Analytical approach by Sorting of Manure for Farming and Electricity from Municipality Solid Waste

Jitendra Kumar Srivastava[1], Kamta Prasad Verma[2], Akash Sahu[3], Prem Prakash Bharti[4], Sanjeev Kushwaha[5]

[1]Assistant Professor(EED) & NSS-Co-ordinator, B.N.College of Engineering &Technology,Lucknow
[2]Lecturer(EED), Government Polytechnic,Jaunpur
[3,4,5]UG Scholar, B.N.College of Engineering &Technology,Lucknow

Abstract:
Waste operation and declining soil fertility are the main issues endured by all developing nations, like India. Currently,agrarian application of Municipal Solid Waste (MSW) is one of the most promising and cost effective options for managing solid waste. It's helpful in working current burning issues viz. soil fertility and MSW operation still there's always a implicit trouble because MSW may contain pathogens and poisonous adulterants. Thus important emphasis has been paid to composting of MSW in recent times operation of compost from MSW in agrarian land helps in upgrading the soil's physico- chemical parcels. Piecemeal from that it also assists in perfecting natural response of cultivated land. Keeping the present situation in mind, this review critically discusses the current script, agrarian application of MSW compost and energy from part of soil microbes and soil microbial response on external solid waste compost operation.
Keywords: Municipality Solid Waste, Manure, Electricity, Smart Technologies etc.

I.INTRODUCTION: The growing urbanization and industrialization has led to in numerous problems in developed as well as in developing countries. There are numerous pressing issues surfaced due to adding population that ultimately poses trouble to the agrarian, ecosystems and environmental sustainability either directly or laterally[2][5][6] (Fig. 1).

Amidst, the generation and operation of External solid waste (MSW) is important as this waste is disposed of unscientifically by low lying area without taking necessary preventives, therefore posing threat to the mortal health and near terrain. Thus there's a critical need to manage the MSW in such a way that while managing its volume and quality, it also helps to sustain the terrain[11][15]. Piecemeal from this, the environmental and health norms along with social adequacy should be achieved. Still, selection of the most applicable route for MSW operation is always being a matter of concern due to numerous environmental, specialized, fiscal, social and legislative constraints which are faced by nearly all industrially growing nations[4][10][18].

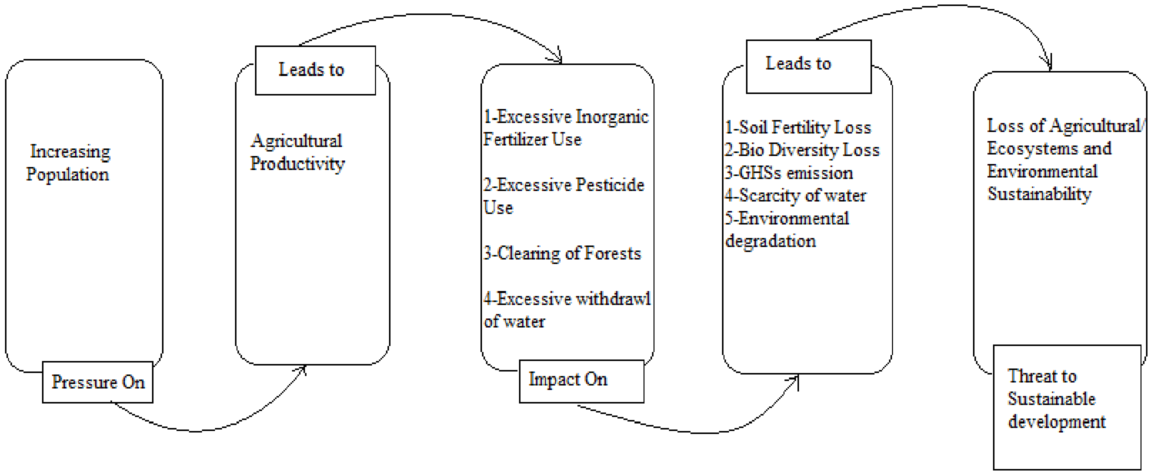

Fig 1: Impact of Increasing Population on Environment health

Generally, waste generated from domestic, marketable, institutional and artificial sectors; and external services are included in MSW. MSW can be treated as renewable resource for a variety of precious products. The organic bit of MSW provides an excellent occasion for product of different value added by- products through the bio refinery conception (maximum application of waste resource)[21][24], farther fuelling the indirect bio economy (maximizing resource effectiveness with least waste generation through which socio- profitable and environmental stability is achieved)[27][29].

In malignancy of having numerous advantages over other conventional waste operation options, composting of MSW isn't as important as vulgarize or in the practice as it deserves in (Fig.2)[31][33].

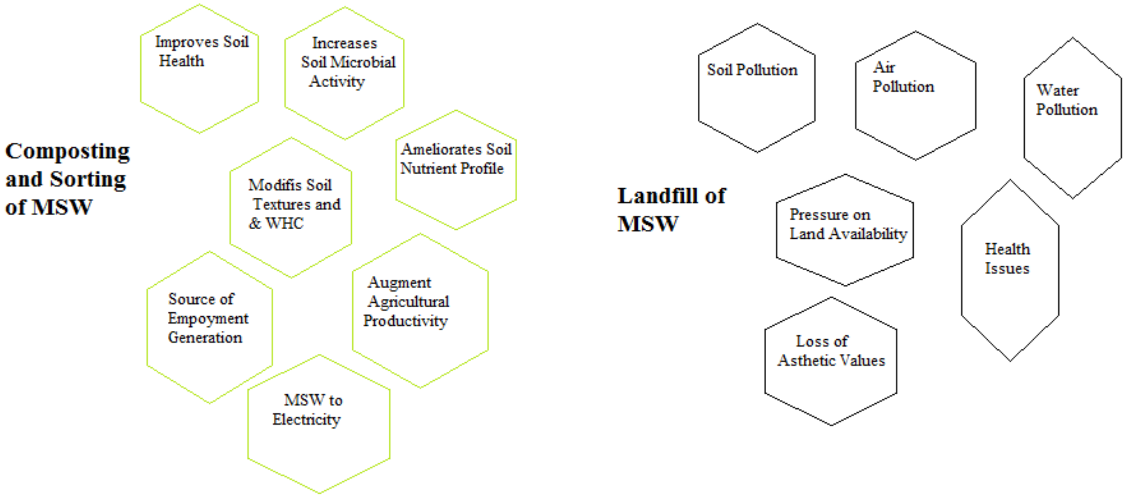

Fig 2: Comparison between landfill/open dumping versus composting and Sorting of MSW

This is due to lack of mindfulness and inactive programs that need to be changed. Government and original authorities should take enterprise to promote composting/ vermicomposting of organic waste[37][39]. For illustration, mindfulness juggernauts and impulses for its installation should be handed to spread this fashion at decentralized position. Also, involvement of public private cooperation (PPP) and community grounded association (CGA) should be encouraged to overcome the problem of fiscal and professionals extremity especially in the developing countries[44][47].Piecemeal from that original authority can induce profit from better duty collection, polluters pay scheme, selling of MSW compost as being performed by Kolkata Municipal Corporation, India[55].

II.EXPECTED BENEFIT AND OPPORTUNITY FROM MSW COMPOST/BIOSOLIDS APPLICATION IN AGRILAND AND ELECTRICITY: Composting of MSW has numerous advantages over inorganic diseases (IDs) whose unbridled use during last many decades has poorly affected the soil's physico-chemical and natural parcels[45][47].Though,IDs add nutrients to the soil incontinently after operation but their long term use may change soil pH and disturb the soil microbial biota.Generally, ID tends to strain or filter down from the shops, thus requires fresh force that pollutes ground water and also emits hothouse feasts (HHFs).On contrary to this, operation of MSW compost compound shops yield and ameliorates soil nutrient profile, microbial exertion, soil texture and soften in capacity.MSW compost is rich in organic matter content, nitrogen(N) and humic substances (substantially humic acid and fulvic acid) Soil organic matter plays a significant part in maintaining soil quality, as it improves soil's physico-chemical and natural(microbial biomass) parcels. Besides this, it has high water holding capacity (WHC) and low bulk viscosity[61][66].Humic acid in MSW compost intensifies the caption exchange capacity (CEC) and buffering capacity of soil.It has been reported by several experimenters that repeated operation of MSW compost in agrarian land helps in adding the organic matter content and C/N rate of soil in comparison to unamended soil.Therefore helps in maintaining soil fertility and its productivity.Thus,the organic toxin (like MSW compost) could be considered as a promising and sustainable volition to inorganic toxin in husbandry and horticulture[71][73].Still, the presence of heavy essence(i.e. Cd, Cu, Zn, Pb etc.).In MSW compost are always being a matter of concern, as it can accumulate in the soil that can be absorbed by the agrarian crops which may beget variety of mortal health issues when shifted at high tropic situations through the progression of food chain. Also, in some cases these heavy essence and redundant nutrients weep through the soil and eventually pollutes beginning groundwater[65].Increased attention of Zn,Cu and Pb in soil amended with MSW compost and set up a dwindling trend in the exertion of phosphatise and urea's conceivably due to high heavy essence attention, while dehydrogenise,catalyse and protease were remained innocent.Although,humic substances in compost act as chelating agent,therefore reduces essence solubility but it also depends on pH, swab content and caption exchange capacity(CEC) of thesoil.In addition, MSW compost occasionally has high swab attention that can pose negative effect on soil texture and shopsgrown.Others implicit pitfalls of using MSWC is presence of pathogens, and some organiccompounds.Although composting is honored as a suitable treatment used for organic wastes and could inactivate several pathogens.Still,some former studies reported that some pathogens, similar as Listeriaspp and Salmonellaspp, have survived during the composting.Also, revealed contagious threat associated with land operation of sewage sludge in international United States and linked 43 different type of mortal contagions in sewage sludge including high cornucopia of respiratory contagions (Coronavirus, Klassevirus, and Cosavirus) with fairly lower presence of Enteroviruses.MSWC may have some organic adulterants due to the presence of ménage dangerous and artificialwastes.The presence of organic composites produced during composting of the MSW(food wastes, yard wastes and mixed paper wastes) and set up toluene,ethylbenzene,4-dichlorobenzene,pisopropyl toluene, and naphthalene being produced in the loftiest quantities. Likewise, demonstrated presence of Polybrominated diphenyl ethers(PBDEs) in sewage sludge collected from different backwaters of Italy, which may negatively affect soil microbial biota, water cycle and mortal health when get accumulated in soil[81][83].Piecemeal from that presence of colourful medicinals and particular care products(PPCPs) like diphenhydramine, triclosan, carbamazepine, sulfamethazine, florfenicol, levamisole, trimethoprimetc.Antibiotics like monensin, tylosin, chlortetracycline, virginiamycin, sulfamethazine is well proved in soil amended with biosolids or beast ordure. The shops have capability to accumulate PPCPs and antibiotics, therefore may pose trouble to mortal health. Effective details of MSW countries with region and application in Table 1 and Table 2 respectively.

