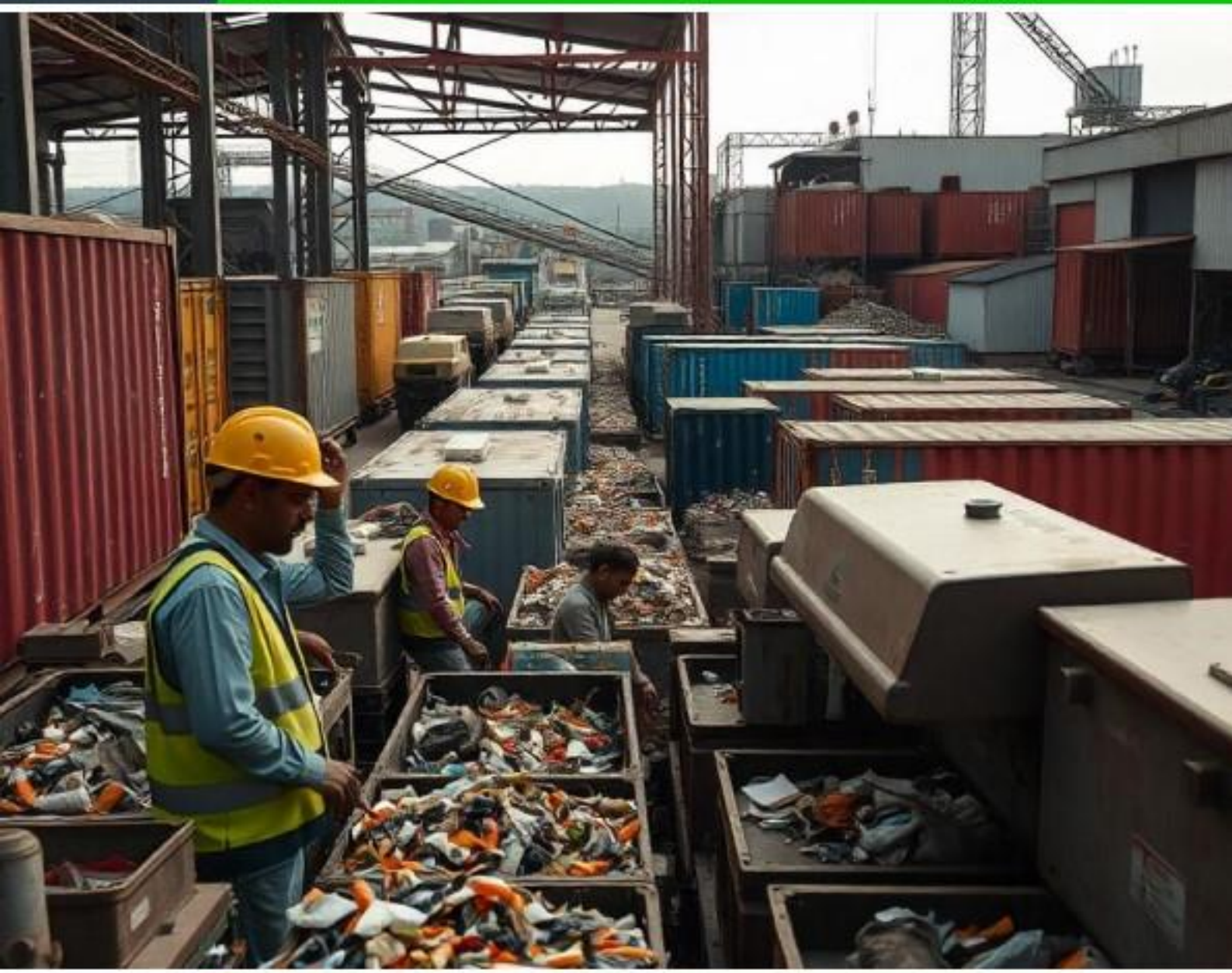

NDC
Technology Roadmap Workshop - Waste

Workshop - May 29, 2024

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List of Abbreviations

(E)	Emerging Technology
ADB	Asian Development Bank
ADP	Annual Development Programme
Bn	Billion
CTCN	Climate Technology Centre and Network
EIA	Environmental Impact Assessment
EPAs	Environmental Protection Agencies
ESIA	Environmental and Social Impact Assessment
GGC	Green Growth Consultants
GGGI	Global Green Growth Institute
IEE	Initial Environmental Examination
MoCC&EC	Ministry of Climate Change and Environmental Coordination
NDC	Nationally Determined Contribution
NGO	Non-Government Organizations
PARC	Pakistan Agricultural Research Council
PARC	Pakistan Agriculture Research Centre
PCRWR	Pakistan Council of Research in Water Resources
PPPs	Public-Private Partnerships
PSDP	Public Sector Development Programme
R&D	Research & Development
RDF	Refuse-derived Fuel
SWAT	Sindh Water and Agriculture Technology
TRM	Technology Roadmap

