

Rebuilding Cities and Communities Post Conflict in the Arab Region

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Table of Contents

1. Introduction	3
2. Goal, aim and objectives	4
3. Methodology	4
3.1. Phase 1: Literature Review	4
3.2. Phase 2: Synthesis of findings and development of recommendations and guidelines tailored to the context of Arab countries post conflict.....	5
4. Challenges faced by Arab countries post conflict	5
4.1. Water Scarcity	8
4.2. Energy Instabilities.....	9
4.3. Waste Management	10
4.4. Climate change implications	11
5. Sustainability, Sustainable Cities and Sustainable Reconstruction	12
5.1. United Nations Sustainable Development Goals (UN SDGs)	14
5.2. Build Back Better (BBB)	15
5.3. Five Capital Model.....	19
5.4. UN Habitat Strategy for Sustainable Neighbourhood Planning.....	20
5.5. Net Zero Carbon Initiatives.....	21
6. Proposed Framework.....	21
7. Well-being and quality of life.....	24
7.1. Aspects promoting well-being and high quality of life.....	26
7.1.1. Health.....	26
7.1.2. Housing, neighborhood, and built environment satisfaction.....	27
7.1.3. Heritage and well-being.....	28
7.1.4. Work and Education	28
7.2. Proposed Strategies for improving well-being and quality of life	29
8. Efficient utilization of waste.....	30
8.1. Barriers and benefits to sustainable C&D waste Management.....	31
8.2. Strategies for managing post-conflict C&D waste.....	32
8.2.1. Emergency Clearance and safety work	32
8.2.2. Identifying adequate waste disposal site	32
8.2.3. Reuse and recycle	33
8.2.4. Landfill	33
9. Availability and Sustainability of water	34
9.1. Water scarcity in conflict affected countries.....	35
9.2. Proposed Strategies for efficient utilization of water.....	35
9.2.1. Water conservation strategies.....	35
9.2.2. Water generation strategies	36
9.2.3. Water Management Strategies.....	36
10. Availability and sustainability of Energy	39
10.1. Proposed Strategies for efficient utilization of energy	39
10.1.1. Energy conservation strategies	39
10.1.2. Production of renewable energy	41
10.1.3. Monitoring and management	42
11. Policies and measures necessary to achieve sustainable and equitable development ..	43
References.....	44

1. Introduction

Over the span of the past few decades, the world has faced a number of crises including a global economic instability, a global pandemic, impacts of climate change, the recent conflict in Ukraine, and protracted conflicts around the world. Given the sequenced and interlinked effects of these events, some countries globally are slowly recovering, while many other developing countries are being further pushed behind.

An accurate illustration of the latter would be conflict affected Arab countries. Many Arab countries have been suffering for decades from many economic, social, and environmental challenges including poverty, unemployment and food insecurity, economic instabilities, and environmental problems [1]. These challenges have been magnified by the global challenges and overlaid by the consequences of destructive conflict that erupted over the past couple of decades affecting countries like Iraq, Libya, Somalia, Sudan, Syria, and Yemen. Most of those countries were hit by massive destruction of vital infrastructure (power, water, and sanitation) and of key assets such as houses, buildings, roads, bridges, schools, and hospitals. These conflicts have in turn generated the displacement of large portions of the population. According to the latest estimates released by United Nations High Commissioner for Refugees (UNHCR), the number of registered refugees is 5.6million Yemeni [2] and 5.7million Syrian [3].

In that vein, certainly, countries and cities post conflict must act fast to restore stability and rebuild infrastructure and affordable housing and provide basic services to the residents and encourage refugees to return to their homes. The cost of reconstructions is, however, massive. For instance, the cost of reconstruction of Syria and Yemen are estimated to be US\$250 billion and US\$40 billion, respectively [4]. These large investments could be lost, if reconstruction of these recovering countries is not well planned and studied.

Given all the complex and multidimension challenges of today's world, it is not sufficient for Arab countries to only invest in rebuilding their cities' infrastructure and physical buildings to just return to pre-conflict status. It is imperative for Arab cities post conflicts to adopt a resilient planning framework that aims to reduce the likelihood of any future shocks or capable of absorbing any occurring ones. However, till present there is limited guidance and frameworks to help and create opportunities for sustainable and resilient recovery and reconstruction of Arab cities post conflict.

2. Goal, aim and objectives

The goal of this report is to provide guidance to create opportunities for sustainable and resilient recovery and reconstruction of Arab cities post conflict. The report aims at providing knowledge base and recommendations to assist policy makers, development partners, private sector and civil society organizations, and other stakeholders to craft public policies and explore policy directions to realize sustainable reconstruction in Arab countries post conflicts. Specifically, the objectives are to:

- Describe the challenges faced by Arab countries post conflicts
- Illustrate the concepts and approaches of reconstruction/rebuilding cities and communities
- Identify the best practice principles for reconstruction and recovery of sustainable and resilient cities and communities that are relevant to Arab countries post-conflict.

3. Methodology

To achieve the objectives of this report, the work was divided into two main phases described in this section.

3.1. Phase 1: Literature Review

This phase included data collection based on in depth review of available literature and guidelines to understand the challenges facing Arab countries post conflict, as well as capture the best practices, principles for reconstruction of sustainable and resilient cities worldwide.

Data was collected from different sources including international and regional reports, published articles, statistical reports, and websites/databases.

3.2. Phase 2: Synthesis of findings and development of recommendations and guidelines tailored to the context of Arab countries post conflict

During this step all findings were compiled and synthesized to capture the lessons learned. The synthesis focused on evidence-based best practices and recommendations to assist governments, civil society, the private sector, and international organizations to explore policy directions to achieve sustainable reconstruction in Arab countries post conflict.

This phase ended by setting recommendations and guidelines tailored to the context of Arab countries post conflict

4. Challenges faced by Arab countries post conflict

The Arab region is rich in its cultural, natural heritage and history. However, several Arab countries have been suffering from many economic, social, and environmental challenges. Many key development efforts have been made in the past to promote economic growth of these countries. Yet, these efforts have been relatively subdued due to multiple challenges [5]. These include the recent global instabilities due to pandemic and the recent conflict in Ukraine. These two major global events had disrupted lives across all countries and negatively affected economic growth in many developing Arab countries and had severe impact particularly on vulnerable groups [1,5].

Another serious challenge facing Arab region is climate change. Arab region is among the world's most vulnerable regions to climate change [6,7]. Arab countries have already been experiencing some of the impacts of climate change in dire ways. The Arab region have started facing rise in average temperatures, more frequent drought, floods, desertification, decrease in precipitation and water scarcity. Climate change coupled with the incessant increase in the

population size, rapid urbanization is imposing additional pressure on the ability of the region to ensure food security, satisfy energy and water demand, sustain livelihoods, protect human health and preserve ecosystems.

All these challenges have been exacerbated by outbreak of several conflicts across the region over the past couple of decades [8].

The United Nations Department of Economic and Social Affairs Division for Sustainable Development has identified several common challenges facing any post conflict countries [9]. These challenges are also applicable in the Arab world and post-affected Arab countries are currently enduring the consequences these major challenges as illustrated below.

Poverty, marginalization, and vulnerability. Arab countries post conflicts suffer from poverty. For instance, half of the Yemeni population were considered poor before the conflict in 2017, while in 2019, 78.5% of the Yemeni population were reported to live on less than US\$3.2 per day and over 20 million Yemeni suffered from food insecurity and 7.4 million were at risk of famine [10, 11]. The percentage of Syrian living below poverty line has increase from 28% in 2010 to 83% in 2019 and around 60% of the Syrian population are suffering from food insecurity [12].

Unsustainable exploitation of natural resources and environmental deterioration: Conflicts usually causes negative impact on the environment through destruction of infrastructure buildings and natural habitat, waste accumulation, , and chemical, biological, and nuclear pollutions due to use of weapons. For instance, it has been reported that Syria had experience further environmental deterioration and poor management of natural resources during the years of conflicts [13]. Oil spills and weapon heavy metal left over from weapons have heavily polluted the soil, ground water and agricultural land. Additionally, there have been huge pressure on natural resources especially in coastal areas due to large number of people have

been leaving their homes and moving to these areas to escape. Also, waste management services have been stopped during the years of conflicts that resulted in air pollution and contamination of soil and ground water [13].

In Yemen for example, due to instability and absence of security, coffee farming has been replaced by narcotic crop qat because of higher immediate returns on qat [13]. This requires larger amounts of water consumption and heavy soil exploitation. This have causes agricultural land soil degradation.

Poor economic performance limited fiscal resources, and disruption of Infrastructures and public services. The conflicts in Arab region were massive and destructive. The infrastructure and buildings have been destroyed. These conflicts have a negative impact on the economy of these countries. According to the World Bank the cumulative GDP losses were estimated at US\$226 billion in Syria from 2011 to 2016, about four times the Syrian GDP in 2010 [14]. Also, it is estimated that since 2015 Yemen have lost a cumulative of US\$126 billion in potential GDP [15].

Additionally, other challenges facing post conflict countries include insecurity, militarization, and lawlessness, societal divisions and poor governance, corruption.

The above challenges have illustrated that conflicts have caused political and social instabilities which hindered economic growth and led to devastating effects on the city's infrastructure, buildings and land as well as magnified the environmental problems facing these countries. These conflicts have deprived residents of these cities from access to basic services and has caused many environmental problems.

In addition to the above list of major challenges, the following section will focus on four major environmental issues facing conflict affected Arab countries naming (1) water scarcity, (2)

energy insecurity, and (3) pollution caused from generation of large amounts of wastes, these problems are overlaid with (4) climate change implications.

