NewTechAqua

New technologies, Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture

D6.1 Report on impact assessment indicators monitoring framework

Project:	**NewTechAqua**
Project No.:	**862658**
Deliverable Version:	**0.2**
Submission Date:	**31.12.2020**
Responsible Partner:	**Gate2Growth**
Author(s):	**Louise Murholt Rosenthal (G2G), Rasmus Egvad (G2G), Silvio Cristiano (UNIVE), Roberto Pastres (UNIVE), and Karen Hamann (IFAU)**

Type of Deliverable

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

R	Document, Report	x
DEM	Demonstrator, pilot, prototype	
DEC	Websites, patent fillings, videos, etc.	
OTHER		
ETHICS	Ethics requirements	
ORDP	Open Research Data Pilot	

Dissemination Level		
PU	Public	x
CO	Confidential, only for Members of the Consortium and Commission Services	
EU-RES	Classified: RESTREINT UE (Commission Decision 2005/444/EC)	
EU-CON	Classified: CONFIDENTIEL UE (Commission Decision 2005/444/EC)	
EU-SEC	Classified: SECRET UE (Commission Decision 2005/444/EC)	

Deliverable approval		
Author/s:	Louise Murholt Rosenthal, Rasmus Egvad, Silvio Cristiano, Roberto Pastres, and Karen Hamann	
Approved internally	Uffe Bundgaard-Jørgensen and Cristobal Aguilera	
Approved by WP Leader:	Cristobal Aguilera	
Approved by Project Coordinator	Dr. Alessio Bonaldo (Università di Bologna)	

Coordinator contacts	
Project Coordinator Name	Dr. Alessio Bonaldo

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Project Coordinator Organization Name	Alma Mater Studiorum - Università di Bologna
Address	Via Zamboni, 33, 40126 Bologna BO, Italy
E-mail	alessio.bonaldo@unibo.it
Project website	https://www.newtechaqua.eu

1. NewTechAqua at a glance

The main goal of the NewTechAqua project is to expand and diversify European aquaculture production of finfish, molluscs and microalgae by developing and validating technologically advanced, resilient and sustainable applications.

In that sense, researchers and partners from the NewTechAqua will test and develop new solutions to:

- **Deliver solutions to improve fish and mollusc health and disease resistance**: prediction models for specific diseases, kits for disease' detection, new breeding programmes, and new diets.
- **Increase the efficiency of aquaculture production systems** via real-time management systems, satellite systems, and recommendations.
- **Make the aquaculture sector more sustainable and circular** through different rearing systems (RAS, biofloc technology, aquaponics) as well as new diets and feed products using fish by-products, fish processing wastewaters, and microalgae, new organic diets using plant proteins to produce more organic fish.
- **Support diversification of fish species** by studying the reproductive cycle of emerging fish species to re-create the best conditions for raising these new species in aquaculture production systems.
- **Develop new eco-friendly fish and molluscs products** with high nutritional value
- **Raise awareness and train professionals** from the aquaculture sector by creating training programmes and conducting studies on consumers' preferences.

With this new set of solutions, NewTechAqua will demonstrate that investment in sustainable aquaculture research and innovation leads to the creation of new value chains, markets, growth and jobs in coastal, offshore and landlocked areas.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

2. Executive Summary

This D6.1 report on impact assessment indicators monitoring framework will provide an overview of impact indicators.

As the main goal of the NewTechAqua project is to expand and diversify European aquaculture production by developing and validating technologically advanced, resilient, and sustainable applications. With this new set of solutions NewTechAqua will demonstrate that investment in sustainable aquaculture research and innovation leads to the creation of new value chains, markets, growth and jobs in coastal, offshore and landlocked areas. This report on impact assessment indicators monitoring framework is crucial to obtain this goal.

The three pillars of the impact assessment indicators monitoring framework that this report will encompass: the environmental-, the economic-, and the social- & health indicators are the sustainable choice for future aquaculture. The methodology listed in this report of both qualitative and quantitative approaches to the three pillars will during the next years of the NewTechAqua project be implemented and concluded in the following four deliverables:

- ***D6.2: Environmental impact assessment [M39]***
- ***D6.3: Economic impact assessment [36]***
- ***D6.4: Social and health assessment [36]***
- ***D6.5: Integrated sustainability and resilience assessment[1] [48]***

[1] Based on the outcome of the work made in T6.2, T6.3 and T6.4 ending with D6.2, D6.3 and D6.4, T6.5 will concentrate on generating a report summarising project impacts and assess the economic, social and environmental resilience of the solutions proposed.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Table of Contents

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

3. Introduction

D6.1 is a report which provides an overview of the impact assessment indicators monitoring framework for the NewTechAqua project.

For a start, we will define indicators as:

Indicators are tools for monitoring, evaluation, forecasting and decision support. They are defined by reference to agreed targets; the confrontation of values taken by an indicator with the corresponding objective allows judging the effectiveness of an action. Indicators are also communication tools that are used to quantify and simplify information to make it understandable to a targeted audience [2](FAO, 2013).

The NewTechAqua project is in its early stages, and currently many of the technical results we base future assessment plans on, are currently not available. However, this report still provides a valuable overview of the significant expected environmental, economic, and social- and health impact of the NewTechAqua project.

The deliverable will provide an overview of the key indicators the consortium will monitor and report in the following deliverables:

- *D6.2: Environmental impact assessment [M39]*
- *D6.3: Economic impact assessment [36]*
- *D6.4: Social and health assessment [36]*
- *D6.5: Integrated sustainability and resilience assessment[3] [48]*

The core of the impact assessments in the NewTechAqua project concentrates on the economic implications of the new aquaculture production systems:

  - *Salmon, selected using the breeding program developed in WP3, farmed using the AI epidemiological model developed in WP2 and supplied to market using innovative processing methods investigated in WP5.*

[2] http://www.fao.org/3/i3194e/i3194e.pdf

[3] Based on the outcome of the work made in T6.2, T6.3 and T6.4 ending with D6.2, D6.3 and D6.4, T6.5 will concentrate on generating a report summarising project impacts and assess the economic, social and environmental resilience of the solutions proposed.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

- *Seabass reared in eco-intensified land-based systems (WP2), fed free catch fishmeal diets (WP1) and supplied to market using innovative minimally processing methods investigated in WP5.*
- *Organic Meagre reproduced according to the protocols developed in WP4, fed the innovative organic diet validated in WP1 and supplied to the market as organic minced product (WP5).*
- *Oyster, selected using the breeding program developed in WP3, farmed controlling pathogens by means of biosensors (WP2) and commercialized using non thermal conservation treatments (WP5).*

The end-result of the 4 deliverables will be a complete overview of the expected impact of the NewTechAqua project.

In section 4. the methodology of the environmental impact assessment will be outlined ending with an overview of the chosen environmental impact indicators. This will be used as monitoring framework for T6.2 ending with D6.2.

In section 5. the methodology of the economic impact assessment will be outlined followed by an overview of the chosen economic impact indicators. This will be used as monitoring framework for T6.3 ending with D6.3.

In section 6. the methodology of the social- & health assessment will be outlined, followed by an overview of the chosen social- & health impact indicators. This will be used as monitoring framework for T6.4 ending with D6.4.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

4. Environmental impact assessment indicators

4.1. Environmental impact assessment

Environmental assessment (**EA**) is a procedure of decision making that makes sure environmental implications are considered before a decision is made (European Commission, 2020)[4]. In Europe, this is a mandatory step in given circumstances: when some individual projects are involved (e.g. dams, motorways, airports, or factories), an 'Environmental Impact Assessment' is required, regulated by Directives 2011/92/EU (European Parliament, 2011)[5] and 2014/52/EU (European Parliament, 2014)[6]; when we come to public plans or programmes, a 'Strategic Environmental Assessment' is needed, as per Directive 2001/42/EC (European Parliament, 2001)[7]. The projects and programmes co-funded by the European Union (including Agricultural and Fisheries Policies) have to comply with the above-mentioned Directives.

Although not compulsory based on such Directives, an **Environmental Impact Assessment** is nevertheless planned and will be carried out within the NewTechAqua project. The aim of such assessment is quantifying to what extent its innovations will cut the environmental burden of given aquaculture supply chains in the European Union and what the environmental sustainability can be for selected innovative supply chains. Since such supply chains do not fit the types of projects of the European Directives, the procedures for the environmental impact assessment will follow scientific approaches tailored and/or promising for industrial processes.

Candidate innovated production systems for the environmental impact assessment are:

- Salmon, selected using the breeding program developed in WP3, farmed using the Artificial Intelligence (AI) epidemiological model developed in WP2 and supplied to market using innovative processing methods investigated in WP5.

- Seabass reared in eco-intensified land based systems (WP2), fed free catch fishmeal diets (WP1) and supplied to market using innovative minimally processing methods investigated in WP5.

[4] European Commission (2020). Environmental Assessment [https://ec.europa.eu/environment/eia/index_en.htm]
[5] European Parliament (2011). Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0092]
[6] European Parliament (2014). Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052]
[7] European Parliament (2001). Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment [https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32001L0042].

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

- Oyster, selected using the breeding program developed in WP3, farmed controlling pathogens by means of biosensors (WP2) and commercialised using non-thermal conservation treatments (WP5).

The candidate innovative supply chain is:

- Organic Meagre reproduced according to the protocols developed in WP4, fed the innovative organic diet validated in WP1 and supplied to the market as organic minced product (WP5).

