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SOLID WASTE MANAGEMNT AND ENVIRONMENTAL IMPACTS IN IRAQ: A REVIEW

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Abstract: Iraq is not an exception to the urgent global issue of solid waste management. Solid waste output has increased dramatically as a result of population growth, urbanization, and industrialization, placing enormous strain on the environment and public health. This article seeks to provide a thorough analysis of the condition of solid waste treatment in Iraq at the moment, noting the difficulties encountered and exploring future waste management techniques. In order to provide useful insights on the current practices and potential developments of solid waste treatment in Iraq, the study focuses on a comprehensive review of the body of available literature and government reports. The results will be a useful tool for stakeholders, researchers, and legislators who want to enhance waste management procedures nationwide.

Key words: Iraq, exception, global, management

INTRODUCTION

Solid waste management is an urgent environmental and public health challenge facing countries around the world and Iraq is no exception[1]. Located in the heart of the Middle East, Iraq has a rich historical heritage and diverse landscapes, from the fertile valleys of the Tigris and Euphrates rivers to the vast deserts of the west. However, as the country experiences rapid urbanization, industrialization and population growth, the generation of solid waste is increasing, requiring urgent attention and long-term solutions[2]. Solid waste management issues in Iraq are diverse and complex, requiring a comprehensive understanding of socio-economic, cultural and environmental aspects[3]. Over the years, urban centers have multiplied, attracting large numbers of rural people in search of better livelihood opportunities. This demographic shift has put pressure on existing waste management infrastructure, leading to increasing challenges in efficient waste collection, transportation and disposal[4]. One of the main factors contributing to the increase in solid waste production is the shift in consumption patterns. Increased disposable income has led to widespread use of single-use plastics and packaging, further increasing the waste burden[5]. Furthermore, the rise of industrial activities and the growing popularity of consumer goods have increased the diversity and toxicity of waste, further complicating its management[6]. Historically, waste operations in Iraq have been characterized by traditional methods such as open-air dumping and incineration, especially in rural areas[7]. While these methods could previously be suitable for small-scale waste volumes, they have become unsustainable in the face of rapid urbanization. Garbage dumping and open burning release harmful pollutants and greenhouse gases into the atmosphere, endangering public health and contributing to environmental degradation[8]. The

environmental consequences of inadequate solid waste management are significant. Unregulated dumping and burning of waste contaminates soil, water and air, posing serious health risks to communities living near landfills[9]. The leaching of toxic substances into groundwater threatens drinking water quality, while the release of methane and other greenhouse gases from waste decomposition contributes to climate change[10]. In addition, poor management of solid waste has adverse impacts on biodiversity and ecosystems[11]. For example, plastic waste poses a significant threat to marine life, with rivers carrying non-biodegradable plastic downstream of the Tigris and Euphrates, eventually reaching the Gulf[12]. This pollution affects marine ecosystems and the livelihoods of coastal communities that depend on fishing and tourism[13]. Recognizing the gravity of the situation, the Iraqi government, in collaboration with international organizations and NGOs, has taken steps to address the solid waste management challenge. Several waste management projects have been launched in major cities such as Baghdad, Basra and Mosul, focusing on initiatives to collect, recycle and turn waste into energy[14]. These projects aim to alleviate immediate waste management problems and promote sustainable practices. In addition, awareness campaigns and education programs have been launched to empower people to segregate their waste and dispose of it responsibly[15]. These efforts aim to promote a culture of waste reduction, reuse and recycling at the individual and community level. Despite these positive initiatives, several obstacles stand in the way of effective solid waste management in Iraq[16]. Insufficient funding, outdated waste management infrastructure and lack of technical expertise remain significant barriers. In addition, political instability and security concerns in some regions further complicate waste management efforts. This comprehensive assessment of the state of solid waste management in Iraq aims to shed light on the challenges and opportunities facing the country[17]. By analyzing waste generation rates, waste composition, current waste management practices and current policies, this study aims to provide sustainable solutions appropriate to the socio-economic context. unique society and environment of Iraq. The ultimate goal of this effort is to develop a comprehensive and practical education[18].

