

Adapting Together, Thriving Tomorrow



# Socioeconomic Scenarios at the National and Sub-National levels for Ghana



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# LIST OF ABBREVIATIONS

|                |                                                             |
|----------------|-------------------------------------------------------------|
| <b>BAU</b>     | Business as Usual                                           |
| <b>CCRA</b>    | Climate Change Risks Assessment                             |
| <b>COP</b>     | Conference of Parties                                       |
| <b>CSAIP</b>   | Climate Smart Agriculture Investment Plans                  |
| <b>CSOs</b>    | Civil Society Organisations                                 |
| <b>EPA</b>     | Environmental Protection Agency                             |
| <b>GDP</b>     | Gross Domestic Product                                      |
| <b>GHG</b>     | Greenhouse Gas                                              |
| <b>GH-NDCs</b> | Ghana's Nationally Determined Contributions                 |
| <b>GIPC</b>    | Ghana Investment Promotion Centre                           |
| <b>GNCCMP</b>  | Ghana National Climate Change Master Plan                   |
| <b>ILO</b>     | International Labour Organisation                           |
| <b>IPCC</b>    | Intergovernmental Panel on Climate Change                   |
| <b>MESTI</b>   | Ministry of Environment, Science, Technology and Innovation |
| <b>MMDAs</b>   | Metropolitan, Municipal, District Assemblies                |
| <b>MoGSCP</b>  | Ministry of Gender, Children and Social Protection          |
| <b>MOH</b>     | Ministry of Health                                          |
| <b>NADMO</b>   | National Disaster Management Organization                   |
| <b>NAP</b>     | National Adaptation Planning                                |
| <b>NCCAS</b>   | National Climate Change Adaptation Strategy                 |
| <b>NCCP</b>    | National Climate Change Policy                              |
| <b>NDCs</b>    | Nationally Determined Contributions                         |
| <b>NHIA</b>    | National Health Insurance Authority                         |
| <b>RCPs</b>    | Representative Concentration Pathways                       |
| <b>SDGs</b>    | Sustainable Development Goals                               |
| <b>SSPs</b>    | Shared Socioeconomic Pathways                               |
| <b>UNDP</b>    | United Nations Development Programme                        |
| <b>UNFCCC</b>  | United Nations Framework Convention on Climate Change       |

# EXECUTIVE SUMMARY

Ghana's attainment of the Sustainable Development Goals (SDGs) and the Nationally Determined Contributions will be adversely affected by current and projected future changes in climate. Ghana is projected to suffer intense drought with the national average temperature expected to increase. At the same time, rainfall patterns of Ghana are also expected to be uncertain with the likelihood of frequent and intense precipitation, as well as frequent and prolonged dry spells. For Ghana to be able to prepare for all the different uncertainties both now and in the future, there is need for certain proactive actions to be taken. These include the preparation of a national climate risk assessment, a business as usual (BAU) scenarios, and preferred socio-economic development scenarios at the national level. Such scenarios will facilitate an understanding and appreciation of current vulnerability and future risks of climate change associated with the current socio-economic development pathways and potential future pathways.

It therefore becomes imperative to develop national socio-economic scenarios to serve as plausible future pathways for Ghana. A range of methods including policy analysis, literature review, and stakeholder workshops were used to complement the global shared socioeconomic pathways to develop three narrative scenarios in six priority sectors of Ghana and two metropolitan assemblies (Sekondi-Takoradi and Tamale). The narratives show that two of the three scenarios developed, i.e., *Ghana Low Road* and the Business-as-Usual pathways, provide an unsustainable pathway going into the future. These unsustainable future pathways are also visible in the two metropolitan assemblies with varying degrees depending on current situations. The third scenario, i.e., *Ghana High Road* provides a sustainable future pathway which ensures improvements in the living standards of the citizenry. The priority sectors under this scenario witness improvements that translate into better opportunities for all. Such improvements are because of proactive climate risk governance adopted by both the national and local government. This work highlights the need for proactiveness in the climate risk governance of Ghana and the promotion of a mix of nature-based and technology-based climate-based solutions. The results are also guided by the fact that amidst current geopolitical disruptions and uncertainties, the reliability of generated scenario narratives may be significantly impacted by current or future geopolitical emergencies.

# 1. BACKGROUND

Ghana is projected to suffer intense drought and increasing rainfall variability. Mean temperature is projected to increase by 1-3°C by 2060 and between 1.5°C and 5.2°C by the 2090s (Environmental Protection Agency, 2020). Rainfall will continue to be uncertain and difficult to predict. Projections of mean annual rainfall from different models predict a wide range of changes but the proportion of total annual rainfall that falls in heavy events tends towards an increase (Asante and Amuakwa-Mensah, 2015). This will adversely affect the attainment of the Sustainable Development Goals (SDGs), particularly those relating to food security (SDG 2), improving gender equality (SDG5), affordable and clean energy (SDG 7), climate action (SDG 13) and the Nationally Determined Contributions. To prepare climate change risk assessments, a business as usual (BAU) and preferred socio-economic development scenarios must be prepared at the national level. These scenarios will facilitate understanding and appreciation of current vulnerability and future risks of climate change impacts associated with the current and future socio-economic development pathways. It is against this background that a national socio-economic scenario becomes imperative as an avenue for the NAP Climate Change Risks Assessment (CCRA) team to generate plausible narrative scenarios for the CCRA case study in two MMDAs: (1) Tamale City (2) Sekondi-Takoradi.

Scenario, as used in the Millennium Ecosystem Assessment (2005), implies the generation of relevant, and plausible sets of stories about how the future might unfold. Climate change scenarios represent “a coherent, internally consistent and plausible description of a possible future state of the world.” Scenarios make it possible to predict the way in which certain events and occurrences may impact societies or specific aspects of societies. They are generally developed to help decision-makers imagine the future in the present by understanding a wide range of possible futures. More importantly, scenarios provide proactive opportunities to embrace uncertainties and understand how decisions made in the present may play out in the future. From a climate change perspective, and particularly as it relates to Ghana’s current adaptation planning efforts, scenarios become critically important to facilitate understanding and appreciation of plausible long-term climate impact manifestations based on certain anthropogenic factors.

Understanding the likely possible course of climatic change therefore requires long-term projections of emissions scenarios based on assumptions such as energy supply and demand and the structure of energy supply systems. Such scenarios will also enhance impact projections, as well as facilitate understanding of possible vulnerability of socio-economic systems. An effective adaptation planning therefore makes it necessary to create an intentional picture of the future in which different climate-impacted socio-economic conditions can be imagined before they happen. Such a picture, which indeed is the scenario, will include economic growth trends, demographic changes, technological changes, changes in governance, lifestyle changes, changes in land use, waste management systems and how such changes will influence vulnerability to climatic change impacts of different groups and at multiple levels. The impetus then will be on acting on what might be by putting in place forward-looking adaptive measures that reduce public exposure to new climate-induced risks, as well as taking advantage of new opportunities emerging from climatic change.

Against this background, it becomes insufficient and unwise to assume, as many early climate impact studies did, that the future resembles the present. The future may be different from the present and the only way to get insights into the future is to use current situations to generate plausible scenarios. For this reason, there is a need for socio-economic scenarios to inform research and policy related to climatic impacts and adaptation in Ghana, and that is what this assignment sets out to accomplish.

## 1.1. Context of Work

Evidence abounds in Ghana to affirm changing climatic conditions and associated impacts on people, communities, and key economic sectors. Risks associated with these changing conditions have become verifiably evident in many sectors and local communities across Ghana to require deeper explorations and understanding to inform the development of appropriate adaptation responses. While employing relevant methodological processes, the socioeconomic scenarios as discussed in this work is premised primarily on changing climatic situations and associated vulnerabilities and risks. These are considered from the perspective of current and projected future appreciation of the nexus between climate change risks and socio-economic development processes in key climate sensitive sectors and communities in Ghana. It is also premised on the assumption that climate change will have many and complex impacts on society and the economy, in ways that turn such impacts into key drivers of change across sectors in local communities in Ghana.

Most importantly, perhaps, the context of this work is the National Adaptation Planning (NAP) and the need for intentional and proactive appreciation of the complexity of climate change impacts, the nature of impacts manifestations in key sectors and how and why impacts, vulnerabilities and adaptation responses should or may inform different governance scenarios. For the purposes of adaptation planning, therefore, it becomes critically important that climate scientists and policy leaders know what future societies may look like to facilitate the making of sufficiently plausible predictions of the vulnerability of different sectors and impact domains to both current and future climate change impacts to inform proactive responses. The socio-economic futures scenarios discussed in this work, as indicated, are first and foremost conceptualized from changing climate conditions and are to serve as channels to systematically address issues of climate uncertainties and how they interface with socioeconomic development pathways of affected sectors and communities. The scenarios, therefore, have been forecasted for key climate-sensitive sectors including the agricultural, water resources, energy, health and transport and infrastructure – based on Ghana’s Revised Nationally Determined Contribution and advice from key stakeholders.

The scenarios are also premised on existing national policies relating to climate change and other socioeconomic factors in Ghana. These policies include the Ghana’s Revised Nationally Determined Contributions (NDCs) (2021), the National Climate Change Policy (NCCP) (MESTI, 2013), the National Climate Change Adaptation Strategy (NCCAS) (2012), National Adaptation Plan (NAP) Framework (2018), Climate Change Master Plan (2015), National Climate Change and Green Economy Learning Strategy (2016). Other policies include the National Water Policy (2007), Integrated Water Resources Management and Investment Plan and National Climate Change Adaptation Strategy (2010), National Environmental Sanitation Strategy and Action Plan (2010) and the Local Government Act 2016 (Act 936), the National Health Policy (2007), Gender Policy for the Health Sector (2009), the SENDAI Framework, Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation (2011–2015), Local Government Act 462, National Building Regulation and Ghana Meteorological Agency Act 682.