These innovated production systems and innovative supply chains are also expected to undergo an *economic* impact assessment (see the next section 5).

The Environmental Impact Assessment will be carried out in NewTechAqua's Task 6.2 (M24–M39). Besides evaluating the reduction of the of the three selected aquaculture supply chains in the European Union listed above (i.e. salmon, seabass, and oyster) and the expected environmental sustainability for the selected innovative supply chains (i.e. organic meagre), the outcomes of the assessment will also allow to make comparisons among the environmental loads of different aquaculture typologies and practices, and to identify potential improvements of the environmental performances of each supply chain at hand.

In practice, business-as-usual and innovative scenarios will be considered for assessing the effectiveness of NewTechAqua's improvement of existing production systems. The sustainability of NewTechAqua's innovative supply chain will be estimated through the same methods, and mostly evaluated by comparison with existing supply chains.

Guiding references to build and quantitatively elaborate each and every scenario will be some selected functional units, i.e. inputs and impacts will be proportioned to the same unit of production, mostly expressed in mass (ton and/or kg of final product). However, in the light of the specific features of an agri-food sector such as the aquaculture one, nutritional units might be explored as well, e.g. the energy content (J and/or kcal) or the protein content (absolute mass and/or mass/mass percentage).

Both consolidated and emerging environmental accounting methods will be applied to the main production systems and supply chains investigated in NewTechAqua, as further described in the next subsection 4.1.

As illustrated instead in subsection 4.2, the way the consortium will analyse environmental impacts will include measuring changes in:

- Airborne impacts
- Waterborne impacts
- Cumulative energy requirements
- Cumulative material requirements
- Cumulative water requirements
- Environmental requirements associated with labour
- Overall environmental pressure

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

4.2. Environmental accounting tools

The NewTechAqua approach to the assessment of the environmental impact of innovations delivered by the project combines consolidated and internationally recognised methods and indicators with promising scientifically sound methodologies, characterized by strong geobiophysical bases. These comprehensive and flexible toolkits will provide reliable evaluations of the environmental pressure concerning the production systems and supply chains to be investigated. A double-fronted attention is paid to both downstream impacts and upstream overall requirements involving the geobiosphere, its compartments, and its resources. Before running any environmental accounting assessment, conceptual models of the targeted production systems and supply chains will be developed in collaboration with partners, including mass balance control and other preliminary scientific checks; such conceptual models will be then used as a starting point for inventorying the flows and matter and energy across system boundaries. Both anthropocentric and nature-based perspectives will be taken into account. All assessments will be performed based on pre-assigned functional units related to the mass of the output; efforts will be made to also provide opportunity for environmental impact comparisons among the different products and supply chains based on final food energy content and other nutritional facts.

Life Cycle Assessment

Life Cycle Assessment is a standardised procedure (ISO, 2006)[8] for the environmental accounting of impacts from human activities, mostly productive ones. Specifically, it is "a cradle-to-grave or cradle-to-cradle analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use" (Muralikrishna & Manickam, 2017)[9]. In NewTechAqua (Task 6.2), Life Cycle Assessment will be applied for estimating a set of core impact indicators, selected from its consolidated ones (e.g. carbon and water footprint, ozone depletion, photochemical oxidation and eutrophication and acidification emissions, cumulative exergy demand). This is a regular, internationally accepted and procedure that has been already applied to aquaculture extensively (see for instance: Henriksson *et al.*, 2012; Bohnes & Laurent, 2019)[10, 11]. The first set of indicators will be complemented by a set of emerging indicators that have been recently proposed for aquatic products, e.g. the appropriated primary production, (Bohnes *et al.*, 2018)[12] and by an intuitive comprehensive index, i.e. the ecological footprint, which has been so far successfully applied to the agrifood sector (McAuliffe *et al.*, 2020)[13]. An overview of Life Cycle Assessment inputs and impacts potentially studied in aquaculture is offered in Figure 4.1.

---

[8] ISO – International Organisation for Standardisation (2006). ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework [https://www.iso.org/standard/37456.html]

[9] Muralikrishna & Manickam (2017). Chapter Five – Life Cycle Assessment. In: *Environmental Management: Science and Engineering for Industry*, BS Publications, India, pp. 57-75.

[10] Henriksson, P. J., Guinée, J. B., Kleijn, R., & de Snoo, G. R. (2012). Life cycle assessment of aquaculture systems—a review of methodologies. *The International Journal of Life Cycle Assessment*, *17*(3), 304-313.

[11] Bohnes, F. A., & Laurent, A. (2019). LCA of aquaculture systems: methodological issues and potential improvements. *The International Journal of Life Cycle Assessment*, *24*(2), 324-337.

[12] Bohnes, F. A., Hauschild, M. Z., Schlundt, J., & Laurent, A. (2019). Life cycle assessments of aquaculture systems: a critical review of reported findings with recommendations for policy and system development. *Reviews in Aquaculture*, *11*(4), 1061-1079.

[13] McAuliffe, G. A., Takahashi, T., & Lee, M. R. (2020). Applications of nutritional functional units in commodity-level life cycle assessment (LCA) of agri-food systems. *The International Journal of Life Cycle Assessment*, *25*(2), 208-221.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

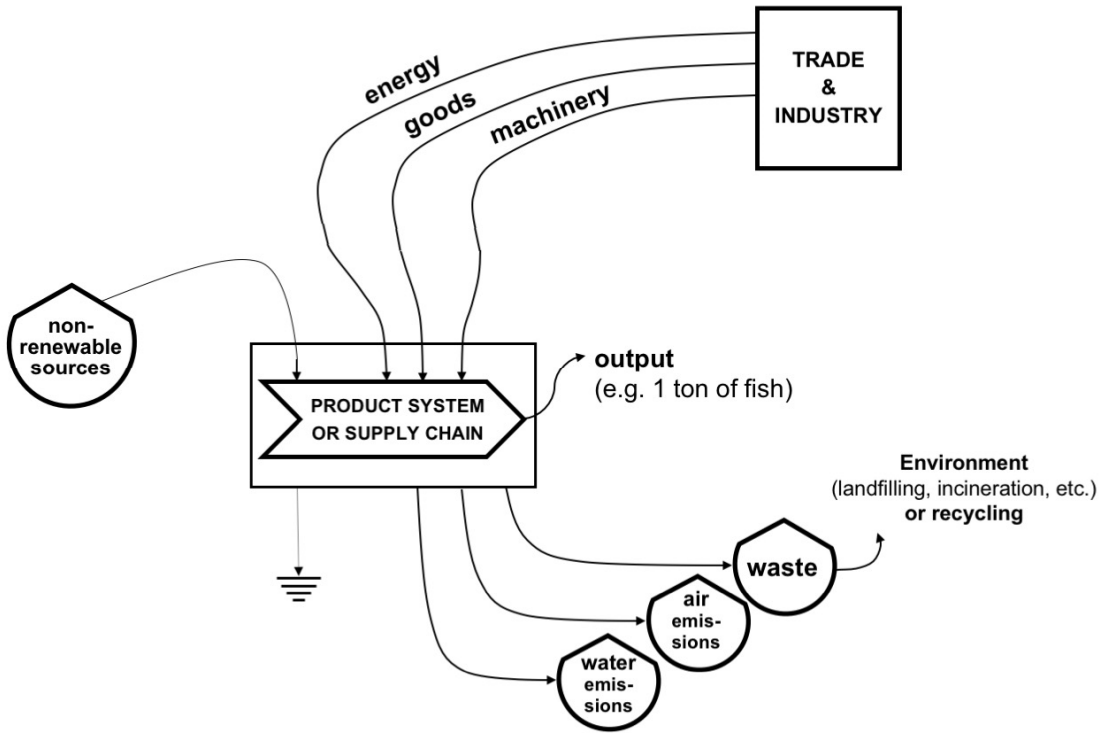

Figure 4.1 – Inputs and impacts from aquaculture that can be accounted for in Life Cycle Assessment

Environmental impact assessment of aquaculture-related products and supply chains have recently involved – among others – salmonidae (Philis *et al.*, 2019; Sherry *et al.*, 2020)[14,15], seabass (Konstantinidis *et al.*, 2020)[16], common carps (Biermann & Geist, 2019)[17], oysters (Ray *et al.*, 2019)[18], clams (Turolla *et al.*, 2020)[19], and integrated multi-trophic systems (Chary *et al.*, 2020; Jaeger *et al.*, 2019)[20, 21].

[14] Philis, G., Ziegler, F., Gansel, L. C., Jansen, M. D., Gracey, E. O., & Stene, A. (2019). Comparing Life Cycle Assessment (LCA) of Salmonid Aquaculture Production Systems: Status and Perspectives. *Sustainability*, *11*(9), 2517.

[15] Sherry, J., & Koester, J. (2020). Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (*Salmo salar*). *Sustainability*, *12*(15), 6079.

[16] Konstantinidis, E., Perdikaris, C., Gouva, E., Nathanalides, C., Bartzanas, T., Anestis, V., ... & Skoufos, I. (2020). Assessing Environmental Impacts of Sea Bass Cage Farms in Greece and Albania Using Life Cycle Assessment. *International Journal of Environmental Research*, 1-12.

[17] Biermann, G., & Geist, J. (2019). Life cycle assessment of common carp (*Cyprinus carpio L.*)–A comparison of the environmental impacts of conventional and organic carp aquaculture in Germany. *Aquaculture*, *501*, 404-415.