2.LITERATURE REVIEW

2.2. **Solid Waste Management**

2.2.1. Common history approach

Solid waste management has evolved significantly over the centuries, driven by changing social attitudes, technological advances and environmental concerns[19]. In the 19th century, waste management was a relatively simple process, especially in rural areas.However, as urbanization increases, cities face increasing waste management challenges due to higher population densities and the accumulation of non-biodegradable waste.Cities face huge amounts of waste, including plastics, metals and other non-biodegradable materials.In the early 20th century, incineration became a popular waste management method, allowing waste volume reduction and energy recovery[20].By the mid-20th century, landfills had become the primary method of waste disposal[21].Waste reduction and recycling programs have evolved as public awareness of the environmental impact of waste has increased[22].Governments and organizations have begun promoting recycling efforts to conserve resources and reduce landfill use.In addition, composting programs for organic waste have become popular, transferring biodegradable waste from landfills and turning it into useful compost[23].In the 21st century, solid waste management continues to be an important issue, with an increasing focus on sustainable practices and circular economy principles[24].Many countries and cities have set ambitious waste diversion and recycling targets to reduce their environmental footprint.As concerns about climate change and environmental pollution increase, waste management is likely to become an even more important aspect of future sustainable development and resource management.Government, industry and

individuals must continue to work together to find innovative and responsible ways to manage solid waste[25].

2.2.2. Management of municipal solid waste in Iraq

Solid waste management in Iraq is facing significant challenges due to the rapid increase in waste generation, which is estimated to be around 31,000 tons per day[26]. The National Solid Waste Management Plan (NSWMP) for Iraq was developed in 2007 by collaboration of international waste management specialists, which contains recommendations for development and explains the background for decisions. The key principles of waste strategy development in Iraq can be summarized as sustainable development, proximately principles and self-sufficiency, precautionary principles, polluter pays principle, producer responsibility, and waste hierarchy Regarding medical waste management, the Ministry of Health and the United Nations Development Programmed (UNDP) in Iraq have signed a $25 million agreement to strengthen medical waste management in the country, which is part of the $100 million Iraq Covid-19 Vaccination Project (ICVP), a loan financed by the World Bank to support the Government of Iraq`s rollout of the COVID-19 vaccine[27]. Under the agreement, UNDP will procure and install approximately 180 shredder autoclaves which convert medical waste – largely from COVID-19 vaccinations – such as syringes, ampules, dressings, and personal protective equipment like masks and gloves into ordinary waste for safe disposal. Solid waste management in Iraq faces significant challenges due to the rapid increase in waste generation and the lack of modern and efficient waste treatment and disposal infrastructure[28]. However, efforts are underway to address these challenges, including the National Solid Waste Management Plan (NSWMP) and a partnership between the Ministry of Health and UNDP to strengthen waste management.

2.2.3. Operational strategy of municipal solid waste management

Municipal solid waste management (MSWM) is an important aspect of urban planning and environmental sustainability[29].MSWM's operational strategy includes an integrated set of actions and processes for the management, collection, transportation, treatment and disposal of solid waste generated by a city or municipality. The following are the key elements of an operational strategy for municipal solid waste management:

Separation of waste at source :Encourage and educate residents to separate waste at source into different categories such as organic waste, recyclable materials (paper, plastic, glass, metal) and non-recyclable materials[30]. This makes subsequent processes more efficient and reduces the amount of waste that ends up in landfills.

Collection and transportation: Develop a systematic collection system with appropriate waste collection points, regular collection times and efficient transportation methods[31]. This could involve trash cans, trucks, compactors, or even innovative methods like community waste collection initiatives.

Resource recycling and recovery: Set up recycling facilities, such as paper mills, plastic recycling plants, or composting facilities. Recycling reduces the need for raw materials, conserves energy and reduces environmental pollution[32].

Composting: Build a composting facility to treat organic waste. Composting turns organic waste into nutrient-rich compost, which can be used for agricultural or landscaping purposes[33].

Facilities that turn waste into energy: In some cases, where recycling and composting are not enough, waste-to-energy facilities may be considered[34]. These plants convert non-recyclable waste into energy through various processes such as incineration or gasification. However, it is essential to ensure that these facilities meet stringent environmental standards.

Landfill management: If the goal is to minimize landfilling, this may still be necessary for some types of waste. Properly designed and managed landfills should be used, considering factors such as location, containment systems, leachate treatment and methane capture to minimize environmental impact[35].

