doctoral student during the period, whereas one person supervised 8 doctoral students over the period! Although many Ph.D were co-supervised between IAM teams (26) or with external colleagues (12), there is an apparent imbalance in the supervision of doctoral students is apparent.

Over the same period, there were 6 departures of researcher/EC/IR, indicating that the recruitments do not completely compensate for the departures and could jeopardise certain activities. The report notes that there is a real problem of distance between the 2 sites, with young MCFs having an understandable need to be on the university site.

But there is a risk of a drop-off between researchers and teacher-researchers, especially as there have been several recruitments during the period. The solutions proposed to maintain the link between the two sites and between them are not very convincing. The Pandemia has not helped in that respect.

The reception of researchers is also very unbalanced. Indeed, of the 11 noted in the table, 9 come from China, and all of the 11 visitors are hosted by only one team of the unit. This is a real problem. This reflects, on the one hand, a low attractiveness of researchers outside the collaboration with China, but also a lack of commitment of the other two teams in this dynamic of welcoming foreign researchers. Finally, the status of visiting researcher for a person who has stayed for 9 years is surprising and raises the question of her real position.

3/ The unit is attractive because of the recognition gained through its success in competitive calls for projects.

Strengths and possibilities linked to the context

The unit manages to maintain its capacity to obtain external funding at an exceptional level. Over the period, the unit has between 85 and 90% of its resources arising from external projects. This high level allows the unit to develop its activities with complete financial freedom.

Moreover, the unit has diversified its funding sources: 30% of its own resources come from regional calls, 50% from national projects (including PIA), 11% from international projects and 10% from valorization.

National contracts form the core of the unit's resources, with 50 national contracts over the period, for a total of 4778 k€, including 16 ANR projects, 6 of which are led by the unit (MITOGLU, WOODWASTE, WABSARF, SULTRAF, FE-S traffic, FUNFIT). The PIA has provided very strong financial support. IAM is strongly involved in the management of the labex ARBRE and in its scientific steering committee. This is reflected in the 31 projects obtained for a total of 1745 k€, and another project alone for 3500 k€.

The unit is also well integrated into the local research network and has strong regional recognition, with 10 projects funded by the territorial authorities, for a total of 1638 k€, 9 of which being led by a member of the unit (CPER FORBOIS2, VITTEST, FUN CASTOR...).

On the international side, IAM benefits from the support from the US Department of Energy (DoE) via the Oak Ridge Laboratory and Plant Microbe Interaction project providing 949 k€. The DoE joint genome initiative for sequencing genomes and transcriptomes also represents an important indirect financial contribution. A collaboration with Beijing Forestry university generates very significant additional resources (520 k€) for personnel recruitment and joint activities. IAM is also associated with two European projects for a total funding of 255 k€.

This financial autonomy has enabled IAM to recruit from its own funds some additional personnel (technical assistants and post-docs) necessary throughout the period to support the activities linked to the projects obtained and to cope with the shortage of recruitment on the technical platforms. It also permits an optimal exploitation of PhD student and post-doc co-funding opportunities.

Weaknesses and risks linked to the context

Direct international funding is rather modest. Despite high visibility, IAM does not lead any major international project, in particular European and ERC project.

Funding sources are diversified but also very dispersed, which implies complex resource management.

Repeated failures of ANR project submission may lead to the discouragement of younger members of staff.

Out of 14 international contracts outside of Europe, 7 have the same IAM project leader. Only 2 other IAM members are project leaders or involved in 9 of these 14 projects.

4/ The unit is attractive for the quality of its major equipment and technological skills.

Strengths and possibilities linked to the context

IAM pursued integration of most of its technical platforms into large scale local labeled facilities for improving management, recruitment of dedicated personnel and visibility. For example, all of its microscopy equipment, previously part of the IAM LEGF (Laboratoire d'EcoGénomique Forestière), is now administratively integrated into the INRAE-labeled SILVATECH ISC. This grouping is relevant because it allows access to all of the equipment of this ISC. Also plant growth chambers have been integrated into the PEPLor platform of the i-SITE LUE.

The unit also manages all the structures necessary for plant cultivation (greenhouse, S2 GMO greenhouse, phytotrons). These structures are essential to the activities of the unit and provide staff and visitors with essential operating capacities. Participation in the PEPLor platform is an opportunity that should not be missed. It will allow the unit to pool its needs and resources to optimise use of greenhouses and other structures located on site.

The implementation of an original platform dedicated to functional and structural approaches to cellular interactions (ASIA) labeled by LUE must also be underlined.

To support its platform management costs, IAM has opened two of them as training and demonstration facilities for the equipment providers.

The TC platform provides new equipment and labs that are made available to the public and serve the different research projects co-designed with non-scientists.

Weaknesses and risks linked to the context

The involvement of IAM's staff in the management of the various platforms, whether greenhouses or ASIA, implies a commitment of human resources that no longer contribute to labs' own research projects. This could jeopardise both participation and maintenance of the platforms and team's activities.

The administrative status of plant growth facilities beyond growth chambers has not been solved yet and requires an urgent solution. The document makes it clear that the financial support required to keep them in operation is still not secure, and that support from the unit is still high.

IAM has chosen to invest internally in computing resources via a new cluster in 2021. This is surprising while the EXPLor platform of LUE offers these resources on a much larger scale. This choice not to integrate immediately the EXPLor platform and therefore not to be able to get involved quickly in its strategic choices and scientific activities could become a weakness and risk for IAM's ability to maintain cutting-edge bioinformatics activity. Yet it was noted that this integration is mentioned as one of IAM's priorities for the next period.

EVALUATION AREA 3: SCIENTIFIC PRODUCTION

Assessment on the scientific production of the unit

The scientific output and quality of the IAM unit is in the range of excellent (Team RSRR and ECPF) to outstanding (Team EGI) in all respects. For Team TC, scientific production is not the main goal (modest number of publications) as this team is in an early stage of development. The synergy between teams through transversal federative projects contributing to scientific productivity of high quality is excellent and must be pursued and intensified by better including all the different teams. The policy of quality criteria (e.g. tools, internal assessment,...) applied by the unit is excellent and its deployment must be continued.

1/ The scientific production of the team meets quality criteria.

Strengths and possibilities linked to the context

The unit applies a quality approach mostly imposed by INRAE. The scientific data are recorded in laboratory notebooks, respect the ethical charters of INRAE and are traceable. Technical data sheets for the use of the instruments are provided and updated. Experimental protocols are available through paper files and/or the internal server. Important collective data are also accessible via the internal server.

The scientific results are discussed during team meetings and evaluated by colleagues specialised in different disciplines and recognized as national and/or international experts by their peers.

Each team reports on emerging themes or high-risk or rare subjects. For example, the theme « involvement of sulfurtransferases in the mechanisms of persulfuration of proteins in plants » was developed in the framework of an ANR young researcher contract in the RSSR team. Four publications were obtained from this work and the project leader has been nominated as IUF member. Team EGI assumes a leadership in genomics, physiology and ecology of forest fungi and develops innovative or more "risky" projects by responding to labex ARBRE proposal calls. For example, the team developed the CulturTruf experimentation program to understand and improve truffle production. Team ECPF focuses on the emergence of new diseases and a recent inflection concerns the scientific front of the demogenetics of forest pathogens. Team TC aims to develop participatory research with citizens. One of the pilot programmes is CITIQUE, an important societal theme relating to ticks.

Overall, the unit aims at excellence for its publications in the best journals of their discipline (300 peer-reviewed articles in 128 different international peer-reviewed scientific journals that are outstanding and of excellent quality as well as particularly prestigious journals (nearly $\frac{1}{3}$ of the articles) like *Nature Communication* (4 articles, 2 in last position and corresponding author), *Nature Ecology and Evolution* (3 articles, 1 last position and corresponding author), *PNAS* (5 articles, 3 last position and corresponding author), *New Phytologist* (29 articles, 11 first position, 10 last position and 11 corresponding author), *Plant Physiology* (3 articles and 1 first position), *Environmental Microbiology* (22 articles, 9 first position, 11 last position and 11 corresponding author). The high number of citations of articles also reflects the outstanding quality of the work published in the unit. As examples,

in *New Phytologist*, several articles are highly cited as Looney et al (2018) with 56 citations, Martino et al. (2018) with 137 citations, Morin et al. (2019) with 91 citations and Lorrain et al. (2019) with 67 citations.