1. Introduction

Pakistan's NDCs 2021 highlight the need for technology and infrastructure to aid emissions reduction, enhance resilience and adaptive capacity, and support sustainable development. The successful implementation of these commitments require a collaborative effort and technological advancements further facilitates the achievement of these objectives. To achieve this, the Ministry of Climate Change and Environmental Coordination (MoCC&EC), through the Climate Technology Centre and Network CTCN's technical assistance, has started the development of Pakistan's Technology Roadmap for the waste and water sectors for NDC implementation.

A technology roadmap for NDC implementation is a strategic planning tool that provides a structured approach to identify, prioritize, and sequence the deployment of technologies to address climate change challenges and promote sustainable development. The project is designed to initiate a collaborative process of designing a comprehensive waste and water sector Technology Roadmap aligned with Pakistan's development and climate targets. As such, three committees have been formulated to enable data/information sharing, and feedback support for developing a roadmap. These committees include an overarching roadmap Committee and a technology committee for the waste and water sectors.

The key purpose of the Technical Committees is to ensure alignment with ongoing regulations, plans, and policies, alignment with the needs of multiple stakeholders at national and subnational levels and The technical committees will also ensure that this technology roadmap outline the pathways that are feasible and realistic in order to accelerate the progress towards climate and sustainable development agendas.

The development of the roadmap is under the leadership of the MoCC&EC with support from the Global Green Growth Institute (GGGI) and the Green Growth Consultants (GGC).

2. Objectives

The first "Technology Roadmap Committee" meeting was carried out to validate the shortlisted technologies and to finalize a scoring criterion for the analysis of the shortlisted technologies. Following that, this 1-day workshop comprising of "2ndTechnology Roadmap Committee Meeting" and 3rd Technical Committee meeting" aimed to present the progress of previous "Water and Waste Sector Committee meetings" and "Technology Roadmap Committee meeting on the water and waste sector technologies" and gather feedback on the evaluation of the shortlisted technologies for further prioritization to streamline the development of the NDC technology roadmap for the Water and Waste Sector

3. Methodology

The workshop began with a presentation on the NDC Technology Roadmap, providing an overview of sub-sector prioritization, technology shortlisting, and the development of scoring criteria. This session was presented as a key step in evaluating the shortlisted technologies for further prioritization, focusing on four existing technologies and one emerging technology.

A total of 60 participants joined the workshop. The list is attached in **ANNEX-I**. Participants were grouped based on sub-sectors. Discussions on the waste sector were held in the morning while the water sector was discussed in the evening. These discussions were guided by a questionnaire provided in **ANNEX-II**, focusing on two major components: Enabling Environment and Project Pipeline. The primary focus of the discussions was on the enabling environment. Participants engaged in discussions

on sub-sector capacities, and existing and emerging technologies, and provided feedback on the developed technology roadmap outline.

4. Discussion/Outcomes

The discussion was based on two major areas; the first was the enabling conditions or enabling environment for existing and emerging technology adoption in Pakistan, and the second was identifying projects. Furthermore, a section on the "TRM outline" was open for feedback and discussions. The discussion mainly revolved around the enabling environment as the section included more questions and details. The outcomes of the discussion are as follows:

4.1. Enabling Environment

The question for assessing the subsector's capacities was:

- **Please rank the technology adoption and implementation potential in terms of its subsector's capacities:**
  (1-Poor, 2-Fair, 3-Satisfactory, 4-Good, 5-Excellent)

The ranking of the technology adoption as per the subsector's capacities is given as follows:

	Municipal Solid Waste	Plastic Waste	Agriculture Waste
Infrastructure	2	1	2
Policy and regulatory landscape	2	3	2
Economic feasibility	2	3	1
Skills and technical capacity	2	2	3
Market and investment opportunities	3	3	4
Social and cultural acceptability	3	2	3

The sub-sector capacities for all Municipal Solid Waste, Plastic Waste, and Agriculture Waste, were around the **fair & satisfactory rankings**. **Infrastructure and economic feasibility along with the market and investment opportunities for agriculture waste were marked poor.** There might have been fluctuations on an individual level but overall, the rankings revolved around the satisfactory and poor marks for infrastructure, policy, and regulatory landscape, economic feasibility, skills and technical capacity, market and investment opportunities, and social and cultural acceptability indicators.