[18] Ray, N. E., Maguire, T. J., Al-Haj, A. N., Henning, M. C., & Fulweiler, R. W. (2019). Low greenhouse gas emissions from oyster aquaculture. *Environmental science & technology*, *53*(15), 9118-9127.

[19] Turolla, E., Castaldelli, G., Fano, E. A., & Tamburini, E. (2020). Life Cycle Assessment (LCA) Proves that Manila Clam Farming (*Ruditapes philippinarum*) is a Fully Sustainable Aquaculture Practice and a Carbon Sink. *Sustainability*, *12*(13), 5252.

[20] Chary, K., Aubin, J., Sadoul, B., Fiandrino, A., Covès, D., & Callier, M. D. (2020). Integrated multi-trophic aquaculture of red drum (*Sciaenops ocellatus*) and sea cucumber (*Holothuria scabra*): Assessing bioremediation and life-cycle impacts. *Aquaculture*, *516*, 734621.

[21] Jaeger, C., Foucard, P., Tocqueville, A., Nahon, S., & Aubin, J. (2019). Mass balanced based LCA of a common carp-lettuce aquaponics system. *Aquacultural Engineering*, *84*, 29-41.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Emergy Accounting

Emergy Accounting aims at measuring the geobiosphere's overall support to processes, comprehensively encompassing both human and ecological systems. Developed by Odum (1988, 1996, 2007)[22, 23, 24], its theoretical framework is concerned with the study of how systems use and organise the resources they need to pursue their systemic goal. In so doing, the upstream resource investments – both coming directly from the geobiosphere and mediated by human techno-economic systems – are accounted for: this way, the "real" value of a product (or a service) can be determined. Emergy Accounting is based upon the concept of emergy[25], which is defined as the total available energy (exergy) used up directly and indirectly to deliver a product or a service. Emergy is expressed in terms of solar equivalent energy, thus is converted from joule into solar equivalent Joule (1 J of solar radiation = 1 seJ). Its unit is the solar emjoule (sej). This way, emergy allows to compute all resource contributions under the same unit, including both the geobiosphere and the human labour, services, and economies that are also necessary and that in turn require geobiophysical inputs. Quantities that are usually neglected in classical economic or energetic analyses are instead considered (and altogether) in Emergy Accounting; among these, unpaid renewable resources, human labour and services, and the often hundred- or thousand-year processes required to create and concentrate a raw resource (hence its "value" in terms of rarity, required efforts, replicability). A crucial perspective shift is operated from the user-side (final recipient) to the donor-side (ultimately, the geobiosphere): this is strictly related to the concept of sustainability. An overview of the inputs that can be evaluated in an assessment based on Emergy Accounting is offered in Figure 4.2.

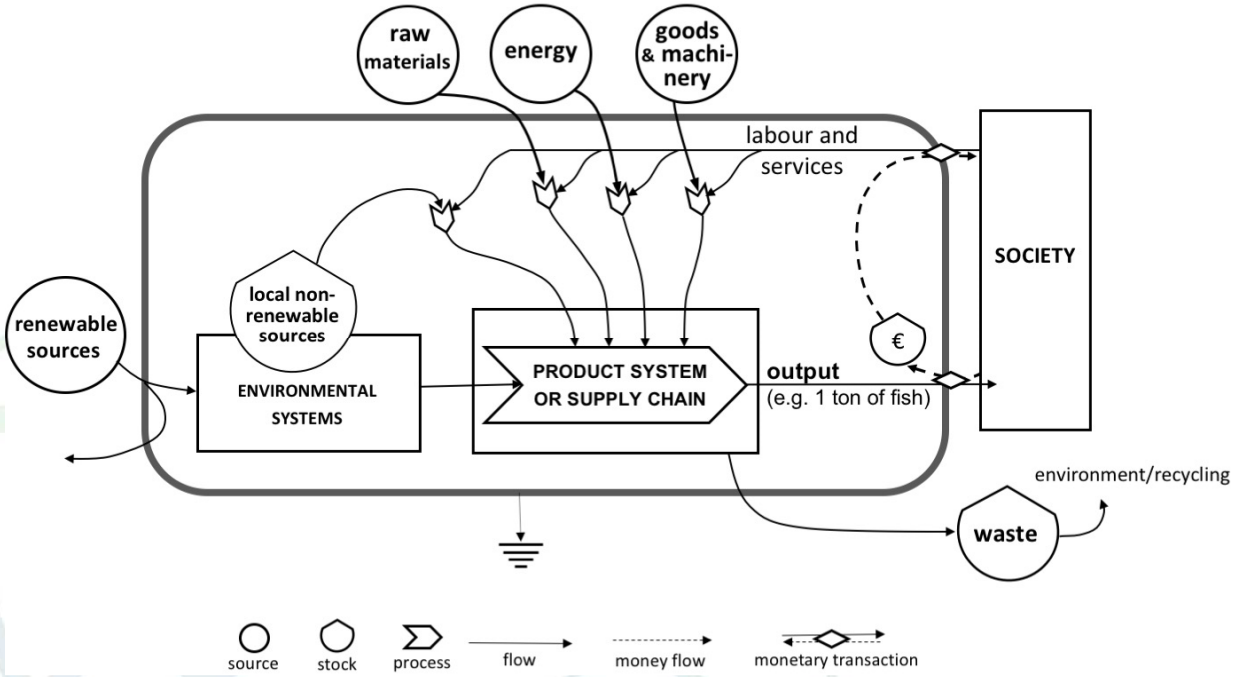

Figure 4.2 – Direct and indirect inputs from aquaculture that can be accounted for through Emergy Accounting

[22] Odum, H. T. (1988). Self-organization, transformity, and information. *Science*, *242*(4882), 1132-1139.
[23] Odum, H. T. (1996). *Environmental accounting: emergy and environmental decision making* (Vol. 707). Wiley.
[24] Odum, H. T. (2007). *Environment, power, and society for the twenty-first century: the hierarchy of energy*. Columbia University Press.
[25] Originally from "embodied energy", yet also taking other direct and indirect resources into account.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Emergy theorist Odum (1996; 2002)[26,27] had already dealt with emergy and aquaculture. Following his first applications, other pioneering environmental assessments using Emergy Accounting for fish farming products and supply chains have been performed so far, sometimes already in combination with Life Cycle Assessment: Cavalett *et al.* (2007)[28], Vassallo *et al.* (2007; 2009)[29 30], Li *et al.* (2011)[31], Zhang *et al.* (2011)[32], Lima *et al.* (2012)[33], Wilfart *et al.* (2012; 2013)[34,35], Zhao *et al.* (2013)[36], Aubin *et al.* (2014)[37], Brown (2015)[38], Wang *et al.* (2015)[39], Bonilla *et al.* (2016)[40], Cheng *et al.* (2017)[41], David *et al.* (2018)[42], Aubin *et al.* (2019)[43], Zhan *et al.* (2019)[44], Su *et al.* (2020)[45], and Maiolo *et al.* (forthcoming)[46].

---

[26] Odum, H. T. (1996). *Environmental accounting: emergy and environmental decision making* (Vol. 707). Wiley.
[27] Odum, H. T. (2002). Emergy accounting. In *Unveiling Wealth* (pp. 135-146). Springer.
[28] Cavalett, O., de Queiroz, J. F., & Ortega, E. (2007). Emergy accounting of fish aquaculture chains in Brazil. *Ecodinamica, 7*, 53-61.
[29] Vassallo, P., Bastianoni, S., Beiso, I., Ridolfi, R., & Fabiano, M. (2007). Emergy analysis for the environmental sustainability of an inshore fish farming system. *Ecological Indicators*, *7*(2), 290-298.
[30] Vassallo, P., Beiso, I., Bastianoni, S., & Fabiano, M. (2009). Dynamic emergy evaluation of a fish farm rearing process. *Journal of Environmental Management*, *90*(8), 2699-2708.
[31] Li, L., Lu, H., Ren, H., Kang, W., & Chen, F. (2011). Emergy evaluations of three aquaculture systems on wetlands surrounding the Pearl River Estuary, China. *Ecological indicators*, *11*(2), 526-534.
[32] Zhang, L. X., Ulgiati, S., Yang, Z. F., & Chen, B. (2011). Emergy evaluation and economic analysis of three wetland fish farming systems in Nansi Lake area, China. *Journal of Environmental Management*, *92*(3), 683-694.
[33] Lima, J. S. G., Rivera, E. C., & Focken, U. (2012). Emergy evaluation of organic and conventional marine shrimp farms in Guaraira Lagoon, Brazil. *Journal of Cleaner Production*, *35*, 194-202.
[34] Wilfart, A., Corson, M. S., & Aubin, J. (2012). Emergy accounting: principles and application for environmental assessment of agricultural and animal production systems. *INRA Productions Animales*, *25*(1), 57-65.
[35] Wilfart, A., Prudhomme, J., Blancheton, J. P., & Aubin, J. (2013). LCA and emergy accounting of aquaculture systems: Towards ecological intensification. *Journal of Environmental Management*, *121*, 96-109.
[36] Zhao, S., Song, K., Gui, F., Cai, H., Jin, W., & Wu, C. (2013). The emergy ecological footprint for small fish farm in China. *Ecological indicators*, *29*, 62-67.
[37] Aubin, J., Wilfart, A., Chary, K., Mathé, S., & Rey-Valette, H. (2014). *Relation between ecosystem-services perception and environmental performance assessed by LCA and emergy accounting: a case study of pond farming in France* (No. hal-02050870).
[38] Brown, M. T. (2015). Cycling emergy: computing emergy in trophic networks. *Ecological modelling, 10*, 37-45.
[39] Wang, G., Dong, S., Tian, X., Gao, Q., & Wang, F. (2015). Sustainability evaluation of different systems for sea cucumber (*Apostich. japon.*) farming based on emergy theory. *Journal of Ocean University of China*, *14*(3), 503-510.
[40] Bonilla, S. H., Silva, H. R., Faustino, R. P., de Alencar Nääs, I., & Duarte, N. (2016, September). Environmental Support for Dilution of Pollutants from Broiler Production and Aquaculture in Brazil. In *IFIP International Conference on Advances in Production Management Systems* (pp. 99-105). Springer, Cham.
[41] Cheng, H., Chen, C., Wu, S., Mirza, Z. A., & Liu, Z. (2017). Emergy evaluation of cropping, poultry rearing, and fish raising systems in the drawdown zone of Three Gorges Reservoir of China. *Journal of Cleaner Production*, *144*, 559-571.
[42] David, L. H. C., Pinho, S. M., & Garcia, F. (2018). Improving the sustainability of tilapia cage farming in Brazil: An emergy approach. *Journal of Cleaner Production*, *201*, 1012-1018.
[43] Aubin, J., Callier, M., Rey-Valette, H., Mathe, S., Wilfart, A., Legendre, M., ... & Blancheton, J. P. (2019). Implementing ecological intensification in fish farming: definition and principles from contrasting experiences. *Reviews in Aquaculture*, *11*(1), 149-167.
[44] Zhan, J., Zhang, F., Chu, X., Liu, W., & Zhang, Y. (2019). Ecosystem services assessment based on emergy accounting in Chongming Island, Eastern China. *Ecological Indicators*, *105*, 464-473.
[45] Su, Y., He, S., Wang, K., Shahtahmassebi, A. R., Zhang, L., Zhang, J., ... & Gan, M. (2020). Quantifying the sustainability of three types of agricultural production in China: An emergy analysis with the integration of environmental pollution. *Journal of Cleaner Production*, *252*, 119650.
[46] Maiolo, S., Cristiano, S., Gonella, F., & Pastres, R. (forthcoming). Ecological sustainability of aquafeed: an emergy assessment of novel or underexploited ingredients.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