## 2. A REVIEW OF SOME EXISTING SOCIOECONOMIC SCENARIOS

The shared socioeconomic pathways (SSPs) were developed to provide scenarios at the global level. However, some studies have adapted these global frameworks to produce country- and local-specific frameworks to inform country- and local-level adaptation and mitigation policies using nationally or locally relevant indicators. Before proceeding to adapt the global SSPs to the Ghana context of Ghana, we begin by providing a summary of some of the studies that have applied the SSPs to a country case. Frame et al. (2018) developed a national socioeconomic scenario nested within the global SSPs for New Zealand considering country specific characteristics. The authors combined the top-down and bottom-up approaches to develop the scenarios based on the contributions of three main stakeholder groups, i.e., researchers, local stakeholders, and national influencers. The researchers relied on previous studies based on the SSPs to develop the scenario architecture. The local stakeholders provided feedback on generated scenarios for the local studies by focusing on aspects most relevant to their contexts. National influencers provided feedback on the key quantitative and qualitative dimensions of the national scenarios over long time frames. The authors developed six scenarios based on a combination of the SSPs, the shared policy assumptions for New Zealand and the representative concentration pathways (RCPs).

Chen et al. (2020) developed national SSP scenarios for Japan coherent with the global SSPs. The authors developed the SSPs of Japan by combining narratives from the global SSPs (i.e., top-down approach) with workshops and existing local projections (bottom-up). In combining both the top-down and bottom-up approaches, the study revealed that local characteristics of Japan such as population, institutional development, and other socioeconomic indicators will evolve differently from the global trends predicted by the global SSPs. For example, contrary to the global SSPs, the population and GDP of Japan are expected to be 20-25% lower in the SSP of Japan. By combining the top-down and bottom-up approaches, the authors managed to first develop the basic narratives in terms of text description of the main drivers of Japan's future development. This was achieved mainly through workshops with stakeholders. Secondly, projections with long-term time horizons (2100) of population, GDP and urbanization were made for each of Japan's SSPs. Finally, a range of integrated assessment models were used to make quantitative projections about energy, land use, and emissions based on the narratives and the associated projections of socioeconomic drivers.

Nilsson et al. (2015) developed local-level SSPs for the Pajala municipality of Sweden utilizing workshops that piloted a new approach of combining the bottom-up participation with scenarios generated within the international climate change research community. In doing so, the study generated locally relevant narratives of possible futures. An important observation was that the resulting local narratives characterized some issues that did not figure predominantly in the global future narratives. However, other local developments such as changes in climate and demography were closely aligned with the global trends. In developing the local SSPs, the authors started from a top-down direction by using the global scenario framework (global SSPs) as boundary conditions in the creation of the locally informed future scenario narratives. Four global SSPs were selected and presented to workshop participants to consider how identified clusters of drivers might play out locally within the four SSPs. The next step in the process of selecting stakeholders and organizing a workshop. The workshop organized sought to provide a local perspective of emerging issues that needed to be considered in developing the narratives. Major components of the workshop included presentations of local challenges for long-term planning, identification and clustering of drivers of change, prioritization of the clusters of drivers and finally the creation of local narratives for different global scenarios.

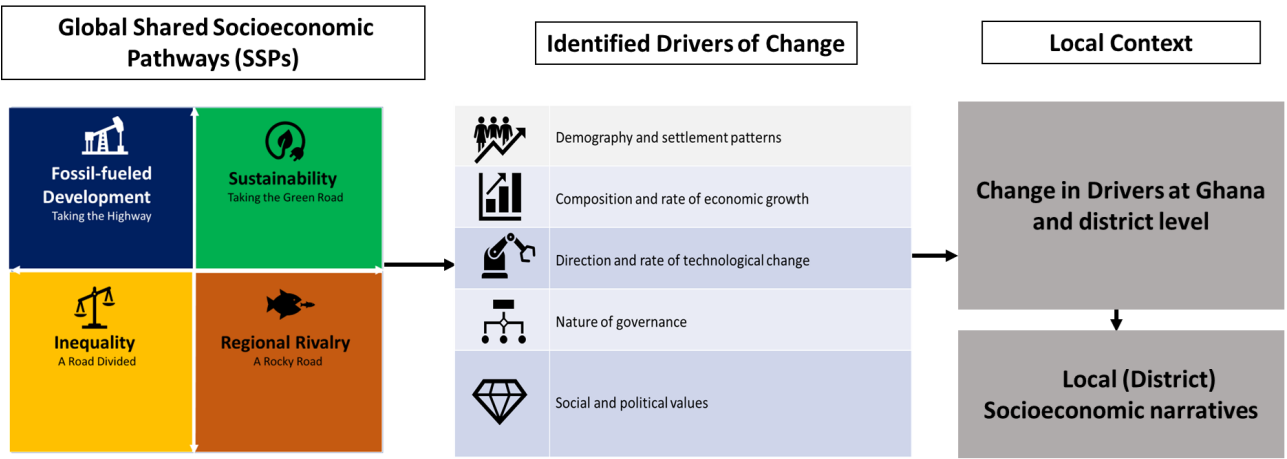
Nilsson et al. (2017) further used the approach highlighted above to develop local narratives for the Barents regions of Norway, Sweden, Finland and northwestern Russia. The global SSPs were used as reference conditions for workshop

participants to answer the question as to what future changes can be expected in the region in relation to economic, environmental, and social issues. In a similar fashion as highlighted above, local stakeholders were invited to workshops to help develop local SSPs. Based on the above reviewed studies, we adopted the best practices to develop socioeconomic narratives for Ghana as a whole and the Sekondi-Takoradi and Tamale metropolitan areas of Ghana. We also developed narratives for selected economic sectors of the Ghanaian economy.

## 2.1. Drivers of Change

Drivers of change are factors that are likely to impact the unfolding of the future in specific contexts. The drivers of change considered here have been grouped into five broad categories namely, demography and settlement patterns, composition and rate of economic growth, direction and rate of technological change, nature of governance and social and political values (Figure 1). Changes in these drivers will have different implications in the future under the five scenarios.

Figure 1: Adapted approach to develop local socioeconomic narratives.



## 2.2. Contextualizing the Global SSPs

To develop the narratives of possible futures for Ghana and the two selected municipalities (Sekondi-Takoradi and Tamale), we consider how the identified category of drivers might play out in the global Shared Socioeconomic Pathways (SSPs) as developed by O'Neill et al. (2015). These SSPs are summarized below:

*SSP1: Sustainability – Taking the Green Road:* This pathway is characterized by more inclusive global development and improved management of global commons, low global population growth and slower economic development, leading to relatively low resource and energy demand. Environmental technologies are favoured. Global, national and regional institutions are strong and flexible, and human well-being has improved.

*SSP2: Middle of the road:* Under this pathway, the world follows a path in which social, economic and technological trends do not shift from historical patterns. Development and income growth continue to be unevenly distributed with some countries making substantially good progress while others fall short of expectations.

*SSP3: Fossil-fueled Development – Taking the Highway:* This SSP is characterized by competitive markets, innovation and participatory societies that produce rapid technological progress and development of human capital as a way to achieve sustainable development. It is a world of intensive fossil fuel development, high energy demand and rapid technological progress, but also characterized by a focus on health, education and institutions to enhance human and social capital.

*SSP4: Inequality – A Road Divided:* This SSP is characterized by increasing inequalities both between and within countries, concentration of power within a small elite, and moderate economic growth in the industrialized world with a large, vulnerable population on the rest of the planet. Technological development is uneven and global markets are volatile due to prevailing political uncertainties.

*SSP5: Regional Rivalry – A Rocky Road:* This SSP is characterized by resurgent nationalism, competitiveness and security, along with weak global institutions. Other features are trade barriers, authoritarian governments and highly regulated economies. Economic development is slow but material consumption intensive.

### 2.3. Localising the Global SSPs

The development of Ghana's scenarios is underpinned by the global SSPs and the sub-regional and national characteristics of Ghana (Figure 2). The global SSPs in this case serve as the boundary conditions and constraints on the local and sectoral scenarios developed to serve as a framework to inform national and local adaptation and mitigation planning. The five Global SSPs highlighted above were condensed into three locally relevant pathways for building the socioeconomic scenarios of Ghana. This was because the five global SSPs were mostly abstract in the case of Ghana and hence the need to condense them into three locally responsive and relevant pathways. These three locally relevant pathways are: the *"Ghana Low Road (Unsustainable Pathway)"*; *"Ghana Business as Usual/Middle of the road"*; and the *"Ghana High Road (Sustainable Pathway)"*. The *"Ghana Low Road"* scenario (Unsustainable Pathway) is mainly characterised by a re-active governance structure with lack of transparency and openness, and favouritism, lack of regulation and enforcement at the national level and a lack of regional engagement and/or integration. These characteristic features of the Ghana Low Road particularly result in increasing and entrenched wealth inequality and desperation. This is a combination of the global SSP4 and SSP5.