4.1. Water Scarcity

The Arab region faces severe levels of water stress. In fact, the water rainfall in this region is below world average. The renewable water resources per inhabitant is estimated to be 650m³ per year in 2014 in the Arab region compared to world average of 6000m³ per year [7]. Thirteen Arab country out of twenty-two receive less than 251mm of annual rainfall [16]. The incessant increase in population size and rapid urbanization in Arab region is further increasing water demand and pressure on urban water infrastructure. Water demand in Arab region is expected to increase by 47% from 2005 to 2030 to be 85billion m³ per year [8].

The Arab region is among the most affected regions by climate change [6,7] which will further exacerbate water scarcity. The increasing water stress will also aggravate the challenges facing the Arab region related to health. An example was provided by the spread of COVID-19, the World Health Organization (WHO) has announced that hand washing was essential to contain the virus spread, yet in many Arab countries a large portion of the population especially people living in rural areas suffered from lack of access to clean water.

Additionally, water scarcity magnifies the challenge related to food insecurity facing the region. The Arab region faces low agricultural productivity with; for instance, cereals yield amount of 2,024kg/ha compared to world average of 4,074kg/ha in 2017 [17].

The conflicts that some Arab countries have experienced have worsen the situation. After the outbreak of conflict in Yemen, 80 percent of the population lack access to clean drinking water and sanitation [8], which has contributed to an unprecedented national cholera outbreak, with more than 900,000 suspected cases and 2,192 associated deaths [18].

Syria was suffering from water scarcity and went through five successive years of drought between 2006 and 2010, prior to the conflict outbreak. This had a serious impact on the agricultural sector. Around 1.3million people were affected and an estimated for 800,000 farmer and herders lost almost all their livestock [19]. Water supply networks have been targeted in the Syrian conflict. In fact, the media reported attacks on drinking water well projects in Al-Khaldiyeh village to the north of Sweida and in Ariqa Dama in Daraa province [20]. It was reported that water pumping station in Al Khafsah in Aleppo stopped working, which has caused loss of access to water for around 3million people [21]. Other attacks on water supplies have also been reported in other cities like Hama and Homs [22]. All these violent destructive acts further deprived citizens from access to clean and safe water.

Neighboring countries hosting refugees such as Jordan and Lebanon have also been affected due to rapid influx of refugees, who added further pressure on water systems.

4.2. Energy Instabilities

Conflict-affected countries were already experiencing high level of energy insecurity and gaps between poor areas and relatively developed cities. Conflicts and instabilities in Arab countries caused destruction of power generation plants and transmission infrastructure as well as shortage of fuel, which have led to failure of many services including health, education, access to water and sewage. Lack of access to energy is considered the major barrier to development. According to the World Bank, in Yemen the electricity access rate of the population has dropped from 66% to 10% in 2017 [23]. The study highlighted the fact that major cities like Sana'a and rural areas have suffered from lack of access to public electricity. The UNDP has conducted a survey in Yemen in 2018 that reported that 70% of survey respondents described electricity service "incapable of meeting needs" [24]. A study conducted on women in Yemen in 2016, reported many negative impacts on lack of access rate of electricity and cooking fuel due to conflict including increase in food insecurity, lack of option to refrigerate food, decline

in medical services due to lack of health clinics able to refrigerate vaccines and other medications as well as lack to provide other life-saving service, lack of lighting causing lack of ability of children to study and lack of security for women [25]. Also, The United Nations Economic and Social Commission for West Asia (ESCAW) reported a decline in electricity access rates in conflict-affected countries like Libya and Syria from 2010 to 2017 due to large-scale destruction of infrastructure [24]. By early 2013, more than 30 power stations were inactive, and at least 40 percent of the country's high voltage power lines had been attacked [26].

Neighboring countries have been affected by conflicts as well as they have hosted thousands of refugees, which have entailed a fast increase in electricity consumption. The cost of providing additional energy services to refugees in Jordan is estimated to be US\$119million in 2017 and in Lebanon it is estimated to be US\$370million per year between 2014 and 2018 [24].

4.3. Waste Management

Even prior to conflicts many Arab countries were suffering from poor waste management. Waste management is limited to collection, transport, and disposal [27]. Several studies reported that conflicts have worsened the situation since governments were unable to provide waste collection services in countries such as in Yemen [28] and Syria [29].

Additionally, conflicts have caused massive destruction in many cities, which led to generating huge amounts of construction and demolition waste. For example, in Syria it is estimated that by 2013, 1.2million houses or around one third of all houses in Syria have been damaged [30]. According to the UNESCO World Heritage Site, 52% of the Aleppo old city housing have been destroyed [31]. The UN habitat also reported that by 2014, 50% of Homs neighborhoods have been heavily destroyed [32].

In Libya, it is estimated that after 2011 around 45,000 housing have been destroyed yielding more than 80million tons of construction and demolition waste [33].

These huge amounts of construction and demolition waste generated in conflict affected Arab countries are either left in streets or thrown in open dump sites causing many environmental problems [28,29].

It is important to highlight that many of the cities affected and damaged by war are historic cities, such as the city of Ancient Aleppo in Syria. According to the world bank 14.9 million tons of debris were produced during the Syrian war in the entire city of Aleppo and thousands of tons of debris in the ancient historic city [32]. Most of these debris consists of stone, wood, metal used in construction of massive historic structures. Therefore, it is imperative to recover these huge amounts of waste from historic buildings and reuse them to restore these buildings and protecting the architectural character and history of these old cities.

A disaster waste management (DWM) framework has been developed by The UNEP-OCHA United Nations Joint Environmental Unit specifically for developing countries with the aim of supporting the full cycle of disaster waste management. The framework is divided into four phases; (1) short-term action; emergency phase, (2) medium term action; early recovery, (3) long-term action; recovery and (4) contingency planning [34]. Yet, there is limited strategies or guideline available in the literature tailored for post conflict waste management with special focus on construction and demolition waste management.

4.4. Climate change implications

The Arab region is one of the most affected areas by climate change [6,7]. In fact, temperatures in the Arab region are rapidly rising and further temperature increase by 2-4°C are expected to occur by 2030 [8]. The region is experiencing frequent droughts and many countries facing reduction in agriculture productivity, water scarcity and land degradation.

Although some Arab countries are witnessing progress, conflict-affect countries are lagging and remain vulnerable to environmental threats [24].

5. Sustainability, Sustainable Cities and Sustainable Reconstruction

The concept of sustainability was developed in 1972 during the United Nations Conference on Human Environment. The first definition of the term ‘sustainable development’ appeared in publication of Brundtland Report entitled ‘Our Common Future’ as the “development that meets the needs of the people today without compromising the ability of future generations to meet their own needs” [35]. Since then, considerable efforts have been made to implement the concept of sustainability in all fields.

Defining sustainable cities and sustainable reconstruction of cities is not an easy task. Since cities differ in many aspects including climate, culture, economy, environment and social, there is no single definition of what makes a city sustainable. Professor Gardner, in his book ‘Can a city be Sustainable?’ [36] provides a summary of seven key principles that make a city sustainable as follows:

- Principle 1: Reduce, circulating and clean flow of materials
- Principle 2: A prominent place for nature
- Principle 3: Compact and connected patterns of development
- Principle 4: Creative placemaking
- Principle 5: Centres of wellbeing
- Principle 6: People centred development
- Principle 7: Participatory governance

Several definitions of sustainable reconstruction are proposed. According to the United Nations General Assembly, sustainable reconstruction can be defined as follows “*The medium and long-term rebuilding and sustainable restoration of resilient critical infrastructures, services, housing, facilities and livelihoods required for the full functioning of a community, or a society affected by a disaster, aligning with the principles of sustainable development and ‘build back better’, to avoid or reduce future disaster risk*” [37].

Also, sustainable reconstruction is defined as *“a range of holistic activities in an integrated process designed not only to reactivate economic and social development but at the same time to create a peaceful environment that will prevent a relapse into violence”* [38].

The above definitions of sustainability, sustainable cities and sustainable reconstruction indicated that the strategies for post-war reconstruction should include multi-dimensions and integrated economic, environmental, and social approaches to address the complexities of recovery.

Till present there is limited frameworks and guidance specifically tailored to rebuilding of Arab countries post conflict. This section provides an overview of sustainability drives and summarises some of the global sustainability movements and goals that provide best practice frameworks and guidance that could be used as reference for developing sustainability goals and drivers for rebuilding of Arab countries post conflict. This section starts by focusing on two major sustainability drives that have gained popularity in the past decades and have formed the foundation of many frameworks and countries vision. First, the Sustainable Development Goals (SDGs) is presented, which offer a clear roadmap for development of nations from all dimensions. The second important concept that is presented is “Building Back Better” (BBB). It is a holistic approach that presents reconstruction of countries and cities post disasters as an opportunity to ensure that affected communities are rebuilt in a resilient manner for the future. The BBB concept has gained popularity and many frameworks have been based on this concept to promote stronger and faster reconstruction strategies for countries and cities post disaster. Then, two reputable sustainability frameworks are presented. The first one is the ‘Five capitals model’, which is a framework for sustainability that focus on economic dimension of “capital” or wealth creation, which is an important dimension in reconstruction of cities and countries experiencing fragile economies like conflict affected Arab countries. The second one is “UN Habitat Strategy for Sustainable Neighbourhood Planning” which addressed issues related to

cities planning to develop more sustainable and resilient cities. Planning of cities is a major aspect that cannot be overlooked when reconstructing post destructive conflicts. Finally, ‘net zero’ concept is presented as it is a widely emerging concept to combat against climate change and will shape the future of the world.