Community awareness and education: Conduct awareness campaigns to educate residents about waste segregation, proper disposal methods and the importance of reducing waste generation[36]. Proper handling of MSW requires an understanding of its physical and chemical properties. The physical properties of MSWs include density, moisture content, particle size and distribution, field capacity, and permeability[37]. Humidity is the amount of water present in the waste and is an important physical property because water exceeding the field capacity will form leachate, which can be a major problem in landfills. MSW chemistry includes organic and inorganic material composition, calorific value, final analysis, immediate analysis and non-combustibility[38]. Organic materials in MSW include compounds with the elements carbon, hydrogen, oxygen, and nitrogen, which make up proteins and organic acids. MSW`s final analysis determines the percentage of carbon, hydrogen, nitrogen, sulfur and oxygen in the waste .MSW analysis instantly determines the percentage of moisture, volatiles, fixed carbon and ash in the waste .Non-combustible materials include glass, ceramics, metals, dust and ash, and make up 12-25% of dry solids[39] .Understanding the physical and chemical properties of MSW is critical for proper waste treatment and management.

2.2. Environmental Impacts of War and Urban Solid Waste in Iraq

The conflict lasted from March 20, 2003 to December 18, 20, involving the invasion of Iraq by a coalition of international forces led by the United States[40].

Oil spills and fires: One of the immediate environmental consequences of the war was the deliberate burning of oil wells and storage by the retreating Iraqi forces. The intentional burning of oil wells has caused massive fires, releasing large amounts of toxic fumes, soot, and greenhouse gases into the atmosphere. Oil spills and destruction of water treatment facilities have resulted in water pollution, posing health risks to people and affecting aquatic life[41].

Exhausted Uranium Ammunition (DU):The use of depleted uranium ammunition by coalition forces in war has raised concerns about the long-term effects on the environment and health[42].

Deforestation and habitat destruction: Conflict and military operations, including bombing, have resulted in deforestation and habitat destruction in various parts of Iraq[43].

Agricultural damage: War and subsequent instability disrupted agricultural activities, affecting food production and food security in the region[44].

The impact of climate change: The burning of oil wells and the release of greenhouse gases during the conflict have contributed to climate change and global warming. Archaeological sites and monuments have been looted or destroyed, causing irreparable damage to Iraq's cultural heritage. It is important to note that the environmental impacts of the war in Iraq are closely related to its humanitarian and geopolitical consequences[45]. War damage to infrastructure, economy and society has exacerbated its overall environmental consequences. Despite efforts to address environmental problems after the war, the long-term impact on Iraq's environment remains a challenge[46].

3.RESULT AND DISCUSSION

Iraq's urban waste management system is not only an environmental and safety concern, but also an economic opportunity for the thousands of people involved in waste collection, reuse and recycling[2]. However, the performance indicators expected for Iraqi solid waste management have the potential to meet the needs of local solid waste management systems and projects.Iraq faces serious environmental problems, exacerbated by destabilization by occupying forces, leading to the collapse of state institutions and posing high environmental risks. These risks continue to threaten people's health, livelihoods and safety.Lack of proper waste management infrastructure in Iraq contributes to the waste management

crisis[5]. The country suffers from operational and managerial deficiencies in its municipal solid waste management system . Rapid economic growth, high population growth, rising personal incomes and sectarian conflict have exacerbated Iraq's garbage disposal problem. Baghdad alone generates more than 1.5 million tons of solid waste each year. is receiving. As a result, most of the waste ends up in unregulated landfills without regard for human health or the environment [27] . This situation puts a huge strain on the waste management infrastructure**.** Efforts have been made in Iraq to address the problem of waste disposal **.**However, further improvements and investments are needed to establish a comprehensive and efficient waste management system in Iraq .In summary, Iraq's municipal solid waste management system is considered an environmental and safety issue[35]. However, it is also an economic opportunity for waste collectors, recyclers and reuse efforts, and the expected KPIs for waste management have the potential to meet the needs of on-site waste management systems and projects. increase. it is hidden. Iraq faces serious environmental problems due to the collapse of state institutions and the accompanying high environmental risks[7]. Lack of proper waste management infrastructure, operational and administrative weaknesses, and overloading of existing infrastructure all contribute to Iraq's waste management crisis. Efforts have been made to address this problem, but further improvements and investments are needed to establish efficient waste management systems in the country[28].