Table 1:

Examples of municipal solid waste application according to the different application directions.The economic, environmental, and social impact of municipal solid waste in producing energy, electricity and fertilizer are briefly presented. Country or region refers to where the actual application was conducted for this municipal solid waste.

MSW/organic Waste Source	Soil type/pH/ EC	Initial nutrient profile of Soil	Experiment type (pot/field)	Crop	Application rate	Post response of treatments	Refrences
Valdemingomez Municipal Waste Treatment Plant Madrid, Spain	Sandy loam soil/6.4/0.1 dS m^{-1}	OC and total N were 8.0 and 0.7 g kg-1. Similarly, P, K, Ca, Mg and Na were 0.03, 0.2, 1.5, 0.2 and 0.01 g kg-1 respectively	Short term/plot	Barley	20 and 80 t ha-1	Increased microbial activity in soil; helped in maintaining long term buffering capacity of soil	Garcia-Gil et al. (2000)
Castel di Sangro, Italy	Clay/8.3	Organic C and total N were 9.7 and 1.36 g kg-1 respectively	Short term/ 2 year field	Sugar beet and durum Wheat rotat	12 t MSW compost ha-1 for sugar beet and 24 t MSW compost	Organic C and total N contents, dehydrogenase and nitrate reductase activities	Crecchio et al. (2001)

				ion	ha-1 for durum wheat	of soil increased. Dehydrogenase activity was positively correlated with b-glucosidase activity	
Municipal waste, Calcutta, India	Alluvial/ 5.5/ 0.294 d Sm^{-1}	OC and total N were 13.9 and 1.7 g kg-1 respectively	Factorial completely randomized design	N/A	0, 2.5, 10, 20 and 40 t ha^{-1}	Substantial increase in MBC, soil respiration, urease and phosphatase activity of the soil; no adverse effect at higher dose	Bhattacharyya et al. (2003)

Table 2:
Examples of municipal solid waste application according to the different application directions. The economic, environmental, and social impact of municipal solid waste in producing energy, electricity, and fertilizer are briefly presented. Country or region refers to where the actual application was conducted for this municipal solid waste. Waste refers to the specific municipal solid waste used in a particular application case. The economic, environmental, and social impact refers, respectively, to cost savings performance, energy saving and emission reduction, and social behaviour gain obtained from municipal solid waste value-added applications are mentioned.

Type of waste	Country or region	Waste	Technology	Application direction	Application examples	Application impact			References
						Economic	Environmental	Social	

Municipal solid waste	Delhi, India	Biodegradable material (> 7%)	Landfill gas technology	Energy and electricity production	Collection of methane from landfills as feedstock for electricity generation	Captured methane can provide electricity for 8–18 million homes (2015)	Helping to reduce greenhouse gas emissions	Energy capture of methane to provide energy to nearby areas	(Ghosh et al. 2018)
Municipal solid waste	China	Biodegradable organic matter in municipal solid waste	Vertical gas extraction well system (low cost, most commonly used). Horizontal gas extraction well system (high efficiency, high cost, difficult to construct)	Energy and electricity production	Power generation and production of biogas (for vehicle and pipeline fuel) using landfill gas technology	The energy efficiency of biogas is equivalent to 228 kilotons of standard coal for energy production	Can replace 85.5% of electricity consumption or 25.3% of natural gas consumption (2015); can replace 90–220 kilotons of standard coal and reduce carbon dioxide emissions by 350–920 kilotons (2020)	Promoting sanitary landfills as an alternative to open-air refuse collection points; producing clean energy	(Fei et al. 2019)
Municipal	Eskisehir,	Organic, paper,	Internal combust	Energy and	Generation of	The net present	Has a low global	Promotes	(Kale and

solid waste	Turkey	glass, plastic, metal, ash, and others	ion reciprocating engines (more broadly, high generation efficiency, and low fuel operating costs) and gas turbines technology	electricity production	electricity at landfll sites by internal combustion engines and collection of landfll gas and methane	value of the maximum electrical energy value is 109,070.1 gigawatt-hour; the minimum cost of electricity generation is only $0.054/ kilowatt-hour; the price of electricity from landfll gas is $0.133/ kilowatt-hour	warming potential (conversion of methane to carbon dioxide when used as fuel in internal combustion engines)	renewable energy development; provides waste reduction and clean energy recovery alternative	Gökçek 2020)
Municipal solid waste	India	70% fine gravel, sand, silt, clay, 15–23% stones, brickbats, concrete	Drying and sieving	Fertilizer applications	Use of soil-like material from landfills as fill (embankment, low-	Reduces the need for fresh topsoil; can be used as earth fll for	It can be used as a low-nutrient compost in nonagricultural applicatio	Effective reduction in old waste deposits in landfll sites	(Kale and Gökçek 2020)

		fragments, 3–5% plastic, wood, textiles, and 0.9–6.5% others			lying areas) and compost (horticultural, non-agricultural applications)	infrastructure projects (road and rail embankments, e.g.); low height large area fll for non-load bearing purposes (parks, golf courses); serving of lowlying areas and deep pits (mine pits)	ns (including parks and nonfood crops); enhances nutrient growth in virgin soils	(< 4.75 mm soil-like material accounts for 40–70% of total excavated waste)	
Municipal solid waste	Dhanbad, India	Solid organic waste	New thermal digestion technology	Fertilizer applications	Organic fertilizer production from the organic fraction of solid waste using the new thermal digestion technology	Maximum weight loss and optimum nutrient retention with minimal energy (150 °C, 135 min); total macronutrients (sodium,	Increased water holding capacity of organic fertilizer (43–55% increase in porosity) for plant growth; maximum nutritional value; >	The effectiveness of thermal digestion in the rapid reduction in solid organic waste and nutrient cycling was demonst	(Kumar and Gupta 2021)

						phosphorus, potassium) in the digested solid organic waste are above the specifed standards for organic fertilizers (>1.2%)	90% seed germination	rated as a novel concept and research database for the clean and sustainable management of solid organic waste	

III.MUNICIPAL SOLID WASTE FOR ENERGY AND ELECTRICITYPRODUCTION: Using External solid waste for waste- to- energy pathway is necessary for waste operation and disposal. Landfill gas and anaerobic digestion are the primary styles for producing energy from external solid waste. Tip gas technology is one of the oldest and most generally used technologies for electricity generation[87][89]. The tip gas process for electricity generation comprises roughly 40 carbon dioxide and 60 methane with a high electrical and thermal energy content. In China set up a maximum tip gas value of 3.3 billion Nm^3 over 30 times, generating up to7.5 billion kilowatt- hours of electricity. The minimal cost of tip gas technology for electricity generation in Turkey is only $0.05/ kilowatthour.

Anaerobic digestion is able of recovering high- quality methane, converting organic waste from external solid waste into electricity and high situations of heat and working energy problems while also carrying compost and guck[91][92].Then the waste recycling phase simplified and the tip process simplified, but it can also have a advanced power generation capacity while producing toxin and biogas as a outgrowth[98].Estimated that using the anaerobic digestion of affordable wastes for biogas generation has the implicit to drop hothouse gas emigrations by roughly 4.36 gigatons of carbon dioxide fellow or 13 of worldwide hothouse gas emigrations from deforestation, finessed emigrations operation, crop burning, tipgas and toxin conflation emigrations. Conversion of external solid waste to energy through a waste- to- energy pathway can produce renewable energy by landing methane. For case, showed that captured methane from Delhi tips supplied 8 – 18 million houses with power in 2015. Methane traps 80 times further heat in the atmosphere than carbon dioxide does tips are releasing far more earth- warming methane into the atmosphere from the corruption of waste than preliminarily allowed a study suggests. Scientists used satellite data from four major metropolises worldwide Delhi and Mumbai in India, Lahore in Pakistan and Buenos Aires in Argentina and set up that emigrations from tips in 2018 and 2019 were 1.4 to 2.6 times advanced than earlier estimates.

When organic waste like food, wood or paper decomposes, it emits methane into the air. tips are the third- largest source of methane emigrations encyclopaedically after oil painting and gas systems and husbandry.

Although methane only accounts for about 11 of hothouse gas emigrations and lasts about a dozen times in the air, it traps 80 times further heat in the atmosphere than carbon dioxide does. Scientists estimate that at least 25 of moment's warming is driven by methane from mortal conduct.

Also, set up that a waste- to- energy factory in Taiwan, China, generated1.33 of original electricity consumption, with anticipated electricity product effectiveness of 30, corresponding to 346 and 748 gigawatt- hours by 2030 and 2060,independently.likewise,suggested combined cogeneration of hydrogen from electrolysis and power from the anaerobic digestion process[103][105].