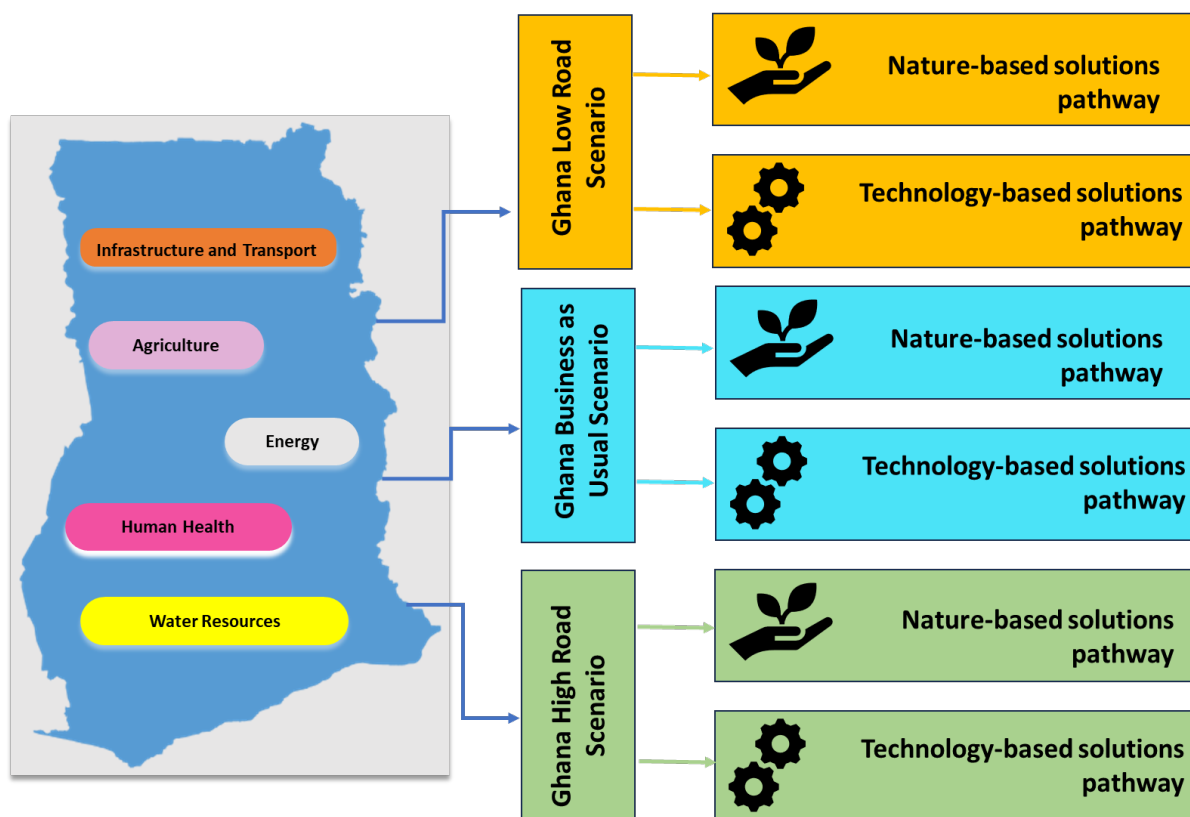
The Ghana Business as Usual (BAU) situation is presented with medium challenges to mitigation and adaptation. As a localised form of the global SSP2, Ghana under this scenario follows a pathway in which social, economic as well as technological trends do not shift markedly from historical patterns. In terms of climate governance, the government of Ghana makes investments in addressing climate impacts albeit in limited amounts. As a middle road pathway, narratives under this scenario are mostly characterised by elements of both the low (unsustainable) road and the high (sustainable) road. That is, climate governance has a semblance of both reactivity and proactivity. This is consistent with the global SSP2. The *"Ghana High Road"* Scenario (Sustainable Pathway) is characterised by a proactive good governance structure that places priority on equity, fairness, transparency, enforcement of regulations as well as open to enhanced regional and global integration and/or engagement. These characteristics ultimately lead to stable social environment capable of advancing development of the country. This is derived from the global SSP1 and SSP3.

These three scenarios will indicate the cause of action in terms of Ghana's climate risk governance. Given that Ghana's climate risk governance involves the coordination of several sectoral policies, strategies and action plans to address the impacts of climate change and build climate resilience, the government's general approach to such governance will have a replica effect on key sectors of the country. The attitude of the government towards climate change (be it, reactive or proactive) will influence climate risk governance processes including climate risk identification, stakeholder engagement, policy and regulation, adaptation planning, mitigation strategies, capacity building, international cooperation and most importantly, resource allocation. Government's attitude towards climate change as described in the three localised scenarios can either hinder or enhance the ongoing process of climate risk governance in terms of effective risk management and building the resilience of communities and ecosystems. It is also from such a perspective that geopolitical issues and uncertainties may impact or may have to be proactively considered in governance decisions especially as they relate to trade, commerce and economics broadly. Under each scenario, however, the government of Ghana is confronted with choosing either nature-based solutions or technology-based solutions solely to address the challenges posed to the country's sectors (Figure 3).

Figure 2: Localised global SSPs



Figure 3: Options under each scenario



### 3. METHODOLOGY

The scenarios were developed by combining top-down and bottom-up approaches as was posited by like Nilsson et al. (2015). This Process followed the “intuitive logics” proposed by Schwartz (1996) and Wack (1985), with slight modifications to suit the context of Ghana. Whereas intuitive logics is a purely bottom-up process, we included aspects of a top-down approach with the aim of producing local scenarios embedded in the global pathways – which can be termed as extended SSPS.

#### 3.1. Development of locally informed future scenario narratives

The top-downside involved the use of the global scenario framework which has been developed within the climate change research community, i.e., the global SSPs, as boundary conditions to create the locally informed future scenario narratives. The global SSPs were developed to provide five distinct and plausible different pathways about future socioeconomic developments as they might unfold in the absence of explicit additional policies and measures to limit climate change forcing or to enhance adaptive capacity. These SSPs are intended to enable climate change research and policy analysis and are designed to span a wide range of combinations of challenges to mitigation and adaptation to climate change (Nilsson et al., 2017). Based on the peculiarity of Ghana, the five global SSPs were merged to produce three distinct future pathways – the Low Road (Unsustainable Pathway), the middle Road and the High Road (Sustainable Pathway).

#### 3.2. Policy analysis

Additionally, the creation of the local scenarios involved an extensive policy analysis of the priority sectors. Policy documents of the various priority sectors, i.e., agriculture, energy, health, water resources, infrastructure, transportation and gender were analysed to identify the policy intentions of the government of Ghana and to help predict possible future policy directions. This enabled the consultants to establish a locally relevant policy direction hence the two local scenario pathways. The drivers of change and the outcome of the policy analysis formed the basis of developing the locally relevant narratives.

#### 3.3. Validation workshops

The bottom-up aspect of the scenario building involved the organization of a workshop for relevant stakeholders to provide their inputs into the established narratives. The workshop was designed to bring together different stakeholders who could bring local, regional as well as sector-specific perspectives to help finetune the developed narratives. The consultants presented the narratives developed through the top-down approach to the stakeholders who later made inputs about how these scenarios may unfold based on experiential insights. These inputs were then used by the consultants to modify the narratives developed earlier to reflect the inputs of the stakeholders. The findings from this workshop formed the basis of the full written narratives, which were drafted by the consultants after the workshop. After incorporating the views of stakeholders in the narratives, the consultants further verified these inputs with the boundary conditions set by the global SSPs to ensure consistency in the locally developed scenarios (see Appendix 1 for the list of stakeholders).

#### 3.4. Limitations

It is important to highlight the fact that this work is limited within the scope provided by the Terms of Reference (TOR) to govern the assignment. Thus, much as the work could have ventured into other areas of critical interest to many Ghanaians by providing broader and far-reaching scenario insights into many sectors and situations, the scope somehow placed a certain limitation of specificity to the process. The most significant limitation, is perhaps, the fact that this work is premised primarily on changing climate conditions, associated risks, and uncertainties and how they influence both socioeconomic conditions in prioritized key sectors within the Ghana NAP

process. It is therefore the case that this work proceeded primarily from the perspective of both current and future socioeconomic change scenarios driven by current vulnerability and future risks of climate change impacts. Thus, all assumptions underpinning the different scenarios are made from the perspective of changing climate conditions, perceived risks, and likely governance choices. Additionally, the report is focused on primary considerations from the perspective of the stipulated priorities of Ghana's NAP process.

## 4. RISK SENSING SENARIOS AND GEOPOLITICAL UNCERTAINTIES

It is also important that a caveat is placed to indicate how current and future geopolitical uncertainties may be discordant to any generated scenarios. As indicated, while the scenarios narratives have been generated from a specified context and informed primarily by changing climate conditions and its associated risks implications, it becomes imperative to indicate upfront how the volatility in current and future global geopolitical landscapes and other uncertainties such as a possible pandemic may influence and even scupper the reliability of scenarios generated. Events such as the recent COVID-19 and the likelihood of another one,<sup>1</sup> together with the recent Russian invasion of Ukraine,<sup>2</sup> and current security concerns in the West African subregion are good examples of how the global landscape have become increasingly volatile and difficult to make any plausible predictions. Regional instability such as the recent coups in Burkina Faso, Guinea, Mali, Chad and Niger further heightens the risks posed by climate change to the economic sectors of Ghana. This uncertainty has potential consequences for global actions as well as national actions and at multiple fronts with varying degrees of complexities. For instance, as a net importer of fuel, hikes in international fuel prices will have lasting impacts on the transport, agriculture as well as the energy sectors.

As Ghana considers how socioeconomic conditions may look like under different climate impact and risk governance scenarios, it becomes critically important that the likely consequences of many global geopolitical, economic and social issues on the horizon are considered in planning processes. As a strategic approach, therefore, scenarios planning may necessarily have to consider risk sensing intelligence to navigate the challenges of uncertainties. Amid such deep and widespread uncertainties at the global level, countries such as Ghana may find it difficult to develop forecasts that are reliable for planning and investment purposes. Risk management approaches such as scenario planning and cognitive risk sensing become useful ways for policy leaders and governance experts to consider risks that are most critical to countries and to prepare for possible consequences associated with multiple plausible outcomes. We therefore provide scenarios narratives below for Ghana minded by the reality of geopolitical uncertainties and its implications on any of the scenarios. That said, we are also minded by the fact that scenarios are simply stories about the future that are envisioned to help promote improved decision-making with respect to evolving circumstances. The scenarios that are most critical for any country to consider, and in this case Ghana, might just be those that are most relevant to its highest priority risk areas. In this regard, while each of the generated scenarios may be significantly impacted by any geopolitical disruptions that have national or local ramifications, attention is given to priority sectors such as Agriculture, Energy and Health. 5.

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1       Uncertainties about the breakout of global pandemics such as the covid-19 and regional epidemics such as the outbreak of Ebola presents grave challenges for human health. The recent outbreak of covid-19 posed serious challenges for the health systems of all countries in the world including the developing world. Such challenges were very glaring in developing countries like Ghana whose health sector is already under resources.

2       For example, the Russian-Ukraine war has implications for global as well as local food security due to increases in fertiliser prices. Furthermore, the reduction in grain export from both Russia and Ukraine has resulted in increased food prices further exacerbating the food insecurity situation globally and Ghana in particular.

## 5. GENDER CONSIDERATIONS

Climate change will affect women and men differently with women suffering disproportionate effects. Generally, women are considered to be more vulnerable to the adverse impacts of climate change. This vulnerability has been attributed to many factors including low capacity and inadequate access to capital and productive assets required to address the climate threats. The IPCC Fourth Assessment Report (2007a) stresses that, “climate change is likely to directly impact children and pregnant women because they are particularly susceptible to vector-and water-borne diseases.” The IPCC identifies gender as one of the socio-economic factors that influence “the capacity to adapt to changing environmental and economic conditions” (IPCC, 2007b). Hence, it has been suggested that these gendered realities directly influence the pathways and ultimate outcomes of climate change policy responses (UNDP, 2011).

