BIO4HUMAN

Mid – term policy brief

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CONTENT

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I. INTRODUCTION

This policy brief has been prepared within the domain of the Bio4HUMAN project - *"Identifying bio-based solutions for waste management applicable to humanitarian sector"* (further referred to as ***"Bio4HUMAN"*** or ***"Project"***).

The aim of the Project is to assess the scope to which **bio-based innovative technological solutions and bio-based systems have the potential to be applied under a humanitarian context, with the simultaneous positive effect on the environment** and therefore **to strengthen the actual implementation by humanitarian responses of the *"do no harm the environment"* principle**. This is in line with the European Union declaration to further promote the development and uptake of innovative solutions that deliver more efficient, cost-effective, environmentally-friendly and climate-proofed humanitarian aid.[1] Hand in hand, in May 2021, the *"Climate and Environment Charter for Humanitarian Organizations"* was officially launched by a collaborative foundation[2], and sent a clear signal that humanitarian actors have a key role to play in addressing both humanitarian and environmental crisis.

Humanitarian settings are the main focus of the Project, and include conflict-affected areas, natural disaster zones, complex emergencies, refugee or "internally displaced people" camps/settlements and protracted crises environments. As case studies Bio4HUMAN targets two countries in Sub-Saharan Africa – the Democratic Republic of Congo and South Sudan, which are both considered as protracted crisis environments, and are characterized by recurrent natural disasters and/or conflicts, longevity of food crises, breakdown of livelihoods, and insufficient institutional capacity to react to the crises. In these two countries different types of locations – cities, camps and villages are the subject of Project's considerations.

This Bio4HUMAN mid – term policy brief is based on the main findings and conclusions from the first three key deliverables of the Project,

[1] The declaration expressed in the *"Communication from the Commission to the European Parliament and the Council on the EU's humanitarian action: new challenges, same principles"*, Brussels, 10.3.2021 COM(2021) 110 final.

[2] The development of the Climate and Environment Charter for Humanitarian Organizations was led by the International Committee of the Red Cross (ICRC) and the International Federation of Red Cross and Red Crescent Societies (IFRC). The works were guided by an Advisory Committee, including representatives of local, national and international NGOs, UN agencies and National Red Cross and Red Crescent Societies, as well as academics, researchers and experts in the humanitarian, development, climate and environmental fields.

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"Humanitarian Sector Needs Assessment Report", ***"List of Bio-based Solutions"*** and ***"Gap Analysis Report"***.

The policy recommendations presented below aim to contribute to the efficient and successful implementation of bio–based solutions into the systems of solid waste management in humanitarian settings.

The recommendations have been divided and presented from three main perspectives:

1) the perspective of countries constituting humanitarian settings;

2) the perspective of the humanitarian organisations and humanitarian supply chains;

3) the perspective of the bioeconomy sector and the providers of bio-based solutions.

II. THE PERSPECTIVE OF COUNTRIES CONSTITUTING HUMANITARIAN SETTINGS

In order to improve the solid waste management in humanitarian settings of the affected countries, it is important to:

1) **Facilitate the development of national policies and regulations setting the solid waste management schemes and procedures**.

   While humanitarian waste can be defined and described (such as its source and packaging details), it cannot be differentiated from general waste present in humanitarian settings, unless it is specifically marked as humanitarian waste. After humanitarian waste enters the waste stream and decays, it blends indistinguishably with general waste. Therefore, for efforts to improve the management of solid waste generated by humanitarian actions to succeed, the general country-

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wide and/or regional-specific regulations are needed. [3] The decentralized approach for solid waste management shall be strongly considered as part of these policies and regulations. Once in place, the legislation will be accompanied by the enforcement measures, and, at the same time, get the appropriate promotion by national and/or regional governments. The legislation will be followed by public strategic and operational plans for solid waste management. The private sector and private entities ought to be strongly involved in the preparation processes of the plans.

2) **Incentivise the development of appropriate solid waste management infrastructure and solid waste management services**.

As each type of waste in humanitarian settings (including humanitarian waste) requires different treatment and disposal methods (for example, organic waste requiring composting or anaerobic digestion, plastics requiring recycling programs, hazardous waste requiring specialized facilities) – there is an understandable need to work on development of the infrastructure. The efforts leading to the improved quality of the general waste management services shall be undertaken, whenever possible. It must be however noted that limited financial resources, lack of technical expertise, security constraints, low electricity access and underdeveloped road networks are the persistent factors hindering the development of comprehensive solid waste management systems.

