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Introduction

Kurdistan regional government faces several challenges, particularly preserving and improving the environment, solving its problems and harmonizing it with Iraq, regional and international requirements. The process of preparing and adopting integrated, flexible and applicable strategies with clear goals considering the available human and financial resources constitutes an urgent need for decision makers in Kurdistan and Iraqi requirement and fundamental condition.

Environment in Kurdistan suffers from several problems which can be attributed to natural and human factors and incorrect policies that isolated Kurdistan and federal Iraq from the rest of the world for many years due to consequent wars, international sanctions and the execrable economic blockade. These factors, among others, have formed significant pressures on the environment. Therefore, rehabilitating and improving the environment quality entails multi-level collaboration of stakeholder efforts to develop environmental strategies and action plans to achieve the goals of reaching a promising future where we and future generations live safely and stably in a healthy and sustainable energy and environment.

Over the recent decades, Kurdistan has gone through several political variables and wars which negatively affected society, population and environment in KR. As a result, environment preservation and promotion and protecting resources against depletion have become a public national responsibility and assumed priority at the local and international level. This has been accompanied by the introduction of many international and regional agreements, conventions and organizations to preserve the environment and ensure sustainability.

Environment preservation means maintaining fauna, flora, resources and ecosystems while using them and the economic resources and wealth in sustained and rationalized manner to promote population living standards and enhance environment without damaging or prejudicing the balance of ecosystems at different levels.

Reason of Environmental Detractions

There are several reasons that have affected the living and non-living components of the environment either directly due to direct contact, or indirectly due to internal and external factors. Types and reasons of environment deterioration can be summarized as follows:

1. Population increase (pressure)

All studies indicate that the population growth rate of the KRG and federal Iraq has been steadily increasing since the 1950s, putting pressure on different environment aspects and causing increased rates of environmental deterioration and prejudiced population resources balance through the following:

a. Increased needs of food, energy, shelter and water resources

b. Growing pressure on environment due to increased liquid and solid waste

c. Population practices such as logging, deforestation, soil degradation and overhunting of wild animals and birds threaten the continuity of ecosystems.

2. Urbanisation (urban growth)

Over the last two decades, migration from rural areas to KRG's cities have tripled due to several overlapping reasons, most importantly the increased tendency to use technological means available in urban areas, searching for better work opportunities or residence and the better health services. This has put pressure on the

elements of urban environment incapable of absorbing the population growth which depletes different resources and increases environment deterioration rates in addition to the associated

consequences and damages which may not be avoidable in the future as well as the deteriorated rural areas.

3. Desertification and land degradation

Scientific studies indicate that deserts constitute approximately 42% of the total area of federal Iraq including (KRG). Moreover, a large percentage of lands exhibit desertification factors such as soil erosion, sand and semi-sand dunes, salinization, waterlogging and natural vegetation deterioration. Desertification has had negative impact on the environment and has directly affected the life of the population and different aspects of natural and environmental life by increasing rates and frequency of sand and dust storms in major cities like Erbil and Sulaymaniyah to unprecedented levels. Hereunder are the most important reasons of desertification:

a. **Natural conditions:** 90% of areas in Federal Iraq (including KRG) have dry climate with temperatures hitting 56°C in the long and dry summer, increased evaporation, decreased rainfall rates to around 150 mm in most areas, prevailing type of wind and natural characteristics of soil.

b. **Human activities:** indiscriminate cutting of natural vegetation, overgrazing, lack of proper systems for irrigation and drainage, lack of effective systems to preserve green spaces, urban sprawl through road construction and earthmoving, and unsustainable use of natural resources.

4. Lack of environmental awareness

Environmental awareness at the societal level (individuals and institutions) is a major pillar in developing the environmental level and performance of any social system. Poor public

awareness is however noticeable despite the tireless efforts of environment departments in ministries of natural resources, this can be attributed to the following reasons:

a. The concept of environmental awareness is new in the KRG and Iraqi society in addition to the limited individual and institutional awareness due to the economic and security priorities under the current conditions.

b. Failure to integrate the environmental dimension in the educational framework, which aims at promoting environmental awareness at all social levels.

c. Society and individuals follow behavioural patterns of negative impact on health and environment.