In addition to renewable energy- to- energy generation has the implicit to reduce hothouse gasemissions.The environmental performance of mongrel and tip gas blending styles in the Nigerian region, with hothouse emigration reduction rates of 76 – 93 and 75 – 85, independently.In addition, using the waste- to- energy conception can save on reactionary energy combustion and significantly reduce the cost of electricity generation.The minimal price of electricity generation is only $0.054/kilowatt- hour compared to$0.133/ kilowatt- hour for tipgas,with a significant reduction in the total quantum of inclined waste. In addition, the waste- to- energy conception provides a way to reclaim, exercise and add value to waste, provides an volition to clean energy recovery and facilitates the sustainable development of druthers to reactionary energy combustion. Both anaerobic digestion and tip gas technologies have good environmental, profitable and social performance for electricity generation. Still, showed that anaerobic digestion has a advanced and further profitable eventuality for electricity generation than tip gas in the study area[107][108].Delved the power generation eventuality of tip gas and anaerobic digestion technologies in Tehran and Beijing over 20 times.They set up that the technologies generated45.2 and41.9 further electricity than tip gas technologies in Tehran and Beijing independently and that anaerobic digestion had the most substantial eventuality to alleviate global warming. Therefore anaerobic digestion has tremendous eventuality for producing power from external solid waste.Tip waste treatment styles presently face the challenge of inefficiency, particularly when treating food waste comprising over 60 of the water content. One approach to working this issue is by reducing the food waste content of waste incineration; for illustration, reducing the waste's water content by 9 – 44 significantly increased spicy value and thus bettered power generation effectiveness.

In conclusion, using waste- to- energy is the stylish way to dispose of and add value to waste to meet the growing world population and the adding volume of external solid waste. At the same time the product of clean renewable energy as an volition to fossil energies creates a righteous cycle in profitable, environmental and social terms contributing to the development of sustainable metropolises and a global green future[110][111].

IV.MUNICIPAL SOLID WASTE FOR FERTILIZER APPLICATION: Uses of inorganic nitrogen comprise about 50 of current agrarian product; still, the heavy use of inorganic diseases poses climate and environmental enterprises. For illustration, inorganic diseases contribute to large quantities of hothouse gas emigrations and eutrophication of the water terrain[115].On the other hand,organic diseases can ameliorate organic carbon in the soil while furnishing sufficient nutrients to shops.Thus replacing inorganic diseases with organic diseases is urgently demanded to address current environmental issues.

External solid waste can be used either to produce high- quality liquid diseases from organic waste or excerpt soil- such like accoutrements from organic waste for tip and toxin use. Several recent studies have shown the possibilities of producing organic diseases from external waste[125][141].For illustration, proposed the birth of organic carbon from external solid waste compost technology to produce 200 L of liquid toxin at €1/litre per 100 kg of dry compost verified the possibility of rooting organic substances from external solid waste's organic bit and accelerating methane product.Birth technologies of high-value organic toxin from external solid waste are entered further attention and invention at a lower cost Conventional detergent and microwave oven- supported birth are common for liquid diseases[145][148].The birth of liquid diseases by alkaline traditional solvent birth ways is a simple, effective and ecofriendly system.In addition, traditional solvent birth is a lower energy- needed ferocious system, with a selling cost of €1/ litre and the toxin yield is ten times advanced than that of water- grounded birth.

Microwave oven- supported birth is considered a more environmental friendly and green technology than conventional solvent birth.Still,microwave oven- supported birth requires more complex conditions during the birth process, similar as advanced temperatures, power and limitations in the dielectric parcels of solid accoutrements. Microwave oven- supported birth is similar to conventional solvent birth ways when adding the operating temperature and reducing the response time[152].

In general, the liquid diseases produced from external solid waste have much advanced total macronutrients(sodium, phosphorus, potassium) than those specified for organic diseases, ameliorate soil water- holding capacity, increase porosity and benefit factory of crop growth[162].The new thermal digestion is a new type of digestion that has been developed to make the operation of organic diseases from the organic bit of solid waste more effective and environmentally friendly, hence achieving maximum weight loss of waste and optimum nutrient retention of toxin with minimal energy consumption within 135 twinkles at 150℃.

In addition, soil- suchlike material from external solid waste piles can be used as filler for road dikes and low- lying areas, Compost for horticulture and other non-agricultural operations. Through the relinquishment of this technology, the total quantum of waste in tips is significantly reduced, reducing the need for fresh soil and saving on tip costs and waste operation and disposal costs[172][180].Considering the possible presence of heavy essence ions in soil- suchlike accoutrements in waste piles, their use for non-edible crops can reduce their threat and hazard while enhancing the nutrient content of virgin soil for non-agricultural operations. Although the feasibility of organic birth from the external solid waste operation has been vindicated, the technology's trustability and the liquid toxin quality still need to be supported by a lot of exploration data[188][189].In addition, applying external solid waste to prize organic liquid diseases still needs important disquisition.Using other organic remainders as raw accoutrements in cutting edge technology.

In conclusion,using more advanced technologies to prize high- quality liquid diseases from the organic bit of external solid waste and using soil- suchlike accoutrements from external solid waste as compost for tipand non-agricultural operations are excellent styles for the valorisation of external solid waste[175].Such an approach in the direction of toxin operations provides a new conception, innovative technology, and a dependable pool of exemplifications for the clean and sustainable operation of solid organic waste.

This section explains the rearmost directions in applying external solid waste in energy, electricity product and toxin and demonstrates system feasibility[89].The exercise of external solid waste isn't only outstanding for generating electricity from waste but also for the significant mitigation of the hothouse effect and the product and negotiation of new energy sources at a lower cost. In addition, external solid waste also performs well in the medication of liquid diseases.Technological inventions have been applied to achieve minimum energy consumption to achieve maximum waste consumption and optimum nutrient retention, reduce product costs and increase the effectiveness of toxin product likewise, treated waste in tip reduces the total quantum of waste, reduce the use of fresh soil and ameliorate soil nutrients. It offers innovative results for clean energy recovery and renewable energy development operations, furnishing the rearmost technology and indefatigable power for value- adding and operation of external solid waste[139].

V.SOLID WASTE PRETREATMENT: Recycling and sorting is the first and critical step in the valorisation and operation of waste programs and installations should ameliorate waste's recovery rate and sorting delicacy. First, the policy section on waste recycling and sorting should be as detailed as possible, down to the unit responsible for enforcing the policy and the rules and regulations[63][92][135].The approach should also suit the characteristics of the region where waste is enforced. Second, waste recycling and sorting installations should also consider the drivers' age and height to make the installations universal simple and effective. In sitting installations, spatial analysis of geographic information systems can be used to screen and identify the most suitable areas or locales for recovering installations.At the same time, governments non-governmental and other associations should concentrate on changing consumer waste in the future[137].

Publicize the negative profitable, environmental and social impacts of magpie waste disposal and call for and companion consumers to reclaim and separate their waste effectively. To achieve early results, consideration could also be given to adding the demand to reclaim and separate waste to the citizens' law of conduct to raise mindfulness of citizens' power[103].In addition the government can also encourage businesses to develop recycling programs for vended goods linked to consumers' waste recycling geste.Also a detailed bracket and characterization of a specific type of artificial solid waste could be conducted.The suggestion of green desulfurization of scrap tires is in line with the indirect frugality and the product of rubber- grounded accoutrements for high- value end ground tires requests will be developed because of current exploration trends.Still,proper sorting and acceptable characterization of scrap rubber before use can significantly ameliorate the process reproducibility and the performance parcels of the attained rubber recycling products[152].In addition to this, suggested that maybe in the future, the perpetration of independent robotic systems for waste recycling could be achieved with automatic sorting and physical sorting of recyclables according to material type. However, this will significantly ameliorate effectiveness and delicacy of recycling and prepare the waste for exercise,If artificial intelligence can be successfully spread to the waste recycling field[80].

In conclusion, recovering sorting technology can ameliorate the recycling rate of waste. The help of a policy system effectively facilitates the recycling of waste Also, recovering according to the nature of specific waste will increase the delicacy of waste recycling.

This section summarizes the prospects for value- added solid waste operations, as shown in Fig.3.This graph illustrates the solid waste value- added openings in terms of operations, profitable feasibility assessment styles and the sorting direction of solid waste recycling

Fig 3: Enhanced recycling and sorting techniques for solid waste contribute to more efficient waste applications.

It's determined how sorting technology for waste recycling can be bettered. There's also a need to expand solid waste operations with added value.Some new evaluation styles and profitable parameters can be added to increase the chances of profitable viability.

VI.PROPOSED PROTOTYPE CONCEPT: In this MSW shorted manure used for agriland and prepared fuel used for furnace fuel. Furnace heat the boiler then steam generated. Steam pressure comes on the turbine after this turbine rotate and produces mechanical energy that connected by belt system with dynamo. Dynamo produces electricity then transmitted to grid.

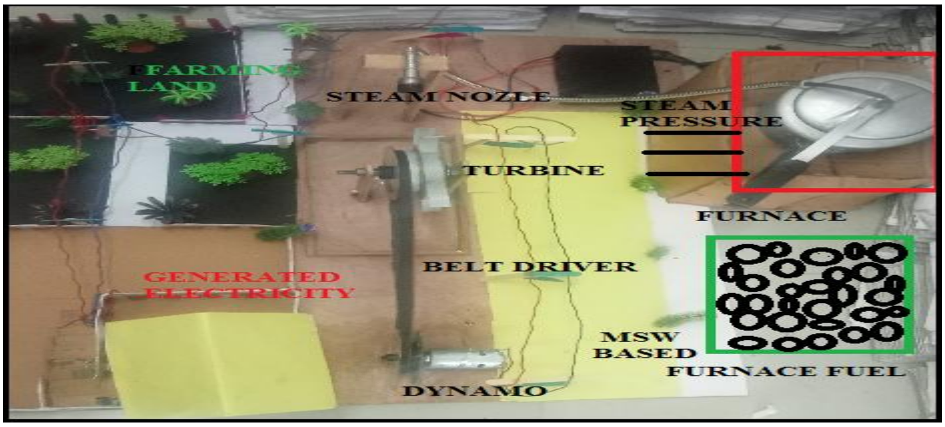

Fig 4: A prototype structure for generation of electricity by MSW Based Fuel

VII.RESULTS: The conversion of external waste into value- added products holds excellent pledge for Agriland and Electricity. However, applicable technologies for effective conversion are still lacking and the specialized walls are substantially due to the diversity of the waste. Unborn experimenters may need to borrow indispensable exploration styles to circumvent the unreliable goods of waste diversity[216].Solid waste exercise in different operation directions, technological invention and unborn sustainable development and furnishing a library of styles for the profitable assessment of actors in the field of solid waste[137].Pyrolysis units for putrefying external solid waste are precious and bear a lot of thermalenergy. The integration into the pyrolysis unit can minimize this pyrolysis heating problem and make the system more eco-friendly and energy effective.