4.1.1. Municipal Solid Waste

The participants were asked to provide targeted feedback on "enabling environment indicators" and "suggestions for emerging technologies" on the selected technologies of each sub-sector. Further, the feedback was taken on the outline for the Technology Roadmap.

Waste Segregation

For Waste Segregation, **participants stressed the importance of integrating** it into the value chain with a focus on end-users. The **group also unanimously focused** on the suggestion that the hospital waste should be carefully disposed of at the dumping site. The government should play a vital role in imparting **awareness to the public** regarding waste segregation technology Through digital media and prints. Enforcement of solid waste disposal laws and following an incentivized approach was also

suggested. Moreover, to ensure the proper implementation of the technology the group suggested that waste collection procedures and points should be allotted. Separate bins for separate types of waste should be installed. The establishment of waste collection procedures and points, along with the installation of separate bins for different types of waste, was recommended.

Engineering Landfill Technology

The group **agreed to the fact that this technology** is based on the 3Rs however this technology needs the allocation of finances for space acquisition and infrastructure development. One of the participants suggested that the landfill site could later be transformed into **recreational parks like the Miyawaki forest in Islamabad**. The group also highlighted the health impacts of the landfill site on the nearby residential areas thereby emphasizing the by-laws to ensure that the location of these sites are at a distance from the residential areas. They proposed that public-private partnership and proper allocation of resources will lead to the successful implementation of the technology. Waste to Energy should be prioritized in this technology. They also underscored the necessity of allocating finances for space acquisition and infrastructure development. Remove this sentence because it is already mentioned.

Composting

The group highlighted that public awareness, especially in the agriculture sector, should be encouraged to adopt nature-based solutions with an added awareness of the benefits of using organic fertilizers that will improve soil fertility and crop yield as well. **They further suggested to incentivize and promote it as a successful business model with co-benefits of health, environment, and economy**. Participants advocated for public awareness campaigns to encourage adoption, highlighting the benefits of organic fertilizers for soil fertility and crop yield. They emphasized incentivizing composting as a successful business model with co-benefits for health, the environment, and the economy.

Waste Valorization (E)

Stakeholders emphasized the need for specific space allocation for garbage collection and the establishment of garbage transfer stations at the community level, particularly when waste is not segregated at the source. They **advocated for the formulation and implementation** of solid waste management policies by both the central government and federating units. To ensure sustainability, they suggested imposing a small tax on the population to fund waste management initiatives. Additionally, **stakeholders recommended organizing capacity-building workshops** at provincial and local levels for individuals involved in the waste management sector. They highlighted that waste valorization presents significant business and employment opportunities, coining the phrase "Trash is Cash." This **approach would promote inclusivity, particularly for youth and vulnerable populations**. Finally, stakeholders believe that through awareness campaigns, the social and cultural acceptability of waste valorization can be achieved. They highlighted waste valorization as a significant business and employment opportunity, emphasizing the importance of awareness campaigns to achieve social and cultural acceptability.

4.1.2. Plastic Waste

For plastic waste, similar approach was observed as MSW sector. The discussion was started with a briefing on existing and emerging technologies, and questions were asked from the group as per the questionnaire. Further, feedback on the outline for the TRM was also taken from the group.

Refuse-derived Fuel (RDF)

The group highlighted that Raising awareness and building capacity about RDF among entrepreneurs, along with investing in the latest efficient RDF technologies, is essential. Market opportunities should leverage the private sector, supported by policy enablers, necessary subsidies, and incentives to mainstream the technology. **Clear policies and regulations are needed** to define the role of RDF materials and address the hazards of dumping plastic waste, such as the aquatic dangers from microplastics, evidenced by fish tumors that have been reported at the Gulpur hydropower project. The **PCRWR has a proposal to tackle microplastics awaiting funding**. They further suggested that an updated inventory on plastic waste collection and recycling is crucial, requiring EPAs to be capacitated and granted more authority. Infrastructure must be extended to the district level for plastic waste management, including collection, identification, segregation, and conversion to RDF, addressing the lack of reuse mechanisms for items like plastic wires. Effective segregation is the critical first step. Monitoring the complete lifecycle of waste is necessary to improve management and utility, which includes creating a plastic waste value chain, with EPAs updating and overseeing these activities with enhanced authority.