3) **Develop additional funding mechanisms supporting the necessary waste management schemes.**

The states shall try to actively explore the available and possible schemes, especially public – private partnerships and fee-based systems, to secure the necessary funding for the most pressing waste management constraints, incl. the needed infrastructure mentioned in point 2) above. The appropriate regulations helping in the development of private businesses functioning in the area of waste management (temporary tax exemptions or reductions) may in the longer – term prove effective for public finances. Reaching out to international

[3] They may in particular take the form of *"waste policies"*, *"the sustainable waste management acts"*, *"national waste management regulations"*, *"solid waste disposal acts"*, *"regional / municipal solid waste statutes"*, or constitute part of *"national environmental regulations"*.

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donors, with humanitarian organisations playing potentially advisory and supportive roles, could also constitute the important pillar of attracting additional funding for properly conducted country-wide and / or regional-based waste management operations.

4) **Enhance the introduction of basic monitoring and measurement systems for the solid waste management purposes.**

Across countries and regions, significant challenges exist regarding the availability of waste data. Inadequate estimates for key indicators, such as total collected waste and the proportion of collected waste deposited in controlled landfills, make it challenging to introduce and implement new and innovative solutions and methods to improve solid waste management in humanitarian settings. The guidelines and tools recently developed and published by the United Nations Environment Programme [4] and the Environmental Sustainability in Humanitarian Supply Chain cluster [5] can provide a supportive role. The humanitarian organisations will advocate for the functioning monitoring and measurement systems, while at the same time acting as the facilitators of already existing substantive know-how.

5) **Take up actions leading to technical capacity building, raising awareness and common knowledge of good solid waste management practices and their correct performance among the general population.**

As many people do not understand proper behaviours in terms of waste management, they cannot be expected to take the necessary steps. Lack of basic knowledge often results in inappropriate composting practices or usage of unnecessary packaging/plastics. In effect, the health of the population may be jeopardised. Therefore, solid waste management shall become the subject of public debate and simultaneously of deliberate governmental activities, like introducing the subject into school curricula, and facilitation of objective capacity building, for example during nutrition and health

[4] United Nations Environment Programme *"Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource"* Nairobi 2024.
[5] *"Waste or Material Characterization Exercise Guidance"*, WREC 2024.

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work in health facilities. The already existing research and development initiatives [6] ought to be further supported and get requisite visibility. Local academia is expected to play an important awareness–raising role.

In this context also the lack of the technical capacity by public and private actors to deal with solid waste management challenges shall be addressed. Exchange visits and events may increase the subject's awareness and help in the learning process. The results of these actions should improve the perception of solid waste management and lead to more responsible behaviour on a professional and private scale.

In all the presented areas, the countries shall seek the constant improvement of coordination efforts and collaboration activities with humanitarian organisations, which should be able to act as facilitators, intermediaries or providers of very concrete solutions.

III. THE PERSPECTIVE OF THE HUMANITARIAN ORGANISATIONS AND THE HUMANITARIAN SUPPLY CHAINS

In order for the humanitarian organisations to make a positive and lasting impact on the solid waste management in humanitarian settings, the following recommendations are presented, starting with governmental and organisational topics and moving on to environmental aspects and operational issues, such as necessary funds for effective application of green procurement rules.

1) **Consolidate and if possible, extend the presence of the sustainability principles in the policies, guidelines and practical operatives of the humanitarian organisations, in order to minimize the environmental**

[6] Examples being: 1) works on biodegradable waste for energy production and optimization of existing practices in the area of microbiology to speed up biogas production (University of Goma, Democratic Republic of Congo); 2) research on design and making of bio-products from organic waste (University of Juba, South Sudan); 3) development of economic models for prototyped solid waste management solutions (FabLab EcoWaste).

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impact of solid waste management and to promote resource efficiency.

Despite the unfavourable political circumstances and actual changes in the general humanitarian strategies of the most important donors, like EU and its member countries, USA and Great Britain, the measures leading to "*reduce*", "*reuse*", and "*recycle*" of waste shall be constantly endorsed and treated by the humanitarian organisations as a high priority issue. The existing examples of guidelines[7] and solid waste management models[8] emphasizing the reduction of plastic waste and the valorisation of bio-waste will be further developed. The by humanitarian organisations already adopted sustainable waste management practices, such as composting organic waste, using renewable energy sources for waste treatment and promoting the use of eco-friendly materials should be continued and, wherever possible, further extended and supplemented by other environment-friendly solutions.