VIII.CONCLUSION: While accelerated global urbanization, technological inventions in husbandry and the expansion of artificial robotization have contributed to mortal development and progress, they've brought more solid waste,accelerating the environmental extremity and energy problems. This review analyzes and summarizes economically feasible styles for valorising solid waste from external, agrarian and artificial sources grounded on the rearmost reusing and value- added technologies. Tips are no longer the primary system of solid waste disposal; new ways of solid waste disposal have set up a way to misbehave with sustainable green development. For case, using solid waste as an indispensable energy source for power generation is one of the most common ways of dealing with solid waste, achieving a positive impact on global warming. In addition, solid wastes can be used for toxin operations, factory parentage, construction material- oil painting,biomethane for machine energy,biochar for soil remediation,biosorbents for wastewater treatment, beast feed, accoutrements for water storehouse systems and conservative natural coffers. As per proposed method manure development for farming as well as energy.Therefore, energy or by products can be attained at a lower cost to maximize solid waste application and cover mortal health the terrain and natural coffers. More importantly, combining value assessment and profitable feasibility analysis is vital to optimizing the profitable benefits of solid waste exercise in different operation directions, technological invention and unborn sustainable development and furnishing a library of styles for the profitable assessment of actors in the field of solid waste.
Despite the significance of recovering waste to realize value, current programs and installations for recycling and application of waste aren't well advanced and there are significant limitations in the measures taken to exercise solid waste in severalcountries.Therefore, there will be further room for advancement in the future in the disquisition of operations and technological invention in solid waste recycling to maximize the value added and application of solid waste.

IX.REFRENCES:

1. AbdollahiSaadatlu E et al (2022) A sustainable model for municipal solid waste system considering global warming potential impact: a case study. Comput Ind Eng 169:108127. https://doi.org/10. 1016/j.cie.2022.108127
2. Abdullah I et al (2022) Conversion of biomass blends (walnut shell and pearl millet) for the production of solid biofuel via torrefaction under diferent conditions. Chemosphere 295:133894. https:// doi.org/10.1016/j.chemosphere.2022.13389
3. Abdulyekeen KA et al (2021) Torrefaction of biomass: production of enhanced solid biofuel from municipal solid waste and other types of biomass. Renew Sustain Energy Rev 150:111436. https://doi.org/10.1016/j.rser.2021.111436
4. Abedinzadeh M et al (2020) Combined use of municipal solid waste biochar and bacterial biosorbent synergistically decreases Cd (II) and Pb (II) concentration in edible tissue of forage maize irrigated with heavy metal–spiked water. Heliyon6:e04688. https:// doi.org/10.1016/j.heliyon.2020.e04688
5. Abraham JJ et al (2022) An experimental study on concrete block using construction demolition waste and life cycle cost analysis. Mater Today: Proc 60:1320–1324. https://doi.org/10.1016/j.matpr.2021. 09.307
6. Afroze S et al (2018) A review on heavy metal ions and dye adsorption from water by agricultural solid waste adsorbents.229,1-50.https://doi.org/10.1007/s11270-018-3869-z

7. Ahmad T et al (2019) Treatment and utilization of dairy industrial waste: a review. Trends Food Sci Technol 88:361–372.https://doi.org/10.1016/j.tifs.2019.04.003
8. Ahmed MJK, Ahmaruzzaman M (2016) A review on potential usage of industrial waste materials for binding heavy metal ions from aqueous solutions. J Water Process Eng 10:39–47. https://doi. org/10.1016/j.jwpe.2016.01.014
9. Akinrinmade AO (2020) Determination of appropriate landfll sites and materials in parts of Kwara State Nigeria using geological, geophysical and geotechnical techniques. Kwara State University (Nigeria)
10. Akor CI et al (2021) Thermokinetic study of residual solid digestate from anaerobic digestion. Chem Eng J 406:127039. https://doi. org/10.1016/j.cej.2020.127039
11. Al-Anzi FS (2022) Building a planter system using waste materials using value engineering environmental assessment. Sci Rep 12:2344. https://doi.org/10.1038/s41598-022-05300-0
12. Almendro-Candel MB et al (2018) Physical properties of soils affected by the use of agricultural waste. https://doi.org/10.5772/intec hopen.77993
13. Al-Osta MA et al (2016) Study of heavy fuel oil fy ash for use in concrete blocks and asphalt concrete mixes. Adv ConcrConstr 4:123. https://doi.org/10.12989/acc.2016.4.2.123
14. Anand S (2010) Solid waste management. Mittal Publications. Anastopoulos I et al (2019) Valorization of agricultural wastes could improve soil fertility and mitigate soil direct N2O emissions. J Environ Manage 250:109389. https://doi.org/10.1016/j.jenvm an.2019.109389
15. Arafat HA et al (2015) Environmental performance and energy recovery potential of five processes for municipal solid waste treatment. J Clean Pro 105:233–240. https://doi.org/10.1016/j. jclepro.2013.11.071
16. Arpia AA et al (2021) Sustainable biofuel and bioenergy production from biomass waste residues using microwave-assisted heating: a comprehensive review. Chem Eng J 403:126233. https://doi. org/10.1016/j.cej.2020.126233
17. Asif M et al (2017) Potential of chitosan alone and in combination with agricultural wastes against the root-knot nematode,*Meloidogyne incognita* infesting eggplant. J Plant Prot Res 57:288–295. https://doi.org/10.1515/jppr-2017-0041
18. Awasthi MK et al (2021a) A critical review on the development stage of biorefnery systems towards the management of apple processing-derived waste. Renew Sustain Energy Rev 143:110972. https://doi.org/10.1016/j.rser.2021.110972
19. Awasthi MK et al (2021b) Techno-economics and life-cycle assessment of biological and thermochemical treatment of bio-waste. Renew Sustain Energy Rev 144:110837. https://doi.org/10. 1016/j.rser.2021.110837
20. Ayeleru OO et al (2021) Cost beneft analysis of a municipal solid waste recycling facility in Soweto. South Africa Waste Manag 134:263–269. https://doi.org/10.1016/j.wasman.2021.08.001
21. Ayodele T et al (2017) Life cycle assessment of waste-to-energy (WtE) technologies for electricity generation using municipal solid waste in Nigeria. Appl Energy 201:200–218. https://doi.org/10.1016/j.apenergy.2017.05.097
22. Azam M et al (2019) Status, characterization, and potential utilization of municipal solid waste as renewable energy source:Lahore case study in Pakistan. Environ Int 134:105291. https:// doi.org/10.1016/j.envint.2019.105291

23. Banerjee M et al (2019) Cu (II) removal using green adsorbents: kinetic modelling and plant scale-up design. Environ Sci Pollut Res 26:11542–11557. https://doi.org/10.1007/s11356-018-1930-5
24. Batista Meneses D et al (2022) Pretreatment methods of lignocellulosic wastes into value-added products: recent advances and possibilities. Biomass Convers Biorefnery 1:547–564. https://doi.org/10.1007/s13399-020-00722-0
25. Bayık GD, Altın A (2018) Conversion of an industrial waste to an oil sorbent by coupling with functional silanes.J Clean Prod196:1052–1064. https://doi.org/10.1016/j.jclepro.2018.06.076
26. Bekchanov M, Mirzabaev A (2018) Circular economy of composting in Sri Lanka: opportunities and challenges for reducing waste related pollution and improving soil health. 202:1107–1119. https://doi.org/10.1016/j.jclepro.2018.08.186
27. Bernal V et al (2018) Physicochemical properties of activated carbon:their effect on the adsorption of pharmaceutical compounds and adsorbate–adsorbent interactions. C-J Carbon Res 4:62. https://doi.org/10.3390/c4040062
28. Bernat K et al (2022) Can the biological stage of a mechanical–biological treatment plant that is designed for mixed municipal solid waste be successfully utilized for effective composting of selectively collected biowaste? Waste Manage 149:291–301. https://doi.org/10.1016/j.wasman.2022.06.025
29. Bharathiraja B et al (2018) Biogas production–a review on composition, fuel properties, feed stock and principles of anaerobic digestion. Renew Sustain Energy Rev 90:570–582. https://doi.org/10.1016/j.rser.2018.03.093
30. Bhattacharya A et al (2021) Taxonomy of antecedents of food waste–a literature review. J Clean Prod 291:125910. https://doi.org/10.1016/j.jclepro.2021.125910
31. Bieliatynskyi A et al (2022) The use of fiber made from fry ash from power plants in China in road and airfield construction. Constr Build Mater 323:126537. https://doi.org/10.1016/j.conbuildmat.2022.126537
32. Bisaglia C et al (2018) Methane/Gasoline Bi-fuel engines as a power source for standard agriculture tractors: development and testing activities. Apple Eng Agric 34:365–375. https://doi.org/10.13031/aea.12262
33. Breunig H et al (2022) Economic and greenhouse gas analysis of regional bioenergy-powered district energy systems in California. ResourConsrvRecy 180:106187. https://doi.org/10.1016/j.resconrec.2022.106187
34. Brigde J, Starr J (2007) Plant nematodes of agricultural importance.Manson publishing Ltd. P,.https://doi.org/10.1201/b15142
35. Cai J et al (2021) Coupling and coordinated development of new urbanization and agro-ecological environment in China. Sci Total Environ 776:145837. https://doi.org/10.1016/j.scitotenv.2021.145837
36. Caiardi F et al (2022) Waste-to-energy innovative system: assessment of integrating anaerobic digestion and pyrolysis technologies.Sustain Prod Consum 31:657–669. https://doi.org/10.1016/j.spc.2022.03.021
37. Campos EV et al (2019) Use of botanical insecticides for sustainable agriculture: future perspectives. Ecol Ind 105:483–495. https://doi.org/10.1016/j.ecolind.2018.04.038