Downcycling

Awareness and capacity building at the grassroots level are essential for effective plastic waste management. **Exploring alternatives to plastic and promoting biodegradable materials** can minimize plastic use. Scaling up efforts to increase the use of discarded products and fostering Public-Private Partnerships (PPPs) for plastic waste management will reduce reliance on the government. **Proper regulations and labeling should support grading** recycled materials for utilization, with defined standards ensuring quality and safety, particularly for items like cooking utensils and medical waste. An updated inventory on plastic waste collection and recycling is crucial, requiring EPAs to be capacitated and given more authority. Reducing waste generation and adhering to the 3Rs (Reduce, Reuse, Recycle) is paramount for minimizing waste at the source. **Monitoring the complete lifecycle of plastic waste** is necessary to enhance management and utility, necessitating the creation of a plastic waste value chain and empowering EPAs to oversee these activities effectively.

Non-Biodegradable Plastic Pyrolysis (E)

To ensure the suitability of Non-Biodegradable Plastic Pyrolysis technology, a **feasibility study or Initial Environmental Examination (IEE) should be conducted** to assess its **carbon footprint and climate impact**. Subsidies will enhance PPP's. moreover, market utilization of the product is crucial. **Microplastic testing and the introduction of a national zero-carbon policy**, along with policy enablers and regulations, are necessary. Market viability and the infrastructural development and management of the technology should be analyzed, maintaining gender inclusivity as a priority. Political and bureaucratic awareness and will along with the formation of a comprehensive data inventory are essential. Developing and utilizing the value chain at the local level, marketing the byproducts, and identifying sources of microplastics are key steps. Conducting sector-based donor conferences can attract investors and improve confidence. Pilot plants should be introduced to raise awareness, and the facility should be made readily available.

Stakeholders suggested several measures to ensure an optimal and inclusive environment for the noted technology. They emphasized infrastructure development, including sustainability assessments like EIA and ESIA studies, and media promotions for awareness. **Capacity building** at all levels, **innovative mechanisms** like vending machines for plastic submission, and **stringent policies** for plastic waste management were recommended. **Economic feasibility** could be ensured through **PPPs** and incentives for waste management companies, along with skill-building initiatives, especially for

women. **Market opportunities** could be **enhanced** through **initial investments**, value chain development, and partnerships with donor agencies and industries. Finally, social and cultural acceptability could be fostered by integrating women's roles, promoting media campaigns, and involving women and vulnerable groups in all processes, Including the establishment of female committees at the household and community levels.

4.1.3. Agriculture Waste

Similarly, for the agriculture waste sub-sector, the discussion was focused on the enabling indicators, followed by the project pipeline, and feedback on the outline for TRM.

Stakeholders suggested that the Enabling Environment for the technologies requires infrastructure, policy, and finances. One of the stakeholder suggested that the technical and economic feasibility of these technologies needs further exploration, with cost or economic data indicating the potential for scalability. Enablers for Sindh could include ADP schemes.

Soil Mulching

Stakeholders mentioned that **feasibility studies are essential for soil mulching technology**. Stakeholder consultations and the replication of best practices are necessary, along with awareness campaigns targeted at farmers. The **economic value of soil mulching should be communicated** to farmers to encourage adoption. Private sector investment in this technology is also recommended. Additionally, **soil mulching can contribute to composting**. Enhanced coordination among government, NGOs, academia, and social media is crucial to convince farming councils to adopt this technology. Issues such as soil erosion and water salination need detailed attention. Farmers must be informed of relevant activities, and capacity building should be undertaken through joint ventures between the government and private sectors. Increased coordination among research institutes and policymakers, as well as use of media to update farmers on a small scale, is recommended. Popularizing this technology by raising awareness and enhancing farmers' capacity is essential.

Vermicompost

Stakeholders stated that **a farmer in Attock is successfully practicing vermicomposting**, which is being utilized in Punjab. **Building farmers' capacity to adapt to this technology is necessary**, and a national policy could facilitate its adoption. Extension services play a crucial role in supporting farmers. Examining available success stories and conducting R&D to compare previous methods with this technique is advised. Focus should be increased in Sindh due to its water-conserving benefits. Although some work has already been done, however more discussion and work among farmers are required. Vermicomposting is a recently adopted technique by a few farmers on a smaller scale and needs to be generalized if viable. Strengthening coordination among stakeholders to promote this technology through media is essential, as it is not commonly used in Pakistan.

Livestock Feeding

Stakeholders suggested that livestock feed can be optimized to control the quality of dung, which can be used to produce valuable products, as **demonstrated in Thailand and China**. In Pakistan, agricultural crop residuals are traditionally either burned or used manually as livestock feed. The processing of fodders should be improved to enhance digestibility. This practice is already well-established in Pakistan but needs refinement to utilize waste effectively.

