Strengthening Sustainable Public Finances Through Scalable and Cost-Efficient Laboratory Services

Impact story: Genome Center of Eastern Finland

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1. Impact objectives

The Genome Center of Eastern Finland (GCEF) functions as a core facility and a provider of gene diagnostic services, with growing role in serving external clients.

The project aimed to **activate and expand the service operations** through 1) renewing sequencing capacity, 2) implementing automated workflows, 3) providing shared access to advanced technologies, and 4) broadening high-precision diagnostic and research services. Together, these objectives build efficient, consistent, and scalable laboratory workflows, that support **sustainable public finances** (Table 1).

2. Actions

The project strengthened sequencing capacity and automation by **acquiring high-technology instruments** selected for both fitness-for-purpose and class-leading efficiency and enabling end-to-end, low touch workflows from extraction to analysis. As UEF's core facility, GCEF provided **shared access and expert consultation** for research groups in health and environmental sciences. Supported by the new instrumentation, the project enabled 1) **the development, validation and accreditation of clinically oriented, targeted gene panel** with structured reporting practices to aid clinical decision-making and 2) **development activities to further expand the diagnostic testing portfolio**. The project advanced environmental DNA (eDNA) analytics by **introducing several service-ready qPCR-based assays** for detecting individual species from environmental water samples. These actions were anticipated to enable flexible, efficient, consistent and scalable operations, fit-for-purpose diagnostic testing and growing uptake of fast and sensitive eDNA services.

Table 1. Impact chain from the project aims to medium- and long-term impacts on sustainable public finance

Main objective	Intermediate objective	Actions	Outputs	Outcomes	Medium- and long-term impacts	Sustainable growth dimension
Activation and expansion of service operations	Renew and automate sequencing capacity	Acquire high-tech instruments; implement automated workflows	End-to-end, low touch workflows; reduced hands-on-time; lower inter-operator variability; higher throughput	Flexible, efficient, consistent and scalable operations	Increased cost-efficiency; shorter turnaround times; improved planning and budgeting; reduced need for repeat analyses and overtime work	Sustainable public finances
	Provide shared access to advanced technologies	Operate UEF core facility; increase and maintain expertise	Shared access to sequencing and molecular analyses	Higher utilization rate; centralized maintenance and troubleshooting	Avoided overlapping acquisitions; shared funding for service contracts and consumable/reagents	
	Broaden high-precision diagnostic and research services	Develop, validate and accredit targeted diagnostic tests	Expanded diagnostic testing portfolio	Fit-for-purpose testing	Right-sized testing; shorter decision cycles; decreased number of repeat tests	
		Develop species-specific qPCR assays; introduce eDNA services	Service-ready eDNA workflows for water samples	Faster and more sensitive detections; growing user uptake	Increased cost- and time-efficiency; improved planning and budgeting	

3. Successes and challenges

The project successfully renewed sequencing capacity and implemented automated workflows. The new infrastructure established **an end-to-end, low-touch workflow** from nucleic acid extraction to analysis. This development reduced hands-on time and inter-operator variability and created readiness for higher sample throughput.

As a UEF core facility, GCEF successfully enabled high-quality research. Several research groups utilized the infrastructure and expert support during the project, demonstrating **active and efficient use of shared resources**. Outreach to the Department of Environmental and Biological Sciences at UEF proved particularly effective in increasing awareness of the capabilities of GCEF. However, toward the end of the project, it became evident that internal visibility and communication within the university should be further strengthened.

Building on the renewed infrastructure, the project succeeded in **expanding the diagnostic service portfolio**. A key challenge in launching new diagnostic tests was the length and complexity of accreditation processes, which required careful validation, iterative documentation, and proficiency testing, leading to long lead times before bringing new services into routine use. Another significant challenge was securing a sufficient and predictable sample flow, which is essential for cost-effective operations. To address this, collaboration with clinicians was strengthened and will continue beyond the project period.

In addition to diagnostic testing, the project successfully introduced **a new service type of qPCR-based eDNA assays**. Progress in expanding eDNA testing through metabarcoding has been slower. While metabarcoding is expected to become an essential tool in ecological
research and global conservation, its implementation requires substantial expertise and extensive method validation.