5. KRG's Inadequate environmental monitoring systems

Environmental monitoring systems serve as a safety valve to alert to the beginning of any environmental deterioration process. Obsoleteness of some monitoring systems and lack of ongoing follow-up and analysis cause environmental problems.

6. Wars and political situation

For four decades, during Saddam Hussain regime, Iraq suffered from external wars with neighbouring countries, conflicts and internal instabilities, which adversely reflected on all the components of environment, whether directly or indirectly.

The region witnessed severe geopolitical, economic and social changes during few decades, which has led to serious and dangerous reflections on local and regional environment in general. Major changes are drying the Marshlands, low water inputs to Iraq, declined green spaces, and negligence regarding the violation of environmental instructions and laws.

Impact of Environmental Deterioration in the KRG

The previous reasons have caused several negative impacts on the environment, which can be summarized as follows:

1. Scarcity and pollution of water resources

Kurdistan suffers from water scarcity and pollution. This can be mainly attributed to population increase, economic growth climate change, and low water inputs from upstream countries. Consequently, it has become necessary to identify the annual water needs to satisfy the requirements without damaging or depleting water resources. In whole Iraq (Including KRG) Agricultural needs are estimated at 51 billion m3 to irrigate 11,300 km2. Civil (population) needs to keep pace with the social and health developments are estimated at around 10 billion m3 annually. Needs of the industrial, oil electricity generation are estimated at 5 billion m3 annually. The increased water loss due to evaporation from rivers, dams and tanks estimated at 8 billion m3 in addition to water needs to recover the Marshlands shall also be taken into consideration.

Water pollution results from the lack of Industrial Wastewater Treatment Plants IWTPs and Wastewater Treatment Plants WWTPs, which affects the quality of water discharged into rivers without proper treatment. Other contaminating factors that increase environmental deterioration include random unlicensed industries in houses and shops which produce and discharge untreated water directly into rivers, animal and veterinary activities, popular electroplating plants, car washes, etc. Furthermore, there is a poor control over such industrial activities, poor enforcement of applicable laws that aim to alleviate the negative impact of discharged untreated water, and inadequate implementation of closed cycle and water reuse policies.

2. Air pollution

The deterioration of air quality in Iraq has negatively affected the environmental and health conditions as chronic respiratory diseases and allergy levels have increased. This deterioration can be attributed to the following reasons:

a. Significant increase in the number of vehicles in general. Old vehicles constitute a large percentage and use fuel inconsistent with the environmental specifications. On the other side, road networks haven't been developed to accommodate such increase.

b. Shortage of national electric power generation because stations are obsolete, and citizens use domestic.

generators (small and large) and the associated noise and pollution.

c. Sabotage and fires affecting oil and derivative pipelines, which increase air pollution. d. Citizens tend to incinerate waste as a substitute to the poor garbage collection activities

e. Over-cutting of trees and forest areas in general and palms in particular to cover citizen needs of fuel; thus, decreasing green spaces.

3. Deterioration of biodiversity

Natural biology has deteriorated and decreased in terms of kind and density as a result of wars and implementing many projects on agricultural lands. Dividing and fragmenting agricultural lands have had a significant impact on decreasing green spaces as natural habitats of different living organisms. Furthermore, drying the Marshlands has directly affected migrating birds. Deterioration of biodiversity can be attributed to the following:

a. Overhunting; represented in poaching during mating seasons or using poison,

   electrocution and explosives b. Impact of chemical and physical factors like high salinity

in lakes and rivers c. Ecological pollution of different kinds and sources like wastewater, air pollution, plant wastes and thermal pollution from power plants.

b. Bringing new and exotic types of fish and animals has caused competition between different species for the already limited food and shelter, which, in turn, reflected negatively on the indigenous species in their natural habitats.

Green Economy

The past few years have witnessed continuous progress in developing the basics of 'green economy' based on some successful models and experiments applied in many advanced and developing countries, especially after the global economic crisis in 2008 which alerted the world to the need to include sustainability in economic policies and not to allow market powers and globalization to control then entirely.

During 2009-2012, several international organizations, especially United Nations Environment Programme UNEP, have developed guidelines and integrated proposals for green economy in many developmental and economic sectors, including energy, water management, agriculture, transportation, tourism, sustainable construction, etc.