The unit regularly presents papers at international and national conferences in invited lectures, selected oral presentations or posters (approximately 50 articles /year between 2016 and 2019 and, 9 and 35 in 2020 and 2021 respectively, due to the context of the Covid-19 health crisis). Invitations to symposia/congresses abroad reached 12, including for example "2nd International Conference on Wild Plant Pathosystems, Helsinki, Finland", "9th International Conference on Mycorrhiza" and "Online seminar series on "Iron-sulfur protein biogenesis 2021". The unit IAM published 236 conference proceedings during the evaluated period.

Weaknesses and risks linked to the context

A potential risk is the great multiplicity of research axes, in particular for team RSRR. Thus, the dilution of efforts could affect scientific production, especially since the status of teacher-researcher is also associated with a significant investment in teaching.

2/ Scientific production is proportionate to the research potential of the unit and shared out between its personnel.

Strengths and possibilities linked to the context

All the scientists of the IAM unit publish. The total number of IAM publications reaches 341 with more than 60% of published works led by members of the unit (first, last or corresponding author). At the unit level, the scientific productivity corresponds to 3.5 articles/full time equivalent scientist/year.

The scientific production shows some disparities between teams with teams RSRR and EGI being the most productive.

Team RSRR has published 102 articles (3.6 articles/ full time equivalent scientist/year) in 62 different international peer-reviewed journals, 45 of which are in the best journal of their discipline, and 51 result of international collaborations. A majority of these articles are led by RSRR members (55, 53, and 59 % as first, last, or corresponding authors respectively). 22.5 % of the articles of the RSRR team are co-authored with other teams of IAM. The RSRR team was invited to 4 international conferences in Germany, Spain and online as well as 6 invited seminars in Europe.

Team EGI has published nearly 200 articles (4.5 articles/full time equivalent scientist/year) with 41, 5, 32 and 38 % of the articles as first, last and corresponding author respectively. The articles shared between Team EGI and other IAM teams account for 13% of EGI production. The EGI team has been invited to 92 international conferences or seminars in Europe, Canada, Australia and China.

Team ECPF has published 50 articles (2.5 articles/full time equivalent scientist/year) in journals of excellent or even exceptional reputation according to NORIA of INRAE, 23 of which are from international collaborations and 5 book chapters. Among all the articles, 32, 20 and 38 % have a ECPF member as first last positions or corresponding author. 8% of the articles are shared with other teams of the unit. Team ECPF has been invited to 10 international conferences or seminars in Europe and Canada.

In spite of its recent creation, and although its activity is dedicated more to participatory science than to academic production, the "Tous Chercheurs" team has 7 publications (1.75 articles/full time equivalent scientist/year) to its credit, 2 of which are ranked Q1. Leader positions in all articles of Team TC are 43% first positions, 28% last positions and 43% as corresponding author. Shared articles between Team TC and other unit teams represent 28%.

IAM also published 39 review articles, among which 19 were published in 1st decile journals with journals as prestigious as *Science*, *Nature Review Microbiology*, *Annual reviews in Ecology, Evolution and Systematics* or *Trend in Plant Science*.

The excellent publication record, and the multiple international collaborations with co-publications and co-supervision of theses for all the teams attest to the quality of science, the reputation of the unit and the scientific soundness. Moreover, inter-team interactions contribute strongly to quality co-publications (nearly 27 co-publications) in journals ranked in Q1. The international partnerships produced 60% of the review articles and peer-reviewed articles (190 articles, 46% as first or last author). As examples, international partnerships were established with University of East Anglia (Norwich), Phytopathology Research, Rijk Zwaan Breeding BV, University of California Los Angeles, Shanghai Center for Plant Stress Biology, Universidad de Murcia,

Transversal federative projects combining complementary skills across the unit contribute to scientific productivity of high quality. For example, the axis "Mechanisms and evolution of the Poplar-Melampsora interaction" involving teams RSRR, EGI and ECPF published more than 20 articles over the period, including 11 articles co-authored by at least two researchers from two different teams. Other interface publications can be noted between teams RSRR and EGI on the "Microbiology of wood degradation" axis. Joint publications also exist between teams EGI and ECPF for the "ecology of fungal communities" axis, with several co-supervised PhD students by researchers from the different teams.

PhD and postdoctoral students contribute strongly to the scientific productivity of the teams and occupy relevant positions in the articles. In team RSRR, PhD and post-doctoral students contributed respectively to 50.5% and 25% of the total number of publications. In team EGI, they are involved in 48 publications as first authors and 56 articles as co-authors. In Team ECPF, their contribution represented 45% of the total number of publications.

Weaknesses and risks linked to the context

All the scientists publish, but a small core of scientists is the driving force for publication, which could constitute a weakness.

Key publishing scientists are emeritus or close to retirement and one of them has published more than 100 papers during the period. The departure of these key scientists is a potential weakness for the scientific production and its quality.

Team ECPF consists of a few scientists implementing long-term strategies such as population genetic approaches. These approaches require large-scale sampling campaigns on the territory or epidemiological approaches with devices deployed on a regional or national scale. As a result, the volume of scientific production is much more modest for this team compared to the others, even if the excellent quality of the work is preserved. The limited number of scientists is a weakness for team valorization.

In contrast to teams RSRR and EGI, which are strongly associated in cross-publications, team ECPF is clearly less associated which constitutes a weakness in the integration of this team in the inter-team projects. Team TC is only involved in 2 shared articles, one with Team RSRR and the other with Team EGI.

Except for the team EGI, international invitations are limited for the other teams.

3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science.

Strengths and possibilities linked to the context

The team leaders ensure the general supervision of the research and, as such, the principles of ethics and scientific integrity in agreement with the unit director. Regular presentation of work through seminars or presentations of experiment advances within the team or unit, with open and frank discussions of results, contributes to the quality control process of the research.

The unit's policy is to accompany the deployment of the national plan for open sciences with systems such as BioRxiv, HAL or Peer Community, and discuss the appropriate choices at meetings of the unit's management board, team or scientific council. In all published work, these systems are used to a limited extent, as the unit has registered 34 preprints in BioRxiv.

All scientists in the unit are aware of the existence of predatory journals and conferences.

The unit's management has begun to consider centralising data archiving at the UMR level. This is currently done by the teams on each site. The bioinformatics colleagues working on the PGD have integrated the notion of archiving source codes.

IAM supports the fact that data generated by public funds justify open science access but only after an initial exploitation of the project by the unit to avoid undue appropriation.

The unit does not carry out research using animal models. The unit management ensures that the research conducted remains as respectful as possible in order to respect the notions of scientific ethics and integrity.

Weaknesses and risks linked to the context

Despite the unit's and teams' centralised archiving efforts, the archiving of publications remains partly the responsibility of individual researchers, which constitutes a risk when a scientist leaves.

Attempts have been made to set up electronic notebooks (e.g. for genomics work) but no solution has yet been found.

Data access and co-publication policies, especially in open science, may differ in national and/or international collaborations and need to be clarified to avoid any risk of data leakage or result appropriation by competitors. The recognition of open science publications remains a point to be clarified within the scientific community and may constitute a risk.

The updating of publications through open dissemination is a weakness.

EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

Assessment on the inclusion of the unit's research in society

Overall translational and outreach activities of the unit are excellent, although unequally dispatched through its teams.

A whole team of IAM (TC) is dedicated to participative science. TC and its CITIQUE "pilot" project as well as the 12 new regional, national and european projects recently hosted and/or initiated by TC confer high public visibility to the unit due to broad success in the public, forest scientists and scientists from many disciplines, and to broad mediatic coverage. TC High level of publication for society is of high interest.

Partnerships with the non-academic and economic sectors are numerous and diversified in the other teams. Most emblematic are technological and methodological development for trufficulture that led to declaration of invention, patents and licences, and initiation of one start-up. IAM very actively communicates the results of its activity to the professional sector and general public, finding a broad audience in the media.

1 / The unit stands out by the quality of its non-academic interactions.