5.1. Sustainable Development Goals (SDGs)

In September 2015, 193 countries have adopted 2030 Agenda for Sustainable Development to address global challenges expressed in 17 Sustainable Development Goals (SDGs). The SDGs have been adopted globally to end poverty, protect the planet and to ensure prosperity for all by 2030. The SDGs are an expanded continuation from Millennium Development Goals (2000-2015), which introduced several new areas for policy actions related to environmental aspect, governance, and peacebuilding, and emphasized the role or partnership to achieve the goals and ‘leave-no one behind’. To accelerate sustainable transformation of conflict-affected countries and build resilience to future shocks or crisis, the SDGs can help set out the common vision to build a peaceful and prosperous future for Arab states post conflicts. The Sustainable Development Goal number 11 (SDG 11-Sustainable Cities and Communities) aims “*to make cities and human settlements inclusive, safe, resilient and sustainable*”. To translate this goal into an implementable solution, a shift toward green and sustainable communities and buildings practices is necessary through an integrated approach that considers the entire life cycle of buildings. This will shift the view that communities and buildings are merely physical infrastructure and concrete and steel structures, to the fact that they are key enablers for the improvement of the quality of life for all, and has at its core environmental advantages (reduce consumption and emissions), economic catalyst (jobs creation), and unprecedented social benefits including strengthening communities, and improving the overall health and wellbeing of the cities’ residents and visitors – all of which inherently contribute to all the other 16 SDG’s. In addition to SDG-11, table 1 summarizes five other SDGs that this paper is also going to

tackle as they are directly linked to SDG-11 and would help in sustainable reconstruction of Arab states post conflict.

Table 1: SDGs that need to be tackled to ensure sustainable reconstruction of Arab states post conflict

	Goal	Goals to be tackled
	SDG3: Good health and Well-being	Ensure well-being for all People living in conflict affected countries suffer from many health problems. Therefore, rebuilding these countries require some strategies that promote better health for all.
	SDG6: Clean Water and Sanitation	Ensure availability and sustainability of water Many Arab countries suffer from lack of access to clean water for all and the conflicts has exacerbated the situation. The current situation requires urgent implementation of sustainable solutions to ensure sustainable water management. This will entail achieving other SDGs related to poverty, food security, good health.
	SDG 7: Affordable and clean energy	Ensure access to sustainable energy Conflict affected countries suffer from high level of energy insecurity and lack of access to electricity, which is a major barrier for development. Therefore, it is imperative to provide solutions to address this need.
	SDG 11: Sustainable Cities and Communities	Build Suitable and resilient cities and communities Shift towards green and sustainable cities and communities planning approaches as well as implement green buildings practices
	SDG 12: Responsible consumption and Production	Ensure sustainable production Conflict affected countries suffer from many economic crises as well poor waste management. Therefore, there should be a focus on developing capacities to enhance waste management approaches to promote waste reduction and reuse and recycle of local material. This will allow achieving SDG 8 as well related to creating new job opportunities and entailing economic growth.
	SDG 13: Climate Action	Take urgent actions to combat climate change Arab countries are most vulnerable to climate change and the conflicts are aggravating the situation. Therefore, urgent actions are needed to combat climate change and its impact.

5.2. Build Back Better (BBB)

Conflicts similar to disasters could lead to massive destruction of infrastructure and houses and depriving people from basic needs. Reconstruction of countries post-conflicts and post

disasters have similar aims of recovering quickly and well after these massive destructions, while ensuring building resilient enough to resist all the mega trends that the whole world is currently facing, notably climate change and economic instabilities.

Therefore, this section focuses on the concept of “Building Back Better” developed to help countries recover after disasters and to point out the concepts that are applicable to the post-conflict reconstruction context.

It was noticed that disasters affected cities faced same difficulties when exposed to similar disaster event. After the catastrophe of Indian Ocean Tsunami, the concept of “Building Back Better (BBB)” was introduced to improve reconstruction practices and help countries recover well after disasters [39,40]. The Tsunami Evaluation Commission Synthesis Report highlighted that fast reconstruction of disaster-affected countries without clear framework can render the country more vulnerable to future disasters [41]. This is because countries tend to construct buildings and infrastructure fast without fully adhering to codes and standards and overlooking many economic, social, and environmental aspects. Similarly, countries post- conflicts tend to reconstruct affected areas quickly overlooking many sustainability aspects

Therefore, the concept of BBB proposes a broad holistic approach to post-disaster reconstruction to ensure that affected communities are regenerated in a resilient manner for the future.

In 2006, former US President Bill Clinton issued the first official document- “Propositions for Building Back Better”- that provides ten propositions as a guideline to implementing BBB ideas in post Indian Ocean Tsunami disaster that are summarized as follows [39]:

- Proposition 1: Governments, donors and aid agencies must recognize that families and communities drive their own recovery.
- Proposition 2: Recovery must promote fairness and equity.
- Proposition 3: Governments must enhance preparedness for future disasters.

- Proposition 4: Local Governments must be empowered to manage recovery efforts, and donors must devote greater resources to strengthening Government recovery institutions, especially at the local level.
- Proposition 5: Good recovery planning and effective coordination depend on good information.
- Proposition 6: The UN, World Bank, and other multilateral agencies must clarify their roles and relationships, especially in addressing the early stages of a recovery process.
- Proposition 7: The expanding role of NGOs and the Red Cross/Red Crescent Movement carries greater responsibilities for quality in recovery efforts.
- Proposition 8: From the start of recovery operations, Governments and aid agencies must create the conditions for entrepreneurs to flourish.
- Proposition 9: Beneficiaries deserve the kind of agency partnerships that move beyond rivalry and unhealthy competition.
- Proposition 10: Good recovery must leave communities safer by reducing risks and building resilience

Almost all these propositions are applicable in the post conflict context, the recovery and reconstruction process cannot be possible without partnership and collaboration of all stakeholders. The reconstruction framework should aim at ensuring resilient future given all the mega trends that are currently experienced as well as reduce the risk of future conflicts and disputes. This could be achieved by rebuilding countries and cities that are inclusive for all, allowing for access to basic needs (such as water and energy) for all in a sustainable manner, promoting well-being of people, encouraging local industries to boost the economy, create new types of job opportunities and reduce exploitation of natural resources.

Since 2006, the concept of BBB has been widely adapted and worldwide research in BBB have emerged. According to Fernandez and Iftekhar, the number of scientific publications has increased from 3 in 2007 to 107 in 2018 [42]. Several guidelines have proposed the concept of BBB as the base for recovery and reconstruction post disaster. According to Mannakkara *et al.* [43], all these guidelines have introduced main concepts for improving recovery and reconstruction that can be summarized as follows –

- *Risk reduction* – Previous post disaster experiences have revealed the importance of identifying the challenges and hazards to determine solutions to reduce risks. The

experience of post disaster reconstruction efforts has identified two major ways of risk reduction

- improving structural designs via improvement and enforcement of building codes. For instance, in Sri Lanka building code is implemented in urban areas more than in rural and coastal areas and that's why these areas have been most affected by Tsunami
- better land use planning – for instance after the Indian Ocean Tsunami resident of coastal area have been relocated away from the high-risk zone to reduce future impact of hazardous areas

Post-conflicts Arab countries, as the rest of the world, are subject to all mega trends naming climate change, rapid urbanization, incessant increase in population size, scarcity of land and water and are also at risk of natural disasters. Therefore, reconstruction activities in these countries should study the effect of global trends on these countries and plan and construct accordingly to ensure better planning and construction of the conflict affected areas.

- *Psychological recovery* – previous experiences have shown that deep understanding of the context and culture of the affected city as well as community participation in the process of reconstruction and recovery lead to better results and satisfaction. For example, some of the new houses constructed in Sri Lanka by humanitarian agencies during the Indian Ocean Tsunami rebuild featured bathrooms made with half-heighted walls and shared bathrooms for males and females which were culturally unacceptable and led to dissatisfaction of residents.

One of the main aspects that are usually overlooked in the reconstruction process of post-conflict and post disaster countries is culture. It is important to consider the unique culture of each city or community while planning for reconstruction.

- *Economic recovery* – Disasters as well as conflicts have severe impact on economy since businesses and industries are disrupted. Thus, it has been reported that strategies to support economic recovery should be provided for each country or city as applicable to the context for instance through business grants, low interest load packages, provide resources, investing in human capital through training programs to help people acquire new skills etc.
- To ensure successful recovery *efficient implementation* through better management of stakeholders involved in the reconstruction and recovery process and well as the use of appropriate post disaster legislation and regulations
- To ensure a sustainable recovery from disaster or conflict it is imperative to *keep monitoring and evaluation* the implemented strategies and activities.

Usually, rebuilding from disasters as well as from conflicts consists of three main phases namely (1) rescue, (2) recovery of basic needs and services including access to clean water,

energy, food, sanitation, mobility, and health care, and (3) reconstruction phase to recover assets lost and well-being of people. Recovery and reconstruction phases represent much more than just a return to pre-disaster status. The concept of BBB provides an unparalleled opportunity to rebuilt cities that are more resilient to future shocks and risks. To achieve this goal, focus should be given to recover asset losses as well as restore effect of disaster or conflict on people's well-being. This cannot be possible without good understanding of challenges caused by disaster or conflict, the collaboration of all stakeholders, good governance, and make cities' residents a major part of this reconstruction and recovery efforts. Similarly rebuilding sustainable and resilient Arab cities post conflict represents an opportunity to alleviate pre-existing challenges and mitigate the impact of future risks due to global mega trends.