4.2 Environmental indicators

The Environmental Accounting methods illustrated in the previous subsection 4.1 will be applied to the above-mentioned scenarios of aquaculture products and supply chains in order to test the validity of the innovative solutions proposed and developed within NewTechAqua. The goal of the Environmental Impact Assessment at hand is measuring their impact for increased productivity, resilience and sustainability. Once the Life Cycle Assessment and the Emergy Accounting evaluation are completed for each scenario, the following indicators will be calculated, in order to define several types of environmental impact – comprising both environmental damages (downstream) and overall ecological requirements (upstream):

- Carbon Footprint (Climate Change contribution)
- Ozone layer depletion
- Photochemical oxidation
- Acidification emissions
- Eutrophication emissions
- Cumulative exergy demand
- Appropriated primary production
- Ecological Footprint

An additional set of emerging indicators will be also provided:

- Specific Emergy
- Renewable Emergy percentage
- Environmental Loading Ratio
- Environmental Yield Ratio
- Emergy Investment Ratio
- Emergy Sustainability Index
- Areal Empower Intensity
- Renewable Support Area

Life-Cycle-based indicators will be estimated using a consolidated software, i.e. SimaPro[47], and up to date databases for secondary data. Inventories will also be used for estimating the emerging indicators and the ecological footprint, resorting – if need be – to appropriate open source programming environments such as R or Octave.

For the first set of indicators, lower values correspond to lesser environmental impact. As to the second set: a lower Specific Emergy is usually associated with an overall higher efficiency; the higher the Renewable Emergy percentage and the Emergy Sustainability Index, tendentially the better the environmental performances; lower Environmental Loading Ratios, Areal Empower Intensities, and Renewable Support Areas are usually associated with lower environmental pressures.

[47] https://simapro.com/

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

The indicators produced within Task 6.2 will be compared with benchmarks, wherever possible, and literature findings, in order to quantify to what extent NewTechAqua innovations will reduce the environmental burden of the consolidate aquaculture supply chains in the EU, i.e. salmon, seabream and oysters, and which could be the environmental sustainability of innovative ones, i.e. organic meagre.

All of these environmental indicators will be also summarised and compared by means of tables and charts, and later discussed with relevant partners. Together with the other impact indicators that will be produced in WP6 (macroeconomic, microeconomic, health, and social ones), such environmental data will contribute to an overall assessment of NewTechAqua's supply chain innovations from WP1-WP5 (salmon, seabass, oyster, and organic meagre). In particular, it will be possible to monitor and evaluate their impacts on productivity, resilience, and sustainability.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

5 Economic impact assessment indicators

5.1. Economic impact assessment

An **economic impact assessment** (**EIA**) is a specific form of analysis which calculate direct and indirect benefits from projects[48]. It examines the effect of an event (or innovation) on the economy in a specified area. For the NewTechAqua project, the economic impact assessment will therefore also concentrate on the economic implications of the new aquaculture production systems.

The consortium will analyse impact on an organizational-, regional-, national-, as well as on European level. An economic impact assessment includes measuring changes in:

- Business output (sales volume),
- Value added (business profits),
- Personal income (wages), and
- Jobs created[49].

The aim of the economic impact assessment for the NewTechAqua project is to measure or estimate the changes in economic activity on the selected innovations to be explored on an organizational level (microeconomic impact assessment), and regional-, national-, and European level (macroeconomic impact assessment).

5.2. Methodology

Innovation Radar

One of the key methodologies used to performed economic impact assessment in NewTechAqua, will be the EC's Innovation Radar (IR). The IR was created by DG Connect as a structured approach to identify and support potential high impact innovations and is an important source of actionable intelligence on innovations emerging from research and innovation projects funded through European Union programmes. The results will be identified in D6.2, D6.3, D6.4, and D6.5.

In T6.3, task leader Gate2Growth (G2G) will use the approach and methodology of the Innovation Radar. We will monitor indicators collected by the Innovation Radar questionnaire (see annex 8.1), but also include other indicators which mainly (but is not limited to) focus on financial indicators. This enables us to better evaluate economic performance and impact and will also give input to WP7. First versions of

[48] http://www.cbabuilder.co.uk/CBA8.html
[49] https://seda.sk.ca/wp-content/uploads/econ-impact-primer.pdf

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

G2G's adapted questionnaires: The "Exploitable Result Identification Questionnaire" (ERIQ) and the "Research Result Identification Questionnaire" has been sent out to partners (see annex 8.2) and will be collected ultimo December 2020.

The initial step is to identify all the potential and expected results coming out of the project. The 1st task is to create an overview of potentially results per partner (result owner), and the market potential of the innovation and gaps in knowledge. We use the EC definitions to define what project results are (Fig. 5.1).

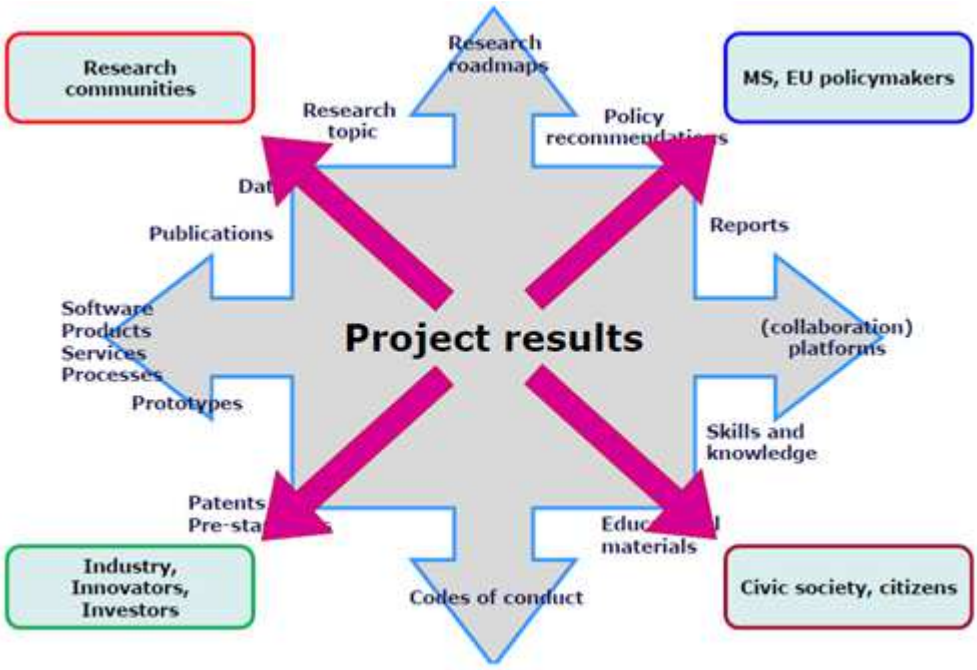

Figure 5.1 – Project results as defined by the EC

To capture the different maturity levels of innovations towards commercialisation, four innovation categories have been created based on respective scores of the Innovation Management and Innovation Readiness Indicators:

- **Market Ready:** This category includes innovations outperforming in innovation management and innovation readiness. These innovations are technologically mature and show high commitment of the project consortium to bring them to the market. They are considered 'Ready for the market'.
- **Tech Ready:** This category includes innovations progressing on technology development process (e.g. pilots, prototypes, demonstration). They are considered 'Advanced on technology preparation'. In order to capitalise on the potential of these innovations, the management team needs to focus on transforming a novel technology or research results into a marketable product or service and to prepare its commercialisation.
- **Business ready:** This category includes innovations for which concrete market-oriented ideas have been put together (e.g. market studies, business plans, end-user engagement). They are considered 'Advanced on market preparation'. Their commercialisation depends on progressing on technology development.
- **Exploring:** This category includes innovations, which actively explore value creation opportunities. They are considered 'Getting things started'. These innovations are in the early

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

phases of technological readiness, but already show high commitment levels from the organisations developing them. Their commercialisation requires efforts in transforming technology into marketable products. Alternatively, this category includes concrete market-oriented ideas, which depend on further progressing on technology development process[50].