38. Campuzano R, González-Martínez S (2017) Infuence of process parameters on the extraction of soluble substances from OFMSW and methane production. Waste Manage 62:61–68. https://doi.org/10.1016/j.wasman.2017.02.015
39. Cao Y et al (2022) Development of a MSW-fueled sustainable co-generation of hydrogen and electricity plant for a better environment comparing PEM and alkaline electrolyzers. Sustain Cities Soc 81:103801. https://doi.org/10.1016/j.scs.2022.103801
40. Cetrulo TB et al (2018) Efectiveness of solid waste policies in developing countries: a case study in Brazil. J Clean Prod 205:179–187. https://doi.org/10.1016/j.jclepro.2018.09.094
41. Chaianong A, Pharino C (2022) How to design an area-based prioritization of biogas production from organic municipal solid waste?Evid Thailand Waste Manag 138:243–252. https://doi.org/10.1016/j.wasman.2021.11.042
42. Chehade G, Dincer I (2021) Progress in green ammonia production aspotential carbon-free fuel. Fuel 299:120845. https://doi.org/10.1016/j.fuel.2021.120845
43. Chen Y-C, Lo S-L (2016) Evaluation of greenhouse gas emissions for several municipal solid waste management strategies. J Clean Prod 113:606–612. https://doi.org/10.1016/j.jclepro.2015.11.058
44. Chen Z et al (2010) Overview on LFG projects in China. Waste Manage 30:1006–1010.https://doi.org/10.1016/j.wasman.2010.02.001
45. Chen T et al (2015) A safety analysis of food waste-derived animal feeds from three typical conversion techniques in China. WastManage 45:42–50. https://doi.org/10.1016/j.wasman.2015.06.041
46. Chen L et al (2022) Strategies to achieve a carbon neutral society:a review. Environ Chem Lett 20:2277–2310.https://doi.org/10.1007/s10311-022-01499-6
47. Commission E (2012) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Innovating for sustainable growth: a bioeconomy for Europe., Brussels, Belgium.
48. Crini G, Lichtfouse E (2018) Advantages and disadvantages of techniques used for wastewater treatment. Environ Chem Lett17:145–155. https://doi.org/10.1007/s10311-018-0785-9
49. Cudjoe D et al (2020) Electricity generation using biogas from organic fraction of municipal solid waste generated in provinces of China: techno-economic and environmental impact analysis. Fuel Process Technol 203:106381. https://doi.org/10.1016/j.fuproc. 2020.106381
50. Cudjoe D et al (2021a) Power generation from municipal solid waste landfilled in the Beijing-Tianjin-Hebei region. Energy 217:119393. https://doi.org/10.1016/j.energy.2020.119393
51. Cudjoe D et al (2021b) Power generation from municipal solid waste landfilled in the Beijing-Tianjin-Hebei region. Energy217:119393. https://doi.org/10.1016/j.energy.2020.119393
52. Dai Y et al (2018) Utilizations of agricultural waste as adsorbent for the removal of contaminants: a review. Chemosphere 211:235– 253. https://doi.org/10.1016/j.chemosphere.2018.06.179
53. Dao TAT et al (2020) Optimization of pectin extraction from fruit peels by response surface method: conventional versus microwave-assisted heating. Food Hydrocoll 113:106475. https:// doi.org/10.1016/j.foodhyd.2020.106475
54. Das S et al (2019) Solid waste management: Scope and the challenge of sustainability. J Clean Prod 228:658–678. https://doi.org/10.1016/j.jclepro.2019.04.323

55. Datta M et al (2021) Feasibility of re-using soil-like material obtained from mining of old MSW dumps as an earth-fll and as compost. Process Saf Environ Prot 147:477–487. https://doi.org/10.1016/j.psep.2020.09.051
56. De Gisi S et al (2016) Characteristics and adsorption capacities of low-cost sorbents for wastewater treatment: a review. Sustain Mater Technol 9:10–40. https://doi.org/10.1016/j.susmat.2016.06.002
57. Demirbas A (2007) Bio-fuels from agricutural residues. Energy Sources, Part a: Recovery, Utilization, Environ Ef 30:101–109. https://doi.org/10.1080/00908310600626788
58. Deniz F, Kepekci RA (2016). Dye biosorption onto pistachio byproduct: a green environmental engineering approach. J Mol Liq 219:194–200. https://doi.org/10.1016/j.molliq.2016.03.018
59. Di Maria F et al (2021) The life cycle approach for assessing the impact of municipal solid waste incineration on the environment and on human health. Sci Total Environ 776:145785. https://doi.org/10.1016/j.scitotenv.2021.145785
60. Diaz LF et al 2011. Compost science and technology. Elsevier Dlamini S et al (2019) Municipal solid waste management in South Africa: from waste to energy recovery through waste-to-energy technologies in Johannesburg. Local Environ 24:249–257. https://doi.org/10.1080/13549839.2018.1561656
61. Dorward LJ (2012) Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? Food policy. 37:463–466. https://doi.org/10.1016/j.foodpol.2012.04.006
62. Duan Y et al (2020) Organic solid waste biorefnery: sustainable strategy for emerging circular bioeconomy in China. Ind Crop Prod 153:112568. https://doi.org/10.1016/j.indcrop.2020. 112568
63. Dumlao-Tan MI, Halog A (2017) Moving towards a circular economy in solid waste management: concepts and practices. Adv Solid Hazard Waste Manag. 29–48. https://doi.org/10.1007/ 978-3-319-57076-1_2
64. Duque-Acevedo M et al (2020) Agricultural waste: review of the evolution, approaches and perspectives on alternative uses.GlobalEcolConserv 22:e00902. https://doi.org/10.1016/j.gecco.2020.e00902
65. El-Azazy M et al (2019) Potato peels as an adsorbent for heavy metals from aqueous solutions: eco-structuring of a green adsorbent operating Plackett-Burman design. J Chem. https://doi.org/10.1155/2019/4926240
66. Elnagmy A et al (2018) Biologecal radiation hazards of some fertilizer brands in upper Egypt. Assiut Univ J Multidiscip Sci Res 47:21–40. https://doi.org/10.21608/aunj.2018.221229
67. Enaime G et al (2020) Biochar for wastewater treatment—conversion technologies and applications. Appl Sci 10:3492. https://doi. org/10.3390/app10103492
68. Eriksson M et al (2015) Carbon footprint of food waste management options in the waste hierarchy–a Swedish case study. J Clean Pro 93:115–125. https://doi.org/10.1016/j.jclepro.2015.01.026
69. Fabiyi OA et al (2018) Suppression of heteroderasacchari in rice with agricultural waste-silver nano particles. J Solid Waste TechnolManag 44:87–91. https://doi.org/10.5276/JSWTM.2018.87
70. Farghali M et al (2022) Seaweed for climate mitigation, wastewater treatment, bioenergy, bioplastic, biochar, food, pharmaceuticals and cosmetics: a review. Environ Chem Lett. https://doi.org/10. 1007/s10311-022-01520-y

71. Fausto-Castro L et al (2020) Selection of food waste with low moisture and high protein content from Mexican restaurants as a supplement to swine feed. J Clean Pro 256:120137. https://doi.org/10. 1016/j.jclepro.2020.120137
72. Fei F et al (2019) Spatio-temporal estimation of landfll gas energy potential: a case study in China. Renew Sustain Energy Rev103:217–226. https://doi.org/10.1016/j.rser.2018.12.036
73. Fernández-Delgado M et al (2020) Recovery of organic carbon from municipal mixed waste compost for the production of fertilizers. J Clean Prod 265:121805. https://doi.org/10.1016/j.jclepro. 2020.121805
74. Fernández-Delgado M et al (2022) Liquid fertilizer production from organic waste by conventional and microwave-assisted extraction technologies: techno-economic and environmental assessment. Sci Total Environ 806:150904.https://doi.org/10.1016/j.scito tenv.2021.150904
75. Ferronato N et al (2021) Sensitivity analysis and improvements of the recycling rate in municipal solid waste life cycle assessment: focus on a Latin American developing context. Waste Manage 128:1–15.https://doi.org/10.1016/j.wasman.2021.04.043
76. Filimonau V et al (2022) Exploring the potential of industrial symbiosis to recover food waste from the foodservice sector in Russia. Sustainable Production and Consumption 29:467–478. https://doi.org/10.1016/j.spc.2021.10.028
77. Forghani F, Hajihassani A (2020) Recent advances in the development of environmentally benign treatments to control root-knot nematodes. Front Plant Sci 11:1125. https://doi.org/10.3389/fpls.2020.01125
78. Gao M et al (2019) Biogas potential, utilization and countermeasures in agricultural provinces: a case study of biogas development in Henan Province China. Renew Sustain Energy Rev 99:191–200.https://doi.org/10.1016/j.rser.2018.10.005
79. Georganas A et al (2020) Bioactive compounds in food waste: a review on the transformation of food waste to animal feed. Foods 9:291.https://doi.org/10.3390/foods9030291
80. Ghosh P et al (2018) Assessment of methane emissions and energy recovery potential from the municipal solid waste landfills of Delhi, India. BioresourTechnol 272:611–615. https://doi.org/ 10.1016/j.biortech.2018.10.069
81. Gil A (2022) Challenges on waste-to-energy for the valorisation of industrial wastes: electricity, heat and cold, bioliquids and biofuels. Monitoring, Management 17:100615. https://doi.org/10.1016/j.enmm.2021.100615
82. Godinho D et al (2019) Recovery of Cr (III) by using chars from the co-gasifcation of agriculture and forestry wastes. Environ Sci Pollut Res 26:22723–22735. https://doi.org/10.1007/s11356-019-05609-w
83. Gonzalez PGA et al (2022) Soybean straw as a feedstock for value added chemicals and materials: recent trends and emerging prospects. BioEnergy Res. https://doi.org/10.1007/ s12155-022-10506-1
84. Gopalakrishnan PK et al (2021) Cost analysis and optimization of Blockchain-based solid waste management traceability system.Waste Manage 120:594–607. https://doi.org/10.1016/j.wasman.2020.10.027
85. Gopikumar S et al (2021) A method of landfill leachate management using internet of things for sustainable smart city development.Sustain Cities Soc 66:102521. https://doi.org/10.1016/j.scs.2020.102521