5.3. Five Capital Model

The Five Capital model of sustainability provides a robust and comprehensive lens on which a strong approach to sustainability can be developed. It takes the stance that everything flows from natural capital and reducing natural capital stocks over time will reduce social and human stocks which are required to produce manufactured and financial capital [44]. These capitals are defined as follows –

- Natural capital: world's stocks of natural assets which include geology, soil, air, water and all living things.
- Human capital: consists of people's health, knowledge, skills and motivation, which are needed to create a productive environment.
- Social capital: concerns the institutions that help maintain and develop human capital
- Manufactured capital: comprises material goods or fixed assets which contribute to the production process e.g. tools, machines and buildings.
- Financial capital: plays an important economic role, enabling the other types of capital to be owned and traded.

This model provides a basis for understanding sustainability in terms of economic concept of wealth creation or 'capital for any organization and more generally for any economy.

Arab conflict affected countries suffer from unsustainable exploitation of natural resources, large number of people leaving their countries and no educational services provided, many economic challenges, Therefore, Arab countries aiming to be rebuilt in sustainable way should maintain and enhance the above listed five capitals and assets instead of depleting and degrading them.

5.4. UN Habitat Strategy for Sustainable Neighbourhood Planning

The United Nations Habitat Strategy for Sustainable Neighborhood Planning outlines five key principles that aim to help new urban development and planning to address issues such as urban sprawl, inequality, pollution, congestion, biodiversity, mobility, and energy [45]. Some of the main objectives of the five principles are to: support development of neighborhoods that promote land use efficiency, promote sustainable and socially equal communities in economically viable ways, encourage walkability, optimize land use to provide a network of streets that facilitate safe mobility, and foster local economy. The five principles are [45]:

1. Adequate space for streets and an efficient street network: the aim of this principle is to develop adequate level of street network that encourage walkability, use of bicycles and public transportation.
2. High density: The aim of principle 2 is to tackle the problem of population growth and rapid urbanization by well-designing and organizing high density neighborhood. It is argued that high density neighborhood has several economic, social and environmental benefits including (1) efficient land use to slow down urban sprawls as the land will be designed to accommodate more people per area, (2) reduce number of public services and accordingly reduce the cost of providing these public services, (3) reduce parking dependency, (4) increase energy efficiency and decrease pollution
3. Mixed land use: The aim of principle 3 is to create local jobs, reduce car usage and promote walkability and use of bicycles and public transportations
4. Social mix: The aim of principle 4 is to ensure availability of houses in different prices in same neighborhood. Principles 4 and 3 are linked together and promote the cohesion and interaction between different social classes.
5. Limited land-use specialization: This principle is again related to principles 3 and 4. The aim of principle 5 is to discourage single function neighborhoods to ensure implementation of mixed land-use and to increase economic diversity.

These principles can be used as the basis for land use planning for sustainable reconstruction of conflict affected cities and countries.

5.5. Net Zero Carbon Initiatives

The latest intergovernmental Panel on Climate Change (IPCC) report released in 2022 has indicated that greenhouse gas emissions (GHG) continue to rise causing many natural disasters including rise in average temperature, drought, desertification, alter biodiversity and ecosystem and many more environmental problems the world is currently starting to experience [46]. This disruption in nature will affect the lives of billions of people around the world and affect many species and plants. The UN climate Change Committee has established the Paris Agreement which establishes international commitments to limiting anthropogenic GHG emissions to prevent global temperature increase beyond 2°C, a threshold scientists reported necessary to avoid catastrophic impacts of climate change. Therefore, many initiatives have been launched to help countries and cities to balance between the amount of GHG produced and the amount removed from the atmosphere to approach net zero. Although the developed countries are responsible for largest position of GHG emissions, developing countries and particularly the Arab region are suffering the most from climate change implications.

The transition to net zero is one of the greatest challenges facing the world today. Buildings and construction industry are responsible for the consumption of 36% of the energy and generation of 39% of carbon dioxide (CO₂) emissions [47].

Therefore, addressing energy use of the building operation and embodied carbon from construction are critical for achieving the climate targets.

6. Proposed Framework

Several Arab countries including Iraq, Libya, Syria and Yemen have experienced conflicts that caused massive destruction of infrastructure and houses depriving people from basic services and needs. This has forced people to leave their homes and countries. The conflicts are by far the biggest and most complicated challenge facing Arab countries that further push conflict-

affected Arab countries far behind. Conflicts are interlinked with numerous challenges including political instabilities, social divisions, fragile economies, disruption of basic services and needs including water scarcity, energy instabilities, poor waste management, food insecurity. This tragic situation requires fast response from all stakeholders to recover and rebuild these countries. It is important to keep in mind that the conflict affected Arab countries were already suffering from many economic, social, and environmental challenges prior to conflict. The conflicts outbreak over the last decade across the Arab region have magnified the intensity of these challenges. Also, the world has been experiencing many intense and cascading global challenges over the past decade including global pandemic, Ukrainian war, and climate change implications. All these challenges accentuate the fact that rebuilding strategies of conflict affected countries cannot be confined to just return back to pre-conflict status. Till present there is limited frameworks and guidance specifically tailored for sustainable rebuilding of Arab countries post conflict.

There is no fit-for-all solution for sustainable reconstruction of Arab cities post conflict, given each city has a unique culture, context, intensity of the conflict, access to natural resources. However, literature has demonstrated that most conflict affected Arab countries suffer from similar and major environmental problems including (1) water scarcity, (2) energy instability and (3) poor waste management and accumulation of huge amounts of construction and demolition waste. All of these challenges are overlaid by climate change. The models and concepts discussed earlier (including SDGs, concept of “Building Back Better” and UN Habitat Strategy for Sustainable Neighbourhood Planning) reveal that to have any chance of success, post-conflict strategies must not only focus on physical reconstruction of infrastructure but rather shall focus on major sustainability themes including: (1) energy and carbon emissions, (2) water, (3) materials and waste, (4) nature and ecology, (5) healthy environments, (6) socioeconomic opportunities, (7) culture, (8) economy finance and funding. Figure 1 illustrates

the themes that are tackled by each model and concept presented earlier. This will ensure rebuilding cities and countries that can reduce the likelihood of any probable future shocks and be resilient enough to any future crises.

Framework Sustainability themes	Energy and Carbon 	Water 	Materials and Waste 	Nature and Ecology 	Healthy Environment 	Socioeconomic opportunities 	Culture 	Economy, Finance and Funding 
SDGs	X	X	X	X	X	X		X
BBB					X	X	X	X
5 Capital Model				X	X	X		X
UN Habitat Strategy for Sustainable Neighborhood planning					X	X		
Net Zero Carbon Initiatives	X							

Figure 1: Main sustainability themes tackled in global models and initiatives

Recovery from post conflict needs immediate emergency action, short-term plans, as well as long-term plans. There are essential steps that need to be taken to ensure conflict and disputes are completely resolved and there is a political stability. It is also imperative to understand that implementing the integrated and holistic approach to transform conflict affected city to sustainable city will not be possible without the collaboration of all stakeholders namely government, civil society, private sector, international organizations, and the citizens. This paper will focus on the following sustainability themes:

1. Planning of cities and communities to promote for Well-being and better quality of life
2. Good waste management strategy with special focus on efficient utilization of construction and demolition (C&D) waste to reduce pollution from these huge amounts of waste while protecting the architectural character and history of cities
3. Availability and sustainability of water
4. Availability and sustainability of energy

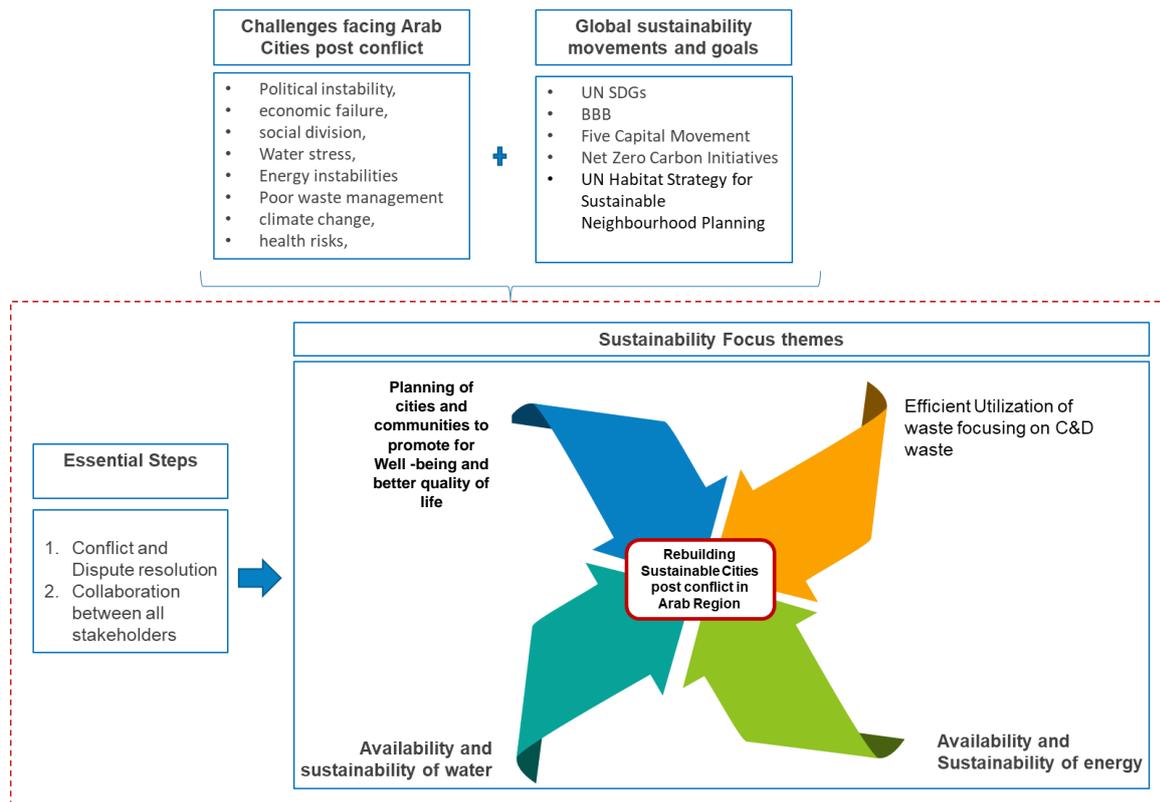


Figure 2: Proposed framework for rebuilding sustainable cities and communities post conflict in the Arab region