4.CONCLUSION AND PERSPECTIVE

Iraq faces major challenges in dealing with solid waste effectively**.**Unfortunately, Iraq's waste management system is struggling to keep up with growing demand, resulting in inadequate collection, treatment and recycling infrastructure. Another major problem is the limited capacity of Iraq's waste treatment and recycling facilities. Several measures can be taken to address the challenges of solid waste management in Iraq and reduce its impact on the environment. Investment in infrastructure, Iraq is investing in developing an efficient and effective solid waste collection and treatment infrastructure. This includes expanding waste treatment and recycling facilities to reduce the amount of waste sent to landfills. Community Awareness and Education, raising public awareness of the importance of proper waste disposal and recycling can promote responsible waste management practices in the community**.**Promoting Recycling By encouraging recycling efforts and supporting the growth of the recycling industry, we can significantly reduce the amount of waste that ends up in landfills and conserve valuable resources**.**International support, Working with international organizations and seeking financial support, sharing knowledge and best practices will help strengthen Iraq's waste management capacity**.**It is critically important that Iraq prioritize the development of comprehensive and sustainable waste management strategies that take into account environmental protection, public health and resource conservation**.**By adopting modern practices and learning from successful waste management models around the world, Iraq can move towards a cleaner and healthier environment for its people.

REFERENCES

1. S. Klyuev et al., “Improvement of technical means for recycling of technogenic waste to construction fiber,” Case Stud. Constr. Mater., vol. 16, no. March, p. e01071, 2022, doi: 10.1016/j.cscm.2022.e01071.
2. L. Traven and M. Široka, “Collection of recyclable waste in the city of Rijeka: Current status and perspectives,” Clean. Waste Syst., vol. 5, no. April, p. 100093, 2023, doi: 10.1016/j.clwas.2023.100093.

3. G. Safo-Adu and N. Owusu-Adzorah, “Solid waste characterisation and recycling potential: A study in secondary schools in Kumasi Metropolis, Ghana,” Clean. Waste Syst., vol. 4, no. November 2022, p. 100065, 2023, doi: 10.1016/j.clwas.2022.100065.
4. M. M. Rahman, R. Nguyen, M. Severson, S. Williams, and D. Hartley, “A decision support tool for e-waste recycling operations using the hen-and-chicks bio-inspired optimization metaheuristic,” Decis. Anal. J., vol. 7, no. December 2022, p. 100216, 2023, doi: 10.1016/j.dajour.2023.100216.
5. M. Priyadarshi, M. Maratha, M. Anish, and V. Kumar, “Dynamic routing for efficient waste collection in resource constrained societies,” Sci. Rep., pp. 1–13, 2023, doi: 10.1038/s41598-023-29593-x.
6. S. Concerns, “Natural Bioactive Compounds from Food Waste : Toxicity and Safety Concerns,” 2021.
7. G. Ulutagay, “T ikrit J ournal o f E ngineering S ciences The reality of solid waste management in Iraq and ways of development,” vol. 28, no. July, pp. 1–20, 2021.
8. J. S. Bihałowicz et al., “Characteristics of Particles Emitted from Waste Fires — A Construction Materials Case Study,” 2022.
9. G. Twagirayezu et al., “Environmental Effects of Electrical and Electronic Waste on Water and Soil : A Review,” vol. 3, pp. 2507–2525, 2022, doi: 10.15244/pjoes/144194.
10. Y. Ndizeye, N. Dongjie, M. Umuhoza, S. Head, and F. Mulwa, “Integrated LCA and OPEN LCA-CML baseline analysis on environmental impact associated with the plastic packaging waste management system of Rubavu city Rwanda,” vol. 2, no. 2, pp. 152–160, 2021, doi: 10.51542/ijscia.v2i2.13.
11. S. M. Eisfeld-pierantonio, N. Pierantonio, and M. P. Simmonds, “The impact of marine debris on cetaceans with consideration of plastics generated by the COVID-19 pandemic ☆,” Environ. Pollut., vol. 300, no. June 2021, p. 118967, 2022, doi: 10.1016/j.envpol.2022.118967.
12. M. Macleod, H. P. H. Arp, M. B. Tekman, and A. Jahnke, “The global threat from plastic pollution,” no. July, 2021, doi: 10.1126/science.abg5433.
13. G. G. N. Thushari and J. D. M. Senevirathna, “Plastic pollution in the marine environment,” Heliyon, vol. 6, no. 8, p. e04709, 2020, doi: 10.1016/j.heliyon.2020.e04709.
14. K. Asante, S. Gyamfi, and M. Amo-Boateng, “Techno-economic analysis of waste-to-energy with solar hybrid: A case study from Kumasi, Ghana,” Sol. Compass, vol. 6, no. March, p. 100041, 2023, doi: 10.1016/j.solcom.2023.100041.
15. U. James, E. Nkanu, U. Bassey, E. Etim, and J. Connie, “Heliyon Sociodemographic factors and environmental workers ’ knowledge of the impact of awareness creation on sustainable disposal of solid wastes,” Heliyon, vol. 9, no. 7, p. e18122, 2023, doi: 10.1016/j.heliyon.2023.e18122.
16. V. Filimonau, H. Algboory, N. K. Mohammed, H. Kadum, J. M. Qasem, and B. J. Muhialdin, “Food waste and its management in the foodservice sector of a developing economy: An exploratory and preliminary study of a sample of restaurants in Iraq,” Tour. Manag. Perspect., vol. 45, no. November 2022, p. 101048, 2023, doi: 10.1016/j.tmp.2022.101048.
17. R. A. Grmasha et al., “Ecological and human health risk assessment of polycyclic aromatic hydrocarbons (PAH) in Tigris river near the oil refineries in Iraq,” Environ. Res., vol. 227, no. March, 2023, doi: 10.1016/j.envres.2023.115791.
18. H. Xia, J. Han, and J. Milisavljevic-Syed, “Predictive modeling for the quantity of recycled end-of-life products using optimized ensemble learners,” Resour. Conserv. Recycl., vol. 197, no. June, p. 107073, 2023, doi: 10.1016/j.resconrec.2023.107073.
19. J. Drangert and J. Hallström, “From pigs to incineration and beyond : The evolution of organic waste and food management in Sweden in the period 1800 – 2000 and future prospects,” City Environ. Interact., p. 100113, 2023, doi: 10.1016/j.cacint.2023.100113.