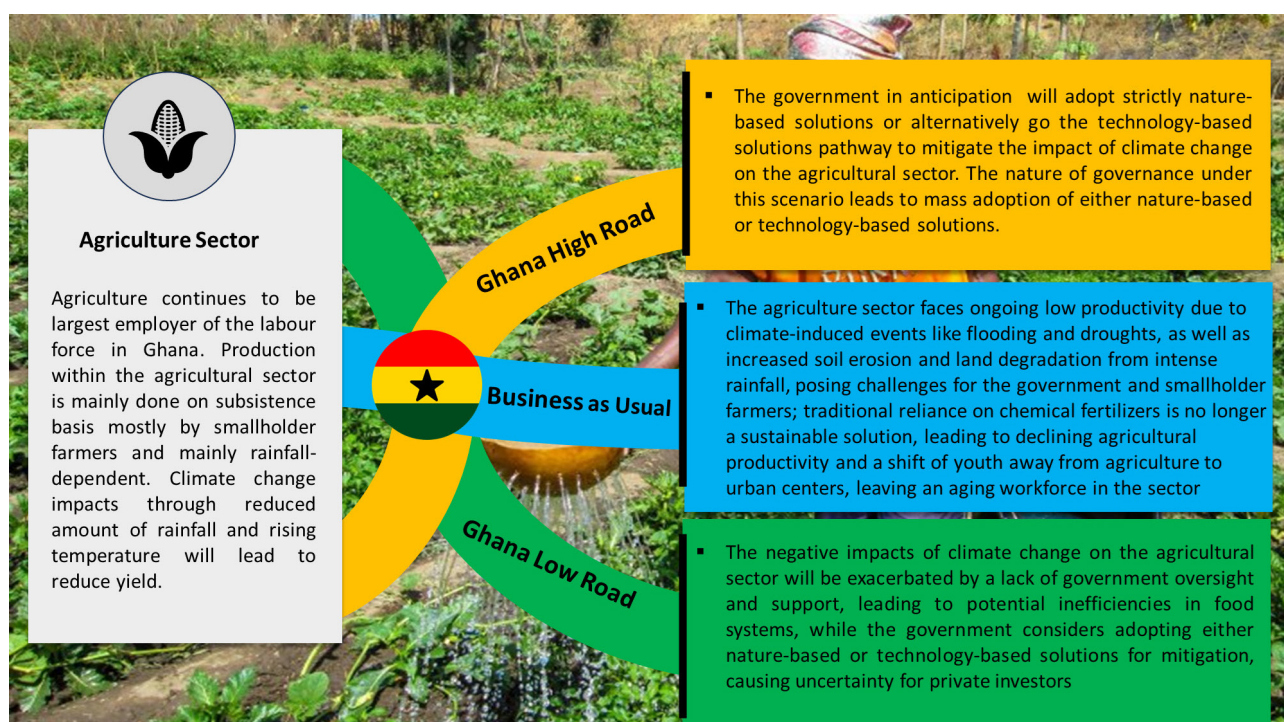
The Government of Ghana over the years has prioritised its social development goals to promote issues of gender equity and equality, survival and development of children, as well as harmonise social protection interventions and programmes to contribute to the National Development. It is therefore important that the Ghana government gives priority to the issues of gender equality. To address the vulnerability of women due to their economic activities, the government, together with development partners should design programmes that encourage livelihood diversification among women. This ensures that the livelihoods of women become secure in the face of climate risk. Also, the government of Ghana will undertake gender mainstreaming into sectors’ policies and programmes. This will ensure that challenges peculiar to the development of women are well addressed. Again, data collection on government interventions should follow a sex-disaggregated format. This will ensure that the impacts of government interventions on the different components of the population are fully captured. Importantly, the government will need institute gender, child and social protection-related programmes and activities at all levels of development, whilst facilitating the integration of gender, children and social protection policy issues into development plans and agenda.

## 6. NARRATIVE FOR THE FUTURE AT THE NATIONAL LEVEL

### 6.1. Agricultural Sector

Although the share of agriculture to Ghana's GDP continues to decline due to the emergence and expansion of new areas within the services and industrial sectors, it continues to be the largest employer of the labour force in Ghana (GIPC, 2021; ILO, 2020). The agricultural sector is sub-categorised into 5 sub-sectors, namely, crops, livestock, cocoa, fisheries and forestry/logging. Production within the agricultural sector is mainly done on subsistence basis mostly by smallholder farmers. Due to the lack of financial and technological resources, agricultural production in Ghana is mainly rainfall-dependent. This makes producers in the sector vulnerable to climate change and variability. The agricultural sector of Ghana will be impacted by the reduction in rainfall amount and rising temperatures associated with climate change. The agriculture sector of Ghana will face a declining amount of water and therefore lead to reduced yields, particularly since Ghana's agriculture depends on rainfall. This lack of water for crops will be compounded by the rising temperatures further causing lower yield levels. Considering this, interventions in the agriculture sector of Ghana are expected to play out under the three scenarios. A snapshot of these three scenarios is presented in Figure 4.

**Figure 4: Agriculture under the localised scenarios**



Under the first scenario – *Ghana Low Road*: two potential policy pathways are likely to be pursued. As noted earlier, this scenario is characterised by reactivity. That is, the government of Ghana only takes reactionary measures after the impacts of climate change have manifested on the agricultural sector. Government's reactivity to climate risk governance causes a delay in the implementation of climate change related policies and action plans in the agriculture sector as outlined in policy documents such as the GNCCMP (2015-2020), MESTI (2013), NCCAS (2010-2020), and the CSAIP. Due to the reactionary nature of the government under this scenario, the negative impacts of climate change will take a toll on the agricultural sector before any measures are taken to mitigate such impacts.

Climate risk governance under this scenario shows an unwillingness to engage relevant stakeholders as well as allocate the required resources needed for adequate adaptation as a result of bureaucratic red tape. Further, due to the lack of transparency and openness, entrenched corruption and favouritism within the country, government initiatives aimed at providing education and subsidies for the uptake of such solutions may be riddled with several malfeasance, with only those who have political connections benefitting from such government interventions.

Additionally, because most of agricultural innovations require huge sums of money for their successful uptake, the government of Ghana will have to facilitate such processes indicating an increase in government financial burden. To meet such financial obligations, the government will resort to either raising taxes or borrowing from external sources.

Although such expenses will eventually be covered with taxes on the ordinary citizenry, the governance under this scenario is predisposed to impede the fair and equitable distribution of opportunities for the uptake of such solutions hence majority of the smallholder farmers at any given point in time may be left with no option but to struggle to make ends meet. Accessing the services and support of government institutions under such a scenario is nearly impossible for a majority of the populace. The agricultural sector under this scenario will experience a decline in productivity and overall output of the sector. This will be a result of the lack of access to critical support and resources needed by most farmers due to the corruption characteristic of the government under this scenario. The agricultural sector will be characterized mostly by inefficient players who do not care about making efficient use of resources. As a result, the food systems of Ghana with the various associated value chains are likely to be inefficient and incapable of meeting the food needs of the populace.

The government of Ghana does not give particular attention to gender issues and remains apathetic to the cause of gender equality. Given that women are engaged in more climate-vulnerable economic activities, the lack of special attention to women will further expose them to climate risks therefore making the vulnerability of women more entrenched. Again, the subsectors of fisheries and cocoa will be affected under this scenario. The reactive approach to climate governance will negatively affect the ability of cocoa farmers to adequately prepare their fields in anticipation of climate events. This will lead to a decline in productivity and cocoa production in the long term. In terms of fisheries, the governance structure associated with this scenario will lead to a depletion of the fish stock in the water bodies of Ghana. This may result from the increasing demand for fish and climate-induced events that is likely to destroy the habitat of these fishes.

The agriculture sector under the *Business-as-Usual* scenario will continue to experience low productivity levels leading to declining overall agriculture output. This low productivity is mostly linked to climatic-induced events such as flooding and droughts. Additionally, more intense rainfall patterns lead to increased incidences of soil erosions and land degradation levels. This presents a real challenge for the government and most smallholder farmers. Consistent with historical patterns, the most promoted option is the continuous and increased use of chemical fertilizers. The persistent use of chemical fertilisers will culminate in a situation whereby fertilizer application can no longer serve as a quick fix for addressing the productivity challenges of the agriculture sector. Associated with this declining agricultural productivity level is an increase in the number of people shifting from agriculture as the main source of livelihood in search of alternatives, mostly in the urban centres. Such movements will mostly be by the youth leading to the majority of those left in agriculture being the aged.

In the third scenario – *Ghana High Road*: the government is proactive in addressing issues of all kinds. In that regard, the government in anticipation of climatic events put in place measure to enable players in the agricultural sector adapt better to the anticipated impacts of climate change. The proactiveness of the government under this scenario enables the government to forecast and predict likely occurrences proactively and prepare adequately to face such challenges. In the first instance, the government in anticipation of climate change impacts on the agricultural sector will institute nature-based solutions to enable farmers to adapt to such anticipated climate

impacts. To forestall the anticipated water shortages for irrigation purposes, there will be the development of dams to store rainwater during the rainy season to be used during the dry seasons. Also, national tree planting exercises will be conducted especially by cash crop farmers to serve as a canopy for their crops to mitigate against the direct sun rays. Moreover, in anticipation of declining soil moisture and fertility levels, other practices such as crop residue mulching, crop rotation among others will be promoted as nature-based solutions. On the other hand, the government of Ghana may adopt a solely technology-based approach in anticipation of the adverse impacts of climate change on the agricultural sector of Ghana. This will result in the government issuing contracts to fertilizer and improved seed (drought-resistant and early maturing varieties) manufacturing firms to expand their operations in order to meet future needs. This may also lead to investments in efficient irrigation technologies that will enable the efficient use of available water sources for irrigation purposes.