86. Gravert TKO et al (2021) Non-target analysis of organic waste amended agricultural soils: characterization of added organic pollution. Chemosphere 280:130582. https://doi.org/10.1016/j.chemosphere.2021.130582
87. Guan Y et al (2019) Dynamic analysis of industrial solid waste metabolism at aggregated and disaggregated levels. J Clean Prod 221:817–827. https://doi.org/10.1016/j.jclepro.2019.01.271
88. Guedes RE et al (2018) Operating parameters for bio-oil production in biomass pyrolysis: a review. J Anal Apple Pyrol 129:134–149.https://doi.org/10.1016/j.jaap.2017.11.019
89. Gujre N et al (2021) Deciphering the dynamics of glomalin and heavy metals in soils contaminated with hazardous municipal solid wastes. J Hazard Mater 416:125869. https://doi.org/10.1016/j.jhazmat.2021.125869
90. Guo J et al (2021) Improving benzo pyrene biodegradation in soil with wheat straw-derived biochar amendment: performance, microbial quantity, CO2 emission, and soil properties. J Anal ApplePyrol 156:105132. https://doi.org/10.1016/j.jaap.2021.105132
91. Gwenzi W et al (2015) Biochar production and applications in sub Saharan Africa: opportunities, constraints, risks and uncertainties. J Environ Manage 150:250–261. https://doi.org/10.1016/j.jenvman.2014.11.027
92. Haile A et al (2021) Pulp and paper mill wastes: utilizations and prospects for high value-added biomaterials. Bioresour Bioprocess 8:1–22. https://doi.org/10.1186/s40643-021-00385-3
93. Haqq-Misra J et al (2022) Future of life in the solar system and beyond. New Frontiers in Astrobiology 255–283. https://doi.org/10.1016/B978-0-12-824162-2.00001-4
94.]Hasan MM et al (2021) Energy recovery from municipal solid waste using pyrolysis technology: a review on current status and developments. Renew Sustain Energy Rev 145:111073. https://doi.org/10.1016/j.rser.2021.111073
95. He X (2017) Information on impacts of climate change and adaptation in China. J Environ Inf. https://doi.org/10.3808/jei.201700367
96. Helliwell R, Burton RJF (2021) The promised land? Exploring the future visions and narrative silences of cellular agriculture in news and industry media. J Rural Stud 84:180–191. https://doi.org/10.1016/j.jrurstud.2021.04.002
97. Huang W, Fooladi H (2021) Economic and environmental estimated assessment of power production from municipal solid waste using anaerobic digestion and landfill gas technologies. Energy Rep 7:4460–4469. https://doi.org/10.1016/j.egyr.2021.07.036
98. Ighalo JO et al (2022) Flash pyrolysis of biomass: a review of recent advances. Clean Technology Environment Policy. https://doi.org/10.1007/ s10098-022-02339-5
99. Jabeen F et al (2022) Trash to energy: a measure for the energy potential of combustible content of domestic solid waste generated from an industrialized city of Pakistan. J Taiwn Inst Chem E 137:104223. https://doi.org/10.1016/j.jtice.2022.104223
100. Janyasuthiwong S et al (2015) Copper, lead and zinc removal from metal-contaminated wastewater by adsorption onto agricultural wastes. Environment Technology 36:3071–3083. https://doi.org/10.1080/ 09593330.2015.1053537
101. Kaab A et al (2019) Combined life cycle assessment and artificial intelligence for prediction of output energy and environmental impacts of sugarcane production. Sci Total Environ 664:1005–1019. https://doi.org/10.1016/j.scitotenv.2019.02.004

102. Kadier A et al (2021) Use of industrial wastes as sustainable nutrient sources for bacterial cellulose (BC) production: mechanism,advances, and future perspectives. Polymers 13:3365. https://doi.org/10.3390/polym13193365
103. Kainthola J et al (2019) A review on enhanced biogas production from anaerobic digestion of lignocellulosic biomass by different enhancement techniques. ProcssBiochem 84:81–90. https://doi.org/10.1016/j.procbio.2019.05.023
104. Kale C, Gökçek M (2020) A techno-economic assessment of landfill gas emissions and energy recovery potential of different landfill areas in Turkey. J Clean Prod 275:122946. https://doi.org/10.1016/j.jclepro.2020.122946
105. Kargbo H et al (2021) "Drop-in" fuel production from biomass: critical review on techno-economic feasibility and sustainability. Renew Sustain Energy Rev 135:110168. https://doi.org/10.1016/j.rser.2020.110168
106. Karić N et al (2022) Bio-waste valorisation: agricultural wastes as biosorbents for removal of (in)organic pollutants in wastewater treatment. Chem Eng J Adv 9:100239. https://doi.org/10.1016/j.ceja.2021.100239
107. Kaya M (2016) Recovery of metals and nonmetals from electronic waste by physical and chemical recycling processes. Waste Manage 57:64–90. https://doi.org/10.1016/j.wasman.2016.08.004
108. Kaza S et al (2018) What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications. https://datatopics.worldbank.org/what-a-waste/
109. Keng ZX et al (2020) Community-scale composting for food waste: a life-cycle assessment-supported case study. J Clea Prod261:121220. https://doi.org/10.1016/j.jclepro.2020.121220
110. Khan MM-U-H et al (2018) Optimal siting of solid waste-to-valueadded facilities through a GIS-based assessment. Sci Total Environ 610:1065–1075. https://doi.org/10.1016/j.scitotenv.2017.08.169
111. Khan S et al (2022a) Technologies for municipal solid waste management: current status, challenges, and future perspectives. Chemosphere 288:132403. https://doi.org/10.1016/j.chemosphere.2021.132403
112. Khan A et al (2022b) Bio-organics management: novel strategies to manage root-knot nematode, *meloidogyne incognita* pest of vegetable crops. GesundePfanzen. https://doi.org/10.1007/s10343-022-00679-2
113. Khanal SK et al (2021) Anaerobic digestion beyond biogas. BiorsourceTechnol 337:125378.https://doi.org/10.1016/j.biortech.2021.125378
114. Khosravi A et al (2022) Production and characterization of hydrocharsand their application in soil improvement and environmental remediation. Chem Eng J 430:133142. https://doi.org/10.1016/j.cej.2021.133142
115. Kizito S et al (2019) Role of nutrient-enriched biochar as a soil amendment during maize growth: exploring practical alternatives to recycle agricultural residuals and to reduce chemical fertilizer demand. Sustainability 11:3211. https://doi.org/10.3390/su11113211
116. Koskinopoulou M et al (2021) Robotic waste sorting technology:toward a vision-based categorization system for the industrial robotic separation of recyclable waste. IEEE Robot Autom Mag 28:50–60. https://doi.org/10.1109/MRA.2021.3066040

117. Kostas ET et al (2017) The application of microwave heating in bioenergy: a review on the microwave pre-treatment and upgrading technologies for biomass. Renew Sustain Energy Rev 77:12–27.https://doi.org/10.1016/j.rser.2017.03.135
118. Kostas ET et al (2020) Microwave pyrolysis of olive pomace for bio-oil and bio-char production. Chem Eng J 387:123404. https://doi.org/10.1016/j.cej.2019.123404
119. Kulkarni BN (2020) Environmental sustainability assessment of land disposal of municipal solid waste generated in Indian cities–a review. Environ Dev 33:1–13. https://doi.org/10.1016/j.envdev.2019.100490
120. Kumar N, Gupta SK (2021) Exploring the feasibility of thermal digestion process: a novel technique, for the rapid treatment and reuse of solid organic waste as organic fertilizer. J Clean Prod 318:128600.https://doi.org/10.1016/j.jclepro.2021.128600
121. Kumla J et al (2020) Cultivation of mushrooms and their lignocellulolytic enzyme production through the utilization of agro-industrial waste. Molecules 25:2811. https://doi.org/10.3390/molecules25122811
122. Lee U et al (2017) Evaluation of landfll gas emissions from municipal solid waste landflls for the life-cycle analysis of waste-to-energy pathways. J Clean Prod 166:335–342. https://doi.org/10.1016/j.jclepro.2017.08.016
123. Leno N et al (2021) Thermochemical digestate fertilizer from solid waste: characterization, labile carbon dynamics, dehydrogenase activity, water holding capacity and biomass allocation in banana. Waste Manag 123:1–14. https://doi.org/10.1016/j.wasman.2021.01.002
124. Li J et al (2021a) Infuence of industrial solid waste as filling materialon mechanical and microstructural characteristics of cementitious backflls. Constr Build Mater 299:124288. https://doi.org/10.1016/j.conbuildmat.2021.124288
125. Li J et al (2021b) Land space simulation of urban agglomerations from the perspective of the symbiosis of urban development and ecological protection: a case study of Changsha-Zhuzhou-Xiangtan urban agglomeration. Ecol Ind 126:107669. https://doi.org/10.1016/j.ecolind.2021.107669
126. Liu Z et al (2013) Production of solid biochar fuel from waste biomass by hydrothermal carbonization. Fuel 103:943–949. https://doi.org/10.1016/j.fuel.2012.07.069
127. Liu L et al (2021) Excessive application of chemical fertilizer and organophosphorus pesticides induced total phosphorus loss from planting causing surface water eutrophication. Sci Rep 11:1–8.https://doi.org/10.1038/s41598-021-02521-7
128. Longsheng C et al (2022) An integrated SWOT-multi-criteria analysis of implementing sustainable waste-to-energy in Pakistan. Renew Energy 195:1438–1453. https://doi.org/10.1016/j.renene.2022.06.112
129. Lu X, Guo Y (2019) Removal of Pb (II) from aqueous solution by sulfur-functionalized walnut shell. Environ Sci Pollut Res 26:12776–12787. https://doi.org/10.1007/s11356-019-04753-7
130. Lu K et al (2021) Integration of life cycle assessment and life cycle cost using building information modeling: a critical review. J Clean Prod 285:125438. https://doi.org/10.1016/j.jclepro.2020.125438
131. Luo M et al (2018) A novel modifcation of lignin on corncob-based biochar to enhance removal of cadmium from water. BioresTechnol 259:312–318. https://doi.org/10.1016/j.biortech.2018.03.075