20. V. Simeonov, “Environmental History of the Twentieth Century. An Introductory Didactic Course,” Chem. Didact. Ecol. Metrol., vol. 24, no. 1, pp. 7–21, 2020, doi: 10.2478/cdem-2019-0001.
21. M. H. Rahman and P. R. Bhoi, “An overview of non-biodegradable bioplastics,” J. Clean. Prod., vol. 294, 2021, doi: 10.1016/j.jclepro.2021.126218.
22. D. Presberger, F. Quoß, L. Rudolph, and T. Bernauer, “Factual information on the environmental impacts of consumption abroad increases citizens’ problem awareness, but not support for mitigating such impacts,” Environ. Sci. Policy, vol. 146, no. April, pp. 101–112, 2023, doi: 10.1016/j.envsci.2023.04.019.
23. H. I. Abdel-Shafy, A. M. Ibrahim, A. M. Al-Sulaiman, and R. A. Okasha, “Landfill leachate: Sources, nature, organic composition, and treatment: An environmental overview,” Ain Shams Eng. J., no. xxxx, p. 102293, 2023, doi: 10.1016/j.asej.2023.102293.
24. M. Zare Jeddi et al., “Developing human biomonitoring as a 21st century toolbox within the European exposure science strategy 2020–2030,” Environ. Int., vol. 168, no. April, 2022, doi: 10.1016/j.envint.2022.107476.
25. M. D. Meena et al., “Municipal solid waste: Opportunities, challenges and management policies in India: A review,” Waste Manag. Bull., vol. 1, no. 1, pp. 4–18, 2023, doi: 10.1016/j.wmb.2023.04.001.
26. M. Ali Al-Mohammed, G. Ulutagay, and W. M. S. Alabdraba, “The reality of solid waste management in Iraq and ways of development,” Tikrit J. Eng. Sci., vol. 28, no. 3, pp. 1–20, 2021, doi: 10.25130/tjes.28.3.01.
27. S. Jawad Khaled and W. Abdul-Ameer Ali, “Evaluation of Medical Waste Management in Three Hospitals in Basrah Governorate,Iraq,” Univ. Thi-Qar J. Sci., vol. 10, no. 1(SI), pp. 1–11, 2023, doi: 10.32792/utq/utjsci/v10i1(si).946.
28. W. Czekała, “applied sciences Modern Technologies for Waste Management : A Review,” 2023.
29. S. J. Fernando and A. Zutshi, “Municipal solid waste management in developing economies: A way forward,” Clean. Waste Syst., vol. 5, no. February, p. 100103, 2023, doi: 10.1016/j.clwas.2023.100103.
30. E. Angouria-Tsorochidou, S. Walk, I. Körner, and M. Thomsen, “Environmental and economic assessment of household food waste source-separation efficiency in a German case study,” Clean. Waste Syst., vol. 5, no. March, p. 100092, 2023, doi: 10.1016/j.clwas.2023.100092.
31. A. Alsobky, M. Ahmed, S. Al Agroudy, and K. El Araby, “A smart framework for municipal solid waste collection management: A case study in Greater Cairo Region,” Ain Shams Eng. J., vol. 14, no. 6, p. 102183, 2023, doi: 10.1016/j.asej.2023.102183.
32. J. Lim, Y. Ahn, and J. Kim, “Optimal sorting and recycling of plastic waste as a renewable energy resource considering economic feasibility and environmental pollution,” Process Saf. Environ. Prot., vol. 169, no. July 2022, pp. 685–696, 2023, doi: 10.1016/j.psep.2022.11.027.
33. J. Pre-proofs, “Optimal Aeration Management Strategy for A Small-Scale Food Waste Composting,” Carbon Resour. Convers., 2023, doi: 10.1016/j.crcon.2023.06.002.
34. S. Mancini, M. Casale, P. Rossi, A. Faraudello, and G. A. Dino, “Operative instruments to support public authorities and industries for the supply of raw materials: A decision support tool to evaluate the sustainable exploitation of extractive waste facilities,” Resour. Policy, vol. 81, no. February, p. 103338, 2023, doi: 10.1016/j.resourpol.2023.103338.
35. M. T. El-Saadony et al., “Hazardous wastes and management strategies of landfill leachates: A comprehensive review,” Environ. Technol. Innov., vol. 31, p. 103150, 2023, doi: 10.1016/j.eti.2023.103150.
36. U. J. Uba, E. N. Efut, U. Bassey Obeten, E. E. Asuquo, and J. C. Uba, “Sociodemographic factors and environmental workers’ knowledge of the impact of awareness creation on sustainable disposal