Strengths and possibilities linked to the context

Partnerships of IAM with the non-academic and economic sectors are numerous and diversified, illustrating the diversity of practical applications of the knowledge and know-how developed in the unit. The most representative aspects are probably the diverse projects developed mainly by EGI around truffle culture: those include the CULTURUF (partnership INRAE, FranceAgrimer, French fédération of trufficultors, agricultural school), DIAGNOTRUF (labex Arbre, WeTruf company) and SOLTRUF (INRAE, CEA, TSE company) projects, dealing with practical approaches as diverse as watering, truffle speciation, and truffle culture-associated agrovolticism. Worth mentioning also a large-scale international academic/private partnership involving, together with IAM, Bayer Crop Science, Syngenta, KeyGene, a foundation and several German and Brazilian academic partners on rust.

IAM mainly via ECPF is very active in information transfer to the socio-economic actors of the forest and trufficulture, via books, publications in professional journals (over 20 of them), technical data sheets (EPPO), expertises (for Anses, MAA), sanitary watch (Plateforme nationale en épidémiologie végétale).

A whole team of IAM (TC) is dedicated to participative science. The "Tous chercheurs" and CITIQUE programmes are unique in France and remarkable by the way they promote participatory science. This initiative is meeting great success in the public and is broadly advertised in media (see TC team).

Weaknesses and risks linked to the context

The diversity of IAM's translational activities implies complex management and follow-up requiring sustained involvement of personnel of the unit.

In spite of their very high public visibility and social impact, the truffle and controlled mycorrhization activities of IAM currently rely on two 80% time members of staff which is not sufficient to match the socio-economic demand.

Few PhD students or post-docs are funded by economic partners. Overall, private funding seems to be lagging behind considering the unit's translational potential.

From seven declarations of invention, only two have been licensed.

2/ The unit develops products for the socio-economic world.

Strengths and possibilities linked to the context

Overall, IAM's activity during the period led to seven declarations of invention (two of them with subsequent licensing) and one licensed patent. In 2019, IAM's know-how on tree mycorrhization also led to the creation of the start-up WeTruf by members of the unit. The latter recruited its first staff member in 2022. Another start-up (Biocode) is still in incubation. IAM's know-how about tree mycorrhization extends beyond truffle culture with morel and Laccaria culture development. IAM also ensures follow-up of ongoing licences, housing private partner's staff for quality control of mycorrhizal plants.

The TC team has implemented a tiquotheque and database in open access.

Weaknesses and risks linked to the context

Licence follow-up is time-consuming for IAM's staff.

The valorisation of TC expertise, pedagogical resources, procedures, and computer products has not been considered from an intellectual property perspective.

3/ The unit shares its knowledge with the general public and takes part in debates in society.

Strengths and possibilities linked to the context

IAM, due to its very popular research topics, has a very high visibility in the media and social networks. Members of all teams, but mainly EGI, contributed to diffusion of information and social debate via public conferences, exhibitions (Salon de l'agriculture, articles in the written press, radio and TV interviews (over 50), podcasts, as movie scientific advisors in major national media such as France Inter, Arte, France 5, as well as in international media. IAM members are also active within local and national administrations such as the "Conseil stratégique de la métropole du Grand Nancy" or the National Parliament.

Activities of the TC team are entirely dedicated to communication with and education of the general public (see Team 4). The different projects and the hosting of various audiences generate numerous interactions with the non-academic world and the socio-economic environment and lead the TC team to ensure numerous and varied actions of knowledge sharing with the public. In both cases, the staff of the TC team is involved in the supervision of these non-academic actors.

Weaknesses and risks linked to the context

While communication with the general public is a major strength of IAM, this activity is unequally shared by its different teams and mainly present in TC and EGI.

C – RECOMMENDATIONS TO THE UNIT

Recommendations regarding the Evaluation Area 1: Profile, Resources and Organisation of the Unit

In front of the massive departure of technical staff, it is essential that the unit take all steps to anticipate and support the creation of technical positions, avoiding a loss of skills and maintaining a good functioning.

It is also important to encourage the mixing of staff belonging to both supervisory bodies in the different teams. It is also necessary to encourage the hosting of young lecturers in the EGI and ECPF teams as well as the incorporation of technical staff INRAE in RSSR.

In addition to the mandatory Data Management Plan for any funded ANR project, IAM should set up a unit-wide Data Management Plan as soon as possible.

The organisation of periodic prospective seminars (1 or 2 days) and events involving both the scientific staff and the technical staff is strongly recommended so that PhD student and Post-docs of both sites meet and know each other. A young researcher club should be created.

The unit is recommended to free up human resources time for the management of the PepLor structures, or encourage the recruitment of staff to take charge of this management, which is currently still the responsibility of the unit's agents.

Recommendations regarding the Evaluation Area 2: Attractiveness

The strong international recognition of IAM should enable it to lead a major European project to provide substantial financial support and consolidate its position as a key player at international level.

Care should be taken to maintain enthusiasm of the unit members, in particular of the young ones, for applying for ANR and international funding.

Senior staff should help to boost international visibility of the younger members of IAM in order to maintain external funding at high levels in the next years.

The unit should keep striving to obtain recruitment of dedicated platform personnel from INRAE and LUE.

The pending situation of plant growth facilities requires an urgent solution: integration into one of the platforms or units, as well as sustainable funding.

Integration of the bioinformatic cluster into the EXPLOR platform of LUE should be accelerated.

The axis with the Max Planck could serve as a draft for a COST (European Cooperation in Science and Technology) network in the field of tree-microorganism interactions, and then apply as a carrier on European projects.

A visionary exercise would be useful to the whole unit to develop different scenarios and design a much stronger scientific identity for the future. The TC platform objectives could be integrated as a common thread between the 3 main teams.

The appointment of a referent within the unit,^[1] particularly on issues of ethics and integrity, would be positive.

Recommendations regarding Evaluation Area 3: Scientific Production

Continue the publication dynamic associated with quality.

Avoid dilution of efforts to increase scientific output and quality.

Optimise the internal expertise of scientific results by intensifying their presentation within the unit.

Validate the results externally with the expertise of scientists from other teams of the unit and by certifying the intellectual property.

Avoid publication driving by a few scientists and extend to all scientists.

Ensure a better integration of all teams in cross-publications, in particular in inter-team projects.

Ensure better archiving of publications at team and unit levels.

Clarify data access and co-publication policies with national and/or international collaborators in order to avoid any disagreement that could lead to data leakage or appropriation of results by competitors.

Clarify procedures for recognition and dissemination of open science publications.

A better balance between the publishing researchers should increase the publication strength of the unit.

Increase the number of invitations to international congresses or seminars for all teams except Team EGI.

Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

Keep striving to adapt IAM's administrative support to the complexity and workload of its translational activities. Strengthen the TC staff in order to cope with the diversity of tasks to be managed.

Secure the fundings for TC management with some new sources of funding for the long term.

Reinforce staff in charge of the truffle and controlled mycorrhization activities to match the socio-economic demand.

Strengthen private funding and better exploit Cifre funding opportunities. Pursue exploitation and licensing of declaration of inventions and patents.

Consider protection and further exploitation of the know-how developed by the TC team. Develop further and take advantage of the TC expertise, pedagogical resources, procedures, and computer products from an intellectual property perspective (methodology).

Encourage all teams to more actively share their knowledge with the general public, if possible via TC activities.
Develop communication programmes with the general public in all the IAM teams, and team up with TC for the communication campaign.
Develop TC as a national centre for PAR or SPR approaches

TEAM-BY-TEAM ASSESSMENT

Team 1: Stress response and redox regulation (RsRR)
 Name of the supervisors: Mr Nicolas Rouhier & Ms Mélanie Morel-Rouhier

THEMES OF THE TEAM

The team is focusing on structure-function relationships in enzymes submitted to redox regulation or involved in intracellular detoxification in plant and fungal models. RSSR's work is structured around seven main topics. Three are dealing with protein post-translational modifications in plants, including enzyme redox regulation, maturation of iron-sulfur proteins, protein persulfuration. One is focused on the enzymatic and biochemical characterization of plant and fungal glutathione transferases, and two others on the saprophytic fungi resistance to toxic compounds and role in polymer degradation. The last concerns molecular interactions between plants and a specific class of fungi, Pucciniales, responsible for plant rust diseases. This work is carried out using protein biochemistry, molecular and cellular biology and physiology at the molecular to organismal scale.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous recommendation was that RSRR could better integrate their scientific goals and projects, RSRR kept developing new research topics with the recruitment of new staff. A dispersion of the team therefore persists. Refocusing and construction of critical mass on the most promising research lines does not seem to be a priority of the team.