7. Well-being and quality of life

As thoroughly discussed earlier, countries post-conflicts face many complex and severe challenges including but not limited to destroyed infrastructure and houses, disrupted basic services, large number of displaced citizens. The most severe challenges in post conflict countries is traumatized communities that suffer from psychological problems, numerous health problems, lack of education and job opportunities. All these challenges caused by conflicts necessitate developing reconstruction strategies that focus on providing well-being and better quality of life for all in cities and communities. In recent years the notion of well-being has grown from the need to mitigate and reduce mental health issues to building and strengthening psychological states not only to prevent future mental illnesses, but also to promote good life. Many studies have revealed that built environment can contribute to well-being through minimizing negative emotional experiences, creating possible social interactions

and well-being, and enacting physical health. The aim of this section is to present potential strategies to be considered during planning of cities and communities to offer better quality of life and promote well-being for all.

The incessant increase in the population size and rapid urbanization overlaid by effect of COVID-19 pandemic, have made improving quality of life in built environment an important issue to tackle in planning cities and communities. Several studies have presented strategies to link between strategies for planning and designing of built environment and well-being of people. The built environment means the physical human-made environment where people’s activity occurs. The proposed strategies to achieve well-being in literature is summarized in the Table 2.

Table 2: Strategies linking cities planning and well being

Strategies	Reference
Physical exercise, community social cohesion, equitable access to healthy food	[48]
open, natural, and green spaces, and urban design that fosters social interaction and safety	[49]
social relationships, leisure, health, and affective experience	[50]
participation and engagement, access, identity, and safety.	[51]

However, none of the above-mentioned studies is capturing all strategies and some possible strategies for post-conflict in Arab region context are not included. Many studies have found a relationship between well-being and quality of life aspects and the built environment. Therefore, this section first discusses different aspects of life that can promote well-being, satisfaction, and high quality of life from literature review. Then, potential strategies to be considered in cities planning to improve well-being and quality of life for post-conflict Arab countries are proposed.

7.1. Aspects promoting well-being and high quality of life

7.1.1. Health

Despite efforts and progress in healthcare sector made over the past years in Arab countries, advances were hampered by conflicts in the region. The Syrian crisis cause complete destruction of 16% and partial damage of 42% of all health facilities [52]. In Yemen, only half the healthcare facilities are currently fully functional [53]. This situation is putting pressure on Arab countries to make huge investment in healthcare sectors to ensure access to healthcare facilities for all. In addition to investing in healthcare sector, it is equally important for countries that aim to achieve sustainable reconstruction to design and plan cities and communities that contribute to better quality of life that can help in preventing many health problems.

Many studies have reported that the built environment can influence physical activity by promoting walking and cycling. Walking and cycling are more reported in compact environments characterized by higher densities and mixed-uses [54,55]. Also, easy accessibility to public transportation instead of dependence on car use promote walking to and from public transit and help maintaining active lifestyles [56-58]. Many studies have also shown that pedestrian-oriented street designs as well as adjacent land uses can contribute to walking habits for residents of cities [59,60].

Several studies have reported evidence linking between active lifestyle, walking, and cycling and reduction in many chronic diseases including diabetes, high blood pressure and heart diseases [61]. Also, less reliance on car and promoting walking and cycling can also contribute to reducing air pollution and carbon dioxide emissions, which in turn contribute to better quality of life for all and increase life expectancy [62,63].

7.1.2. Housing, neighborhood, and built environment satisfaction

People living in conflict affected countries are suffering from profound mental health and psychological well-being due to exposure to conflict-related violence for long time. The built environment can have a major influence on the mental well-being of people. Therefore, one of the main elements that should be considered in planning of cities and communities post conflict is to promote life satisfaction and happiness. Several studies have reported that housing satisfaction contributes to life satisfaction and happiness [64,65]. The most reported aspects that lead to housing satisfaction include (1) adequate size, (2) adequate interior space, (3) amenities, and (4) prices. In addition to the quality of the house itself, neighborhood attached to housing also could provide satisfaction as it could provide a safe place for children to play and facilitate daily activities and therefore improve well-being and psychological status [66]. In fact, safe and inclusive neighborhoods promote social interaction and safety for all to play, live and work. Therefore, neighborhood satisfaction is related to accessibility of diverse type of uses and amenities, access to public transportation and access to usable green spaces [67,68]. The COVID-19 crisis has shed the light on the vulnerability of densely populated and unplanned cities and communities to face the pandemic, adding pressure to the necessity of a paradigm shift in planning and designing of cities and communities. [69].

Studies have shown evidence that accessibility to public transport contributes to increasing mobility and social interaction, which lead to reduction in depression [70]. Also, it was reported that access to green space, nature and vegetation reduce stress, mental fatigue and improve feeling of safety, which promote emotional well-being [71].

Many Arab countries suffer from social inequalities, where not all neighborhoods have access to same quality of life and amenities, which usually lead to lower neighborhood satisfaction [72]. Additionally, people with disabilities in many Arab countries faces physical barriers in public spaces and transportation system due to stair access, high curbs, narrow doorways, etc.

According to the bio-psycho-social model [73], “disability is a result of the societal and environmental elements that hinder an individual (with a health condition) from interacting fully with his or her surroundings”. In that vein, cities poorly planned and designed could be a major cause of hindering an individual from fully participating in the society. Therefore, it is imperative that all cities and neighborhood to be designed to be inclusive for all.

7.1.3. Heritage and well-being

Many conflict-affected cities are rich in their cultural, natural heritage and history that have been damaged. A growing body of evidence has demonstrated could contribute to wellbeing. Heritage and Society [74], produced by Historic England on behalf of the Historic Environment Forum as part of their Heritage Counts series, found that engaging with or living near heritage contributes to higher life satisfaction and quality of life. The research highlighted the therapeutic effects of historic landscapes and ‘blue’ and ‘green’ spaces (such as canals, rivers, and historic parks), and the importance of shared identity and connection. Additionally, conservation of heritage and rebuilding historical cities and would not only contribute to wellbeing of people, but also will be source of income to the city from tourism.

7.1.4. Work and Education

Work and education opportunities and satisfaction are ones of the most important aspects of life. In many Arab countries especially developing ones, people tend to leave their home and country to find good job or education opportunity. Additionally, one way to attract the large number of people that migrated from conflict-affected Arab countries is to provide job and educational opportunities that will encourage them to go back to their home-country. According to some studies denser, vibrant cities increase access to goods and services, facilitate daily interaction, attract talent, facilitate entrepreneurship, and enable social and economic mobility [75,76].

7.2. Proposed Strategies for improving well-being and quality of life

Arab countries post conflicts suffer from many complex challenges and adopting proper cities planning at early stage in the process of reconstruction could influence the overall satisfaction and wellbeing of cities' residences as well as provide higher quality of life. Therefore, the proposed framework tackles the following built environment components: (1) land use, and (2) transportation. The three main aspects of life discussed above (naming (1) health, housing, (2) neighborhood and cities satisfaction, and (3) work and education) shed the light on potential seven strategies to improve well-being and quality of life for all as follows:

1. Provide easy and accessible diverse uses
2. Provide easily accessible, socially inclusive public spaces
3. Integrate urban nature in various forms (green spaces, vegetation, etc.)
4. Develop aesthetically pleasing buildings and public spaces all while keeping culture/history of the city
5. Improve public transportation
6. Promote for walking and cycling (implement pedestrianization; restrict car travel and car parking to the extent possible)
7. Provide opportunities for work and education

These strategies will lead to better quality of life for all, reduce health problems, have economic benefits, and conserve the environment.