The nature of governance under this scenario leads to mass adoption of either nature-based or technology-based solutions. The level of fairness, equity and transparency coupled with regulator mechanisms and international integration leads to compliance and cooperation from both smallholder farmers and the international community. The proactiveness coupled with equity in the distribution of government interventions encourages players in the agricultural sector to effectively engage in climate mitigation and adaptation practices. The engagements at the regional and global levels further enhance the adaptation capacity of players in the agricultural sector as they are likely to receive donor support due to international compliance. For example, Ghana's continued compliance with the implementation of climate actions under the UNFCCC enhances the country's chances of accessing international funding to enhance mitigation and build the adaptation capacity of players in the sector.

The proactiveness of the government will ensure that the agricultural sector of Ghana is characterized by sustainable farm practices such as the adoption of climate-smart agriculture, agroecology, nature-based as well as technology-based solutions. There will also be a shift in the food systems of Ghana with more focus on curbing post-harvest losses and food waste to ensure efficient food distribution. The government adopts pragmatic mechanisms to mainstream gender in agricultural policies and ensure that sex-disaggregated data are collected for effective climate change adaptation interventions across the country.<sup>3</sup>

In terms of the fisheries sub-sector efforts are made to enforce the by-laws governing fishing thereby reducing the use of lights and unauthorized fishing nets. Actors in the sub-sector observe the calendar for fishing and avoid the use of harmful chemicals in their fishing activities. With respect to timber harvesting, all actors in the industry commit to following the guidelines and observe the protocols to ensure sustainable harvesting of timber. Loggers comply with replacing logged trees leading to a regeneration of the vegetation cover of the country. The stability and progress achieved under this scenario will lead to a decline in internal migration as almost all parts of the country become fertile for production. Overall, the impact of climate change on agriculture under this scenario is negligible.

The cocoa subsector is likely to see improvement under this scenario. The government in collaboration with COCOBOD will embark on sensitisation about the impacts of climate change on cocoa production and this will make farmers fully aware of the challenges and hence take precautionary actions. This will help reduce the adverse effect of climate change on the cocoa subsector.

## 6.2. Energy Sector

Ghana's energy sector broadly comprises of the power/electricity and petroleum subsectors. The main sources of power/electricity supply in Ghana are from hydro, thermal (which is fuelled by crude oil, natural gas and diesel) as well as solar. The petroleum subsector consists of mainly offshore basins currently under exploration (Ministry

<sup>3</sup> Gender mainstreaming is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes so that both women and men benefit, and inequality is not perpetuated.

of Energy, 2023). The composition and nature of the energy sector will face significant changes under different scenarios. Additionally, the rapid increase in the population of Ghana, and increasing urbanisation will cause increases in energy demand. Compounding such rising energy needs will be the need for more energy for cooling room temperatures due to rising temperatures, that is, there will be an increase in energy demand for powering air-conditioning systems. These scenarios are presented in Figure 5.

In the first scenario – *Ghana Low Road*: the reactionary nature of the government will lead to an imminent energy crisis (at least in the short term) due to lack of adequate preparation to face the challenges posed by climate change to the energy sources of Ghana. Without adequate preparation, the impacts of climate change will affect the different sources of energy for the Ghanaian economy. Additionally, rapid increase in energy demand will not be met by the existing energy sources and generational capacity and therefore there is likely to be energy shortfalls. To cope with such situations, the government, in an effort to address such energy challenges, will either go the nature-based or technology-based approach to solve these challenges.

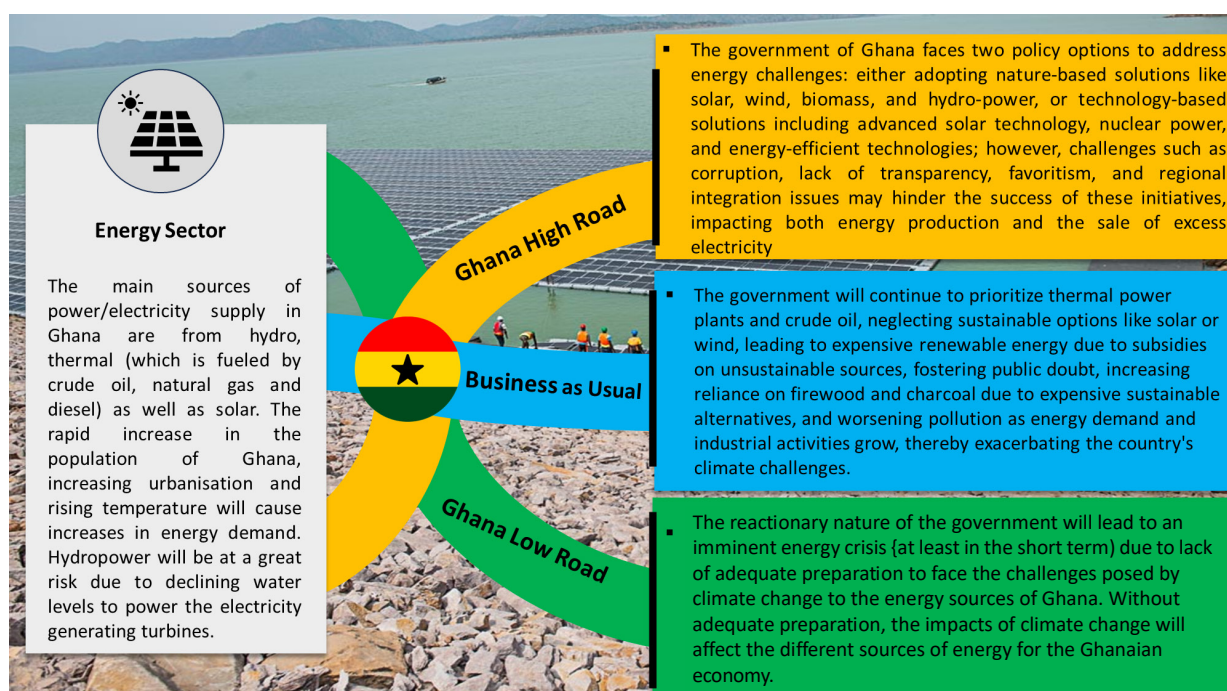
Nature-based energy solutions commonly referred to as green alternatives such as solar, wind and hydropower will be harnessed to fill the energy gap in terms of electricity production. These options seem to be the best nature-based alternatives given the abundance of sunlight, wind and water bodies in Ghana. Additional alternatives such as biomass energy (i.e., the use of organic material such as agricultural waste), wave energy and offshore wind farms will also be explored to help close the electricity deficit faced by the country. Alternatively, the government of Ghana may adopt strictly technology-based solutions to address the energy crises arising as a result of climate change. Such technology-based solutions may include advanced solar technology that enhance the efficiency and effectiveness of solar conversion. Further, other technologies to be adopted include energy storage systems, smart grid systems and energy management systems that enhance the efficient storage, real time monitoring and optimum utilisation of renewable energy sources.

These solutions present alternatives for addressing energy challenges that may face the country due to changes in the climate. However, the reactionary mode of governance coupled with the lack of transparency and openness, corruption, favouritism, and the lack of regional integration will reduce the level of success of such technologies aimed at addressing climate-induced energy crises. First, the lack of international or regional integration/cooperation can affect the extraction of crude as well as the sale of excess electricity.<sup>4</sup> As such, the isolation from international partners may lead to players in the crude oil downstream facing challenges in accessing investment from international investors who under this scenario have become risk averse due to the absence of international organizations to enforce international contracts. In terms of electricity generation, Ghana may find it difficult to export its excess capacity to sub-regional countries like Togo due to the mistrust among nations in executing their contracts. On the other hand, the maintenance of Ghana's thermal plant will be jeopardized due to the absence of international experts to carry out such maintenance routines. Second, the lack of transparency and openness as well as favouritism and corruption may lead to control of energy resources residing in the hands of a select few. The provision of prospecting licenses for new oil and power producers will be halted due to vested interest of the few. This will result in energy shortfalls overtime. To compound the already unequal access to resources, energy generation challenges coupled with distributional inefficiencies will drive the cost of energy up and thereby deny access to the underprivileged in society. This will mean that the energy sector will supply energy to only the well-endowed in the society. This can further heighten tensions and lead to physical confrontations leading to potential damage to properties. The challenges in accessing energy by the most vulnerable in society will drive them to look for alternative energy sources such as wood fuel which will further cause destruction to the environment.

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4 International cooperation is particularly important for two reasons; (1) recognition of international arbitration processes and (2) credibility in contract execution. Lacking international credibility due to the refusal to acknowledge such international processes creates an unstable investment environment for potential investors.

**Figure 5: Energy under the localised scenarios**



For the *Business-as-Usual* scenario in the energy sector, the government of Ghana will continue to pursue and procure thermal power plants as a solution to the electricity challenges of the country. Additionally, crude oil products will continue to be the major fuel used in most sectors of the country's economy. Very limited effort is made to shift the country's energy sources to more sustainable sources such as solar or wind. The lack of concerted government effort in this direction results in very high prices of renewable energy sources compared to traditional unsustainable sources due to government subsidies and tax measures on energy products. The continuous prioritization of unsustainable energy sources over sustainable sources will raise doubts in the minds of the citizenry who will in turn expand their use of unsustainable energy sources such as firewood and charcoal due to the rising cost of sustainable alternatives. Given the increases in energy demand rising from a growing population and increased industrial activities, the continuous reliance on unsustainable energy sources will lead to greater pollution levels further worsening the climate of the country.

Under the third scenario – *Ghana High Road*: the proactiveness of the government leads to the rolling out of alternative energy sources in anticipation of future shortfalls in energy supply due to climate change. Two policy pathways available to follow are either the strictly nature-based energy solutions or the strictly technology-based solutions. However, under this case, government makes initial investments into the chosen policy pathway before the full impact of climate change on energy sources is manifested. As a result, the government may be able to adequately prepare the country to withstand the energy challenges associated with climate change.

In a particular instance, the government makes substantial investments into nature-based energy sources at an earlier period which clearly aims to support existing energy sources and possibly to replace them in case they fail to function a result of future climate changes. Due to the proactive nature of such investments, the government is able to adequately build local expertise that is capable of operating and manufacturing the nature-based solutions such as solar power, wind power, hydropower, biomass energy, wave energy, and offshore wind farms. Alternatively, such proactive investments are made into technology-based energy sources such as advanced solar technologies, energy storage systems, smart grid systems, energy management systems as well as nuclear power.