The team was encouraged to pursue the development of national and international collaborative programs. However, RSRR was active and successful in local and national fundraising, but only obtained very limited and punctual funds for international collaboration so far.

As recommended, in order to consolidate its reputation, RSRR further consolidated its leading position in the field of sulfur metabolism, publishing some significant papers, highlighted by specialists in the field. Yet the team seems to rarely target generalist top journals to increase its visibility and was not involved in international multi-partner collaborative projects.

In order to improve its interactions with the socio-economic world, RSRR was quite active in transfer activities to non-academic partners through five projects having as common focus development of sustainable bioeconomy. Yet communication with a larger public remains scarce, except for an emeritus member of the group.

With regard to training, an increasing number of young members of the team have taken PhD (co)supervision, yet the number of them assuming independent leadership in the activity could still increase, as one member assumed 7 Ph/D supervisions, probably with the agreement of the doctoral school.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	3
Lecturer and associate lecturer	5
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	0
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	5
Subtotal permanent personnel in active employment	14
Non-permanent teacher-researchers, researchers and associates	2

Non-permanent research supporting personnel (PAR)	0
Post-docs	0
PhD Students	9
Subtotal non-permanent personnel	11
Total	25

EVALUATION

Overall assessment of the team

RSSR stands out as excellent in its research and training activities. It keeps successfully developing and extending an original and increasingly promising research line on sulfur and redox metabolism in plants and fungi. The scientific production of the team is excellent, yet RSSR has the potential to do even better with respect to top standard publications. The group has a very good international visibility. It is an excellent fund raiser at the local and national level, but could strive to attract more international funds to develop more ambitious collaborative projects. RSSR is formed essentially of EC with strong involvement in training and training via research. The team keeps very actively fostering non-academic partnerships aiming at sustainable agriculture and bioeconomy, with a start-up in incubation. Communication with the non-academic world is good, but could be further intensified.

Strengths and possibilities linked to the context

RSSR benefits from a very favourable ecosystem encompassing Lorraine university of excellence, the Pôle A2F and the labex ARBRE and the Grand Est region providing significant and diversified funding opportunities. The team exploits it very efficiently, raising more than 1.3 M€ from these sources over the period. It was also quite successful raising support from ANR (seven projects, four of which with the team members as main leader). Overall, the team secured an average of 199 k€/year of regional funding and 321 k€/year of national funding.

The team has implemented in 2017 an original platform (ASIA), located in the lab and managed by the engineer of the group. ASIA is providing unique technology, expertise and training to study the regulation of protein biological activity and physiology and cellular interactions. It has obtained the quality label StAR-LUE of Lorraine university of excellence.

The solid tools and know-how built in the context of the historical work of the group on glutathione transferases currently permits the extension of RSSR's activity to the whole field of sulfur and redox biochemistry in plants and microorganisms. The field is currently in fast expansion and has increasing potential. RSSR is a well visible and recognized actor in this field both nationally and internationally as shown by 4 invitations at international conferences, six invited seminars in Europe and USA, and by the selection of two publications of the group for highlights or comments in *J. Biol. Chem.* in 2020 or *BMC Biology and New Phytol.* in 2017-2019. The originality of another *J. Biol. Chem.* paper carried by a young member of the team was recognized by a nomination at the Institut Universitaire de France as junior member in 2021.

Although mainly consisting in teaching staff (80%), some of which was only recently recruited (2 members), the team is very productive, with on average 3,4 papers published/scientist/year. This means an overall production of 107 peer-reviewed articles published on the period in 62 different international journals, 72% of them in the best journals of their disciplines. For 50 % of these articles, members of RSSR are first, last or corresponding authors. Some of the latter are published in the best journals in the field. To be mentioned for example 1 article in *Proc. Natl. Acad. Sci. USA*, 3 in *J. Biol. Chem.*, 6 in *New Phytol.*, 1 in *J. Exp. Bot.*, 1 in *Plant Physiol.* Worth mentioning also three reviews in the high impact series of Annual Reviews and Current Opinion. About half of the publications (51) result from international collaborations. Almost all of them are in open access. All members of the team are publishing. To be mentioned also the contribution of the team to an atlas of iron proteins: Encyclopedia of Inorganic and Bioinorganic Chemistry, Metalloprotein Active Site Assembly.

RSSR maintains and promotes an excellent synergy with team EGI, involving common grant applications and common publications (17) as well as co-supervision of PhD students.

Nine PhD students supervised by the team members defended during the contract. Nine post-docs were hosted (from 11 months to almost 4 years). All PhD students have been publishing, signing about 50% of the articles of the group. Students having defended during the period have signed on average 4,7 papers (1 to 12), half of them as first author. Most post-docs have published. Two others have manuscripts submitted or expect publications to come.

Five collaborative projects with private or socio-economic partners were initiated or running during the evaluated period with a total of 362 k€ of support funding. All of them were exploiting the know-how and tools implemented by RSRR to foster new applications in sustainable and green bioeconomy (such as biomass valorisation, prediction and tracing of wood durability, characterization of novel bioactive compounds, polymer degradation, bioremediation). In the context of the collaborative project AVANCE with the company Biolie, a technician was recruited supported by the ANR "Plan de relance", hosted 30% by RSRR and 70% by the company.

Team RSRR collaborative projects led to six declarations of invention. One of them sparked the creation of a start-up named Biocode, in incubation since April 2022.

One of the emeritus members of the team is very active in public, largely philosophic but also scientific, debate and diffusion of information, mainly through the online media "The Conversation", but also via videos. Other members contributed to videos available online. A PhD student of the group won the contest "My thesis in 40 seconds" in Lorraine in 2016, and was a national finalist of the contest.

Weaknesses and risks linked to the context

With three part-time technicians for ten scientists (8 of which with teaching positions), RSRR's technical support is clearly insufficient.

Available space and spatial organisation of the lab are not optimised.

Seven research topics and one technical platform for ten scientists (8 with heavy teaching duties and one engineer being platform manager) with support of three part-time technicians sound like thematic dispersion and insufficient exploitation of cooperation and synergies.

The quantitative scientific production of RSRR is impressive. Yet, although the team produces excellent papers, it rarely seeks to publish in the top generalist journals with high visibility. Publication rates between members of the team show large variations both for permanent staff and for students. Some post-docs seem to strive for valorization of their work.

The team did not raise significant resources from EC or other international funding agencies and does not seem to attract self-funded international post-docs.

Collaborations with private partners do not exploit Cifre or LabCom funding.

Diffusion of information to the non-academic world and general public is limited, concerning the general public mainly relying on an emeritus member of the team.

RECOMMENDATIONS TO THE TEAM

Keep striving to improve technical support.

Discuss with hosting and funding institutions to obtain facilities adapted to your needs.

The number of research topics seems to increase with each recruitment. Optimise cooperation and synergies via refocusing on the most promising research lines.

Even if it means decreasing quantity, seek moving the balance of publications to higher quality using top ranking journals. This would obviously require more cooperation and complementation, and tackling scientific questions using complementary approaches. The recent recruitment of staff members bringing novel competencies opens interesting possibilities to do so. Also seek to improve balance of publication rates among the members of the team (permanents and non permanents).

Better exploit international funding opportunities to support more ambitious long-term projects (EC, HFSP). For industrial partnerships, strive to better exploit PhD Cifre funding or LabCom opportunities.

Encourage young permanent members of the team to contribute to diffusion of information and dialogue with the non-academic world.