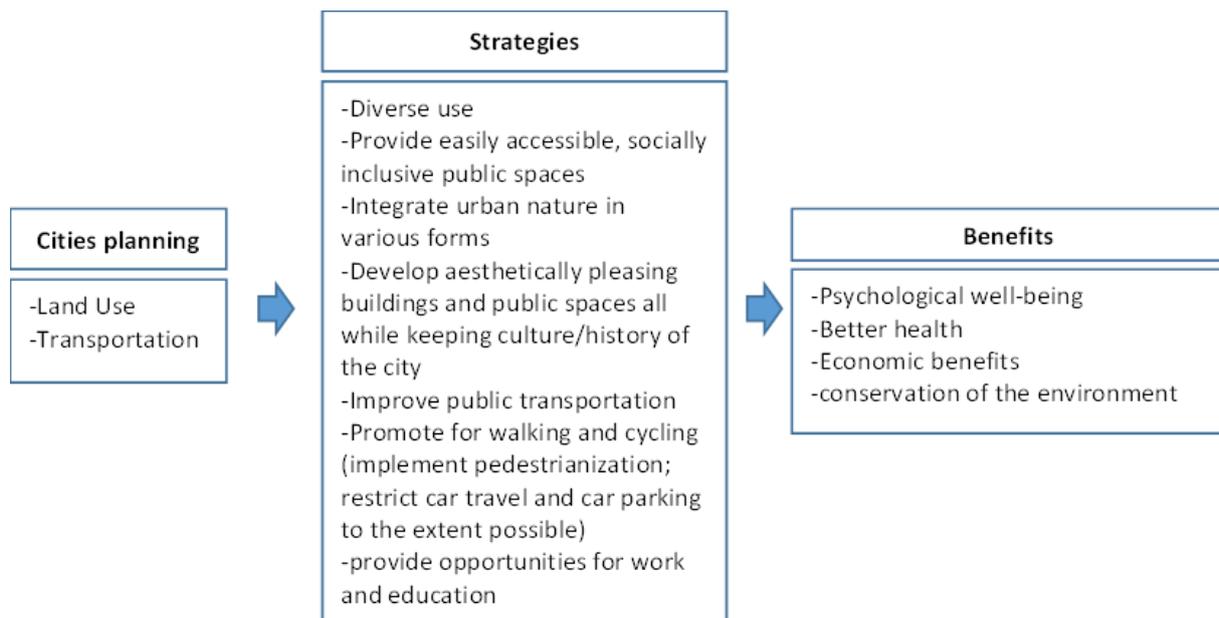


Figure 3: Well-being and quality of life proposed strategies

8. Efficient utilization of waste

As thoroughly discussed, earlier conflicts in Arab countries cause massive destruction and have; therefore, resulted in generation of huge amounts of construction and demolition (C&D). Most of these countries were already experiencing poor waste management before conflict, conflicts have worsened the situation since government were unable to provide waste collection services. According to Lauritzen [77], one of the most important challenges of disaster response is C&D waste management. It is impossible to avoid waste generation during conflict, thus waste minimization via reuse or recycle remain the main waste management strategy [78]. C&D waste generated during conflicts is often mixed with hazardous waste, human tissues and blood. C&D waste in Arab countries is usually collected and mixed with municipal waste and disposed together, this practice overburdens collection and recycling capacity [79]. Therefore, a more sustainable framework for C&D waste management in Arab countries post-conflict is imperative.

8.1. Barriers and benefits to sustainable C&D waste Management

Conflicts result to generation and accumulation of huge volume of waste in affected areas.

The major challenge of C&D waste in post conflicts is that these large amounts of C&D waste are usually mixed with hazardous waste that render the collection, separation, and cleaning process difficult. Many studies have identified several barriers to C&D waste management in countries post conflict and disaster including [33]:

- The time to collect the large amount of wasted material and transport it to recycling and recovery factories and sites and then transport recycled material again to construction site
- Lack of specialists and specialized equipment in post conflict waste
- Inability to physically separate materials
- Lack of awareness of those working in the reconstruction field of the importance to use recycled materials in rebuilding process
- Lack of knowledge and know how on proper recycling practices.
- Absence of a clear authority responsible for construction waste management
- Unavailability of disposal sites

Despite all these barriers, C&D waste management in post conflict is an important aspect of the response and recovery of conflict affected area to reduce several environmental problems.

Many countries post disaster were able to benefit from recycling of C&D waste. For example, the Northridge Earthquake in the US in 1994 [80,81], Thailand and Sri Lanka [82,83], and Beirut [84], have reported various environmental, economic, and social benefits including:

- Reducing space needed for landfilling
- Reduction in air pollution from waste left in the streets or open dump sites as well as reduce emissions from transportation of raw materials for construction
- Creation of new types of job opportunities
- Conservation of natural resources

Similarly, waste management provide an opportunity for post conflict countries to create “green jobs”, promote efficient use of resources, and reduce pollution caused by accumulation of C&D waste.

8.2. Strategies for managing post-conflict C&D waste

This section addresses the second phase of the disaster waste management framework, presented earlier, including location of a disposal site for waste, and waste collection, transportation reuse/recycling activities. C&D waste management in Arab countries requires to adapt the following steps and illustrated in Figure 4.

8.2.1. Emergency Clearance and safety work

The first and foremost step in C&D waste management post conflict is removal of waste to clear the way for emergency services, save lives of people and relief operations to run unabated.

Many conflict-affected countries suffer from widespread pollution throughout the country including presence of abandoned munitions and unexploded ordnance. Therefore, it is imperative that professional bomb disposal units and technologies to remove post-conflict waste before any construction industry activity takes place or waste collected for reuse or recycling.

8.2.2. Identifying adequate waste disposal site

Collecting waste material for reuse or recycle requires that material be first accumulated at a specified points to separate and/or recycle. For instance, after the Nepal earthquake that happened in 2015, a site at the centre of Kathmandu was left open to be used an emergency rescue space during a disaster [85]. Having an accessible and adjacent area to the reconstruction work where material is accumulated, sorted and/or reuse will considerably reduce the cost of transportation, recycling and disposing of the waste. Studies have found that recycling on or near the site can cut project cost to about 40 to 50% of the reconstruction using new materials [85].

8.2.3. Reuse and recycle

Reconstruction of all damaged cities in Arab countries post conflict will require huge amounts of new building materials. For instance, it was reported that if the Old City of Aleppo needs to be rebuilt, it would require approximately seven times the annual output of all quarries in Syria [85]. The idea of using recycled C&D waste has been widely implemented in the United States and European construction industries. The first applications started after the Second World War where rubble "debris" from destroyed buildings was used to produce bricks [86]. This have helped in removing rubble from destroyed cities and satisfy the huge demand on construction material to reconstruct the destroyed German towns [86]. Yet, this practice of using recycled material in construction industry is still limited in most of the Arab countries.

8.2.4. Landfill

Usually after major conflicts the volume of waste generated surpasses available waste disposal capacity [87]. To overcome these challenges, landfilling must be the last option for waste generated post-conflict and be limited only to hard to recycle material only.

To implement these four listed steps above (emergency clearance and safety work, identifying adequate waste disposal site, reuse and recycle, and landfill) collaboration of all stakeholders is required. the government, the, business community, academic institutions and research centres and international organizations should collaborate to develop implementable solutions that suit each country.

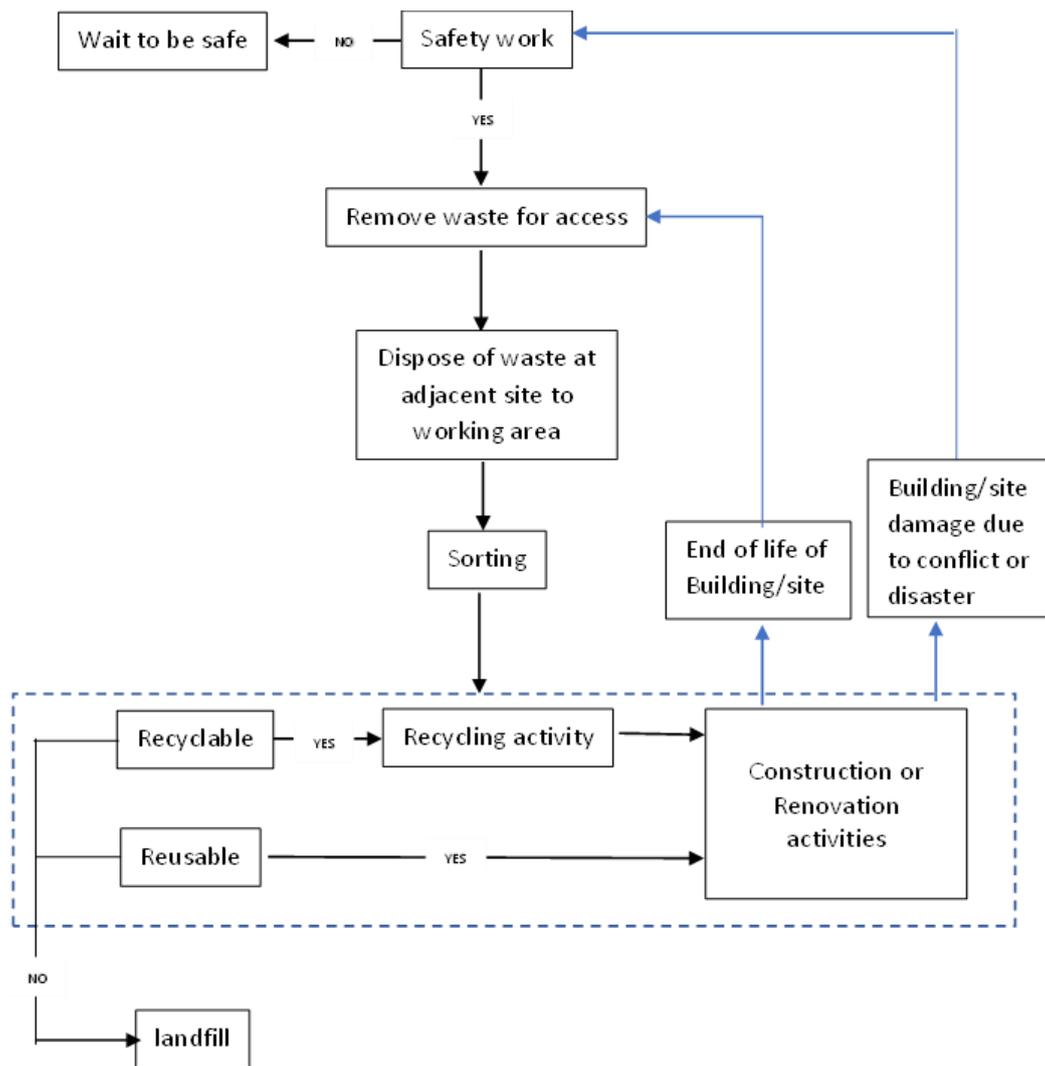


Figure 4: Closing the loop of C&D waste in conflict affected Arab countries

9. Availability and Sustainability of water

Water has a crucial role in daily use as well as in agriculture and industrial sectors. The rapid increase in the population size, urbanization, industrialization, and the pressing need for food security resulted into water scarcity. This water shortage is overlaid by massive destruction of water management infrastructure in conflict-torn Arab countries. Inequality of access and mismanagement of freshwater resources could result into water and food insecurity as well as create risks for potential conflicts [88,89]. Therefore, developing strategies to ensure efficient use of water is key for inclusive, safe, and resilient cities.