Implementation of circular economy principles - like the creation of closed-loop systems, where waste materials are reused or recycled back into the supply chain, simultaneously reducing the need for virgin resources - is likewise an important element of sustainable operations. The further-reaching ambition shall foresee the introduction of circular bioeconomy principles, where the substitution of the linear economic model by a circular model is strengthened by the replacement of the fossil resource by a bio-based one.

2) **Introduce mechanisms allowing for the identification of amounts and types of waste that the given humanitarian intervention produces.**

Quantifying and categorizing the general waste and humanitarian waste is difficult, as the destination countries of humanitarian aid lack infrastructure, mechanisms and resources to monitor waste. For the humanitarian organisations the difficulties lie in the cross-cutting nature of this issue, which is usually handled by various staff at different levels.

[7] *"Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts"*, UNHCR 2024.
[8] To name just: 1) solid waste management hierarchy, 2) integrated solid waste management practices.

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Nevertheless, the subject of the proper identification of amounts and types of waste that the given humanitarian intervention produces shall be given more attention, particularly by preparation of necessary tools and utilisation of existing schemes, like subscription to waste collection companies. The by WREC[9] newly developed methodologies to be implemented by humanitarian organisations, e.g. waste audits, surveys, observations, and waste weighing exercises – shall be taken into the further and extended considerations. Standardization in measurements and in reporting of waste are necessary to adequately estimate simple indicators, such as total collected waste and the share of collected waste deposited in controlled landfills. The necessary prioritisation and intentional behaviour of humanitarian actors, including strengthened funding and designated personnel, are very much required in this context. The availability of more detailed information will allow for a more targeted response from the bioeconomy sector, and potentially better adjusted bio-based products and bio-based technologies.

3) **Implement tools, procedures and platforms that permit proper coordination and partnerships between governments, humanitarian organisations, donors and other stakeholders of the solid waste management system.**

The coordination and partnerships at different levels of solid waste management are key for successful system implementation. They shall reduce "working in silos" models, where, for example, waste collectors do not create linkages with waste transformers. At the same time, the coordination efforts and partnerships shall enhance pooling of resources and sharing of knowledge. Implementation of multilayer and multi-stakeholder projects, co-created and co-developed by humanitarian organisations, is the necessary step on the way to the introduction of ultimate mechanisms. All of these coordination and partnerships initiatives should be accompanied by internal efforts of the humanitarian organisation to properly prioritise the challenges posed by solid waste management, by building and enhancing expertise, and by facilitating the access to the needed equipment.

[9] *"The Environmental Sustainability in Humanitarian Logistics Project"* responsible for providing coordination, information management, and for facilitating access to common logistics services to ensure an effective and efficient logistics response takes place in humanitarian emergency missions.

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4) **Empowering locally-led actions and co-create conditions in the humanitarian settings for new circular business ventures.**

Local entrepreneurs and communities have the potential to address waste management issues in various settings, especially by implementing resilient, localized waste-to-resource business models that support the development of local circular (bio)economies. Allowing safer access to waste (e.g. in refugee camps and settlements) to enable local small-scale enterprises to enter the waste-based economy, while managing health and safety risks, is one of the necessary preconditions. The other being the involvement of the local regulators and authorities who shall actively support and promote the new business trends. The substantive area of energy recovery technologies, like landfill gas recovery, bio-digesters for organic solid waste, and domestic biogas technologies, has one of the biggest endogenous potentials to help create locally grassroots lasting entrepreneurs and to generate new employment opportunities, potentially also directly related to the implementation of bio-based technologies. The stronger presence of the bioeconomy principles in these circular business models, featuring *inter alia* extended usage of biodegradable products being returned to the organic and nutrient cycle and further bio-technological utilisation of organic and waste streams, shall make the business ventures more resilient and foresighted.

5) **Put sufficient emphasis on the sustainability issues of the whole humanitarian supply chains.**

As nearly 90% of humanitarian waste is produced as a result of logistics operations, the environmental impacts and sustainability features of these operations must be carefully considered. Utilisation in a greater scope of innovative solutions like bio-based products (packages, bags, tapes, pads, films, foams) and bio-based technologies (particularly the ones being able to deal with waste at the final destination), shall constitute one of the key elements of the sustainability focused approach in structuring and operating humanitarian supply chains. More common best practices - such as minimization of branded packaging, proper selection of adequate warehouses, utilisation of standard and modular packaging units to

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limit repacking and introduction of routing systems and automated tracking – will continue to play an important role. Also, socio-economic factors, like training local suppliers to meet international environmental standards, inevitably supports sustainable procurement and local economies, while at the same time reduces reliance on external sources.