Team 2: Ecogenomics of interactions (EGI)

Name of the supervisor: Mr Stéphane Uroz

THEMES OF THE TEAM

The EGI team focuses its research on the forest trees and their biotic environment. They use multidisciplinary and multi-scale (from the genome, the cell to the region) approaches to study interaction of forest trees with their pathogens, symbionts, and the microbiota in general. Their research is broken down according to three main themes: (i) evolutionary genomics of fungi and of their modes of life, (ii) molecular mechanisms of the tree-microbe (fungi, bacteria, soil) interactions and (iii) functioning of forest microbial communities. The themes are inter-connected and knowledge gained from each theme feeds the others.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

There is no section in the current HCERES report for specific answers to previous recommendations, on a team-by-team basis, only recommendations to the unit as a whole are addressed. In addition, due to the outstanding outcomes of the team, there were only very minor recommendations. As a consequence, among the 4 recommendations of the previous evaluation:

1-The research strategy of the team is excellent and is delivering world class science but this is not fully represented in the journals they are publishing in. Interdisciplinary journals such as the Nature and Science journal families should be targeted and the publishing strategy revisited to elevate the research output. Given the quality of this work, team EGI should redouble its efforts to publish more of its research in the highest quality multidisciplinary journals.

2-The team should set up specific actions regarding outreach to be and to have a more strategic impact.

3-The team needs to look to develop international partnerships for Ph.D. training, Marie Curie ITNs would be a logical place to start. Formal Ph.D. involvement with outreach needs to be developed.

4-Develop a succession plan for maintaining continuity of skills.

Only responses for point 1 can be found in the individual report. The team has clearly improved its efforts to publish in high standard multidisciplinary journals, with one *Science*, eight papers in *Nature* journals and reviews in *Annual Review of Ecology*, *Annual Review of Phytopathology*, *Current Opinion in Microbiology* or *Current Opinion in Plant Biology*.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	6
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	14
Subtotal permanent personnel in active employment	21
Non-permanent teacher-researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	0
Post-docs	0
PhD Students	4
Subtotal non-permanent personnel	4

Total	25
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EVALUATION

Overall assessment of the team

The team is recognized worldwide for its achievements on fungal genomics and tree-fungi interactions and has pioneered the Ecogenomics (ecology & genomics). EGI's research output, funding capabilities and public outreach is excellent to outstanding. Future staff retirements may jeopardise research activities and team knowledge, thus requiring a strategic plan.

Strengths and possibilities linked to the context

The EGI team has been internationally acknowledged for its pioneering work on fungal genomics initiated decades ago, and the functional analyses of tree-fungi interactions. During the previous period, the team initiated studies to understand the rules governing mycosphere assembly and generated novel insights into the structuring of fungal and bacterial communities in temperate forests. This third axis of research now has become a full and innovative research topic, and it has to be underlined that the three research axes are interconnected (ca. 10% of the papers of the group are common to two or three axes), are of equal importance and productivity (for papers led by one team member: 48 papers for axis 1, 40 for axis 2, and 49 for axis 3), and together, make up a highly consistent research template.

EGI team is the leading group and published 60% of the papers of the IAM unit. In the previous evaluation, the team has been acknowledged as "an outstanding team, delivering internationally excellent research. It is internationally recognised in its focus areas of research. The group should be commended for the quality of their work and engagement with the academic community." This scientific international recognition has even increased during the evaluated period with a high number of 193 publications for 35 permanent staff, most of them (60%) being led by one group member, and 70% of them being classified as "outstanding" or "excellent" by NORIA. One particularity of the group is that among the four "highly cited researchers" it encompasses, three are engineers (including one IE). This is very unusual and deserves to be highlighted. In addition, one must underline the strong policy to fight against predatory journals, with a volunteer limitation to less than 5% for publication in *Frontiers* or *MDPI journals*.

The international appeal is also shown via the huge number of long-lasting and efficient international collaborations producing a minimum of 31 co-authored publications with partners.

There have been 12 Ph.D. thesis defended in the period (plus one that gave up), less than in the previous period (14), and four additional in progress. This slight reduction may likely be due to the Covid crisis preventing, among others, exchanges of foreign students for a long time period. All PhD students publish as first authors with an average of three publications per student, and they are involved in the life of the team, even on practical issues, thus contributing to the building of team spirit.

At the local level, the team has been instrumental in the building, and still is leading the labex ARBRE. It benefits from a series of fundings, including recruitment funding from the Oak Ridge National Laboratory (ORNL) from the USA on plant-microbe interactions. It also strongly benefits from its interactions with JGI providing for free mammoth amounts of genomic/transcriptomic data.

The team had outstanding outreach activity during the period with more than 50 involvements in TV or radio programmes in National media (Radio France, France 2), involvement as experts in movies for Arte and France 5, and involvement in screening-debates.

Weaknesses and risks linked to the context

While the team has important manpower and expertise, a series of retirements are likely for the next period (2 DR, 5 AI or technicians, one IE)..., but the loss of technical staff and the accompanying "historical" knowledge of the team, while general at INRAE, may be a threat for scientific activity and extension activities and the team must anticipate it. Yet, a new CR position has been recruited for September 2022.

One of the most visible and active scientists of the group, strongly involved in interactions with China, and in truffle research may also retire within the next period. Plans for maintaining these activities have to be thought over.

There is one main threat to applied research (truffle and controlled mycorrhization) in the team, strongly dependent on technical staff and necessitating infrastructures requiring important human investment. While these two projects are unique at the national level and of importance for the socio-economic partners, additional support through permanent positions would be necessary/welcome.

Only one HDR has been defended in the period. The retirement of senior scientists will only leave 4 HDR in the team. Promotion of young scientists and IR to pass the HDR is important.

The strong involvement in interactions with China, while of strategic importance, may also be questioned in the current complex international context.

The massive amount of data generated by JGI, while being freely accessible, and of general importance for the whole of the community, cannot be treated by the team, and only very marginally transformed into research questions. What may be the future of this interaction with JGI and how can the team best exploit these genomic data?

RECOMMENDATIONS TO THE TEAM

The team is globally excellent to outstanding, with few weaknesses. Major risks in the short- to mid-term are derived from future retirements and a decrease in number of researchers. While there is confidence that the remaining team can maintain research outputs commensurate with international excellence, a detailed strategy that specifies the number of targeted recruitments in the future, continued fundamental and applied research activities and knowledge transfer is recommended.

Team 3: Ecology of forest pathogenic fungi (ECPF)

Name of the supervisor: Mr Pascal Frey

THEMES OF THE TEAM

The ECPF team focuses on the fungal and oomycete pathogens of forest trees. The research falls into the following four main themes: 1) emergence of forest tree diseases and their causes, 2) pathogen dispersal and genetic consequences, 3) host pathogen adaptation and 4) effect of diseases on forest stands. The research scales from the individual, population and community level within natural and managed forest ecosystems, and spans the disciplines of population genetics, epidemiology, community ecology and modelling. Fungal tree disease case studies include ash dieback, larch death and needle blight of conifer trees, and with involvement in a transversal IAM unit project on poplar rust.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Four main recommendations were made to the ECPF team. Though these recommendations were not directly addressed within the ECPF team's self-evaluation, some relevance to these points are seen within the evaluation.

1. The ECPF team had a decreasing trend of scientific papers and average journal impact factor across the evaluation period. It was recommended to keep up on planned and well executed work. Relevant to this point, it was mentioned that the team has "long-term" publications, several years of data collection and lengthy analyses (Ref. 2, C1.), and speculatively this could relate to the decreasing publication trend found across the period. A similar decreasing trend is also apparent for this period, with a high of 14 publications in 2016 and the lowest in 2019 and 2020 (1 and 4 papers, respectively).

2. It was suggested that the international initiatives could be improved, through attracting more international postdocs, and leading international collaborations. In the evaluated period, the team now includes that 23 of their 38 publications result from international collaborations in mostly the EU but also beyond, and have obtained 1 EC funded project as a partner, but with no evidence for the attraction of international postdocs (1 postdoc during the period, FR).

3. It was recommended to continue to work with poplar breeders and health authorities, and to provide seminars, interviews and organised meetings, and also to consider new avenues for reaching the general public, such as social media. Regarding point 3, the team has continued to work with DSF and ANSES (funding a PhD student), and has participated in several general public events (science festival, magazine, radio, news interviews, debates) and social media via twitter.