Integrated Biomass Gasification (E)

Stakeholders mentioned a case of a restaurant with a **biogas facility on its lower floor**, exemplifying a sustainable **building with women-friendly toilets**. Emphasis should be on promoting the intermediate

benefits of this emerging technology rather than long-term gains. The **Ministry of Japan is investing 2 billion USD** in a similar project, indicating the potential for substantial government initiatives. Nippon Steel's interest in investing in biomass gasification in Australia further supports this technology's promise. However, Pakistan currently lacks an enabling environment for biomass gasification, and traditional practices prevail. A project in Sindh did not achieve significant success, highlighting the need to build trust and capacity through pilot projects. Given the significance of agriculture in Pakistan's agrarian economy, with 60% of its rural population and 46% of labor engaged in agricultural activities, prioritizing this technology is crucial. Addressing the lack of government coordination is also necessary.

Further, stakeholders suggested several measures to promote Integrated Biomass Gasification: ensuring carpeted road connectivity of each village to the nearest city, developing National/Macro Policy Plans, and encouraging government or private sectors to intervene in order to facilitate most farmers with financial constraints. **Public-Private Partnerships (PPPs) should be utilized**, and media campaigns are needed to drive cultural change. Skills development and capacity building for farmers, creating investment opportunities, and enhancing social and cultural acceptability are important. Government support-based infrastructure is crucial for trust and readiness among communities to transition to new technologies. Consistent policy-making and support from the government can attract investment opportunities. **Developing viable policies in consultation with stakeholders**, using local materials and resources for economic feasibility, providing training to communities and institutions, and conducting research to develop high-value products from raw agricultural waste are recommended. **For successful implementation, steps include scoping, engaging the local community, emphasizing benefits, and piloting projects**. Coordination between research institutes and the government, along with the use of media for capacity building and awareness-raising, is essential. Consistency in policy-making and leveraging local resources and skills are necessary, especially considering Sindh's dry barren land. Biogas adoption by small farmers is limited due to the cost, and technical support for small horticulture crop growers is lacking.

4.1.4. Feedback on the Technology Roadmap Outline

The **outline is satisfactory, but some recommendations were recorded**: Agri-waste management should be prioritized above all, due to the major connection of the population to this sub-sector. Include liquid waste management in the municipal waste. **Include education-based awareness in the road map outline**. Regular consultative seminars with the government should be conducted with special emphasis on prioritizing the technology sector in ABD plan. **Implementation should be prioritized for on-ground action,** with special attention to Environmental Impact Assessments (EIAs) for new technologies. An enabling environment, **coupled with community awareness and gender inclusivity**, must be a priority, along with stringent regulations and strengthened implementation. Monitoring mechanisms along with highlighting the impact of health sector is essential. Introducing new technologies to convert harmful plastics into environmentally friendly products is crucial. **Policies should be monitored and students** with innovative solutions should be engaged. Pilots for emerging technologies should be introduced for feasibility assessment. Stakeholder awareness, health-based inventories, proper management of vehicular tires to avoid burning, recycling of plastic wires and disposal of accessories like laptops and batteries are important considerations. The proposed outline is attached below (**ANNEX-II**).

4.2. Project Pipeline

Communication gap and political instability are present which disrupts project implementation. A stakeholder mentioned that the project of Sindh Water and Agriculture Technology (SWAT) Project can be included in this. The **following project was mentioned** by a stakeholder in the **agriculture waste** sector.

Name	Arshad Ashraf

Job Title	Principal Scientific Officer
Department, Province	PARC, Federal
Contact Number	03235017456
Email	Mashr22@yahoo.com
What sub-sector are you filling it for	Agriculture waste
Title of project	Development of Bio compost and Vermicompost for agriculture waste
Brief Description	National Agriculture Research Centre, Islamabad developed bio composts under public-private partnerships for promoting organic farming in Pakistan
What technology has been prioritized?	Vermicompost products
Status (has it been completely halted? was it assessed? Etc.)	Progressing as planned and needs to be promoted in different provinces
What was the funding source, if any?	PSDP (Gov of Pakistan)
What contributed	N/A
Please note the challenges faced during its implementation	Shortage of funds, lack of extension services
Was a technical/economic/social feasibility or any other analysis conducted	N/A
Do you have access to the documents and/or studies for this project?	N/A
Can you provide us with the documents for the listed project?	N/A

5. Conclusion

The discussions highlighted in this document are centered on the enabling environment for technology adoption in Pakistan and the identification of projects, with a strong emphasis on the former. The outcomes underscore the importance of various factors such as infrastructure, policy and regulatory landscape, economic feasibility, skills and technical capacity, market and investment opportunities, and social and cultural acceptability. These factors collectively determine the potential for successful technology adoption in sub-sectors like municipal solid waste, plastic waste, and agricultural waste.