9.1. Water scarcity in conflict affected countries

To recognize the vital role of water in reconstruction of sustainable cities, it is first important to understand the interaction between water and conflict. This topic has been thoroughly studied by Gleick's work in which it was argued that water is considered as follows [90]:

- Water is a trigger of conflict where water is unequally accessed
- Water is a weapon of conflict where water resources are used as a tool in violent conflict by for example manipulating infrastructure, contaminating water resources or withholding water supplies
- Water is a causality of conflict where water resources or water systems are intentionally or incidentally damaged or destroyed

These problems in conflict affected areas are overlaid by other global challenges including rapid population growth according to Gleick [90] "*[A]s the world grows, as population grows, the economy grows, as demand for water grows, the scarcity of water is more and more likely to lead to conflicts of one kind or another*". Other studies [91,92] identified other factors that could aggravate water scarcity in conflict affected countries described below:

- Water pollution due to explosives contamination, faecal matter especially due to large number of displaced people from the homes
- Wasted water due to leakage due to damaged water infrastructure as well as lack of regular maintenance of water infrastructure due to high costs

9.2. Proposed Strategies for efficient utilization of water

Addressing water and fragility challenges require immediate response to basic people's need as well as long-term approaches to build back better. The latter requires strategies that should focus on providing solutions for water conservation, alternative ways of water generation and efficient water management thoroughly discussed below and in Figure 5.

9.2.1. Water conservation strategies

The first approach, when reconstructing a city, to efficiently utilize water should be related to reduce water consumption and demand all while meeting people's basic needs. This requires implementing strategies at both the scale of the city's planning as well as at the scale of the

building. The building and construction sector globally is responsible for 30% of the freshwater consumption and generation of 30% of water effluent [47]. The proposed strategies to be implement are as follows –

- Optimize irrigated landscape by using native plants and low water consuming plant
- Design efficient irrigation systems such as drip irrigation
- Efficient design and construction of water distribution networks to minimize leakage, regular maintenance
- Install efficient low flow and ultra-low flow plumbing fixtures and appliances/equipment at buildings scale

Additionally, it is of utmost importance to invest in education and awareness campaigns to raise awareness of people to change culture and behaviour in water consumption in Arab region.

9.2.2. Water generation strategies

The second approach to allow for efficient water use in reconstruction of cities is to implement solutions that can promote water generation. The proposed strategies include the following –

- Use of bioswales to allow for water infiltration and recharge of underground water
- Design and construct rainwater harvesting system to collect rainwater to be reused in landscape irrigation
- Design and construct wastewater treatment plants to collect wastewater from buildings and cities to be reused for irrigation purposes
- Design and construct at building scale greywater treatment plants to collect greywater from lavatories and showers as well as condensate water from air conditioning systems to be reused for irrigation or flushing purposed
- Design and construct at water desalination plant, especially in countries that have costal lines, to produce clean drinking water

9.2.3. Water Management Strategies

The third approach for efficient water utilization is to continuously monitor water networks and infrastructure and this could be done by designing and implementing Supervisory Control and Data Acquisition (SCADA) systems for water networks. For irrigation for examples, SCADA system can be designed to change water supply based on relative humidity and ambient temperature. Also, meters can be installed on water networks integrated with SCADA

systems to manage and detect leaks in network to avoid wasted water. Installing these smart systems will not only help in monitoring water consumption but will also help in collect data of water consumption pattern for different areas. This data can then be analysed and used by decision makers to review policies r on certain areas to foster positive cultural and behavioural change.

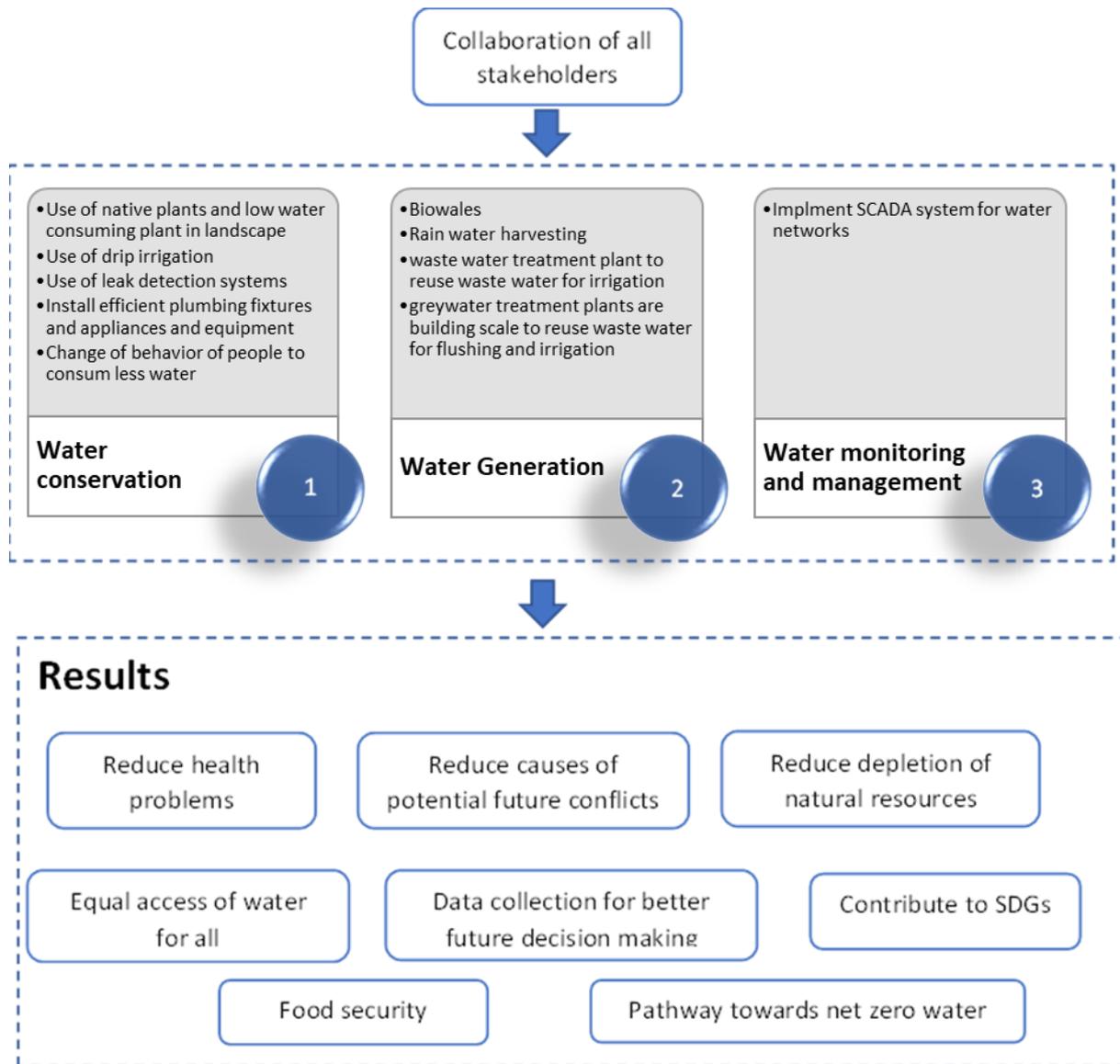


Figure 5: Proposed strategies to ensure availability and Sustainability of water

10. Availability and sustainability of Energy

Similar to water, energy has major role in a countries' development in all sectors and infrastructure is massively destructed during conflict. Access to energy is again faced by global challenges. Energy was key in the development of the Arab regions for decades. Oil has always been the primary source of energy, yet the use of non-renewable energy from fossil fuel sources contribute to large emissions and global warming. Therefore, to craft new development trajectories in the Arab region it becomes imperative to develop sustainable energy strategies at cities' scale and buildings' scale.

10.1. Proposed Strategies for efficient utilization of energy

The best practice for energy planning is the Energy Pyramid [93,94], which is based on two main approaches as follows:

1. Energy conservation and reuse to reduce the use energy
2. Transition towards use of renewable sources of energy

These approaches are thoroughly discussed below and illustrated in Figure 6.