As far as it is possible and feasible, the sustainability and environmentally conscious approaches shall be binding for all stages of the humanitarian supply chain, including the mostly overlooked intermediate phases, like goods handling and transport. The challenges of implementing bio–based packaging (cartons, films, tapes) into the given supply chain stages, where the repacking and reloading takes place, must be addressed in a systemic manner.

6) **Constantly raise awareness of the costs connected to the "greening" of humanitarian interventions and to the proper "end-of-life management".**

The implementation of sustainable/integrated solid waste management and sustainable supply chains management usually incurs additional costs (even though more can be saved in long term), human resources and time. The same applies to the introduction of end-of-life management options, extending the lifecycle of relief items through reuse, repurposing, or recycling programs.

The aim is to further extend the existing minimal specific funding from humanitarian donors to support humanitarian organisations in greening their operations and organisational structures and in systematically contributing to waste reduction by utilising biodegradable solutions. This shall result in going beyond already financed the most obvious activities, such as measurements of environmental footprints, hiring of environmental advisors, and transitioning to solar energy for the facilities.

7) **Make use of existing green procurement rules emphasizing environmental responsibility in purchasing decisions**.

Green procurement, the process of acquiring goods, services, and works with a reduced environmental impact throughout their life cycle,

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from production to disposal, aims to incorporate environmental considerations into purchasing decisions, thus promoting sustainability and responsible resource management. The successful implementation of green procurement in the humanitarian sector will mean the vital presence of environmental considerations in all the important acquisitions, from the planning stage to the disposal stage of the procurement cycle.

Environmental impact and sustainability criteria, like prioritisation of eco-friendly products, reduction of single-use plastics and incorporation of recycled and biodegradable materials, shall constitute integral elements of the procurement policies, guidelines and practices for the humanitarian purchasing. Waste reduction, easier end-stage management, economic inclusivity, social improvements, and significant reduction of humanitarian organisations' environmental footprints – are the obvious positive results.

8) **Demonstrate an open attitude versus innovative solutions, including bio-based solutions, which have the material or technological potential to improve the solid waste management in humanitarian settings.**

These sustainable solutions may *inter alia* help reduce the plastic pollution problem linked to poor end-of-life management, shift away from fossil based to bio-based products and limit the environmental footprint – all positively contributing to the climate change constraints. Further on, waste valorisation projects, like *"small-scale residue utilization pathways for high-value products"* could constitute the right framework for the local implementation of innovative bio-based solutions.

Humanitarian organisations shall therefore adopt a holistic approach and – by collaborating with external bio-based experts – analyse various environmental impacts of the innovative solutions. This shall ultimately lead to making informed choices when comparing different options. Thinking on a bigger scale, striving for systemic shifts and making bold decisions is the recommended way forward. The relevant guidelines and appropriate training programs for the humanitarian partners on greening humanitarian aid, with a view to reducing the climate and environmental footprint of humanitarian aid, will also

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contribute to ascertaining the expected attitude.

IV. THE PERSPECTIVE OF THE BIOECONOMY AND THE PROVIDERS OF THE BIO-BASED SOLUTIONS

In order for the stakeholders of the bioeconomy to decidedly enter the growing market of humanitarian interventions, which may constitute a totally new and prosperous field of business operations, it is important to:

1) **Research and deliver further bio-based innovative solutions potentially helping with humanitarian waste, while simultaneously considering the entire context of waste in humanitarian settings.**

   It is expected for bio-based innovations to be sustainable and scalable across different contexts. However, a solution that works in one area might fail in another, if the entire waste ecosystem is not considered. Understanding and considering local practices, available infrastructure, and cultural attitudes toward waste are crucial factors.

   Furthermore, addressing only a portion of the waste problem might shift the burden rather than solve it. For example, replacing plastic with another bio-based material without considering the local waste processing capabilities, might lead to new environmental constraints. As humanitarian settings often operate with limited resources, this demanded holistic approach will ensure that innovations are resource-efficient and do not inadvertently waste materials or effort by focusing too narrowly on one aspect of waste. The constant development of adequate infrastructure for processing and utilization of bio-based materials is, in many cases, a vital precondition for effective implementation of bio-based solutions.