The four maturity levels of innovations are aimed to be identified at each of the potential innovations in the New Tech Aqua project.

Life Cycle Costing methodology

Furthermore, a Life Cycle Costing methodology will be used and implemented in the Deliverable D6.3 on economic impact assessment, where costs are calculated on the basis of the whole life-cycle of the supplies, services and works included in the new production systems. This analysis will be based on the work done in the environmental impact assessment in task 6.2. Furthermore, the CAPEX and OPEX over expected lifetime will be analysed and calculated on selected innovations.

The use of the life cycle costing methodology in New Tech Aqua is to estimate the benefits accrued from this project to get a more valuable analysis to decide whether the innovations are fit for commercial exploitation or not.

The classic effect borne out of this project, are to be viewed in the context of (1) spending/sales, (2) income, and (3) employment effects[51].

5.3 Microeconomic assessment indicators

The key to microeconomic impact assessment is the consideration of direct effects borne out of projects, especially relating to employment and expenditure on organizational level. Economic impact assessments assume that employment will increase as an outcome of a successful project[52].

5.3.1 Indicators selected

The microeconomic impact assessment will include following selected indicators:

- CAPEX (Capital Expenditures),
- OPEX (Operating Expenses),
- Investment needed to take the innovation to the market,
- Market-readiness of selected solutions (TRL-level during project duration),
- Market potential of selected solutions (Innovation Radar),
- ROI calculated on a 5- and 10-year period after project end,
- Employment,
- Patents applied for.

[50] https://www.innoradar.eu/methodology
[51] https://journals.sagepub.com/doi/10.1177/0047287506288870
[52] http://www.cbabuilder.co.uk/CBA8.html

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

5.4 Macroeconomic assessment indicators

Whereas microeconomic impact assessment will benefit the specific organizations, a broader macro-economic analysis of the macro-economic impact assessment is needed.

Key to macroeconomic impact assessment is the consideration of direct effects borne out of projects, especially relating to employment and expenditure on regional, national, and European level.

The macroeconomic assessment will identify and quantify the economic impact the New Tech Aqua projects will produce at regional, national, and European scales.

5.4.1 Indicators selected

The macroeconomic impact assessment will include following selected indicators:

- Research: number of articles disseminated/published,
- Employment created on regional, national, and European scale,
- Economic growth based on average wages.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

6 Health and social impact assessment indicators

6.1 Introduction to social and health impact indicators

The assessment of the social and health impacts from the NewTechAqua project will **focus on** the social and health impacts that occur or might occur as **a consequence of the innovations of project.**

Social impact indicators are used for assessing (and measuring) the social changes occurring or expected to occur in the future as a result of changes in organizations' structures or actions. These changes may be implemented to impact a defined target group, and/or affect a wider social group (UnLtd, 2020)[53]. Some of these changes can have a **direct social impact** (i.e. a causal relation), for example that "10 % more people acted in a certain way because of this change". However, a more profound social impact may occur at a later stage where it is less clear if the changes implemented were the only cause of positive or negative series of further social impacts. This wider social impact is referred to as the **indirect impact**.

Health impact indicators are used for assessing how changes or external conditions may impact the health of people. The health indicators, as proposed by the WHO (2015) are related to nutritional status, diseases, demographics (e.g. life expectancy), accidents, and other factors[54]. The activities and innovations from the NTA-project are primarily targeted at organizations (businesses) and therefore, the health impact assessment will be focused on the health of people in companies and business taking up NTA-innovations. As explained in the introductory section, the assessment of social and health impact indicators will be carried out for the four production systems already defined.

6.2 Methodology

6.2.1 Social impact indicators

For both categories of indicators (social and health) it is emphasized to arrive at indicators that can be used to explain how the innovations derived from each of the four production systems in the NTA-project has or could have an impact on people's lives and well-being. This means that generic indicators about

[53] https://www.unltd.org.uk/our-support/learning-area/defining-social-impact-indicators-setting-targets-and-refining-your-social

[54] https://apps.who.int/iris/bitstream/handle/10665/173589/WHO_HIS_HSI_2015.3_eng.pdf?sequence=1

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

e.g. socio-demographic conditions, health or work have been adapted to be applicable to a NTA-context. The approach is explained further for the social and health impact indicators in the following paragraphs.

Put simply, **social impact is the change that an action or organization brings to peoples' lives**[55], or in our context, the changes stemming from the NTA-innovations and their impact on the employees of the businesses in the NTA target sectors. The **direct social impact** occurs at the organizational level of analysis (**company level**) because most of the NTA-innovations are targeted at improving production systems in the aquaculture sector; in the fish feed industry, and seafood processing. When organizations take up new practices or implement new technologies this will have a subsequent impact on people: employees, suppliers, customers and other social groups (Meldrum et al, 2020; Hamann et al, 2019). A sustainable development of aquaculture is dependent on society's acceptance of this kind of food production method. This acceptance is closely connected with issues such as transparency, fairness and animal welfare (FAO, 2013). It is therefore relevant to consider the social impact in a wider context going beyond the organization. This wider context is referred to as the **indirect social impact** related to the NTA-innovations.

Our social impact analysis will focus on the direct social impact occurring among employees and management as consequences of the implementation of NTA-innovations in organizations. It is anticipated that we can gather this kind of quantitative and qualitative data through interviews. If further data gathering proves it feasible, it will be attempted to collect information about the indirect social impact on e.g. the local community, the industry, or consumers.

To illustrate the approach: A company with aquaculture production implements new technology developed in the NTA-project. The direct social impact would be derived from how this new technology impacts the organization with regards to its people: did the new technology create more jobs, pose requirements for changes in the skills base, provide opportunities for young or senior citizens, enable the company to engage in new value chains, or require changes in the organization of the business.

The social impact indicators include measurable conditions (quantitative indicators) and qualitative indicators, Table 6.1. The latter ones are non-measurable however they are important for explaining how an organization may contribute to change peoples' lives. The qualitative indicators can relate to aims that the organization may work towards as well as the consequences of the organization's action, in our case, by taking up a NTA-innovation (Meldrum et al, 2020).

Social impact indicator	**How to measure (quantitative) or How to assess the impact (qualitative)**
Jobs	Effect of change in job numbers be group of employees (management, team leaders, workers) Type of new/lost jobs in the organization Effect of change in job numbers by collaborative partners

[55] file:///C:/Users/Acer/Downloads/silo.tips_a-guide-to-measuring-social-impact.pdf

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Fairness	Equal opportunities for males and females Males as % of workforce; Females as % of workforce Fair wages (wages seem fair compared to wages in the sector in this area) Decent working hours (number of shifts per day, number of hours to work per day) Existing relevant workers' representatives organization or trade union to support workers incl. fish farmers
Tasks	Facilitation of tasks (work is made easier) Tasks that un-trained new workers can carry out NTA-innovation enhances work motivation Tasks become more technology-oriented
Skills	Current skills base by workers in the organization is applicable Possible to recruit workers with required qualifications to man/operate/implement the NTA-innovation
Training	Possible to collaborate with external organizations (e.g. technical colleges, universities, other) for provision of skills In-house provision of skills to the workforce in the organization In-house provision of skills to workers losing their jobs as a consequence of NTA-innovations
Recruiting workforce	NTA-innovation supports the organization to appear as interesting employer Possible to recruit workforce from local area
Transparency	Employees have access to information about the business and/or production practices

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

	Society has access to information about the business and its products (e.g. from websites, annual reports, product information) Production or products certified under a sustainability label (ASC, organic etc.) Membership of fish farming organization or industry association

Table 6.1: List of social impact indicators for assessing the impact of the NTA-project on organizations and their employees

6.2.2 Health impact indicators

The selection of health impact indicators will follow the approach outlined for the social impact indicators: Assessing the impact on human health stemming from NTA-innovations. The focus of the health impact assessment will be on the **direct impact**, thus the impact on the people in organizations that take up NTA-innovations. We will also look at the **indirect impact** which is defined as the impact related to food safety, nutrition, and worker safety occurring within social groups like consumers, fishermen and workers at fish farms (FAO 2013). Fishing is among the most dangerous professions in the world, it is claimed by ILO (International Labour Office)[56]. With the NTA-innovations, a push towards having more land-based seafood production systems and better and safer working conditions could be envisioned. This could have an impact on the accident rate in the fisheries and seafood production. It is therefore relevant to consider more dimensions of "health" for the impact assessment.