For municipal solid waste, strategies such as waste segregation, engineering landfill technology, composting, and waste valorization were discussed, emphasizing the need for public awareness, policy enforcement, and public-private partnerships. In plastic waste management, the focus was on refuse

derived fuel (RDF), downcycling, and non-biodegradable plastic pyrolysis, with recommendations on capacity building, market utilization, and stringent policies. Agricultural waste management strategies included soil mulching, vermicomposting, livestock feeding, and integrated biomass gasification, with an emphasis on coordination among stakeholders, feasibility studies, and capacity building.

Feedback on the technology roadmap outline suggested: prioritizing agri-waste management, incorporating liquid waste management in municipal waste, and emphasizing education-based awareness and gender inclusivity. The need for regular consultative seminars, stringent regulations, and monitoring mechanisms was also highlighted. Additionally, the discussion on project pipelines revealed challenges like communication gaps and political instability, and the need for funding and extension services.

Overall, the discussions and outcomes provided a comprehensive roadmap for improving the enabling environment and project implementation for technology adoption in Pakistan. By addressing the identified challenges and leveraging the recommendations, there is potential to significantly enhance the management of municipal, plastic, and agricultural waste, ultimately contributing to sustainable development and environmental conservation in the country.

6. Way Forward

Moving forward, the evaluation of technologies will adhere to the scoring criteria established and validated in previous committee meetings. This thorough assessment will prioritize a selection of five technologies, with four existing technologies and one emerging technology. The committee will then validate this prioritized list through detailed consultation.

These prioritized technologies will serve as the foundation for developing the Nationally Determined Contributions (NDC) technology roadmap specifically tailored for the waste and water sectors. This roadmap will outline strategic directions and actionable plans to enhance technological implementation in these areas.

Moreover, to support the advancement of these prioritized technologies, detailed ideas and concept notes will be developed. These documents will aim at securing the funding for selected projects within the water and waste sectors, ensuring the effective deployment and integration of these critical technologies.

ANNEX-I – Participant List

S. No	Name	Institution/designation	Gender	Sector
1	Ingvild Solvang	GGGI	F	Development
2	Fazal Akbar	AS (D), (LG&RDD), KP	M	GOV
3	Wasi Haider	R.A (GGC)	M	Development
4	Ayesha Bashir	Adaptation Industries Development Expert	F	Development
5	Tahreem Fatima	R.A (P&D), Sindh	F	GOV
6	Leena Aftab	(GGC)	F	Development
7	Syed Tarrar Hussain	AD (EPA, GB)	M	GOV
8	Tahreem Zeeshan	Manager (GGC)	F	Private
9	Muhammad Asad	F&A Officer	M	Private
10	Niazullah Khan	Consultant	M	Development
11	Muhammad khalid Mehmood	JRO, Rwp, LGRD	M	GOV
12	Kumail Abbas	R.O (GGC)	M	Development
13	Hamza Arshad	R.O (GGC)	M	Development
15	Maham Faraz Abbasi	Consultant	F	Development
16	Muhammad Irshad	WASH Advisor	M	Development
17	Allah Warayo Rindh	Additional Director General, Agri Dept. Sindh	M	GOV
18	Naeema Yousaf	Statistical Officer (PBS)	F	GOV

19	Farah Naz	SRO, PCRWR	F	GOV
20	Obaid-ur-Rehman	MoCC	M	GOV
21	Qurat-ul-Ain Ahmad	Head Water, GCISC	F	GOV
22	Madiha Naz	Assistant Director, MoCC	F	GOV
23	Yasir Bashir	Director (Projects) LG&CDD, Punjab	M	GOV
24	Asadullah Saleem	Sector Specialist, POAF	M	GOV
25	Abdul Rehman Iqbal	Assistant Director, (Technical) Sindh EPA	M	GOV
26	Uzair Naqvi	Environmental Geologist, (PDO), AJK	M	GOV
27	Irfan Khan	Technical Advisor (GIZ)	M	Development
28	Dr. Nasir Javed	Waste Specialist/Consultant	M	Development
29	Abdul Rouf Baloch	Secretary, Local Govt. Balochistan	M	GOV
30	Hameedullah	Sector Advisor WASH-WHH	M	Development
31	Engr. Sardar Khalid Gandapur	Executive Engineer, PHE Manshera	M	GOV
32	Michael Bak	Senior Analyst, CARD	M	Development
33	Shahnawaz Arif	Advocacy Coordinator, WHH	M	Development
34	Usama Iqbal	Finance Coordinator, AGHAE	M	Development
35	Umer Zia	WASH officer Program, AGAHE	M	Development
				Development