of solid wastes," Heliyon, vol. 9, no. 7, p. e18122, 2023, doi: 10.1016/j.heliyon.2023.e18122.
37. Y. A. Fatimah, A. Widianto, and M. Hanafi, "Cyber-physical System Enabled in Sustainable Waste Management 4.0: A Smart Waste Collection System for Indonesian Semi-Urban Cities," Procedia Manuf., vol. 43, pp. 535–542, 2020, doi: 10.1016/j.promfg.2020.02.169.
38. H. Ji et al., "Response of size-dependent chemical composition of dissolved organic and inorganic species to land use types in tropical coastal headstreams," Ecol. Indic., vol. 152, no. January, p. 110348, 2023, doi: 10.1016/j.ecolind.2023.110348.
39. B. S. Ramadan, I. Rachman, and T. Matsumoto, "Activity and emission inventory of open waste burning at the household level in developing countries: a case study of Semarang City," J. Mater. Cycles Waste Manag., vol. 24, no. 3, pp. 1194–1204, 2022, doi: 10.1007/s10163-022-01371-3.
40. A. M. Al-shammari, "Environmental pollutions associated to conflicts in Iraq and related health problems," vol. 31, no. 2, pp. 245–250, 2016, doi: 10.1515/reveh-2015-0024.
41. M. Skelton et al., "War and oncology : cancer care in fi ve Iraqi provinces impacted by the ISIL con fl ict," no. May, pp. 1–13, 2023, doi: 10.3389/fonc.2023.1151242.
42. T. M. Salman and M. A. Algrifi, "Measurement of Uranium Concentration in Basrah Soils Using the CR-39 Biomedicine and Chemical Sciences Measurement of Uranium Concentration in Basrah Soils Using the CR-39 Detector," no. July, 2022, doi: 10.48112/bcs.v1i3.174.
43. S. Ali, H. Shah, A. Bilal, M. M. Ahmad, and S. S. Bukhari, "Deforestation Is Causing a Great Loss in Avian Diversity in Pakistan Deforestation Is Causing a Great Loss in Avian Diversity in Pakistan," no. July, 2022, doi: 10.11648/j.ajz.20220503.11.
44. R. Neyter, O. Nivievskyi, and V. Litvinov, "AGRICULTURAL WAR DAMAGES REVIEW," no. 2, 2022.
45. C. Economy, "Understanding the climate change impact on health," no. July, pp. 2023–2026, 2023.
46. K. P. M, "Impacts of climate change : Basis for a teaching enhancement approach for climate action," no. July, 2023, doi: 10.5861/ijrse.2023.49.