4. There was concern that the number of papers by PhD students was decreasing. It was recommended that it was important to stay up to date with developments in molecular biology and evolution, and to be more active in engaging in doctoral training schemes (e.g. Marie Curie ITN). There is now a good average of 3 papers per thesis during this report period, but no evidence was provided for engagement in doctoral training schemes.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	2
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	7
Subtotal permanent personnel in active employment	10
Non-permanent teacher-researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	0

	Post-docs	0
	PhD Students	2
	Subtotal non-permanent personnel	2
	Total	12

EVALUATION

Overall assessment of the team

ECPF continues to work diligently and successfully in the field of forest tree diseases, including several important pathosystems. The team is excellent at raising national funds for projects, but could better exploit EU funding opportunities and schemes for international collaboration. While the publication record of the team is very good, the team could strive for a greater number of publications per researcher and within higher quality journals. Dissemination of research to academics and society is good. The team is intermediate in size, consisting of all INRAE staff, and could strive to attract candidates for postdoc fellowship applications, visiting professors and open competitions.

Strengths and possibilities linked to the context

ECPF is one of two teams in France dedicated to the important discipline of forest pathology, and are on the research forefront of emerging tree diseases. This is demonstrated by the productivity of the team and recognition and collaboration at the national and international level, and with non-academic collaborations with the Department of Forest Health (DSF), ANSES, and GIS Peuplier.

Considering its intermediate size [3 DR/CR researchers; 12 INRAE staff members in total (1 CR and 2 IE lost, 1 IR recruited)], the team acquired significant funds for operation during the period; 950K€ of national/regional funding (6 ANR, 4 Ministère MAA, 2 INRA, 1 regional agency) and 83K€ of international funding (1 EC H2020), resulting an average of 181K€ per year of funding.

The team's portfolio of research evenly spreads across their 4 main axes of research. The publication record is very good, with 38 articles published within topic specific (e.g. *Forest Pathology*) to more generalist journals (e.g. *Applied and Environmental Microbiology*) mostly classified as high quality (11% outstanding, 61% excellent, 18% correct; INRAE's NORIA classification). Several papers are on the topic of ash dieback and poplar rust. Of these publications, 24 (63%) included a member being first, last or corresponding author, with at least 12 being in mid-tier or above journals (e.g. *Molecular Ecology*, *Journal of Ecology*, *Environmental Microbiology*). Based on the average number of researchers/engineers during the period, 1.3 publications/full time scientist/year was produced. Most members contributed to the publications, with almost half (17 articles) including PhD/postdoc as co-authors (94% first authors), 4 publications with co-authors from other IAM teams, and 61% of publications were derived from international collaborations. All but 3 publications are open access. Also, 5 book chapters and 3 monographs were produced.

ECPF was very active in the participation of various symposiums, conferences, and workshops. In total there were 50 productions, mostly all consisting of first, last or corresponding author contributions, and several of which being international conferences. PhD students were co-authors of 19 of the productions, and 16 included co-authors from other IAM teams. Also, there were 5 invitations to symposiums/conferences (France, Sweden, Finland and UK) and 3 for University/Institute seminars. The team also co-organized 1 international conference and 3 national symposiums.

During the report period, there were 6 PhD students - 4 defended their thesis and 2 students joined in 2019. All but 1 student defended within 36 months from starting. ECPF members directed 5 of the 6 theses, and with 4 of 6 co-supervised by members of other teams. Funding stemmed from diverse sources - two contracts supported by ANR, 1 EC H2020, and 1 DSF/ANSES funding. The team also supervised 22 interns/master students (stagiaire).

The team demonstrates good participation in science communication to society through the production of 4 animations, participation in a science festival (Fête de la science), and several magazine, radio and news interviews (15 in total), and debates (11, with 8 including other IAM team members). They also participate in awareness-raising activities for school children. ECPF has also produced 4 technology/professional reviews.

Weaknesses and risks linked to the context

The team is intermediate in size (12 INRAE members), and currently there are only 3 DR/CR researchers, and additionally a technician who will be retiring in 2022 and is responsible for management of field experiments. This positioning does not allow for maximising responses to emerging diseases and increasing research productivity. In this respect, the poplar rust, the historical model of the team, and the one that is represented in all four axes, allows in-depth dissection of all relevant aspects of forest pathology and links with other teams. In addition, the inflexion towards demogenetic approaches may be a complicated choice that will only be relevant for a few models with specific life traits.

The main weaknesses of the team are their intermediate size, their specificity in forest pathology and emerging tree diseases, with few national teams (but significant interactions with foreign labs) working in the same area, resulting in relative scientific isolation. Conversely, the isolation mentioned from other population genetic teams in France does not seem to be a weakness in view of the highly dynamic French community on these approaches.

The team is composed of all researchers/engineers/tech. and no teacher-researchers for maximising synergies with higher education on Forest Pathology.

The team has maintained a restricted flow of publications. They have less publications/researcher/year - ECPF with 1.3 when compared to RSRR and EGI with 3.4 and 5.6 per researcher per year, respectively.

While the team has a strong network of national and international collaborators, projects are mostly coordinated by collaborators (4 of 6 ANR; all 3 MMA and the EC project), and major exploitation of EU funding schemes was not apparent.

Participation in editorial boards appears to involve only 1 member of the team, who is an editor for 2 journals. This underappreciates the potential contribution of the team to the larger scientific community, although no information is provided in regard to serving on e.g. grant panels.

There appears to be a CR (started in 2006) that doesn't have an HDR, thereby further limiting the already small pool of researchers (2) that can direct a PhD thesis.

There is no joint project and interactions with industry.

RECOMMENDATIONS TO THE TEAM

With a larger cohort of researchers (and postdocs) the 4 research themes of the team could be better supported, and synergistic opportunities increased and potential for leading to higher productivity per researcher. The committee recommends to continue collaboration efforts with the mycology unit of the LSV of ANSES, ease joint project opportunities, work towards securing the emerging diseases in forests pole through the proposed merger with the mycology unit, and search for exceptional candidates to join the team through INRAE's open competition.

The team is recommended to strategize project experiments to produce 'short and long term' derived datasets for publications and aim for publishing in at least mid-tier journals.

The team should be able to drive forward international research agendas through coordination of projects from EU funding schemes and e.g. ANR-PRCI.

The committee recommends that the team seeks out candidates and opportunities to obtain international postdocs and visiting professors through various programs (e.g. Fulbright, HFSP, Marie Curie) and for knowledge exchange and preparation of joint grant applications.

The team should increase interactions with industry for development of e.g. tree pathogen resistance through breeding, by utilization of joint funding schemes e.g. Marie Curie ITN-Industrial partners, COST actions, ANR-PRCE.

The committee also recommends increasing dynamic exposure of the team and research outputs through updating and modernization of the team webpage and with links to existing social media accounts.

Team 4: Tous Chercheurs
 Name of the supervisor: Ms Annick Brun-Jacob

THEMES OF THE TEAM

The TC team, dedicated to participative science, has been so far mainly focused on tick and Lyme disease (the CITIQUE project) to build a database on the ecology of tick bites and a collection of tick samples from diverse origins to answer diverse scientific questions and raise awareness of the public about the risk resulting from tick bites.

For the participatory approach the main missions, themes and activities are:

1. The education of non-scientists to the research process in immersion in an open laboratory equipped with real scientific equipments, which is an essential prerequisite to understand how scientific knowledge is generated and to be able to develop a critical thinking.
2. The constitution of a database on the ecology of tick bites as well as a tick library gathering ticks sent by citizens in order to make this unique biological resource in France available to researchers.
3. The participation of citizens to research internships in the Tous Chercheurs laboratory where they themselves analyze ticks sent by other citizens

Since 2018, the "Clés de Sols" project on "Soil Diversity" and quality has also been supported by the TC team. New themes have recently are currently addressed by TC. They refer to the following projects. At the regional level: Prophet, Millefeuille, Ecologie Chimique Inverse, Sylvothérapie, Mallette Eco'citoyenne. At the National level: Clés de Sol n° 2, Tous en sol, Sols périurbains et maraîchage, Tunique anti-tique. At the European level: Teatime 4EU, Benchmarks, EJPSOIL.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The TC (Tous Chercheurs) Team was created in 2020 and thus was not evaluated in the previous evaluation.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	1
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	0
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	4
Non-permanent teacher-researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	0
Post-docs	0
PhD Students	0
Subtotal non-permanent personnel	0
Total	4

EVALUATION

Overall assessment of the team

TC activity in participative science is excellent. The "Tous chercheurs" and CITIQUE programmes are unique in France and remarkable by the way they promote Participatory Action Research and Citizen Sciences. TC was until recently focused on tick and Lyme disease (CITIQUE project). Its scientific production mainly consists in a database on ecology of tick bites and a collection of tick samples from diverse origins to answer scientific questions and raise awareness of the public about the risk resulting from tick bites. It also provides students recruited to supervise the internship an opportunity of outreach activity recognized by the doctoral school as a training session. TC is self-sufficient and supported by a broad network and funding sources from national and regional institutions. The initiative is meeting great success among various publics and broadly advertised in the media. Scientific publications of TC are still modest in relation to its recent start, but is expected to increase with exploitation of the CITIQUE tools by the scientific community. Potential risks for the future of this team pertain to the heavy workload resulting from fundraising, funding management and planned thematic diversification.