Green economy was one of the most important themes discussed during the UN Conference on Sustainable Development (Rio+20) which was held in Brazil in June 2012. The outcome document entitled "The future we want" includes the following recommendations on green economy at a global level:

1. Green economy should eradicate poverty, enhance social inclusion, realize economic growth, improve human well-being, create opportunities of decent work, and ensure that ecological systems continue performing their duties properly;

2. Green economy policies should consider developing countries' needs, sovereignty, rights and special conditions; and

3. Green economy policies should bridge the technological gap between advanced and developing countries

Strategic Objectives
Protect and Improve Air Quality

Pollution in general, and air pollution in particular, is associated with human activity because of the urgent need to provide different services like drinking water, food, electricity, energy, industry and transportation as well as to disposing of both solid and liquid materials resulting from such activities.

Main sources of air pollution are: a. Natural sources: dust, dirt and fumes. b. Industrial sources: movable and fixed sources usually resulting from means of transport, fuel burning, power plants, industries and solid waste incineration. These sources contain sulphur and nitrogen oxides, hydrocarbons, carbon monoxide, suspended particulates, and gases causing greenhouse. Air pollution affects directly and negatively the human health and environment through spread diseases and damaged environment.

Relevant Issues and Proposed Solutions
Air Pollution from Natural Sources

Issues and Proposed Solutions

1. Dust storms

The frequency and severity of sandstorms have increased in the KRG due to deteriorated vegetation and increased impact of desertification. This requires comprehensive planning, surveys to learn reasons, taking measures to address them and promoting relevant awareness.

2. Weather and climate

Change of weather, climate and geography of Iraq have led to expanded desert areas, high temperatures, low rainfall, increased rates of solar irradiance, low humidity and soil cover disintegration by movement of military vehicles which, in turn, generates dry dusty air. Accordingly, it is important to study and improve weather and climate changes and conditions.

3. Landscape degradation

There is clear deterioration of green spaces due to poor attention, insufficient irrigation and indiscriminate cutting of trees for security considerations, and fuel alternatives increases area of exposed land which is a main source for dust.

Air Pollution from Fixed Industrial Sources

Issues and proposed solutions

1. Legislations and determinants of gas emissions

Iraq lacks legislations and determinants of gas emissions. This calls for accelerating the enactment of the necessary laws to control and limit environment-polluting activities and install air quality monitoring stations with test and analysis labs in all governorates.

2. Air pollution control and treatment units

Lack of special units to treat air emitted from most factories and major industries in the country like cement, bricks, oils, glass, petrochemicals and power stations is a main source of pollution. Moreover, most available units are obsolete and work inefficiently. In addition, using black oil, which is considered the worst kind, as fuel by owners of stone ovens mostly located in densely populated residential areas inside cities have increased the concentrations of gaseous pollutants and aerosols in the ambient air. Therefore, an integrated plan should be developed to control movable and fixed industrial sources of air pollution, including the establishment of treatment units in factories and major industries.

3. Spread of private generators

The continuous shortage of electric power supply and use of electric generators to satisfy both domestic and commercial energy needs causes environmental damage which affects air quality due to burning large, unbalanced and uncalculated quantities of gasoline and, occasionally, black oil, in addition to the associated noise. This requires expanding

central electric supply coverage and sustainability and reducing the use of private generators.

4. Random incineration

Random incineration of wastes takes place due to poor municipal services. Consequently, large amounts of air pollutants are discharged into the atmosphere, negatively affecting human health and environment. Addressing this problem requires developing an effective waste Integrated Management IM system, especially collection and disposal according to sound environmental principles which prevent incineration and its resulted air pollution.

5. Use of poor quality fuel

Heavy black oil resulting from oil refining is used to operate power stations and many other industrial fields, as well as stone ovens and generators in residential and commercial quarters.

6. Energy inefficiency

KRG suffers from insufficient power production and shortage of fuel supply (Kerosene, gasoline, gasoil) causing the importing of such products from multiple sources, some of which are of poor specifications, low efficiency and inconsistent with environmental standards. This requires gradual transformation to cleaner fuel and implementing strategies and initiatives to increase energy consumption efficiency.