36	M. Sajid Zaman	Consultant (WASH)	M	
37	Saima Nazir	DD (R&P), MoCC	F	GOV
38	Eunkyo Choi	M&E Specialist/ GPC, KOICA	F	Development
39	Irfan Wali	AD, LG&RD (GB)	M	GOV
40	Dr. Khalid Farooq	CSO, PBS	M	GOV
41	Kiran Anwaar	Senior Research Officer, PCRWR	F	GOV
42	Syed Shahneel	Coordination Expert	M	Development
43	Ahsan ullah Khan	CDO, PHED Punjab	M	GOV
44	Pervaiz Nasir	WASH Specialist, WaterAid	M	Development
45	Rizwan Ali	Assistant Chief (Env & CC) P&D Board, Punjab	M	GOV
46	Naheed Rajput	National Water Sector Coordinator	F	GOV
47	Dr. Sardar Muhammad Rafique Khan	Deputy Director (CC), EPA-AJK	M	GOV
48	M Nawaz	Staff Officer, LG Balochistan	M	GOV
49	Noor-ul-Huda	AD MoCC	F	GOV
50	Ramsha Malik	AD MoCC	F	GOV
51	Engr. Ubaidullah	Research Officer, PHED KPK	M	GOV
52	Dr. Tariq Mahmood	Meteorologist, PMD	M	GOV
53	Dr. Arshad Ashraf	Principal Scientist, PARC	M	GOV
				GOV

54	Kamran Khan	Research Officer, EAD	M	
55	Shoukat Ali	I/Tech, EPA Punjab	M	GOV
56	Aqsa Nawaz	Research Assistant, EPA Rawalpindi	F	GOV
57	M Bilal	PM	M	Private
58	Mubarak Ali Sarwar	CEO, AGAHE	M	Development
59	Afsar Khan	Dy. Director, EPA KPK	M	GOV
60	Abdul Qadeer Kakar	Additional Secretary, PHED Balochistan	M	GOV

ANNEX-II – Questionnaire & TRM Outline

Part 1. Enabling Environment and TRM Feedback

Enabling Conditions

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i. Please note the factors and conditions you believe are crucial indicators of a technology's enabling environment for the waste sector and identified sub-sectors.

ii. Please rank the technologies' adoption and implementation potential in terms of its **subsector's capacities**:

(1-poor, 2-Fair,3-Satisfactory,4-Good,5-Excellent)

	Municipal Solid Waste	**Plastic Waste**	**Agriculture Waste**
Infrastructure			
Policy and regulatory landscape			
Economic feasibility and affordability			
Skills and technical capacity			
Market and investment opportunities			
Social and cultural acceptability			

iii. In the Municipal Solid Waste sub-sector, please provide your feedback on enabling conditions about the following technologies:

Waste Segregation	
Engineered Landfill Technology	
Composting	

iv. In the Plastic Waste, sub-sector, please provide your feedback on enabling conditions about the following technologies:

Refuse Derived Fuels	

Downcycling	

v. In the Agricultural Waste sub-sector, please provide your feedback on enabling conditions about the following technologies:

Soil Mulching	
Vermi Composting	
Livestock Feeding	

Emerging Technologies

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i. Please rank the emerging technologies in terms of existing capacities in the sub-sectors that may enable its uptake. (1-poor, 2-Fair,3-Satisfactory,4-Good,5-Excellent)

	Waste Valorization **(Municipal Solid Waste)**	Non-Biodegradable Plastic Pyrolysis **(Plastic Waste)**	Integrated Biomass Gasification **(Agricultural Waste)**
Infrastructure			
Policy and regulatory landscape			
Economic feasibility and affordability			
Skills and technical capacity			
Market and investment opportunities			
Social and cultural acceptability			

i. Keeping in mind Pakistan's enabling environment, which emerging technology do you believe is best suited to be prioritized for Pakistan?

ii. What measures would you suggest to ensure an optimal and efficient inclusive environment for the noted technology?

Feedback for the Technology Roadmap Map (TRM) Outline

i. Please answer the following in yes/no

Do you believe this outline accurately reflects an inclusive and informed TRM for Pakistan's water/waste sectors	
The TRM outline is well-organized	
Does this TRM possess a logical flow of information	
The TRM outline includes proposal of interventions to ensure the adoption and implementation of the identified technologies in Pakistan	
I believe my feedback in discussions and surveys will inform the formulation of this TRM	
This TRM reflects an inclusive and gendersensitive assessment of the identified	

ii. Do you have any recommendations and/or additions to the outline?