Strengths and possibilities linked to the context

The "Tous chercheurs" and CITIQUE programmes are unique in France. They are both remarkable by the way they promote Participatory Action Research (PAR) and Citizen Sciences (CS) within the INRAE network and other research institutions. They are a source of inspiration for other Participatory and Science Research (PSR) programmes in France. It is also one of the main lines of development of the Science Research-Society dynamic carried out by the University of Lorraine in partnership with the academic structures of the region (INRAE, INRIA, CNRS, INSERM, CHU).

The subject of tick ecology and associated pathogens is addressed by a participatory approach with non-scientific actors but in close collaboration with a wide range of research teams, with the aim of answering questions of major importance in terms of human and animal health (ticks are the primary vectors of disease in humans and animals in Europe). The TC team is thus taking on a subject of very high scientific and societal value. The platform welcomes different types of public, from high school students to citizens of all ages, who experience the research process like researchers. This unique platform in France is mentioned in the LPR report (paragraphe 247) as a model to follow which represents a form of recognition to the concept and enlighten what TC can bring to "*faire de la recherche autrement*".

The CITIQUE benefits from the funding support of different partners (health professionals, insurance companies), and local and regional public actors. The TC team has been able to raise some very significant resources to build a support platform, which is housed at the INRAE Grand Est - Nancy Centre in an old building that has been completely renovated.

Many students involved in the programme get the chance to be trained into Science and Participatory Research (PhD and postdoc, Masters) or to the scientific process (middle school and high school students). Thus, more than 600 students were welcomed in the TC laboratory between 2016 and 2021, including 132 middle school students and 472 high school students.

The CITIQUE project aroused strong interest among researchers from very different disciplines: human and veterinary health, epidemiology and ecology, economic sciences, sociology, etc. Many of the results already obtained are sources of new research questions, often multidisciplinary, and are the subject of partner's submitted projects.

Since 2018, the participatory research project "*Clés de Sols*" on "*Soil Diversity and quality*" has been supported by the TC team. This project is in line with the scientific strategy of the unit, which is interested in the study of a continuum of tree-fungus bacteria-soil interactions, on a major societal issue (soil quality).

These efforts are broadly acknowledged by a very wide dissemination of the team's actions in all forms of media. The team is developing formally drafted participatory science and research project engineering procedures that can be used as a reference when more precise frameworks need to be established for the development of new citizen science platforms.

At the end of 2021, the TC team was awarded the "Prix de la Recherche Participative 2021" for the CITIQUE project in the category « Crowdsourcing ». The recent labelling of this project by the MESRI (April 2022, only 8 winners among 30 applications from university sites) underlines the importance of the actions.

Weaknesses and risks linked to the context

TC is currently managed by two part-time permanent members of IAM's staff helped by occasional (often short-term) recruits and relies on PhD and postdoc student involvement. The administrative procedures for hosting many short term staff are time consuming and complex.

However the small TC members team do not have enough time left to capitalise on the methodology and PAR approaches, as well as on the CITIQUE resources and results and to translate them into a series of scientific articles which would be very welcome in the scientific community. However, during the period 2016-2021, the TC team has contributed to seven scientific articles in peer-reviewed journals based on the first results brought by the CITIQUE program.

Funding is hard to raise and sources are very dispersed which require much energy from the two coordinators. The successes of the CITIQUE initiative should not mask certain risks for the future, in particular with regard to the very heavy workload that is expected to result from TC activity diversification.

As far as doctoral students are concerned, many of them are involved in the supervision of citizen research internships for their research expertise and their knowledge of the scientific process, but not for their thesis projects per se.

RECOMMENDATIONS TO THE TEAM

TC should keep striving to consolidate its staff and activities with recruitment of full-time personnel and to obtain recurrent institutional funding. Secure some new sources of funding for the long term.

The TC staff EC at UL could be lecturing within the TC platform itself and not only at university. Part of the TC platform activities are devoted to teaching research methodologies to students.

TC members should keep striving to secure a scientific output from the CITIQUE project with publications.

TC must have a more integrated approach to PAR including the three other IAM teams.

Explore the opportunity to welcome personnel having expressed the desire of professional development and asked for mobilisation.

Strengthen the scientific expertise of TC in terms of methodology. The team's vocation is to extend the expertise it has acquired in the design, animation and implementation of the CITIQUE program to other fields of research related to major societal issues such as global changes.

Develop TC as a national centre for PAR or SPR approaches. Discuss the option of having TC as a national platform for INRAE. Developing TC as an incubation centre for the similar PAR programs is very timely and relevant. The development of the TC platform is in line with the evolution of the research processes in France. The demand for know-how and expertise in developing PAR projects is exponential.

The valorisation of TC expertise, pedagogical resources, procedures, and computer products could be considered from an intellectual property perspective.

CONDUCT OF THE INTERVIEWS

Date

Start: 08 September 2022 at 08:30am

End: 08 September 2022 at 18:00pm

Interview conducted: online

INTERVIEW SCHEDULE

8h45-9h00 Closed meeting of the committee + Hcéres Scientific Advisor

9h00 Open session:

9h00-9h15 Introducing the committee and the Hcéres evaluation process

9h15-9h50 General presentation of the unit: 15 min + 20 min discussion

9h50-10h25 Team 1 presentation: Stress response and redox regulation (RsRR): 15 min + 20 min discussion

10h40-11h15 Team 2 presentation: Ecogenomics of interactions (EGI): 15 min + 20 min discussion

11h15-11h50 Team 3 presentation: Ecology of forest pathogenic fungi (ECPF): 15 min + 20 min discussion

11h50-12h25 Team 4 presentation Tous chercheurs (15 min + 20 min discussion)

12h25 -13h30 Closed: debriefing and lunch break

13h30: Restricted sessions

13h30-14h00 Meeting with the scientists (DR, CR, IR, Pr, MCF)

14h00-14h30 Meeting with the support staff (in French) (IE, AI, T)

14h30-15h00 Meeting with non-permanent staff (Ph.D students, post-doc, personnel with short-term contracts)

15h30-15h30 Meeting with the supervising bodies

15h30-16h00 Meeting with the direction of the unit

16h00-18h00 Closed meeting of the committee

GENERAL OBSERVATIONS OF THE SUPERVISORS

Nancy, March 9, 2023

**Direction de la Recherche et de
la Valorisation**

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Objet : General comments on the evaluation report - DER-PUR230023131 – IAM
(Interactions Arbres Micro-organismes).


Dear Sir or Madam,

Thank you for the evaluation report made for the research unit IAM (Interactions Arbres Micro-organismes), that you sent us on February 6, 2023. I would also like to sincerely thank the evaluators for the quality of the exchanges and for the analysis of this research unit.


Please find attached the general observations made by the unit on the evaluation report submitted.

Thanking you again for this evaluation which will allow the joint research unit IAM to continue its reflection on the basis of the recommendations made, please accept, Madam, Sir, the expression of my respectful greetings.

Vice President of the Scientific Council,



Alain HEHN



Answer from the UMR 1136 IAM to the Hcéres committee's report

CAMPAGNE D'ÉVALUATION 2022-2023 VAGUE C

We thank the Hcéres committee for the detailed analysis of the UMR IAM *Document d'Auto-Évaluation* (DAE), the visit and exchanges with the UMR personal on September 2022 and for the positive report transmitted to the UMR in February 2023.