7. Overlap between industrial and residential areas

Iraqi cities have industrial zones containing numerous air-polluting craft industries like metal melting, pottery, electric and gas welding, etc. Currently, the problem is of urgent importance due to residential and industrial areas overlapping. More precisely, residential areas have expanded over some industrial areas which were, at time of establishment, remote, outside city centre and considered fit for industrial activities. Such areas, however, are undoubtedly unfit now for residence, and the persistent industrial air-polluting activities subject people to multiple types of pollution including noise. A transformational step shall be introduced in urban planning to face this problem by designating special locations for craft industries, providing proper infrastructure, transferring these industries to new locations, introducing strict conditions to prevent emissions and pollutants and developing a proper environmental monitoring program.

Air Pollution from Movable Industrial Sources

Issues and proposed solutions

1. Inadequate public transport

Population concentrates in governorate centres and cities. Thus, the increased rate of public transport use generates a continuous pressure on environment and quality of air. Transition into sustainable modes of transport requires expanding public transport range, efficiency and coverage of urban areas and developing the urban planning principles to increase the number and quality of transport services in the suburbs.

2. Random increase of vehicles

Vehicles have increased in a significant, yet dangerous, way over the recent years following the allowed importation without any controls. This abrupt increase along with traffic congestions has aggravated the deterioration of air quality. Moreover, most vehicles are old and require full maintenance. This, however, can't be currently enforced by law due to the economic conditions of the state and most individuals. Iraq suffers from fuel containing two toxic substances, and tetraethyl lead. Therefore, it's necessary to encourage replacing old vehicles with modern ones within suitable economic incentives, reducing imports of old cars, developing maintenance centres and adopting gradual transformation to fuel that generates after burning gas concentrations in line with the environmental requirements.

Noise

Issues and proposed solutions

1. Spread of generators of different capacities

The continuous shortage of electric power supply and relying on private generators to satisfy domestic and commercial needs increase the level of noise in cities and residential areas. Addressing this problem requires expanding central electric supply coverage and sustainability and reducing the use of private generators.

2. Transport and industry

Cars have significantly increased over the recent years causing traffic congestion and increasing levels of noise. Therefore, transport planning in cities and suburbs should be

developed so as to improve road networks in order to facilitate traffic flow, reduce congestion and build tunnels and bridges which contribute to traffic flow and reduce resulting pollution.

Quality Check, Measurement and Monitoring

Issues and proposed solutions

1. Air quality monitoring stations

Ministry of Natural Resources MoNR has constructed and operated a number of fixed and mobile air quality measurement stations to acquire sufficient information about air quality in cities. These stations collect air samples and conduct relevant tests and measurements (concentrations of PM10, CO, SO2, NOx, O3, Benzene, toluene, ethyl, lead and some heavy metals as well as the monthly average of dust fall). The station system shall be maintained and developed to cover larger areas, especially hot spots. It is also necessary to monitor air-polluting industrial activities and coordinate with the stakeholders to maintain existing particle settlers or gas washing units or construct them in lacking plants.

2. Databases

Lack of an integrated and updated database undermines decision makers, technical officials and professionals' ability to accurately diagnose air pollution problems and, thus, find proper solutions and responses. It therefore has been necessary to develop an environmental database and manage it in terms of information gathering and documentation or transfer, exchange and dissemination by all traditional and electronic means to access them generally and directly.

3. KRG's air pollution standards

There are still no clear regulations of the national air pollution standards. These regulations should be enacted by virtue of a binding legislation in consistency with the best regional and international standards. Furthermore, measurement tools should be developed to gather results and information on such standards and indicators.

4. Air quality monitoring research

Iraqi scientific institutions fail to assume an effective role in conducting air quality monitoring tests, especially for some heavy metals like mercury and lead. Availability of similar academic information will help stakeholders respond scientifically to future problems.

Clean Energy

Issues and Proposed Solutions

1. Use of clean fuel

Iraq uses fuel of high lead and sulphur concentrations which pollute air and harm human health and environment by emissions from vehicles and factories. Clean fuel must be used in fixed and mobile energy sources to reduce polluting emissions by designing proper mechanisms to dispose of leaded gasoline and reduce sulphur in diesel oil to protect public health and environment.

2. Use of renewable energy

Excessive production and consumption of traditional energy sources cause a steady increase in emissions from power stations and other energy utilities. This requires using renewable energy like solar, wind, hydroelectric and biomass energy to reduce emissions.