The proactive nature of such investments by the government coupled with the level of equity, fairness, transparency as well as regional and global integration leads to numerous positive outcomes under this scenario. First, the Government of Ghana through its international commitments has taken actions to ensure that national resources are utilized sustainably and to also ensure inclusive growth of the economy. Given the shift in policy towards sustainability, energy sources will shift to more renewable sources and therefore significantly alter the energy composition of the country. Major players in the energy sector will be exposed to alternative energy sources and technologies. The country will begin to shift its energy generation from the use of crude oil-related sources to more sustainable technologies such as solar and wind. Efforts will also be made to shift Ghana from having hydro as a major source of electricity to more environmentally/ecosystem friendly options. This will be to ensure that the ecosystem and biodiversity around the Volta River are further protected due to the importance placed on sustainable resource utilisation. The shift to renewables will see a rise of a new industry leading to new employment avenues, but mostly for the skilled labour pool. The shift in energy sources will lead to a cleaner environment leading to a healthier population. Second, the proactive institution of such sustainable energy sources will result in declining energy prices as more measures will be taken to ensure efficient monitoring and utilisation of energy resources.

### 6.3. Health Sector

The health sector of Ghana is structured in a decentralized manner and designed with a pro-poor lens. The institutional structure of the health sector is made up of the Ministry of Health (MOH) as policy maker and regulator, the Ghana Health Service, several Teaching Hospitals as well as Faith-based and Private-for-Profit practitioners who act as care providers and the National Health Insurance Authority (NHIA) which is a purchaser of health care services for its insured members. The health sector is likely to undergo substantial transformation under different scenarios. Climatic events associated with climate change are likely to impact the health sector of Ghana significantly with the likely increase in both vector-borne and water borne diseases. This will present a great challenge for existing health infrastructure and the manifesting impact may depend on the nature and scope of policy options pursued. The three scenarios of human health are illustrated in Figure 6.

**Figure 6: Human health under the localised scenarios**



Under the first scenario – *Ghana Low Road*: the reactionary nature of the government policy drive will determine the level of impact manifested on the human population of Ghana. The “wait and see” approach adopted will lead to an overwhelming of the health infrastructure of the country with little support systems. The increase in climate-related diseases will increase the proportion of the sick in society and due to the inadequate preparation made, such sudden increase in patient numbers will increase the pressure on existing health workers and health infrastructure. Under this scenario, two policy pathways likely to be pursued as discussed initially are the strictly nature-based solutions or the strictly technology-based solutions to health problems.

In pursuing strictly nature-based health solutions, the government will ensure the creation of green spaces and parks, urban greening, natural light and biophilic design of government buildings, as well as the promotion of natural healing remedies. Such solutions will ensure the utilisation of the natural environment to better human health. Alternatively, strictly technology-based solutions such as electronic health records, telemedicine and telehealth, wearable devices and health trackers, artificial intelligence in healthcare, as well as precision medicine will be promoted to address health challenges posed by climate change.

Despite the efficacy of these health technologies, the characteristics of the government under this scenario will make the efficacy questionable due to the institutional limitations. The favouritism and corruption under this scenario make accessing the services and support of government institutions in the health sector become difficult for majority of the population. Most Ghanaians will not have access to safe health care. This may be due to inadequate investments in the health sector to cater for the rise in climate-induced health challenges. The concentration of wealth and resources in the hands of a few will have detrimental implications for the general health of the population. In such situations, it is likely that the majority of the population may not have the resources to access healthcare services in times of need and this may further deteriorate the health status of such people. In addition, the most vulnerable in society will not have access to quality health delivery because most health facilities around the country will be less resourced to provide quality healthcare. Despite the bleak prospects for the future, the birth rate will continue to increase as experienced in most of the developing world. This will usher in the new challenge of addressing prenatal and antenatal health challenges which may compound the numerous challenges already facing the health sector.

Secondly, the lack of regional and global integration will lead to a breakdown in the sharing of critical health information. Such a situation will affect access to critical vaccines especially for children may not be accessible given the absence of international organizations to facilitate such processes. Developments in the health sector following a *business-as-usual* scenario will imply a lack of prioritization of climate-related health issues. The government under this scenario will follow historical patterns of waiting to respond to emergencies in an ad hoc manner. This will mean an inadequate preparation of the health system of the country to address any climate-related health emergencies. There is limited public education about the health challenges associated with climate change. The lack of concerted efforts to make the health system of the country more robust to climate-induced health emergencies leaves the sector vulnerable and exposed to potential challenges. This may be worsened by the high levels of pollution which result from the use of unsustainable energy sources. There will likely be an increase in waterborne and vector-borne diseases due to the lack of public education and limited health infrastructure to meet the growing health needs of the population.

Under the third scenario – *Ghana High Road*: the distinctive feature of governance under this scenario is the proactiveness of government to address climate change induced health challenges. Under this scenario, the government of Ghana clearly foresees the impending climate-induced health challenges and as such prepares the health sector adequately in time to deal with any impending climate-induced health challenges. The government of Ghana follows one of two possible policy pathways. In one instance, the government pursues a strictly nature-

based solution in anticipation of an impending climate-induced crises. In the alternative pathway, the government of Ghana follows a strictly technology-based health solution to the impending climate-induced health crises.

As indicated early on, nature-based health solutions such as of green spaces and parks, urban greening, natural light and biophilic designs, and natural healing remedies will be promoted in anticipation of an impending health crises driven by climate change. Alternatively, strictly technology-based health solutions such as electronic health records, telemedicine and telehealth, wearable devices and health trackers, artificial intelligence in healthcare, precision medicine and robotics and automation will be employed to mitigate against climate-induced health challenges.

The most important feature of the government under this scenario is its proactiveness to addressing the challenges of the health sector. The government of Ghana in anticipation of an increase in climate-induced health problems initiates one of the two policy pathways identified above. Due to the early planning in anticipation of such health challenges, health workers are adequately trained to handle climate-induced diseases. Additionally, more health workers are employed to make up for any future shortfalls. In relation to the adoption and implementation of new technologies, the ample time due to accurate planning provides opportunity for health workers to upgrade their skills in the use of new health technologies, be it nature-based or technology-based.

Due to adequate and proper planning, human health is expected to be relatively better under this scenario. There is stable growth in the population of Ghana which translates into less pressure on existing health facilities in the country. As a result, people get the necessary health attention they need. This implies an increase in the life expectancy of the populace. Moreover, the use of sustainable resources leading to a decline in the use of harmful resources ensures a healthy environment which supports healthy living.

#### **6.4. Water Resource Sector**

Ghana is naturally endowed with numerous water resources in the form of rivers, lakes, streams and lagoons. These sources of water are essential for the day-to-day activities of all households in Ghana and have potential for irrigation and power generation. This notwithstanding, climate change poses significant threat to the water resources of the country. Climate change may lead to increasing frequency and intensity of floods and deteriorating water quality. This is likely to have a particularly harsh effect on women and girls because of their distinct roles in relation to water collection and use and their specific vulnerabilities in the context of disasters.<sup>5</sup> There is therefore the need to ensure that the water resources of Ghana are managed sustainably. Sustainability of the water resources will require efficient management of water resources in the delivery of water supply and demand as well as the development of new water sources to ensure access to adequate and portable water. Figure 7 summarises the scenarios for water resources.

Under the first scenario – *Ghana Low Road*: water resources will be heavily impacted by climatic events such as floods and droughts. The lack of adequate preparation by the government to face potential future challenges to the water resources posed by climate change will lead to an imminent water crisis in the short term. This is because reactive measures adopted after the water resources of the country have already been impacted will. Traditionally, men and women in developing rural communities have different roles that they play in water access, use, knowledge and governance (Boateng et al., 2013). not be sufficient to roll back the impact experienced. However, this may change in the long term as the policies and measures adopted after the impact may start to yield the expected results. Two alternative policy pathways available under this scenario will be to pursue either a nature-based approach or a technology-based approach. Although, women and girls are disproportionately affected by

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<sup>5</sup> Traditionally, men and women in developing rural communities have different roles that they play in water access, use, knowledge and governance (Boateng et al., 2013).

the effects of climate change on water resources, gender issues in water resources are not prioritised by the government of Ghana.<sup>6</sup>

Nature-based solutions available for addressing climate-induced water challenges include wetland restoration, rainwater harvesting, riparian buffer zones, natural water filtration, coastal ecosystem restoration and nature-based water storage. Alternatively, technology-based solutions to be pursued include water treatment technology, desalination, water recycling and reuse, smart water networks as well as water leakage detection systems. The effectiveness of these solutions in addressing the climate-related water challenges depends on the proactiveness of government policies and measures adopted.

The characteristics of governance under this scenario coupled with government's reactive approach will eventually lead to water shortages in the short term with close to permanent destruction of some water sources. Given the level of corruption and lack of law enforcement, the country is likely to lose its wetlands, which will be converted into residential areas at great speed. Further, existing rivers, streams and lakes will lose their buffer to logging and sand winning activities. The rise in illegal mining will lead to the destruction of most water resources in the country, further exacerbating the impact of climate change on the water resources of the country. The reactionary nature of government under this scenario means that most of these activities will cause damage to the water resources of the country before measures are taken to reclaim these resources. As a result of the lag between restoration efforts and the actual time these resources are restored, the country will experience significant water shortages leading to an increase in waterborne diseases. Damage to water resources will have the ripple effect of increasing flooding as traditional water sources may no longer be able to withhold rainwater from intensified rainfall patterns.

The *business-as-usual* scenario of the water resources of Ghana points to a grim future. Following historical development in the water resources of the country, the water resources of Ghana will suffer immensely due to the sector's neglect and lack of effort on the part of the government to safeguard the remaining water resources. With the increase in illegal activities, the water resources of the country will be depleted at the current rate of events. This notwithstanding will be worsened by extreme weather events leading to quicker rates of water bodies drying up. Additionally, the continuous rate of turning wetlands into residential areas will affect the availability of water buffers and collection points in the future under this scenario.