A new ERDF-funded project, DNA-TUUMA, started in the beginning of 2026 will continue strengthening the infrastructure, broadening the research applications, and expanding the customer base.

4. Impact mechanism

Concrete outputs of renewed infrastructure led to immediate service-level outcomes, including increased **flexibility, efficiency, consistency, and scalability of operations**. These outcomes enable cost-efficient service delivery with shorter turnaround times, supporting sustainable public finances. In the longer term, these effects further improve planning and budgeting and reduce repeat analyses and overtime work, further strengthening the sustainability of the service system.

Providing shared access to advanced technologies to UEF research groups leads to **higher utilization rates of the instrumentation and centralized maintenance and troubleshooting**. Over the medium and long term, shared access avoids overlapping acquisitions across units and institutions and enables shared funding of service contracts and consumables/reagents, supporting sustainable public finances through better use of shared resources.

The resulting outcome of expanded diagnostic portfolio is **fit-for-purpose testing**, that generates consistent, interpretable, and clinically relevant diagnostic information. Reduced repeat testing, cost-conscious targeted panels, and shorter decision-making times all contribute to sustainable public finances.

The introduction of eDNA services increases uptake of **sensitive, species-specific detection methods** in environmental workflows. Medium- and long-term effects include more precise, cost- and time-efficient monitoring and better planning and budgeting, thereby fostering sustainable public finances.

5. Medium- and long-term impact and systemic effects

Medium- and long-term impacts

The flexibility, efficiency, consistency and scalability established during the project are expected to reduce the cost per sample and increase predictability. This enables prices and services to be aligned more closely with actual costs and supports steady, well-planned budgets. Centralized access to the renewed infrastructure and expertise makes it easier for research groups to use advanced methods without purchasing their own high-cost instruments. As a result, resources can be directed to method development, training, and research projects, supporting high-quality research. Other national universities benefit from the same high-technology instrumentation through commissioned research services.

In diagnostics, fit-for-purpose testing and clear, rapid reporting are expected to improve the allocation of public resources and help patients avoid delayed diagnoses and more intensive treatments. The introduction of eDNA services supports the replacement of time-consuming and labor-intensive conventional monitoring methods, thereby reducing detection costs and increasing sensitivity. Decisions can be made sooner, and planning and budgeting become more reliable both for authorities and companies.

Anticipated development trajectories

Over the coming years, the renewed infrastructure is expected to support a shift toward **higher-throughput, fully standardized sequencing workflows**. Research indicates that automated NGS workflows consistently reduce hands-on time, minimize inter-operator variability, and enable more predictable sequencing capacity (Hoffmann et al., 2024). As these workflows stabilize, they are likely to spread across research and clinical laboratories, particularly as laboratories seek scalable solutions in response to increasing sample volumes.

In diagnostics, **targeted, clinically focused gene panels** have been found to reduce data noise, facilitate interpretation, and support more efficient clinical decision-making compared with broader sequencing approaches (Das et al., 2025). More accessible validation procedures of gene panels are expected to shorten the time to launch diagnostic panels for new indications.

The accreditation timelines will still limit the implementation into clinical use. On the other hand, sample availability is constantly improving through biobank activities especially in Finland but at EU level as well.

In environmental monitoring, **qPCR-based eDNA assays** are anticipated to gain increasing regional uptake due to their demonstrated sensitivity, cost-efficiency, and suitability for routine species detection (Buxton et al., 2021). This method has raised substantial interest in the
environmental sector and is expected to be approved by the environmental authorities in near future. Metabarcoding workflows will likely expand more slowly due to their higher methodological complexity and greater need for standardization (Shea et al. 2023).

Overall, the anticipated development trajectory suggests that the use of **automated genomic workflows, targeted diagnostics, and molecular monitoring tools** will spread steadily into regional health and environmental systems.

Systemic effects

The project's results are expected to generate systemic effects that strengthen sustainable public finances. Diffusion of automated and standardized NGS workflows improves comparability and capacity use across laboratories, shortening turnaround times and avoiding overlapping development. As a result, public-sector laboratory capacity is utilized more efficiently and this creates a system-level cost-saving impact and improves the predictability of the public finances.