3. Production of energy from wastes

Currently, the potential to generate electric power from wastes, which contribute in reducing and transforming accumulated waste into sustainable resources, isn't utilized. This requires sound environmental management of solid waste starting from separation and treatment to final disposal and linkage to organic gas production utilities using plasma converters to produce clean fuel.

Protection and Sustainable Use of Biodiversity

Biodiversity, its sustainability and safety are themes under increasing environmental pressure and deterioration despite assuming priority in local and international environmental attention. Over recent years, Ministry of Natural Resources MoNR has adopted a clear policy to activate the sustainability of biodiversity as Iraq has become member no. 192 of the Convention on Biological Diversity. MoNR also seeks to join other conventions like Convention on International Trade in Endangered Species of Wild Fauna and Flora CITES, and the Convention on the Conservation of Wildlife.

According to the National Report provided to the Secretary of the Convention on Biological Diversity in 2010, Iraq contains about 80 types of freshwater fish, 16 of which require special protection, in addition to more than 374 types of birds, 18 of which are

threatened species according to the International Union for Conservation of Nature IUCN red list. According to "Iraq Plants" book, there are about 2,500 types of plants, 195 of which are endemic, in addition to 74 types of mammals of 24 families, 10 types of amphibians of 5 families, 97 types of reptiles of 19 families, more than 2,000 types of insects and 2,312 types of algae.

Iraq has several important habitats especially in the centre, southern and northern part (Kurdistan) which is part of the environmental hot-spots and includes a number of natural heritage sites of international importance. Previously, forests constituted 12% of Iraq's area but have deteriorated to 4% in recent years, especially in Kirkuk and Mosul.

Many environmental practices cause deterioration of biodiversity like the deterioration of reserves protected under international conventions and agreements, disturbance of mating habitats and tracks of immigration, dividing of natural environments and habitats and introducing foreign blights or species into the country. Therefore, it is necessary to monitor and document the national progress towards achieving the objectives of biodiversity (2020) approved by Nagoya Convention on Biological Diversity in 2010.

Generally, the environmental measures necessary to protect biodiversity require commitment and conformity with the characteristics of ecosystems and comprehensive urban development plans. These plans shall consider the potential environmental risks associated with urban development so as not to exceed the capacity of the area in addition to observing the environmental performance determinants so that urban development isn't implemented on the expense of biodiversity in the area.

Biodiversity preservation as a strategic objective aims at maintaining local endangered species and protecting sensitive and aesthetic ecosystems (such as the Marshlands and

river banks) which have suffered from negligence and incorrect practices causing the deterioration of living organisms and the emergence of new animals and plants.

Develop and Improve Waste Management

Hazardous and non-hazardous solid waste should be managed in a way that ensures the safety and health of human and environment through an integrated system of multiple interrelated aspects and components. Hence, it is necessary to use proper means consistent with the current conditions, available resources and determinants, i.e. adopting the best options to meet environmental standards at the least possible costs and higher recovery rate of available resources in full compliance with the effective laws and regulations Solid waste may be classified in many ways: decomposable and non-decomposable, flammable and not flammable and hazardous and non-hazardous. Lack of waste Integrated Management IM causes environmental problems negatively affecting man and nature, e.g. spread of diseases and epidemics and damaged city aesthetic standards.

Reduction of Oil Pollution

Oil pollution is a major problem of top priority in the Iraqi environment due to the harmful effects caused by crude oil and petroleum derivative spill into the water, affecting biological species like fish and birds as well as agricultural land, soil, orchards and drinking water purification stations causing mechanical problems and clogged filters. Oil pollution can be attributed to several operations and practices near coasts and shores

like direct discharge (without treatment) of ballast water by ships and boats, industrial discharges from power stations and production plants and oil tankers sinking when colliding with shipwrecks or due to lack of safety or durability requirements.

Reduction of Radioactive Contamination

Ionizing radiation exists in environment either in a natural form within the Earth geological structure or through industrial radioactive sources which has been used in different applications of medicine, – diagnosis or treatment – industry, oil, agriculture, research, fire alarms, lightning arresters, military, etc. Protecting the environment and humans from pollution and radiation constitute a top priority in this field, which isn't an easy task due to the large number of radioactive sources of different kinds.