132. Mabalane PN et al (2021) A techno-economic analysis of anaerobic digestion and gasifcation hybrid system: energy recovery from municipal solid waste in South Africa. Waste Biomass Valorization 12:1167–1184. https://doi.org/10.1007/s12649-020-01043-z
133. Mahmud R et al (2021) Integration of techno-economic analysis and life cycle assessment for sustainable process design–a review. J Clean Prod 317:128247. https://doi.org/10.1016/j.jclepro.2021.128247
134. Maleita C et al (2017) Naphthoquinones from walnut husk residues show strong nematicidal activities against the root-knot nematode *meloidogynehispanica*. ACS Sustain Chem Eng 5:3390 3398.https://doi.org/10.1021/acssuschemeng.7b00039
135. Mandal K (2019) Review on evolution of municipal solid waste management in India: practices, challenges and policy implications. J Mater Cycles Waste Manage 21:1263–1279. https://doi.org/10.1007/s10163-019-00880-y
136. Maroušek J et al (2020) Techno-economic assessment of potato waste management in developing economies.Clean Technol Environ Policy 22:937–944. https://doi.org/10.1007/s10098-020-01835-w
137. Mavridis S, Voudrias EA (2021) Using biogas from municipal solid waste for energy production: comparison between anaerobic digestion and sanitary landfilling. Energy Convers Manage 247:114613. https://doi.org/10.1016/j.enconman.2021.114613
138. Md Badrul Hisham NH et al (2019) Production of biosurfactant produced from used cooking oil by *Bacillus* sp. HIP3 for heavy metals removal. Molecules 24:2617. https://doi.org/10.3390/molecules24142617
139. Meneguzzo F et al (2019) Real-scale integral valorization of waste orange peel via hydrodynamic cavitation. Processes 7:581. https://doi.org/10.3390/pr7090581 [140]Mian MM et al (2017) Municipal solid waste management in China: a comparative analysis. J Mater Cycles Waste Manage19:1127–1135. https://doi.org/10.1007/s10163-016-0509-9
140. Mishra S et al (2021) The utilization of agro-biomass/byproductsfor efective bio-removal of dyes from dyeing wastewater: a comprehensive review. J Environ Chem Eng 9:104901. https://doi.org/10.1016/j.jece.2020.104901
141. Mlaik N et al (2019) Enzymatic pre-hydrolysis of organic fraction of municipal solid waste to enhance anaerobic digestion. Biomass Bioenerg 127:105286. https://doi.org/10.1016/j.biombioe.2019.105286
142. Moharm AE et al (2022) Fabrication and characterization of effective biochar biosorbent derived from agricultural waste to remove cationic dyes from wastewater. Polymers 14:2587. https://doi.org/10.3390/polym14132587
143. Monda H et al (2017) Molecular characteristics of water-extractable organic matter from different composted biomasses and their effects on seed germination and early growth of maize. Sci Total Environ 590:40–49.https://doi.org/10.1016/j.scitotenv.2017.03.026
144. Mondal P et al (2021) Municipal solid waste fired combined cycle plant: techno-economic performance optimization using response surface methodology. Energy Converse Manage 237:114133. https://doi.org/10.1016/j.enconman.2021.114133
145. Moult J et al (2018) Greenhouse gas emissions of food waste disposal options for UK retailers. Food Policy 77:50–58. https://doi.org/10.1016/j.foodpol.2018.04.003

146. Mourad M (2016) Recycling, recovering and preventing “foodwaste”: competing solutions for food systems sustainability in the United States and France. J Clean Pro 126:461–477. https://doi.org/10.1016/j.jclepro.2016.03.084
147. Mr P et al (2022) Recycling of agricultural (orange and olive) biowastes into ecofriendly fertilizers for improving soil and garlicquality. Resour, Conserv Recycling Adv 15:200083. https://doi.org/10.1016/j.rcradv.2022.200083
148. Mrozik W et al (2021) Environmental impacts, pollution sources and pathways of spent lithium-ion batteries. Energy Environ Sci 14:6099–6121. https://doi.org/10.1039/D1EE00691F
149. Murtaza B et al (2019) Municipal solid waste compost improves crop productivity in saline-sodic soil: a multivariate analysis of soil chemical properties and yield response. Commun Soil Sci Pla 50:1013–1029. https://doi.org/10.1080/00103624.2019.1603305
150. Myers SS et al (2017) [Accepted Manuscript] climate change and global food systems: potential impacts on food security and undernutrition. Annu Rev Public Health. https://doi.org/10.1146/annurev-publhealth-031816-044356
151. Nabavi V et al (2020) Feasibility study on the production and consumption of wood pellets in Iran to meet return-on investment and greenhouse gas emissions targets. Renew Energy 151:1–20. https://doi.org/10.1016/j.renene.2019.10.140
152. Ng KS et al (2021) Techno-economic assessment of a novel integrated system of mechanical-biological treatment and valorisation of residual municipal solid waste into hydrogen: a case study in the UK. J Clean Prod 298:126706. https://doi.org/10.1016/j.jclepro.2021.126706
153. Norouzi O, Dutta AJE (2022) The current status and future potential of biogas production from Canada’s organic fraction municipal solid waste. Energies 15:475. https://doi.org/10.3390/en15020475
154. Obeng GY et al (2020) Coconut wastes as bioresource for sustainable energy: quantifying wastes, calorifc values and emissions in Ghana. Energies 13:2178. https://doi.org/10.3390/en13092178
155. Ogunjuyigbe A et al (2017) Electricity generation from municipal solid waste in some selected cities of Nigeria: an assessment of feasibility, potential and technologies. Renew Sustain Energy Rev80:149–162. https://doi.org/10.1016/j.rser.2017.05.177\
156. Olujobi O et al (2022) Conversion of organic wastes to electricity in Nigeria: legal perspective on the challenges and prospects.Int J Environ Sci Te19:939–950. https://doi.org/10.1007/s13762-020-03059-3
157. Oni BA et al (2019) Signifcance of biochar application to the environment and economy. Annals Agric Sci 64:222–236. https://doi.org/10.1016/j.aoas.2019.12.006
158. Osman AI et al (2022a) Hydrogen production, storage, utilisation and environmental impacts: a review. Environ Chem Lett 20:153–188. https://doi.org/10.1007/s10311-021-01322-8
159. Osman AI et al (2022b) Biochar for agronomy, animal farming, anaerobic digestion, composting, water treatment, soil remediation, construction, energy storage, and carbon sequestration: a review. Environ Chem Lett 20:2385–2485. https://doi.org/10.1007/s10311-022-01424-x
160. Otsuka K, Fan S (2021) Agricultural development: new perspectives in a changing world. International Food Policy Research Institute,Washington, D.C.
161. Pandey A, Asif M (2022) Assessment of energy and environmental sustainability in South Asia in the perspective of the sustainable development goals. Renew Sustain Energy Rev 165:112492.https://doi.org/10.1016/j.rser.2022.112492

162. Pardo-Giménez A et al (2020) Optimization of cultivation techniques improves the agronomic behavior of *Agaricus subrufescens*. Sci Rep 10:1–9. https://doi.org/10.1038/s41598-020-65081-2
163. Patel SK et al (2021) Integrating strategies for sustainable conversion of waste biomass into dark-fermentative hydrogen and valueadded products. Renew Sust Energ Rev 150:111491. https://doi.org/10.1016/j.rser.2021.111491
164. Patrizio P et al (2015) Biomethane as transport fuel–a comparison with other biogas utilization pathways in northern Italy. Appl Energy157:25–34.https://doi.org/10.1016/j.apenergy.2015.07.074
165. Pawel I (2014) The cost of storage–how to calculate the levelized cost of stored energy (LCOE) and applications to renewable energygeneration. Energy Procedia 46:68–77. https://doi.org/10.1016/j.egypro.2014.01.159
166. Peng C et al (2016) Production of char from sewage sludge employing hydrothermal carbonization: char properties, combustion behavior and thermal characteristics. Fuel 176:110–118. https://doi. org/10.1016/j.fuel.2016.02.068
167. Petrillo A et al (2022) Multi-criteria analysis for life cycle assessment and life cycle costing of lightweight artifcial aggregates from industrial waste by double-step cold bonding palletization. J Clean Prod 351:131395. https://doi.org/10.1016/j.jclepro.2022.131395
168. Picot-Allain C et al (2021) Conventional versus green extraction techniques–a comparative perspective. CurrOpin Food Sci 40:144–156. https://doi.org/10.1016/j.cofs.2021.02.009
169. Porter C (2016). World agricultural prospects the road to 2050. Supply Intelligence Ltd.
Praveen S et al (2021) Techno-economic feasibility of biochar as biosorbent for basic dye sequestration. J Indian Chem Soc 98:100107. https://doi.org/10.1016/j.jics.2021.100107
170. Pryshlakivsky J, Searcy C (2021) Life cycle assessment as a decisionmaking tool: practitioner and managerial considerations. J Clean Prod 309:127344.https://doi.org/10.1016/j.jclepro.2021.127344
171. Pu X et al (2020) Utilization of industrial waste lithium-silicon-powder for the fabrication of novel nap zeolite for aqueous Cu (II) removal. J Clean Prod 265:121822. https://doi.org/10.1016/j.jclepro.2020.121822
172. Rajeh C et al (2021) Food loss and food waste recovery as animal feed:a systematic review. J Matr Cycles Wast 23:1–17. https://doi.org/10.1007/s10163-020-01102-6
173. Rashid MI, Shahzad K (2021) Food waste recycling for compost production and its economic and environmental assessment as circular economy indicators of solid waste management. J Clean Pro 317:128467. https://doi.org/10.1016/j.jclepro.2021.128467
174. Razzaq A et al (2021) Dynamic and causality interrelationships from municipal solid waste recycling to economic growth, carbon emissions and energy efficiency using a novel bootstrapping autoregressive distributed lag. Resource Conserve Recycle 166:105372. https://doi.org/10.1016/j.resconrec.2020.105372
175. Rittl TF et al (2018) Greenhouse gas emissions from soil amended with agricultural residue biochars: effects of feedstock type, production temperature and soil moisture. Biomass Bioenergy 117:1 9.https://doi.org/10.1016/j.biombioe.2018.07.004
176. Roman FF et al (2021) Hydrochars from compost derived from municipal solid waste: production process optimization and catalytic applications. J Environ Chem Eng 9:104888. https://doi.org/10.1016/j.jece.2020.10488