Establishing targeted diagnostic accelerates clinical decision-making, decreases the need for intensive treatments, and facilitates cost management through a standardized test portfolio. Right-sized, appropriately targeted testing for the right patients scales the impact to the system level.

Widespread adoption of qPCR-based eDNA assays saves time and resources while increasing sensitivity, facilitating regional decision-making and improving planning and budgeting this way, individual assays evolve into ecosystem-level practice that reshapes environmental monitoring and decision-making across entire region.

6. EU-level impact

The project supports several EU-level policy objectives by strengthening genomic infrastructure, standardizing diagnostic and environmental monitoring practices, and enabling more efficient use of public resources.

The project contributes to **EU-level efforts to harmonize research practices**. This is consistent with the goals of BBMRI-ERIC, which aims to "reducing the fragmentation of the bio-medical research landscape through harmonization of procedures, implementation of common standards and fostering high-level collaboration" (BBMRI-ERIC, n.d.).

Automated and standardized NGS processes improve comparability of clinical data between the member states and enable multi-laboratory collaborations that are essential for advancing precision medicine across the EU. Furthermore, the expansion of targeted diagnostics supports **EU health strategies** that emphasize equitable access to effective, cost-efficient genomic testing, contributing to more consistent and sustainable public healthcare systems (EUCOPE, n.d.).

The introduction of qPCR-based eDNA workflows aligns with the EU's growing emphasis on sensitive, and cost-efficient biodiversity monitoring, as highlighted in recent EU-funded reviews of biobanking and environmental data infrastructures (European Commission, n.d.). As these
methods become more widely adopted across member states, they can facilitate cross-border environmental assessments, improve ecological risk management, and support the **EU's ambitions for coordinated environmental governance**.

Overall, the project strengthens the technological and methodological foundations that enable EU-level cooperation in health, research, and environmental monitoring, thereby enhancing the efficiency and long-term sustainability of public finances across member states.

7. Monitoring and evaluation

Indicators used to monitor and evaluate the medium- and long-term impacts of the project are presented in Table 2. The primary data source is the laboratory database, which contains detailed information on all samples received and analyzed by the laboratory.

Table 2. Quantitative indicators to assess the impact on sustainable public finances

Indicator group	Indicator	Aim	Source
Cost-efficiency	Cost per sample (€/sample)	Decreasing trend	Accounting
	eDNA detection cost per target (€/species)	Decreasing trend	Accounting
Process performance	Turnaround time (from arrival to report), median	Shorter processing time	Laboratory database
	Turnaround time variability	Reduced variability	Laboratory database
	Quality control failures	Decreasing trend	Laboratory database
Access and reach	Number of visiting UEF groups (internal)	Increasing trend	Instrument diary
	Number of client organizations (external)	Increasing trend	Project register
	Customer base diversity (external)	Increasing trend	Project register
Capacity	Instrument utilization (%)	Higher utilization	Instrument diary
	Weekly sample throughput	Increasing trend	Laboratory database

Justification and scope

The indicators in Table 2 were selected to capture the core pathways by which the project contributes to sustainable public finances: 1) **cost-efficiency** (cost per sample; eDNA cost per target), 2) **process performance** (turnaround time and its variability; quality control failures),
3**) access and reach** by both internal and external clients (number of visiting UEF groups; number and diversity of external client

organizations), and 4) **process capacity** (instrument utilization and weekly sample throughput). Together, these measures reflect reduced repeat
analyses and overtime work, improved planning and budgeting, and higher utilization of shared resources.

Data sources, frequency, and responsibilities

The baseline year is 2025. Indicators are compiled at least annually from the laboratory database (samples and turnaround time), accounting systems (person-hours, reagents, service agreements), instrument diaries (utilization), and the project register (user base). The gathered data and related reports are presented to project PI (the director of GCEF).

Use of results

Results inform capacity planning, pricing and cost-recovery policies, maintenance scheduling, and investment decisions (e.g., workflow automation and service contracts). Trends are reviewed annually to prioritize actions with the highest impact on cost, quality, and predictability.

Limitations

The laboratory does not have access to clinical or patient-level data; therefore, clinical outcomes (e.g., patient pathways, health gains) are out of scope. The indicators focus on operational and financial performance within the laboratory's responsibilities.

8. References

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