Integrated Management of Hazardous Chemicals

Hazardous and toxic chemicals attract international attention because chemicals are used in different fields of life and have been the reason for several environmental accidents and risks resulting from their use, circulation, transport and waste disposal. Hazardous chemicals may affect the life of humans and other living organisms through the food chain and exceeds it to natural ecosystems like seas, rivers, wetlands, forests and soil in addition to the ozone layer and climate change in general.

International attention is evident through the large number of concluded international conventions and agreements, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Stockholm

Convention on Persistent Organic Pollutants, Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Montreal Protocol for the Protection of the Ozone Layer.

Iraq became a signatory of Basel Convention in 2011 and of Montreal Protocol in 2008 and seeks to accede to the other environmental conventions on chemicals.

Hazardous chemical of direct toxic effects on health and environment spread in Kurdistan and Iraq as a result of industrial and production operations, storage, trading, transfer, uncontrolled use or random destruction of chemicals.

Developed Institutional and Legal Framework of Environment Sector

Environment is a multi-knowledge sector encompassing several scientific, economic, social and political cases and issues. By law, MoNR is the sectoral authority concerned with Environment Protection and Improvement EPI on the national and international level. Nevertheless, other relevant institutions affect the environment directly or indirectly and their active contribution is considered a necessary requirement and precondition for reaching the Strategic Objectives. The environment sector in Iraq is institutionalized by a number of laws, regulations and instructions affecting the environment directly or indirectly Over the last three decades, the KRG has witnessed a significant environmental deterioration for several reasons addressed above. This has been a significant challenge which requires the concerted efforts of different stakeholders and building active institutions under a proper legal framework. Even though the beginning of environmental institutions and institutional work started in the 1950s, achievements on the ground are at best modest. Currently, the KRG still lacks the

elements and requirements of environmental security and suffers from a clear marginalization in enforcing the national and international EPI legislations and covenants.

Mitigating the Adverse Social Impact and Building a Robust Social Protection System

The most immediate priority is to stabilize the economy without further increasing socio-political fragility. Strengthening and retooling social protection mechanisms to deal with the emergency are critical priorities for the Government. In light of the emergency, social protection should be a top short-term priority. Existing social protection mechanisms should be strengthened and to extent possible retooled to handle the ongoing social and humanitarian crisis. The Government has recently developed a robust social protection framework to protect the poor and the vulnerable. Furthermore, the reform program proposes a range of actions, which should be carefully assessed to identify the vulnerable population groups likely to be affected, and to estimate the size of the adverse welfare impact. In particular, actions related to changes and increases in income taxes; phasing out and lowering subsidies on petroleum, electricity, wheat, and on agricultural inputs have the potential to adversely impact less-well off households. In addition, given the size of the public sector, which employs individuals of varying education levels, some of the proposed reforms to the civil service, such as rationalization of public sector employment, could adversely affect the less-well off.

Risks to the Reform within Environments and Sustainability Program

There are substantial risks that could jeopardize the success of the reform program, which is ambitious and far-reaching in its implications. The risks range from security threats to Environments protection, social responsibility, political and economic challenges. Political tensions between the KRG and the Central Government could continue to persist. Furthermore, political tensions between the main political parties in the KRG could endure. In parallel, security risks remain significant. ISIS could continue to pose a security threat to the KRG. The potential for a takeover of Mosul by the Iraqi military force may increase the influx of IDPs to the KRG. Moreover, oil prices could remain depressed for a protracted period of time, thereby limiting the scope for higher fiscal revenues and economic growth. Should any of these risks materialize, their impact on the progress of the reform program may be disruptive.

The Lay-Out of the Report

The detailed action plan presented in this reform roadmap is prepared in light of the strategic objectives discussed above. This work builds on an ongoing productive engagement of World environmental agency with line ministries, private sector, academia and the international partners which resulted in development of in-depth technical assessments and analytical work in all sectors of the energy, economy, in the KR across diverse sectors. The findings and policy recommendations of these evidence-based analytical works are based on comprehensive consultations with all stakeholders in KR. The report covers environmental and sustainability wide issues such as private sector development, trade and investment regime, labour market as well as sectoral issues.