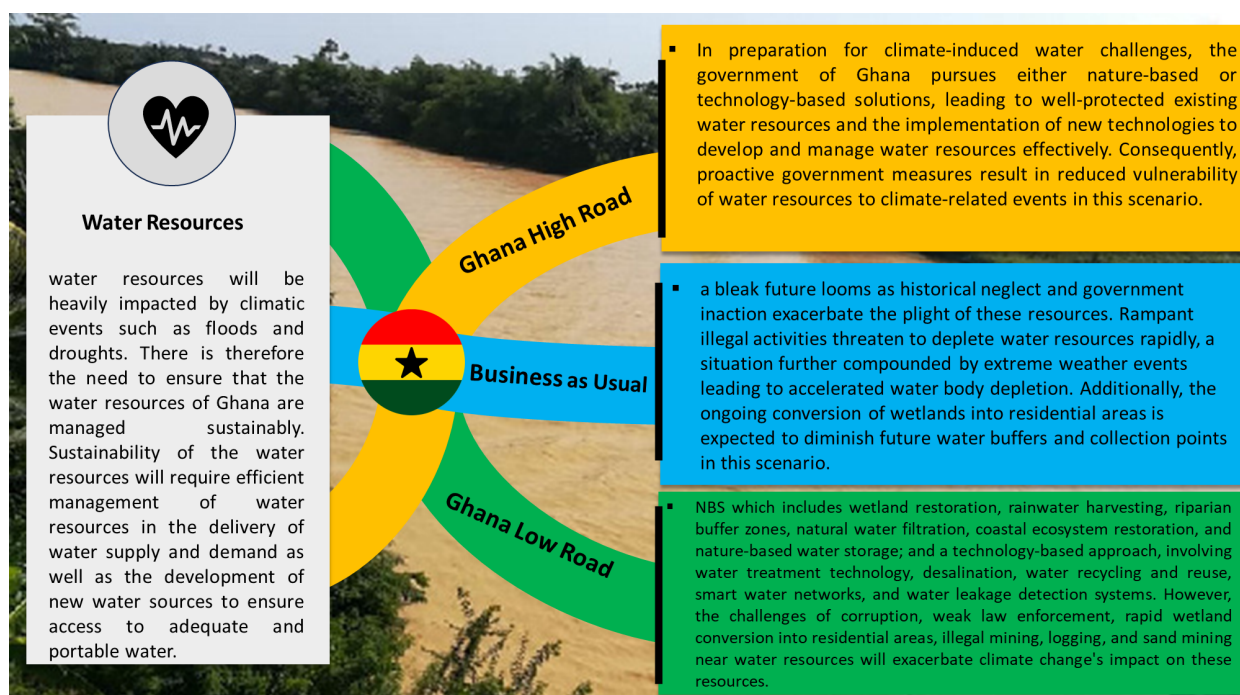
In the third scenario – *Ghana High Road*: water resources under this scenario will be less affected by climate-related events due to the proactive measures adopted by the government of Ghana. Due to the government's foresight and adequate planning in anticipation of climate-induced water challenges, the existing water resources of the country are well protected and new technologies are employed to further develop new water resources and enhance water management systems. Similarly, the government undertakes either one of two policy pathways, i.e., nature-based water solutions or technology-based water solutions.

In anticipation of the impacts of climate change on water resources in Ghana in the future, the government of Ghana adopts either a strictly nature-based approach or a strictly technology-based approach to safeguard the water resources of the country. Nature-based solutions adopted include wetland restoration which will help to improve the quality of water and reduce flood risks. Additional nature-based solutions such as coastal ecosystem restoration, riparian buffer zones and natural water filtration will all be adopted to preserve and improve the quality of existing water resources. Technology-based solutions such as water treatment technologies and desalination will be adopted to remove contaminants and other substances from existing water sources to make them safe for consumption. The proactiveness of the government under this scenario ensures that water resources are well protected and able to withstand the impact of climate change.

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<sup>6</sup> Since women and girls are mostly in charge of fetching water and firewood, the drying up of water resources and destruction of forests means that they will have to walk longer distances to get such basic household needs.

**Figure 7: Water resources under the localised scenarios**



Gender issues in the water sector are properly integrated into national and regional level planning and programmes. Sex-disaggregated data are collected on the water scarcity situation in the country by governmental agencies and units as well as Civil Society Organisations.

Most importantly, the equity, fairness, law enforcement and international integration characteristic of the government under this scenario will lead to trust in the government in its effort at protecting water resources. This is because some actions such as the restoration of wetlands will require execution without fear or favour. Furthermore, the proactiveness of government leads to little or no water crisis in the face of climate change due to the appropriate measure taken in time to avert any challenges.

## 6.5. Infrastructure and Transport Sector

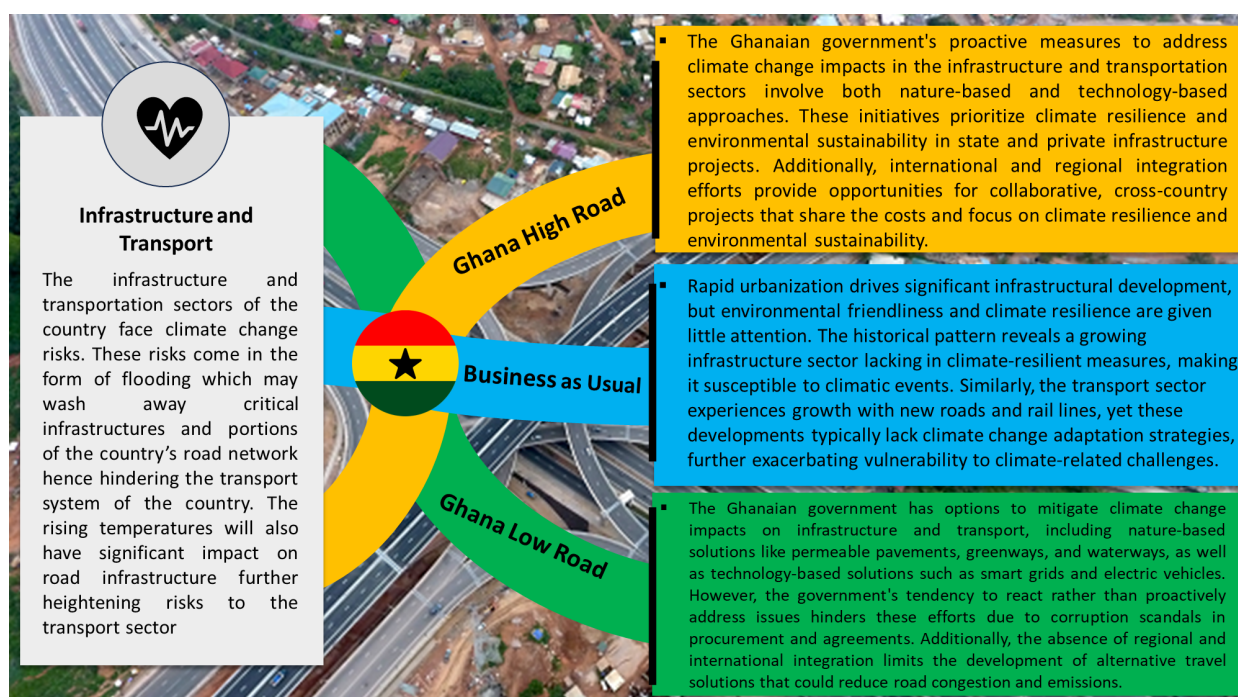
The infrastructure and transport sectors of Ghana are also threatened by the rise in climate change impacts and climate-induced disasters. The importance attached to these interlinked sectors makes it imperative for the government to pursue policy pathways that will make these sectors resilient to the impacts of climate change. Women and men will be affected differently by the impacts of climate change manifestations on the physical transport structures depending on the transport mode they use most. Overall, climate change increases the vulnerability of infrastructure, accelerates the deterioration of infrastructure assets, and increases the need and cost of maintenance. The two scenarios for infrastructure and transport are summed up in Figure 8.

Under the first scenario – *Ghana Low Road*: the infrastructure and transportation sectors of the country face climate change risks. These risks come in the form of flooding which may wash away critical infrastructures and portions of the country's road network hence hindering the transport system of the country. The rising temperatures will also have significant impact on road infrastructure further heightening risks to the transport sector. Importantly, new infrastructural projects may not consider climate change in its design, hence; making them vulnerable to climate impacts. The government of Ghana can address these impacts through a strictly nature-based approach or a strictly technology-based approach.

Nature-based approaches explored to deal with the impacts of climate change on the infrastructure and transport sectors include the use of permeable pavements, natural drainage systems, living shorelines, greenways and bike lanes, sustainable public transportation as well as waterway transportation such as ferries and barges to reduce the emissions associated with road congestion. Alternatively, strictly technology-based solutions such as smart grids, intelligent transportation systems, remote sensing and imaging, electric vehicles, as well as bike-sharing and micro-mobility solutions are considered by the government.

However, the reactionary nature of the government under this scenario reduces the efficiency and effectiveness of such rolled out interventions as the procurement and agreements are mostly marred with corruption scandals. Importantly, the lack of regional and international integration hinders the development of alternative travel solutions which would otherwise reduce congestion on roads and emissions.

**Figure 8: Infrastructure and transport under the localised scenarios**



The *Business-as-Usual* scenario for the infrastructure and transport sector of Ghana will be characterized by high infrastructural development with little consideration for environmental friendliness. The historical patterns indicate a growing infrastructural sector with less focus on making these infrastructures climate-resilient. Ghana will witness a growth in new infrastructure with fast urbanization taking centre stage. However, the lack of enforcement for climate-resilient infrastructure will cause the sector's growth to be vulnerable to climatic events. In addition, the transport sector will continue to witness a rise in transport infrastructure such as new roads and rail lines. However, such new transport infrastructure will not be designed to withstand the impact of climate change.

Under the third scenario – *Ghana High Road*: the government will take proactive measures to adapt the infrastructure and transportation sectors of the country to climate change. This is either achieved through a strictly nature-based or technology-based approach. Due to the proactiveness in implementing such solutions, most state building and new private infrastructure are constructed to include climate considerations hence making them climate resilient and environmentally friendly. Gender issues are seriously considered in the infrastructure and transport sector. The National household travel survey (2013) data suggests that in rural Ghana, 82.4% of women and 66.1% of men commute on foot to work daily.