Part 2. Project Pipeline

The questionnaire table is to be filled out (multiple copies will be provided)

Name	
Job Title	
Department, Province	
Contact Number	
Email	
What sub-sector are you filling it for	
Title of project	
Brief Description	
What technology has been prioritized?	
Status (has it been completely halted? was it assessed? Etc.)	
What was the funding source, if any?	
What contributed	
Please note the challenges due to which it was not completed/implemented	
Was a technical/economic/social feasibility or any other analysis conducted	
Do you have access to the documents and/or studies for this project?	
Can you provide us with the documents for the listed project?	

Part 3 - Proposed Outline for NDC Technology Roadmap for Water And Waste Sectors

1. Introduction and Scenario
    a. Overview of Pakistan's water and waste sectors
        i. Existing situation of Pakistan's water/waste sectors
        ii. Impacts of climate change
        iii. Management/delivery overview iv. Governance, stakeholders and policies
        v. Main challenges/barriers (technical, social, financial, etc.)
        vi. Overview of technology utilization and adoption in waste/water sectors
    b. Problem statement and purpose of the NDC Technology Roadmap for the water and waste sectors
2. Vision
    a. Vision statement
    b. Objectives
    c. Rationale and strategic alignment with NDCs/policies/national strategies

3. Methodology
    a. Development process
    b. Sector prioritization and emerging/existing technology mapping
    c. Technology assessment and scoring

4. Assessment of Identified technologies

This section will be given in a summarized form, it can be 1) divided by sectors and sub-sectors, 2) it can also be divided by one section for each technology, 3) Few roadmaps went by process chains as well e.g waste management process chain or water service chain, 4) ANOTHER option is division by existing/emerging categories

    a. Introduce short-listed technologies for each sub-sector
    b. Policy and regulatory framework analysis

Item	Suggestions
Policy and regulatory frameworks	• Identification and review of existing policy and regulatory landscape • Identify existing strategies and pathways for integrating waste wand water technologies
Associated stakeholder identification and roles	• Map and identify stakeholders for the water/waste sectors and identified sub-sectors

    c. Technical capacity and infrastructure

Item	Suggestions
Infrastructure	• Assessment of existing infrastructure in Pakistan for the noted technologies

Technical assistance and capacity building	• Identify is training or advisory support exists for technology integration • Analysis of skills in Pakistan for technology utilization

d. Market Readiness and Economic feasibility

Item	Suggestions
a. Competitiveness	• Market capacity will be assessed through baseline analysis to assess the integration of new technologies. • Consumer based surveys will be conducted to ensure if the incorporated technologies are consumer friendly and efficient.
b. Business opportunities and Analysis	• Business opportunities for exploring business potential and opportunities • Feasibility assessment for the technologies to check if the market conditions are favorable
c. Market, industries and infrastructure	• • Identify existing business potential and opportunities Feasibility assessment for the technologies to check if the market conditions are favorable • Does a market exist for the identified technologies • Explore-sector based approaches

e. Gender and Social Considerations

Item	Suggestions
Inclusive access	• The potential of the technology to accelerate access for women and vulnerable groups and promote inclusion will be assessed
Impacts	• The impacts of the technology on women and vulnerable social groups will be assessed

f. Environmental and climate impacts

This section will assess the environmental and climate impacts of technologies and their suitability in the context of Pakistan

5) NDC Technology Roadmap for the Water and Waste Sectors Action Plan

a. Vision and objectives
b. Alignment with NDCs
c. Implementation Plan

This plan will include different actions, can be divided in terms of types of actions e.g.

policy/regulations, Market, industry, infrastructure, R&D, mobilization of finance, development of a specific strategy/plan, capacity building and provision of technical support

Action Plan (short-term and long-term) and Milestones	Milestones/Targets	Deadline	Identify stakeholders
Address short-term and longterm actions to introduce and incorporate proposed technologies in the identified sectors. The implementation will be dependent on timed actions and achievable milestones. • 5 years as Short-term action (e.g. Technology: engineered landfill for municipal waste. Short-term action: waste segregation (organic, plastic and non-biodegradable waste is segregated) • 5+ years as long-term actions (Long-term Action: waste to energy and Pollution reduction (land, water and air).	Associated milestones and/or achievements that aligns with the identified actions	Specific yearly deadline for the identified actions and milestones to be achieved.	Identification of stakeholders relevant to the development and implementation of identified actions and milestones

6) Alignment with NDCs and National Strategies
This will include an alignment of identified actions and milestones with NDC targets it corresponds/contributes to. It will also include a section on contributions to national strategies.

7) Conclusion