To illustrate the approach: A company takes up an NTA-innovation that enables a less dangerous production method. The **direct health impact** would be improved worker safety. Further in this example, the NTA-innovation enables the company to produce more taste seafood products, which is anticipated to lead to increased sales. The **indirect health impact** would occur among consumers following their increased intake of seafood.

The WHO has published a list of 100 global health indicators[57], and some of these could be adapted to assess the indirect impact stemming from the NTA-project's innovations. For example, the WHO report proposes indicators such as "low consumption of fruit and vegetables" and "high consumption of saturated fats" as indicators for human health related to diet. These indicators could be adapted to meet the requirement of the NTA-project so we could deploy an indicator like "consumption of seafood" to reflect an indirect health impact on consumers. Table 6.2 shows a list of indicators that can be used for assessing the anticipated health impact resulting from the innovations in the NTA-project.

[56] https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_071324/lang--en/index.htm
[57] https://apps.who.int/iris/bitstream/handle/10665/173589/WHO_HIS_HSI_2015.3_eng.pdf?sequence=1

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Health impact indicator	NTA-relevant health impact indicator	How to measure (quantitative) or how to assess the impact (qualitative)
Low consumption of fruit and vegetables; High consumption of saturated fat	Seafood consumption	Kg per person per year in that area and/or in that market
Children under 5 that are overweight; Overweight and obesity by adults	Overweight and obesity in population	% of population (in that area) that is overweight or obese
Fatal deaths in the fisheries; Injuries occurred in relation to fisheries and aquaculture production	Worker safety improvement	Explain how the innovation impacts worker safety; Explain how worker safety issues are included in work protocols; Anticipated reduction in % or numbers in work accidents
Health and hygiene	Food safety	Does the business have a food safety certification (ISO , HACCP, other) Does the innovation lead to improvement in food safety standard Extended shelf-life of products

Table 6.2: List of health impact indicators for assessing the impact of the NTA-project.

6.2.3 How to gather data for the social and health impact assessment

The social and health impacts from the NTA-project will be captured from interviews with the research and business partners of the consortium. Interviews will be based on a questionnaire with a list of the quantitative indicators to gather numerical data and open-ended questions for assessing the impact in a wider perspective (qualitative assessment). Furthermore, the respondents in interviews will be asked to provide a tentative timeframe for when the explained social and health impacts could be achieved. The questionnaire will be piloted in a short interview with a business partner and a research partner of the consortium. It is foreseen that all business partners and key research partners involved in each of the four production systems will be asked to participate in an interview. IFAU is responsible for this work as part of task 6.4.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

7 Conclusion

This D6.1 report on impact assessment indicators monitoring framework provides an overview of impact indicators which are tools for monitoring, evaluation, forecasting and decision support.

The main goal of the NewTechAqua project is to expand and diversify European aquaculture production of finfish, molluscs and microalgae by developing and validating technologically advanced, resilient and sustainable applications.
In that sense, researchers and partners from the NewTechAqua will test and develop new solutions to:

- Deliver solutions to improve fish and mollusc health and disease resistance: prediction models for specific diseases, kits for disease' detection, new breeding programmes, and new diets.
- Increase the efficiency of aquaculture production systems via real-time management systems, satellite systems, and recommendations.
- Make the aquaculture sector more sustainable and circular through different rearing systems (RAS, biofloc technology, aquaponics) as well as new diets and feed products using fish by-products, fish processing wastewaters, and microalgae, new organic diets using plant proteins to produce more organic fish.
- Support diversification of fish species by studying the reproductive cycle of emerging fish species to re-create the best conditions for raising these new species in aquaculture production systems.
- Develop new eco-friendly fish and molluscs products with high nutritional value
- Raise awareness and train professionals from the aquaculture sector by creating training programmes and conducting studies on consumers' preferences.

With this new set of solutions, NewTechAqua will demonstrate that investment in sustainable aquaculture research and innovation leads to the creation of new value chains, markets, growth and jobs in coastal, offshore and landlocked areas.

The three pillars of the impact assessment indicators monitoring framework: the environmental, the economic, and the social- & health indicators are the sustainable choice for future aquaculture. The methodology listed in this report of both qualitative and quantitative approaches to the three pillars will during the next years of the NewTechAqua project be implemented and concluded in the following four deliverables:

- ***D6.2: Environmental impact assessment [M39]***
- ***D6.3: Economic impact assessment [36]***
- ***D6.4: Social and health assessment [36]***
- ***D6.5: Integrated sustainability and resilience assessment[58] [48]***

The chosen impact assessment indicators monitoring framework that are selected are:

Environmental indicators selected:

[58] Based on the outcome of the work made in T6.2, T6.3 and T6.4 ending with D6.2, D6.3 and D6.4, T6.5 will concentrate on generating a report summarising project impacts and assess the economic, social and environmental resilience of the solutions proposed.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

The goal of the Environmental Impact Assessment at hand is measuring their impact for increased productivity, resilience, and sustainability. Once the Life Cycle Assessment and the Emergy Accounting evaluation are completed for each scenario, the following indicators will be calculated, in order to define several types of environmental impact – comprising both environmental damages (downstream) and overall ecological requirements (upstream):

- Carbon Footprint (Climate Change contribution)
- Ozone layer depletion
- Photochemical oxidation
- Acidification emissions
- Eutrophication emissions
- Cumulative exergy demand
- Appropriated primary production
- Ecological Footprint

An additional set of emerging indicators will be also provided:

- Specific Emergy
- Renewable Emergy percentage
- Environmental Loading Ratio
- Environmental Yield Ratio
- Emergy Investment Ratio
- Emergy Sustainability Index
- Areal Empower Intensity
- Renewable Support Area

Economic indicators selected:

The microeconomic impact assessment will include following selected indicators:

- CAPEX (Capital Expenditures),
- OPEX (Operating Expenses),
- Investment needed to take the innovation to the market,
- Market-readiness of selected solutions (TRL-level during project duration),
- Market potential of selected solutions (Innovation Radar),
- ROI calculated on a 5- and10-year period after project end,
- Employment,
- Patents applied for.

The macroeconomic impact assessment will include following selected indicators:

- Research: number of articles disseminated/published,

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

- Employment created on regional, national, and European scale,
- Economic growth based on average wages.

Social- & Health indicators selected:

The social impact assessment will include following selected indicators:

- Fairness, equal opportunities and working conditions
- Tasks and work motivation
- Skills by the workforce
- Training
- Recruiting workforce
- Transparency of the business

The health impact assessment will include following selected indicators:

- Consumption of seafood
- Obesity and overweight in population
- Worker safety
- Food safety

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

8. References

8.1 Environmental indicators:

Muralikrishna & Manickam (2017). Chapter Five – Life Cycle Assessment. In: Environmental Management: Science and Engineering for Industry, BS Publications, India, pp. 57-75.

Henriksson, P. J., Guinée, J. B., Kleijn, R., & de Snoo, G. R. (2012). Life cycle assessment of aquaculture systems—a review of methodologies. The International Journal of Life Cycle Assessment, 17(3), 304-313.

Bohnes, F. A., & Laurent, A. (2019). LCA of aquaculture systems: methodological issues and potential improvements. The International Journal of Life Cycle Assessment, 24(2), 324-337.

Bohnes, F. A., Hauschild, M. Z., Schlundt, J., & Laurent, A. (2019). Life cycle assessments of aquaculture systems: a critical review of reported findings with recommendations for policy and system development. Reviews in Aquaculture, 11(4), 1061-1079.

McAuliffe, G. A., Takahashi, T., & Lee, M. R. (2020). Applications of nutritional functional units in commodity-level life cycle assessment (LCA) of agri-food systems. The International Journal of Life Cycle Assessment, 25(2), 208-221.

Philis, G., Ziegler, F., Gansel, L. C., Jansen, M. D., Gracey, E. O., & Stene, A. (2019). Comparing Life Cycle Assessment (LCA) of Salmonid Aquaculture Production Systems: Status and Perspectives. Sustainability, 11(9), 2517.

Sherry, J., & Koester, J. (2020). Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (Salmo salar). Sustainability, 12(15), 6079.

Konstantinidis, E., Perdikaris, C., Gouva, E., Nathanalides, C., Bartzanas, T., Anestis, V., ... & Skoufos, I. (2020). Assessing Environmental Impacts of Sea Bass Cage Farms in Greece and Albania Using Life Cycle Assessment. International Journal of Environmental Research, 1-12.

Biermann, G., & Geist, J. (2019). Life cycle assessment of common carp (Cyprinus carpio L.)–A comparison of the environmental impacts of conventional and organic carp aquaculture in Germany. Aquaculture, 501, 404-415.

Ray, N. E., Maguire, T. J., Al-Haj, A. N., Henning, M. C., & Fulweiler, R. W. (2019). Low greenhouse gas emissions from oyster aquaculture. Environmental science & technology, 53(15), 9118-9127.

Turolla, E., Castaldelli, G., Fano, E. A., & Tamburini, E. (2020). Life Cycle Assessment (LCA) Proves that Manila Clam Farming (Ruditapes philippinarum) is a Fully Sustainable Aquaculture Practice and a Carbon Sink. Sustainability, 12(13), 5252.

Chary, K., Aubin, J., Sadoul, B., Fiandrino, A., Covès, D., & Callier, M. D. (2020). Integrated multi-trophic aquaculture of red drum (Sciaenops ocellatus) and sea cucumber (Holothuria scabra): Assessing bioremediation and life-cycle impacts. Aquaculture, 516, 734621.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Jaeger, C., Foucard, P., Tocqueville, A., Nahon, S., & Aubin, J. (2019). Mass balanced based LCA of a common carp-lettuce aquaponics system. Aquacultural Engineering, 84, 29-41.