We acknowledge all the recommendations sent to the UMR, which clearly mirror many of the actions that the UMR already envisions for its next project over the 2024-2028 period: this is a solid support to strengthen our future scientific orientations.

We particularly acknowledge the priority recommendation to strengthen recruitment of new technical staff. There is a crucial need for more support in the RSRR team at University, in the EGI team at INRAE which suffers from recent retirements and in the recently created Tous Chercheurs team. We hope that both the tutelles UL and INRAE will support the demands already expressed by IAM in this direction. Discussions have started between IAM, INRAE and UL to clarify the status and position of the Tous Chercheurs team. We hope that this unique and very successful team will pursue in a stable and safe environment for the benefice of its *participatory science and research* project. All recommendations for the creation of a young researcher club, and periodic strategic seminars with both technical and scientific staff will be implemented in the frame of the future project of the UMR IAM. We also do agree with the recommendation made by the committee to increase IAM international attractiveness. Some of the weaknesses and risks were already identified and we plan to address these aspects in the frame of the next IAM project.

There are a few points for which the unit would like to bring answers or comments.

- We felt some contradictions in the report concerning the size and the capacity of the IAM unit in terms of goal and ambition on international projects. On page 8 it is stated that scientific ambitions are too large for a team and later on that it should deploy more efforts to host European projects (the said team is already part of European projects). There is the mention of a lack of direct international funding and lead of international projects in the unit, which is contradictory to the PMI project which has been running for more than ten years now and the strategic lead of international consortia with the JGI. Also, we would like to bring to the committee's attention that several attempts were made and submitted to European calls in the period 2016-2021 by members of the unit without success. In fact, both teams RSRR and ECPF have started international collaborations and projects in 2022 and 2023. Finally, obtaining more international funding might not be a priority requirement since both the funding capacity and international collaborations are pointed out as sufficient by the experts.

- The committee questions on page 7 what the unit intends by « *strategic choices in terms of recruitment* »? We meant that we managed the scientific orientations of newly hired scientists in the unit. e.g.: plant physiology at EGI and RSRR to strengthen our expertise on both sites; strengthening of transversal topics on wood microbiology and poplar-rust pathosystem at RSRR; strengthening bioinformatics at EGI and emerging diseases of forest trees at ECPF.

Related to the previous point, we do not understand the remark from the committee on page 11 « *The solutions to maintain the link between the two sites are not very convincing* ». We are surprised by the lack of confidence on this point. We have positioned two young lecturers at RSRR (among the five most recent additions to the unit) on transversal topics, i.e. with intention to support transversal projects between UL and INRAE teams. For one of them, there are already several publications with the two other teams at INRAE and one PhD co-supervised. The other lecturer joined the unit in 2021.

Up-to-now, we have also demonstrated that positioning PhD students and projects at the interface between researchers from the different teams was an effective mean to strengthen the link between the two sites and we are pursuing this effort. Also, the existence of platforms on the two sites is effective to support

such exchanges. There are currently several ANR or Labex projects set between researchers of the two sites and the different teams. Altogether, these actions motivated our answer to this remark.

- We do not fully agree with the statement made on page 15 « *a small core of scientists is the driving core of publication* » and the focus given in the report to the possible retirement of said productive scientists. It is true that the remarkable international scientific contribution and recognition of Francis Martin's research directly impact the volume and quality of IAM production as well as the international visibility of the EGI team and of the UMR IAM. This being said, the production of IAM researchers is diversified and rather homogenous in the different teams (e.g. survey based on the *Web-of-Science* as a source, h-index, numbers of articles and citations as a reference over the period 2016-2021). Except for our emeritus colleague and two close-collaborating engineers, a majority of researchers in the three teams range from an h-index of 8 to 12 with significant numbers of publications on personal projects set within their own networks. In conclusion, there is a sufficient core of productive researchers between 35 and 55 years-old in the different teams, ensuring a certain stability for the future project of the unit. When our colleague will cease his research activities (which is not yet planned!), the overall IAM production will undoubtedly drop but will be in accordance with a productive research unit of our size.

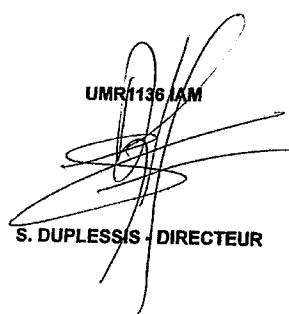
Presently, our colleague Francis Martin is hosted as an INRAE emeritus DR (page 5 of the DAE) for a 5-years period. Among the missions set in accordance with the ECODIV division is the transfer of expertise and support for collaborations to his closest collaborators. This has been engaged as stated on page 9 of the DAE. For instance, in the latest version of the PMI project with the ORNL, Claire Veneault-Fourrey is identified as co-PI. Similarly, Annegret Kohler is already identified by our historical partner JGI and should be in a leading position for the unit on genomics projects. Finally, another mission is to clarify the opportunities with Chinese partners from Francis Martin's recent partnerships. This task is a priority target for our next project.

Finally, a significant number of recommendations proposed by the committee are already in place in 2023 and were considered before the report from the committee was transmitted by the Hcéres and they will be part of the new IAM project (2024-2028). We regret the decoupling which was imposed by the evaluation agenda between the general review performed by this committee and the IAM future project which could not be shared beforehand with the committee.

We once more thank the committee for its recommendations as they support our current actions and will help to strengthen our future project.

Sebastien Duplessis
Director of the UMR IAM.

UMR1136 IAM



S. DUPLESSIS - DIRECTEUR

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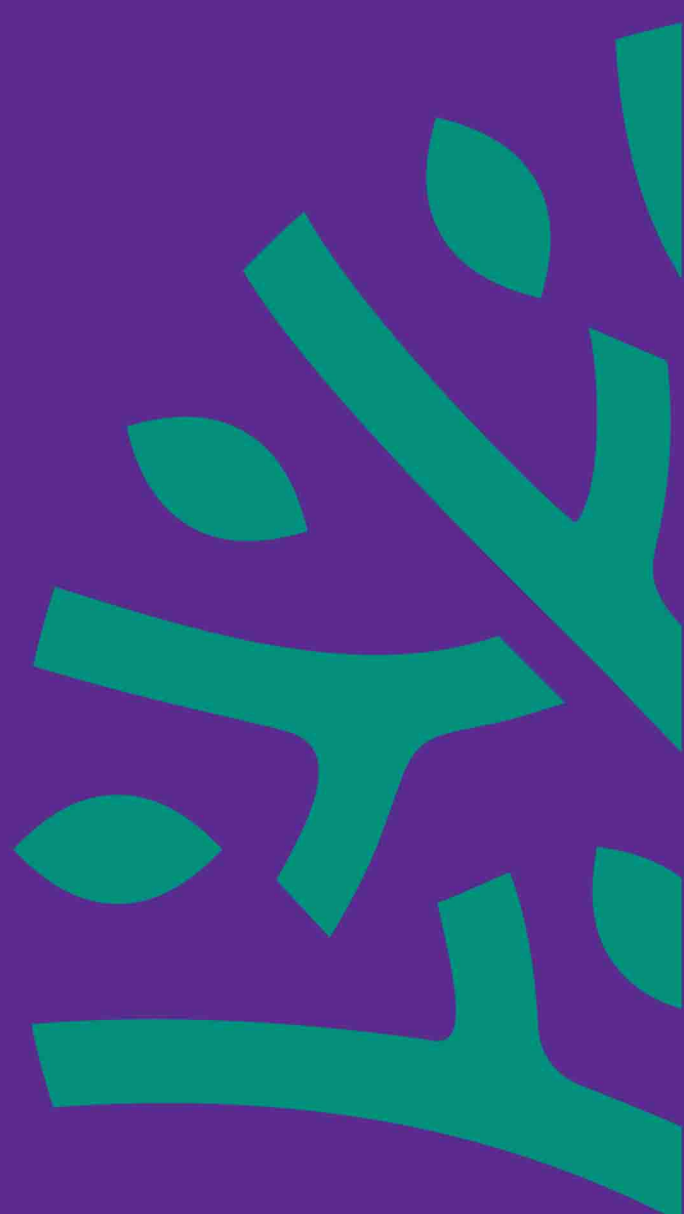
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