177. Rosa-Clot M, Tina GM (2020) Chapter 10–levelized cost of energy(LCOE) analysis. In: Rosa-Clot M, Marco Tina G (eds) Floating PV plants. Academic Press, pp 119–127. https://doi.org/10.1016/B978-0-12-817061-8.00010-5
178. Rosales E et al (2017) Challenges and recent advances in biochar aslow-cost biosorbent: from batch assays to continuous-fow systems. Biorsource Technol 246:176-192. https://doi.org/10.1016/j.biortech.2017.06.084
179. Rybicka J et al (2016) Technology readiness level assessment of composites recycling technologies. J Clean Prod 112:1001–1012.https://doi.org/10.1016/j.jclepro.2015.08.104
180. Saad S et al (2010) Chemically modified sugarcane bagasse as a potentially low-cost bio sorbent for dye removal. Desalination 264:123–128. https://doi.org/10.1016/j.desal.2010.07.015
181. Sadeghi S et al (2022) Microbial characteristics of municipal solid waste compost: occupational and public health risks from surface applied compost. Waste Manage 144:98–105. https://doi.org/10.1016/j.wasman.2022.03.012
182. Saja AMA et al (2021) Municipal solid waste management practices and challenges in the southeastern coastal cities of Sri Lanka.Sustainability 13:4556. https://doi.org/10.3390/su13084556
183. Salemdeeb R et al (2017) Environmental and health impacts of using food waste as animal feed: a comparative analysis of food waste management options. J Clean Prod 140:871–880. https://doi.org/10.1016/j.jclepro.2016.05.049
184. Solis M, Silveira S (2020) Technologies for chemical recycling of household plastics–a technical review and TRL assessment.Waste Manage 105:128–138. https://doi.org/10.1016/j.wasman.2020.01.038
185. Sun C et al (2021) Compound utilization of construction and industrial waste as cementitious recycled powder in mortar. Resoure Conserve Recycle 170:105561. https://doi.org/10.1016/j.resconrec.2021.105561
186. Tahat M et al (2020) Soil health and sustainable agriculture. Excessive and disproportionate use of chemicals cause soil contamination and nutritional stress 12:4859. https://doi.org/10.3390/su12124859
187. Talwar N, Holden NM (2022) The limitations of bioeconomy LCA studies for understanding the transition to sustainable bioeconomy. Int J Life Cycle Assess 27:680–703. https://doi.org/10.1007/s11367-022-02053-w
188. Tawfk A et al (2022) Methods to alleviate the inhibition of sludge anaerobic digestion by emerging contaminants: a review. Environ Chem Lett. https://doi.org/10.1007/s10311-022-01465-2
189. Thanigaivel S et al (2022) Exploration of effective biorefinery approach to obtain the commercial value-added products from algae. Sustain Energy Technol Assess 53:102450. https://doi.org/10.1016/j.seta.2022.102450
190. Timilsina GR (2021) Are renewable energy technologies cost competitive for electricity generation? Renew Energy 180: 658–672. https://doi.org/10.1016/j.renene.2021.08.088
191. Torok VA et al (2021) Human food waste to animal feed: opportunities and challenges. Anim Prod Sci 2:1129–1139. https://doi.org/10.1071/AN20631
192. Tripathi N et al (2019) Biomass waste utilisation in low-carbon products: harnessing a major potential resource. NPJ ClimAtmosSci 2:1–10. https://doi.org/10.1038/s41612-019-0093-5

193. Tun MM, Juchelkova D (2018) Assessment of solid waste generation and greenhouse gas emission potential in Yangon city, Myanmar. J Mater Cycles Waste Manage 20:1397–1408. https://doi.org/10.1007/s10163-017-0697-y
194. Tyagi VK et al (2018) Anaerobic co-digestion of organic fraction of municipal solid waste (OFMSW): progress and challenges.Renew Sustain Energy Rev 93:380–399. https://doi.org/10.1016/j.rser.2018.05.051
195. Uddin M et al (2021) Prospects of bioenergy production from organic waste using anaerobic digestion technology: a mini review.Front Energy Res 9:627093. https://doi.org/10.3389/fenrg.2021.627093
196. Usmani Z et al (2020) Advancement in valorization technologies to improve utilization of bio-based waste in bioeconomy context.Renew Sust Energ Rev 131:109965. https://doi.org/10.1016/j.rser.2020.109965
197. Van Nguyen TT et al (2022) Valorization of agriculture waste biomass as biochar: as frst-rate biosorbent for remediation of contaminated soil. Chemosphere 307:135834. https://doi.org/10.1016/j.chemosphere.2022.135834
198. Wang C et al (2022) Reduction in net greenhouse gas emissions through a combination of pig manure and reduced inorganic fertilizer application in a double-rice cropping system: threeyear results. Agric Ecosyst Environ 326:107799. https://doi.org/10.1016/j.agee.2021.107799
199. Wiśniewska P et al (2022) Waste tire rubber devulcanization technologies: state-of-the-art, limitations and future perspectives.Waste Manage 150:174–184. https://doi.org/10.1016/j.wasman.2022.07.002
200. Wu F et al (2022) High value-added resource utilization of solid waste: review of prospects for supercritical CO2 extraction of valuable metals. J Clean Prod 372:133813. https://doi.org/10.1016/j.jclepro.2022.133813
201. Xiao L et al (2021) Biochar promotes methane production during anaerobic digestion of organic waste. Environ Chem Lett19:3557–3564. https://doi.org/10.1007/s10311-021-01251-6
202. Xiu S, Shahbazi A (2012) Bio-oil production and upgrading research:a review. Renew Sustain Energy Rev 16:4406–4414. https://doi.org/10.1016/j.rser.2012.04.028
203. Xue X et al (2022) Thermodynamic and economic analyses of a new compressed air energy storage system incorporated with a waste-to-energy plant and a biogas power plant. Energy 261:125367. https://doi.org/10.1016/j.energy.2022.125367
204. Yaashikaa PR, Kumar PS (2022) Bioremediation of hazardous pollutants from agricultural soils: a sustainable approach for waste management towards urban sustainability. Environ Pollut 312:120031. https://doi.org/10.1016/j.envpol.2022.120031
205. Yan Y et al (2022) Enhancing enzyme activity via low-intensity ultrasound for protein extraction from excess sludge. Chemophere 303:134936. https://doi.org/10.1016/j.chemosphere.2022.134936
206. Yang N et al (2012) Greenhouse gas emissions from MSW incineration in China: impacts of waste characteristics and energy recovery. Waste Manage 32:2552–2560. https://doi.org/10.1016/j.wasman.2012.06.008\
207. Yang Y et al (2019) Estimate of restaurant food waste and its biogas production potential in China. J Clean Pro 211:309–320.https://doi.org/10.1016/j.jclepro.2018.11.160
208. Yang M et al (2022) Circular economy strategies for combating climate change and other environmental issues. Environ Chem Lett.https://doi.org/10.1007/s10311-022-01499-6

209. Yelatontsev D (2023) Production of versatile biosorbent via ecofriendly utilization of non-wood biomass. Chem Eng J 451:138811. https://doi.org/10.1016/j.cej.2022.138811
210. Yong ZJ et al (2021) Biogas and biofertilizer production from organic fraction municipal solid waste for sustainable circular economy and environmental protection in Malaysia. Sci Total Environ 776:145961. https://doi.org/10.1016/j.scitotenv.2021.145961
211. Zhao J et al (2022) How renewable energy alleviate energy poverty?A global analysis. Renew Energy 186:299–311. https://doi.org/10.1016/j.renene.2022.01.005
212. Zhou Z, Zhang L (2022) Sustainable waste management and waste to energy: valuation of energy potential of MSW in the Greater Bay Area of China. Energy Policy 163:112857. https://doi.org/10.1016/j.enpol.2022.112857
213. Zhou H et al (2017) Water sources of Nitrariasibirica and response to precipitation in two desert habitats. J ApplEcol 28:2083–2092. https://doi.org/10.13287/j.1001-9332.201707.021
214. Zhu Y et al (2021) A review of municipal solid waste in China:characteristics, compositions, infuential factors and treatment technologies. Environ Dev Sustain 23:6603–6622. https://doi.org/10.1007/s10668-020-00959-9
215. Zu Ermgassen EK et al (2016) Reducing the land use of EU pork production: where there’s swill, there’s a way. Food Policy 58:35–48. https://doi.org/10.1016/j.foodpol.2015.11.001