Odum, H. T. (1988). Self-organization, transformity, and information. Science, 242(4882), 1132-1139.

Odum, H. T. (1996). Environmental accounting: energy and environmental decision making (Vol. 707). Wiley.

Odum, H. T. (2007). Environment, power, and society for the twenty-first century: the hierarchy of energy. Columbia University Press.

Originally from “embodied energy”, yet also taking other direct and indirect resources into account.

Odum, H. T. (1996). Environmental accounting: emergy and environmental decision making (Vol. 707). Wiley.

Odum, H. T. (2002). Emergy accounting. In Unveiling Wealth (pp. 135-146). Springer.

Cavalett, O., de Queiroz, J. F., & Ortega, E. (2007). Emergy accounting of fish aquaculture chains in Brazil. Ecodinamica, 7, 53-61.

Vassallo, P., Bastianoni, S., Beiso, I., Ridolfi, R., & Fabiano, M. (2007). Emergy analysis for the environmental sustainability of an inshore fish farming system. Ecological Indicators, 7(2), 290-298.

Vassallo, P., Beiso, I., Bastianoni, S., & Fabiano, M. (2009). Dynamic emergy evaluation of a fish farm rearing process. Journal of Environmental Management, 90(8), 2699-2708.

Li, L., Lu, H., Ren, H., Kang, W., & Chen, F. (2011). Emergy evaluations of three aquaculture systems on wetlands surrounding the Pearl River Estuary, China. Ecological indicators, 11(2), 526-534.

Zhang, L. X., Ulgiati, S., Yang, Z. F., & Chen, B. (2011). Emergy evaluation and economic analysis of three wetland fish farming systems in Nansi Lake area, China. Journal of Environmental Management, 92(3), 683-694.

Lima, J. S. G., Rivera, E. C., & Focken, U. (2012). Emergy evaluation of organic and conventional marine shrimp farms in Guaraira Lagoon, Brazil. Journal of Cleaner Production, 35, 194-202.

Wilfart, A., Corson, M. S., & Aubin, J. (2012). Emergy accounting: principles and application for environmental assessment of agricultural and animal production systems. INRA Productions Animales, 25(1), 57-65.

Wilfart, A., Prudhomme, J., Blancheton, J. P., & Aubin, J. (2013). LCA and emergy accounting of aquaculture systems: Towards ecological intensification. Journal of Environmental Management, 121, 96-109.

Zhao, S., Song, K., Gui, F., Cai, H., Jin, W., & Wu, C. (2013). The emergy ecological footprint for small fish farm in China. Ecological indicators, 29, 62-67.

Aubin, J., Wilfart, A., Chary, K., Mathé, S., & Rey-Valette, H. (2014). Relation between ecosystem-services perception and environmental performance assessed by LCA and emergy accounting: a case study of pond farming in France (No. hal-02050870).

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Brown, M. T. (2015). Cycling emergy: computing emergy in trophic networks. Ecological modelling, 10, 37-45.

Wang, G., Dong, S., Tian, X., Gao, Q., & Wang, F. (2015). Sustainability evaluation of different systems for sea cucumber (Apostich. japon.) farming based on emergy theory. Journal of Ocean University of China, 14(3), 503-510.

Bonilla, S. H., Silva, H. R., Faustino, R. P., de Alencar Nääs, I., & Duarte, N. (2016, September). Environmental Support for Dilution of Pollutants from Broiler Production and Aquaculture in Brazil. In IFIP International Conference on Advances in Production Management Systems (pp. 99-105). Springer, Cham.

Cheng, H., Chen, C., Wu, S., Mirza, Z. A., & Liu, Z. (2017). Emergy evaluation of cropping, poultry rearing, and fish raising systems in the drawdown zone of Three Gorges Reservoir of China. Journal of Cleaner Production, 144, 559-571.

David, L. H. C., Pinho, S. M., & Garcia, F. (2018). Improving the sustainability of tilapia cage farming in Brazil: An emergy approach. Journal of Cleaner Production, 201, 1012-1018.

Aubin, J., Callier, M., Rey-Valette, H., Mathe, S., Wilfart, A., Legendre, M., ... & Blancheton, J. P. (2019). Implementing ecological intensification in fish farming: definition and principles from contrasting experiences. Reviews in Aquaculture, 11(1), 149-167.

Zhan, J., Zhang, F., Chu, X., Liu, W., & Zhang, Y. (2019). Ecosystem services assessment based on emergy accounting in Chongming Island, Eastern China. Ecological Indicators, 105, 464-473.

Su, Y., He, S., Wang, K., Shahtahmassebi, A. R., Zhang, L., Zhang, J., ... & Gan, M. (2020). Quantifying the sustainability of three types of agricultural production in China: An emergy analysis with the integration of environmental pollution. Journal of Cleaner Production, 252, 119650.

Maiolo, S., Cristiano, S., Gonella, F., & Pastres, R. (forthcoming). Ecological sustainability of aquafeed: an emergy assessment of novel or underexploited ingredients.

8.2 Economic indicators:

European Commission (2020). Environmental Assessment https://ec.europa.eu/environment/eia/index_en.htm

European Parliament (2011). Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0092

European Parliament (2014). Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052

European Parliament (2001). Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32001L0042

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

ISO – International Organisation for Standardisation (2006). ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework https://www.iso.org/standard/37456.html

CBA Builder by Dr. Dan Wheatley. The project was funded by the Economics Network and the Centre for Education in the Built Environment (CEBE) as part of the Teaching and Learning Development Projects 2010/11 http://www.cbabuilder.co.uk/CBA8.html

Glen and Burton Weisbrod (1997): Assessing the Economic Impacts of Transportation Projects. National Academy of Sciences / Transportation Research Board as Transportation Research Circular #477. https://seda.sk.ca/wp-content/uploads/econ-impact-primer.pdf

The Innovation Radar (2015) by DG Connect. A structured approach to identify and support potential high impact innovations and is an important source of actionable intelligence on innovations emerging from research and innovation projects funded through European Union programmes. https://www.innoradar.eu/methodology

John L. Crompton (2006): Economic Impact Studies. Department of Recreation, Park, and Tourism Sciences at Texas A&M University. Volume: 45 issue: 1, page(s): 67-82 https://journals.sagepub.com/doi/10.1177/0047287506288870

8.3 Social- & Health indicators:

FAO (2013): Indicators for sustainable aquaculture in the Mediterranean and Black Sea Countries – Guide for the use of indicators to monitor sustainable development of aquaculture; Studies & Reviews no. 93, General Fisheries Commission for the Mediterranean, http://www.fao.org/3/i3194e/i3194e.pdf

ILO (1999): Fishing amongst the most dangerous professions, press release, https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_071324/lang--en/index.htm

Hamann K., Hegyi A., Zelenak L., Loi A., Gentile M. (2019): New professions and career paths in the food and drink industry - Delivering High-level Food Industry Skills in the Digital Economy; https://effat.org/wp-content/uploads/2020/03/Digitalisation_FINALREPORT_high.pdf

Meldrum B., Read P., Harrison C. (2020): A guide to measuring social impact; the Social Impact Tracker, file:///C:/Users/Acer/Downloads/silo.tips_a-guide-to-measuring-social-impact.pdf

UnLtd (2020): What is social impact and what are social impact indicators; https://www.unltd.org.uk/our-support/learning-area/defining-social-impact-indicators-setting-targets-and-refining-your-social

WHO (2015): Global reference list of 100 core health indicators, https://apps.who.int/iris/bitstream/handle/10665/173589/WHO_HIS_HSI_2015.3_eng.pdf?sequence=1

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

9 Annexes

9.1 The Innovation Radar questionnaire

Innovation Radar Questionnaire by EC DG CONNECT

Note: the first 16 questions below are to be answered for <u>each</u> innovation the project develops (up to a maximum of 3 innovations).

1) **Describe the innovation (in less than 300 characters, spaces included):**

2) **Is the innovation developed within the project…:**
   a) Under development
   b) Already developed but not yet being exploited
   c) being exploited

3) **Characterise the type of innovation (only to be answered if 2b or 2c is selected)**
   - Significantly improved product
   - New product
   - Significantly improved service (except consulting ones)
   - New service (except consulting ones)
   - Significantly improved process
   - New process
   - Significantly improved marketing method
   - New marketing method
   - Significantly improved organisational method
   - New organisational method
   - Consulting services
   - Other

4) **If other, please specify:**

5) **Characterise the macro type of innovation (only to be answered if "under development" is selected for Q2):**
   - Product
   - Marketing method
   - Organisational method
   - Process
   - Service (non-consulting)
   - Consulting service
   - Do not know yet

6) **Will the innovation be introduced to the market or deployed within a partner:**
   a) Introduced new to the market (commercial exploitation)
   b) Deployed within a partner (internal exploitation: Changes in organisation, new internal processes implemented, etc.)
   c) No exploitation planned

7) **If no exploitation planned, please explain why no exploitation is planned (answer only if 6(c) is selected)**

8) **Is there a clear owner of the innovation in the consortium or multiple owners?**
   - A clear owner
   - Multiple owners

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

9) Indicate who is the "owner" of the innovation: ...