   In order to generate expected synergies between effective waste management in humanitarian destinations and the technological capacities and opportunities offered by bioeconomy, it would be highly advisable for the providers of bio-based solutions to coordinate the research and development efforts with humanitarian organisations and include local research facilities. With this scenario in place, there is

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higher probability of proposing and delivering solutions based on the local needs, while simultaneously complying with local conditions, possibilities and expectations.

2) **Address the horizontally understood sustainability and ecosystem topics connected to the development and delivery of bio-based solutions.**

As many of the bio-based solutions rely on plant-based materials such as corn (e.g. laminating films) and seaweed (e.g. packaging for products), and the favoured scenario foresees, where possible, researching the solutions with local feedstock being a core ingredient – two types of concerns must be addressed.

The first one relates to growing bio-feedstock on arable land, which may potentially compete with food production. This anxiety applies particularly in cases when the raw material, semi–finished product or final product are developed at the site of the humanitarian intervention. The consequences on ecosystems and food security that result from moving the actual production to the humanitarian destination must be therefore considered very carefully, by utilizing tools such as social Life Cycle Assessments.

The second concern refers to overharvesting seaweed and disrupting marine ecosystems by large scale seaweed farming. It is therefore necessary to ensure the responsible sourcing in every case. The cases of potential influence on marine ecosystems must be checked by utilizing available methodologies like "*Impact World Plus - Plastic physical effect on biota or Fisheries impact*" in environmental Life Cycle Assessments.

Other cases of the production of bio-based solutions and their influence on given ecosystems must regularly remain high on the sustainability agenda.

3) **Continue the work on bio-based materials and their features, with the aim to further improve the positive environmental impact.**

In this context, it should be noted that, in a few impact categories, some bio-based materials can have a higher environmental impact

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than fossil-based materials (e.g., fossil resource depletion, ozone depletion, human toxicity, terrestrial ecotoxicity, photochemical ozone formation, acidification, and eutrophication). However, some impacts caused by fossil-based materials, such as the effects of plastic debris in the ocean, are not currently measured by the EF 3.1 impact assessment methodology. Thus, it is crucial to consider the full range of relevant impact indicators to ensure a comprehensive assessment. A holistic approach allows for better visualization of the overall environmental performance, helps avoid trade-offs between impact categories, and ensures that key sustainability aspects, such as biodiversity loss and long-term ecosystem effects, are not overlooked.

To purposefully employ the products utilizing bio-based materials with the aim to reduce the environmental impact of solid waste generated in humanitarian settings, the characteristics of the bio-based materials must be constantly improving. The overall environmental and health aspects must be respected by bio-based solutions and waste innovations, as, for instance, replacing one type of waste with another might reduce pollution in one form, but increase it in another, if not carefully planned.
The environmental concerns connected to the bio-based solutions must simultaneously involve the different production stages and the potential additional requirements for significant amounts of energy and water, which relates mostly to the products involving intensive processing.

The general claim of the more favourable environmental impact, resulting from the introduction of the bio-based solutions, must be proven in each and every case.

4) **Ensure the necessary quality and functionality of the proposed bio–based solutions.**

There is an obvious need to ensure features such as stability, strength and water resistance for most of the bio-based solutions. These bio-based materials must perform reliably. This is of particular importance for food packaging as an alternative to petroleum-based plastics, as food loss and food waste resulting from inappropriate or defective packaging can cause significant environmental emissions. The varied

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climatic conditions of humanitarian settings, where potential bio–based solutions are to be used, must be taken into consideration in order to guarantee the expected performance.

5) **Further research & development efforts should take up the challenges of "end-of life" scenarios for the bio–based solutions.**

There are already identified bio-based solutions in existence that are potentially applicable to humanitarian interventions and that definitely contribute to a more circular bioeconomy. These solutions exercise features of renewability, recyclability, biodegradability (up to 100%), compostability (up to 100%, including home compostability and industrial compostability) and sustainability (in terms of sourcing the feedstock).

However, at the same time, there is a need to ensure specific conditions (e.g. humidity, temperature) for the biodegradable products to break down completely. The market availability of compostable products requires industrial facilities (high temperatures over a long period of time) to degrade. Some bio-based products are still partially composed of fossil-based plastic (bio-PET/starch blends) and contain chemicals that make their end-of-life management challenging. Biodegradable plastics also need a separate collection system: if they end up in a landfill, their breakdown results in carbon and methane emissions, and when collected alongside recyclable plastics, they can contaminate recyclable plastic batches and cause damage to recycling infrastructure.