10.1.1. Energy conservation strategies

Energy conservation strategies should start at the planning and designing phase of the cities to ensure implementing optimum urban planning option that would make it easier to apply energy conservation strategies at building scale inside the city. Nowadays, it is becoming possible to not only develop building-scale energy models but also to develop city -scale energy models to test different scenarios to optimize energy performance of the whole city as well account for important factors such as heat island effect [95,96]. Heat island effect is caused by built environment (buildings, roads, and infrastructure) that absorbs heat from sun and re-emit this heat more than the surrounding landscape. This cause overall increase in ambient temperatures. Therefore, it is imperative to plan cities to reduce heat island effect focusing on the following [97] –

- Studying the urban geometry, in fact studies have shown that the height and spacing between buildings affects the amount of radiation received and emitted by urban infrastructure
- Reducing anthropogenic heat or heat emitted from manmade source such as cars, air conditioners, industrial facilities
- allowing for more green spaces at the city scale as well as encouraging green landscape of building's roof.

By focusing on implementing strategies that can reduce heat island effect, this will help in reducing the ambient temperature which in turn will help in reducing energy used for cooling across the whole city.

The building and construction sector are globally responsible for 36% of energy consumption [47]. Although it is widely assumed that lighting is at the core of the energy demand in buildings, however, factually in the Middle East most of the energy used by buildings cater for the Heating Ventilation and Air Conditioning (HVAC) Systems [98].

Heating and cooling loads are significantly affected by the external weather and solar radiations coming from the sun and transferred into the building through walls and windows. Hence, there are several passive strategies to reduce heat gain from the sun radiations. During the initial design stage, locating the buildings in shaded areas (by trees and/or other surrounding structures and/or architectural shades) allow buildings to remain cooler. Also, selecting low thermal conductive material for the walls, windows, and roof along with optimizing building orientation can significantly reduce the overall building required cooling/heating loads.

Additionally, there are many mechanical systems that can be selected to reduce energy used for cooling and/or heating, including but not limited to: (1) install variable cooling/heating systems that can vary based on occupancy instead of constant ones, (2) install heat recovery systems to reuse the air exhausted from the building to cool down the fresh air from the outdoor before being introduced into the conditioning system, (3) use of demand control ventilation,

(4) use of water cooled systems instead of air cooled systems especially in large projects, (5) use of air economizer to provide free cooling when outside temperature is suitable.

10.1.2. Production of renewable energy

Many efforts have been made to replace traditional non-renewable energy sources by renewable sources. The Arab region hosts the planet's largest levels of solar radiation; therefore, harnessing fraction of this could meet the entire region demand for energy. Yet the usage of solar energy as source of power is still limited in the region. There is an absolute need for investing in large scale solar power plants and corresponding infrastructure at the city-scale. As well promoting the use of solar energy, as source of power at building level. Some examples of implementation include constructing photovoltaic solar cells on roof or walls of a building to supply power and to heat water. Yet, their application in the Arab region is still non-encouraging due to the limited availability of suppliers, required constant maintenance and lack of awareness and marketing.

Another challenge in the Arab region is to provide sustainable source of energy for the most vulnerable society. In conflict affected countries, many people have been displaced from their homes and have no access to affordable source of power. In this context some initiatives by UN agencies have been implemented to construct small and decentralized solar solutions to meet the need of localized displaced communities in countries like Yemen [8].

Another important renewable energy source applicable in Arab countries context is biomass. Biogas is produced through anaerobic fermentation of organic carbon-based material such as plant residue including rice straws, wheat straws, malt straw, ground cotton stalk and corn stalk under controlled environment. In an anaerobic fermentation process bacteria decompose or digest organic material in the absence of oxygen to produce biogas. Biogas is a mixture of methane and carbon dioxide. Methane is the component chiefly responsible for a typical

calorific value of 21–24 MJ/m³ or around 6 kWh/m³ [99]. Biogas is a clean, efficient and renewable source of energy that can be used as a substitute for natural gas or liquefied petroleum gas especially for rural communities. The energy content of 1.0 m³ of purified biogas is equal to 1.1 L of gasoline, 1.7 L of bioethanol, or 0.97 m³ of natural gas [100]. Biogas is often used for cooking, heating, lighting, or electricity generation.

10.1.3. Monitoring and management

An important aspect in energy sector is monitoring and management. It is imperative to install smart meters integrated with SCADA system to monitor the usage of energy as well as collect data that can help policy makers take decision regarding energy subsidies.

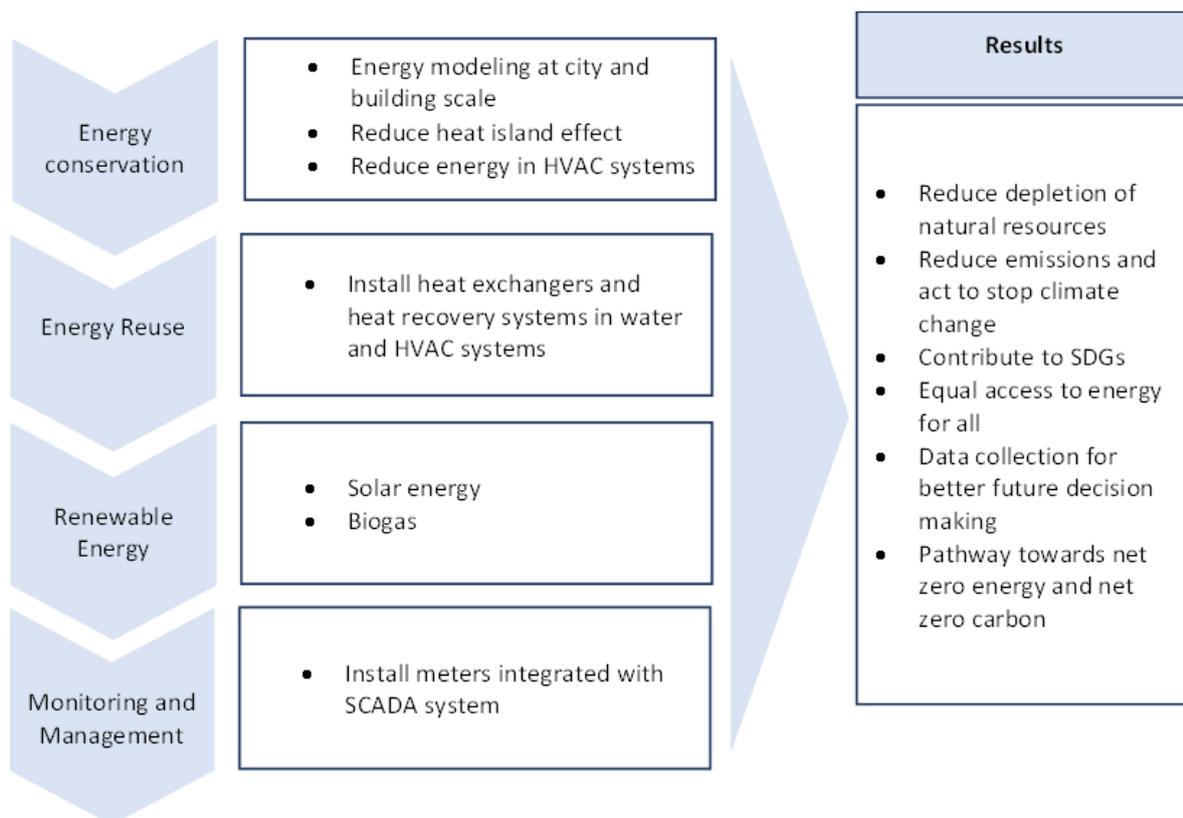


Figure 6: Proposed strategies to ensure availability and Sustainability of energy

11. Policies and measures necessary to achieve sustainable and equitable development

Although destructive conflicts erupted in the Arab region during the past decades caused severe and complex challenges, they are now offering opportunities to build back better. The proposed framework aims to rebuilding sustainable cities and communities post conflict in the Arab Region that are capable to absorb future shocks due to global mega trends. This framework also promotes economic growth, while enhancing the human well-being and quality of life all while preserving and protecting the environment and natural resources. Yet, the implementation of the proposed strategies will not be possible without the collaboration of all stakeholders and below is an initial set of recommendations to the role of each:

1. *Government to:*

- Establish a robust governance for the reconstruction activities across its entire value chain (policies & regulations, planning, funding, execution, and monitoring).
- Adopt the implementation of SDGs with special focus on SDGs 3,6,7,11,12 and 13
- Enforce policies, standards and build rating systems to support the construction industry in its environmental and sustainable shift (design and products).
- Develop and implement national regulations to control the consumption and productions of energy, water, emissions, waste generations, etc.
- Introduce incentives, tax reductions and marketing approaches to promote implementing sustainable strategies in reconstruction process
- Work on awareness activities, campaigns training programs for all stakeholders including consumer, producers, and governments.
- Building a monitoring and evaluation system to collect data from main infrastructure and buildings to allow for developing better solutions that are efficient in the Arab context, as well as monitor the progress and evaluate impact in this field (which can be implemented by developing affordable ways to measure all required data from different infrastructure and buildings and build a database that is well governed).

2. *The civil society, the private sector, and international organizations to:*

- Help in capability development in the construction sector (e.g. training programs and technical assistance about green buildings, smart cities, building back better strategies etc.).
- Build a network to exchange information, success stories and case studies from other countries.
- Transfer the latest technology in the field and build capacities in the country.
- Fund gaps in the ecosystem according to preference and degree of specialization

3. *Developers, contractors, suppliers, and technical designers to:*

- Invest in improving the efficiency of equipment and systems.
- Develop tools and practices to implement sustainable practices in all aspects of buildings, cities, and communities.

4. *The people to*

- Be aware of the individual behaviour impact on the overall sustainability of cities in the future.

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