10) Indicate the step(s) already done (or are foreseen) in the project in order to bring the innovation to (or closer to) the market (answer only if 6(a) is selected)

	Done	Planned in project	Not Planned	Desirable
1. Technology transfer				
2. Engagement by Industrial research team of one of their company's business units in project activities				
3. Pilot				
4. Capital investment (VC, Angel, other)				
5. Investment from public authority (national, regional)				
6. Business plan				
7. Prototyping				
8. Market study				
9. Demonstration or Testing activities				
10. Feasibility study				
11. Launch a start-up or spin-off				
12. Other				

11) If other, please specify

12) Indicate which participant(s) (up to a maximum of 3) is/are the key organisation(s) in the project delivering this innovation. For each of these identify under the next question their needs to fulfil their market potential.
Org1:
Org2:
Org3:

13) Indicate their needs to fulfil their market potential

	Investor readiness training	Investor introductions	Biz plan development	Expanding to more markets	Legal advice (IPR or other)	Mentoring	Partnership with other company (technology or other)	Incubation	Startup accelerator
Org 1									
Org 2									
Org 3									

14) When do you expect that such innovation could be commercialised? (answer only if 6(a) is selected)
- Less than 1 year
- Between 1 and 2 years
- Between 3 and 5 years
- More than 5 years

15) Have any of the project partners...
(only to be answered if "Done" or "Planned in Project" is chosen for 10.5 "Investment from public authority")
a) already applied for support from private investors

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

b) already applied for investement from public authorities
c) Planning to start discussions with private or public investors

16) Which partners are in discussion with investors (or are planning such discussions)?

(the above questions are to be answered for each innovation developed by the project, up to a maximum of 3 innovations)

General Questions

(questions below are to be answered once in the project review, not for each innovation)

1) How does the consortium engage end-users?
   - End user organisation in the consortium
   - An end user organisation outside of the consortium is consulted
   - No end user organisation in the consortium or consulted

2) Are there in the consortium internal IPR issues that could compromise the ability of a project partner to exploit new products/solutions/services, internally or in the market place?
   - yes
   - no

3) Please provide specifics of the IPR issues:

4) Which are the external bottlenecks that compromise the ability of project partners to exploit new products, solutions or services, internally or in the market place?
   - IPR
   - Standards
   - Regulation
   - Financing
   - Workforce's skills
   - Trade issues (between MS, globally)
   - Others

5) Indicate how many patents have been applied for by the project: _____
6) Does the review panel consider the project performance in terms of innovation?
   - Exceeding expectations
   - Meeting expectations
   - Performing below expectations

7) General observations of innovation expert on this project's innovation performance:

8) How would you rate the level of commitment of relevant partners to exploit the innovation?
   - Very low
   - Low
   - Average
   - High
   - Very High
   - None

9) Please indicate the 1 partner (excluding large enterprises) that the panel considers to be the most impressive in terms of innovation potential:
10) Please enter some tag words (comma separated) to represent what "innovation elements" are strong in the project:
11) Please enter some tag words (comma separated) to represent what "innovation elements" can be improved (or are absent) in the project:

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

9.2 Exploitable Result Identification Questionnaire (ERIQ)

General Information			
Organization name			
Location			
Goal(s) in NewTechAqua			
Innovation Description			
Innovation name			
Innovation type (hardware, product, software, service, etc.)			
Short innovation description			
Innovation characterization	Choose from the list		
Current TRL* (1-9)	Choose from the list	**TRL end of project (1-9)**	Choose from the list
Level of innovation	Choose from the list	**Time to market (years after project end)**	Choose from the list
Market Description (if relevant)			
Market size	Choose from the list	**Market trends**	Choose from the list
Targeted geography (country, region etc.)			
Targeted customer segments			
Market maturity	Choose from the list	**Market competition**	Choose from the list
Unique selling points (USPs), compared to existing solutions. (in short bullets)			
Supply Chain/value chain (if relevant)			
Input: Have you identified how you will get enough raw materials for your production?	Yes ☐ No ☐	**If yes, please elaborate**	

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Input: Do have indication of the price of the raw materials?	Yes ☐ No ☐	**If yes, please elaborate**	
Product (Output): Have you identified and/or been in contact with potential customers?	Yes ☐ No ☐	**If yes, please elaborate**	
Product (Output): (If yes above) are the customers willing to pay a premium for the new product (if needed)?	Yes ☐ No ☐ N/A ☐	**If yes, please elaborate**	
Waste stream (Output): Do you know what to do with the waste raw material after production?	Yes ☐ No ☐	**If yes, please elaborate**	
Financial Information (if relevant)			
Additional funding needed to bring innovation to market.	Choose from the list	**Founding sources (choose as many as relevant)**	Internal sales ☐, Loans ☐, Private Equity: - Business Angels ☐, - Venture Capital ☐, - Industrial Investors ☐, Public funds: - EU funding programs ☐, - National funding programs ☐, - Follow-up/parallel projects ☐, Other ☐, Not known ☐.
Expected revenue from innovation at end of project	Choose from the list	**Expected revenue from innovation 5 years after end of project**	Choose from the list
Expected employment growth from innovation at end of project (FTE‡: full-time equivalent)	Choose from the list	**Expected employment growth from innovation, 5 years after end of project**	Choose from the list
IPR (Intellectual Property Rights) & Standards (if relevant)			

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Status of IPR: Background (type and partner owner)			
Status of IPR: Results/Foreground (type and partner owner)			
Are there any IPR/Patents issues to be resolved with the consortium?	Yes ☐ No ☐	**If yes, please elaborate**	
Do you expect to be able to apply for patents during/after the project?	Yes ☐ No ☐	**If yes, please elaborate**	
Do you expect to be able to apply for trademarks or other IPR during/after the project?	Yes ☐ No ☐	**If yes, please elaborate**	
Standardisation: Describe whether there are any legal, normative or ethical requirements connected to the development of your product/Early requirements?	Yes ☐ No ☐	**If yes, please elaborate**	
Risks (fill in as many as needed)			
Risk 1			
Type of risk:	Choose from the list	**Description:**	
Likelihood of occurring:	Choose from the list	**Impact if occurring:**	Choose from the list
Risk mitigation measure:			
Risk 2			
Type of risk:	Choose from the list	**Description:**	
Likelihood of occurring:	Choose from the list	**Impact if occurring:**	Choose from the list

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Risk mitigation measure:			
Risk 3			
Type of risk:	Choose from the list	**Description:**	
Likelihood of occurring:	Choose from the list	**Impact if occurring:**	Choose from the list
Risk mitigation measure:			
Risk 4			
Type of risk:	Choose from the list	**Description:**	
Likelihood of occurring:	Choose from the list	**Impact if occurring:**	Choose from the list
Risk mitigation measure:			
Risk 5			
Type of risk:	Choose from the list	**Description:**	
Likelihood of occurring:	Choose from the list	**Impact if occurring:**	Choose from the list
Risk mitigation measure:			

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

9.3 Research Result Identification Questionnaire (RRIQ)

General Information			
Organization name			
Location			
Goal(s) in NewTechAqua			
Research Topic Overview			
Research field			
Research topic			
Main scientific journals			
How many publications in total on this research topic in literature?	Approximations are also ok	**Total number of citations for these publications:**	Approximations are also ok
How many publications in 2020 on this topic?	In total, not only by your group, but approximations are also ok	**Publications per year, increasing or decreasing rate lately?**	Numbers would be nice
Your NewTechAqua Research Overview			
Brief description of your research in NewTechAqua	5 lines		
Scientific challenges of your research	In bullet points		
How many FTE* researchers work on NewTechAqua research?	Professionals in R&D sector, PhDs, post-docs, research/lab assistants, technicians, workers, undergrad/master students, other…?		
How many individual projects funded under NewTechAqua in your research group?	e.g., sometimes young professionals, PhD students can work on 2 projects, so the FTE may be different than the number of projects		
Expected number and type of publications from NewTechAqua research	E.g Papers on journals, reports, etc.		
Any theses containing NewTechAqua results?	PhD, MSc, BSc theses		
Do you plan to use results from	…as preliminary results for instance. If yes, please elaborate.		

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

NewTechAqua in future proposals?			
Collaborations with parties not from the NewTechAqua consortium?	(if they are needed to complete NewTechAqua-relevant research) If yes, please elaborate.		
NewTechAqua-relevant publications to date	Number; before starting NewTechAqua	**Citations for these publications:**	
Commercial Potential of Research			
Who could potentially use your NewTechAqua research results?			
NewTechAqua research results will become part of a commercial product/service:	Yes ☐ No ☐	**If yes, please elaborate**	Including estimated time to market
Any foreseen spin-offs related to NewTechAqua research?	Yes ☐ No ☐	**If yes, please elaborate**	
Do you already have patents related to the topic?	From before NewTechAqua		
Financial Information			
Additional funding needed to complete research after SLIM?	Estimate figure	**Funding sources**	
IPR (Intellectual Property Rights) & Standards			
Are there any IPR/Patents issues to be resolved with the consortium?	Yes ☐ No ☐	**If yes, please elaborate**	
Do you expect to be able to apply for patents during/after the project?	Yes ☐ No ☐	**If yes, please elaborate**	
Do you expect to be able to apply for trademarks or other IPR during/after the project?	Yes ☐ No ☐	**If yes, please elaborate**	
Standardisation, any early requirements?	Yes ☐ No ☐	**If yes, please elaborate**	

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.