Therefore, it is absolutely necessary to put more emphasis on the bio-technological side of the "end of life" scenarios offered by particular bio-based solutions. At the same time, the compostability and/or biodegradability claims expressed by solution owners must be evidence-based, feasible and well documented. In this context it must be noted that in particular Life Cycle Assessment scenarios for given products and technologies are becoming more and more important for future users, including humanitarian organisations.

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6) **Consider the price and availability factors.**

An important challenge closely connected to the quality and functionality of bio-based solutions is the cost factor. There are already bio-based solutions in existence that can be delivered at the same cost level as the comparable fossil–based alternatives. But, for most bio-based products, one of the key barriers remains: the higher cost compared to traditional products. This elevated cost is often associated with environmental, social and governance investment, which shall be regulated and calculated reasonable, as to ensure the highest possible level of competitiveness for bio-based products and technologies.

In cases of bio-regenerative materials, e.g. seaweed, hemp, mushrooms, the availability – understood as the potential of suppliers being able to ensure the materials in large quantities to meet the needs of humanitarian organisations – also remains a challenge. In cases where the production or the technologies are shifted to the humanitarian destinations, these availability issues must be dealt with in a systemic manner.

7) **Recognize the multi-threaded aspect of transferring the production and the technological installation of bio-based solutions to the countries requiring humanitarian aid.**

As for the dislocation of production sites for the bio-based solutions helping the humanitarian cause, these opportunities will be far and few between. If undertaken by state undertaken initiatives or by individual business, they generally lead to positive results by potentially serving as development/livelihood projects, including knowledge transfer and job creation. At the same time, however, it must be assured that the potential transfers of new production capacities do not eliminate the existing local production.

Far more likely are the local enforcements of small to medium-scale technologies helping dealing with solid waste management. In these cases, the issues of applicability of the technology for humanitarian purposes and its ability to form part of a development component to the humanitarian intervention, must get proper pre-emptive considerations.

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In both cases, i.e. of transferring the production sites and of the local implementation of technological installations, the extended feasibility analysis will be recommended.

8) **Regionally and locally promote the advantages and positive environmental impacts of the bioeconomy in general, and bio-based solutions in particular.**

For the time –being, the approaches of *"bioeconomy"* and the applications of *"bio-based solution"* are not well known in the humanitarian context, and the stakeholders are not very familiar with these terms. The awareness raising activities may be objectively based on the better understandable and partially familiar solutions, like fertilizer production from organic waste, animal feed production (Black Soldier Fly larvae feeding on organic waste), biogas production in bio-digesters, and the introduction of biodegradable sisal bags, paper plates and packaging replacing plastic items. The expressed local concerns about complicated, slow and costly implementation of bio–based solutions must be addressed.

The ultimate goal of these promotional and awareness raising activities shall be the highest possible involvement of local non-governmental organisations and potential local suppliers. Where feasible and applicable, the humanitarian organisations ought also be involved in the local implementation processes of bio-based solutions.

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V. CONCLUSIONS

There is a political will at EU level to support humanitarian partners' efforts to reduce their environmental footprint. As humanitarian aid constitutes a complex multi-entity system, in order to reach this ambitious goal, there is a need for all key stakeholders to act. The most important entities in this regard are obviously the humanitarian organisations, followed by the countries being subjected to humanitarian interventions.

As the first part of BioHUMAN demonstrated, the bioeconomy and the innovative bio-based solutions have the potential to establish themselves as one of the key elements of the overall activities leading to more sustainable and environmentally friendly humanitarian interventions. The availability of bio-based products to eliminate the need for plastic-based solutions and of technologies allowing for transformation of local organic solid waste – constitute a good basis for expected synergies between humanitarian aid and opportunities offered by the bioeconomy.

It is, however, required for the bio-based entities to clearly and consequently recognize the humanitarian operations as a stable and constantly growing market for bio-based products and bio-based technologies. The more open and engaged attitudes of businesses versus European capacity building initiatives like Bio4HUMAN, would also be encouraged.

The public support for the innovative "out of box" bio-based solutions shall be continued and strengthened, if affordable. From the Bio4HUMAN perspective, it would be advisable to introduce mechanisms assisting the development of bio-based technologies requiring lower to medium-level investment. The practical options for transition of pilot installation to actual *"in field"* operating technological facilities shall also be worked out. Publicly led initiatives promoting and popularizing market ready bio-based solutions are likewise highly recommended.

As the Project moves to its second part, further policy recommendations will be worked out based on the environmental, social, economic and governmental analysis. They will be presented in the final Bio4HUMAN policy brief.

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