## 7. SUB-NATIONAL NARRATIVES—SEKONDI-TAKORADI AND TAMALE METROPOLITAN ASSEMBLIES

### 7.1. Ghana low road:

Under this scenario, the reactionary approach to policy at the national level is transmitted to policy decisions at the regional and local levels. This is particularly due to the centralised system of governance in Ghana. Local authority is only able to roll out solutions once they get the required resources from the national government. As a result, the inefficiencies in the policy process at the national level are also endemic at the local levels. The high level of favouritism and corruption as well as the lack of transparency and law enforcement characteristic at the national level are also rampant at the local levels.

In both the Sekondi-Takoradi and Tamale metropolitan assemblies, there are no active preparations being made in anticipation of future climatic events such as floods and droughts. The attitude adopted by the local authorities is one of a “wait and see” attitude to the issues of climate change. This notwithstanding, the local governments of these assemblies will respond reactively to any climatic event using either a strictly nature-based approach or a strictly technology-based approach.

In the area of agriculture and food production, the lack of proactive measures to counter future climate changes will lead to an imminent food shortage with different degrees between Sekondi-Takoradi and Tamale. In the Sekondi-Takoradi area, the lack of preparation for a potential change in climatic conditions will lead to smallholder farmers being able to cultivate only during the major season as rainfall amounts are expected to reduce significantly across the country. This will affect the food supply in the metropolis and lead to food insecurity as a majority of farmers cultivate for domestic consumption. In the Tamale area, smallholder farmers will face a dire situation in their production decisions. With a declining rainfall pattern, farmers will only be able to cultivate crops that have shorter maturity duration (e.g., early millet). The significant reduction in the length of the rainy season implies that the majority of farmers in the Tamale areas will experience crop failures leading to food shortages. In cases where high rainfall intensity is recorded, the lack of expertise and knowledge on the part of farmers to control the impact of such rain on the soil will lead to increased levels of soil degradation and hence reduced crop productivity.

Moreover, the fishing industry of the Sekondi-Takoradi areas will come under immense pressure due to increasing demand. This will lead to the use of unsustainable methods by fisherfolks in an attempt to meet the rising demand.

In terms of energy, the Sekondi-Takoradi enclave will continue to be the hub of petroleum production with a significant increase in the production of petroleum products due to energy shortfall resulting from climate change. In the interim, crude oil will continue to be a major source of energy given that the government has not prepared the local area well enough to transition to “clean energy”. Climate change will play a less significant role in the energy dynamics of the Sekondi-Takoradi area. However, reduced rainfall amount will lead to a declining volume of water in the hydroelectricity generating dams of Ghana leading to an imminent energy crisis in the Tamale areas.

The health of people in the Sekondi-Takoradi area will be significantly impacted by climate change. Climate-induced events particularly floods will lead to serious health challenges in the Sekondi-Takoradi area. This is due to the proximity of the area to important water sources which are likely to overflow because of intense rainfall. Such flooding will lead to contamination of important water sources hence increasing health risks. Regarding Tamale and its environs,

two possible set of events are likely to increase the health risks of residents in the area. First, intense rainfall amounts will cause flooding that may contaminate the water sources in the area. Secondly, prolonged drought periods in the Northern part of Ghana will lead to severe water shortages likely impacting the health of residents in the area. Additionally, the health sectors of the two metropolitan assemblies will be woefully resourced to address the increasing level of climate-induced health cases. This will put immense pressure on the health infrastructure and personnel in these areas.

Closely aligned with the health sectors of the Sekondi-Takoradi and Tamale metropolitan areas is the water resources of the areas. The changes in climate will have an untoward impact on the water resources of the areas due to the unpreparedness of both the national and local governments. In the Sekondi-Takoradi area, the urbanisation resulting from the growth of the petroleum industry will lead to the conversion of wetlands and water channels and buffer zones into residential areas. This will increase the risk of flooding due to limited natural water holding spaces. Additionally, such conversion of wetlands and buffer zones will affect the natural water resources in the area hence reducing water availability in the municipality. In another instance, the loss of wetlands will increase the risks of sea erosion in the Sekondi-Takoradi areas. In the Tamale metropolis, both flooding and drought will reduce the water resources in the area. Flooding from intense rainfall will cause rivers to overflow their banks leading to contamination of all ground water sources in the area. Drought on the other hand will lead to a decline in the number of water sources as more water sources are likely to dry up.

The lack of preparation to deal with future climate events will lead to significant damage to both the infrastructure and transport sector of both Sekondi-Takoradi and Tamale metropolitan assemblies. The sea level rise associated with climate change will lead to significant destruction of infrastructure along the coast of Takoradi area. Such infrastructure is likely to include road networks connecting communities along the coast. This will therefore impact the transportation sector of the area negatively. The flooding associated with intense rainfall events will also cause significant damage to the infrastructure in the Tamale metropolitan assembly. Similarly, most of this damaged infrastructure will be those relevant to the transport sector of the area. The destruction to infrastructure in both metropolis is due to the lack of planning to make infrastructure climate resilient.

## **7.2. Ghana Business-as-Usual**

Under the business-as-usual scenario, the various local governments continue to follow their historical patterns of risk management and governance. In the agriculture sector, productivity in both the Sekondi-Takoradi and Tamale metropolitan assemblies will continue to experience low productivity levels due to the agricultural techniques being used. Farmers under this scenario will continue to use increasing amounts of inorganic fertilizer to a point where such fertilizer will be ineffective in increasing yield. The productivity decline will be heightened by the variability in rainfall occasioned by climate change. The decline in productivity and farm incomes will lead to emigration, especially in the Tamale area towards southern Ghana.

In terms of the energy sector, there will be further development in the oil and gas industry of the Sekondi-Takoradi area leading to additional employment opportunities and an increase in the supply of LPG for domestic use. In the Tamale area, however, there will be an increase in the use of charcoal and firewood which will have implications for the tree cover of the metropolitan assembly.

Based on the historical trends in health delivery in the two metropolitan assemblies, the business-as-usual scenario presents increased health challenges in both locations. There will be little or no attempt to educate residents in both metropolitan assemblies on climate-related health challenges. This will expose most people to climate-induced health challenges which will in turn increase pressure on the existing health facilities. This is in spite of the low investments being made in the health sector.

The water resources of the Sekondi-Takoradi metropolitan area will experience encroachment due to increasing urbanization. Water catchment and wetlands will continue to be encroached on by estate developers who are increasingly under pressure to provide houses. This will result in the loss of water resources and the contamination of existing water sources. In the Tamale metropolitan assembly, the existing water resources will come under pressure from the livestock of nomads. This will heighten water conflicts between residents and nomadic herdsman who also need water for their cattle. Again, the increased level of deforestation due to the need for firewood and charcoal will deplete the tree cover of water resources leading to the drying up of water bodies. This will eventually lead to water shortages in the Tamale metro.

Infrastructural development in the Sekondi-Takoradi enclave will continue to increase with little planning and adherence to environmentally friendly guidelines. The local assembly will struggle to enforce guidelines on infrastructure development due to limited manpower. In the Tamale enclave, infrastructure will also follow old procedures with less regard for environment concerns.

### **7.3. Ghana High Road**

This scenario is characterised by proactiveness on the part of the national and local governments in addressing climate change. Accompanying such proactiveness is the existence of equity, fairness, transparency and law enforcement at all levels of government. These important features of the governance structure under this scenario informs all decisions regarding climate change adaptation measures.

The proactiveness of the government in addressing climate change challenges results in the adoption of appropriate measures to mitigate the impact of climate change on agriculture in both the Sekondi-Takoradi and Tamale metropolitan areas. The government, in anticipation of climate change impacts will invest in the construction of irrigation facilities and promote the adoption of sustainable agricultural practices (either solely nature-based or technology-based). Such actions will prepare smallholder farmers to adapt their agricultural activities to changes in the climate. As a result, the changes in climate have little or no impact on the agricultural sectors of both metros. Most importantly, smallholder farmers, especially those in the Sekondi-Takoradi areas are able to cultivate all year round leading to an abundance of food crops. Farmers in the Tamale metro and its environs are now faced with less risk in agriculture and are thus able to cultivate in large amounts for both domestic and sales purposes. Proactive measures adopted by the Sekondi-Takoradi metropolitan assembly to address the challenges of the fishery industry will yield positive results. This will lead to the preservation of fish species and the development of a sustainable fish extraction strategy which is understood and accepted by all stakeholders in the subsector.

Energy generation under this scenario is also less impacted by changes in the climate. Players in the energy industry are able to build their capacity to adopt renewable energy sources. This helps the energy sector to withstand any shocks that may result from climate-induced events such as prolonged droughts. In terms of power generation, power producers in southern Ghana mostly rely on renewables such as wind, wave, solar and thermal which are less sensitive to climatic changes. For power producers in northern Ghana, the most likely option adopted is solar and wind energy. These renewable energy sources are able to help reduce the dependence of both metropolitan assemblies on the climate sensitive hydropower source. As a result, the energy supply of these two assemblies are stable and with the adoption of efficient energy consumer products, energy demand is also brought down leading to low challenges in meeting the energy needs of residents in both metropolises.

Under this scenario, the impact of climate change on human health in the Sekondi-Takoradi and Tamale metropolitan assemblies are less impacted by climate change due to significant measures taken by the local governments of the areas in anticipation of climate change risks. In the Sekondi-Takoradi metropolitan assembly, health facilities in the area are well equipped to treat climate-induced diseases and more health infrastructure are put up in anticipation of increased patients. This helps to reduce the pressure on health facilities in the Sekondi-Takoradi

metro. In Tamale, similar investments are made in the health sector and as such the health system is fully equipped to address any rise in climate-induced diseases.

In terms of water, the sustainable path adopted by the metropolitan assemblies lead to increased awareness of the value of water and the need for conscious conservation methods. This will result in increased adoption of water conservation technologies across all locations and at both domestic and industrial levels. In terms of water supply, investments are made to protect water bodies and sources with a view to preventing wastage, pollution, contamination and all forms of inefficiencies along the water supply channels. There is also a commitment to standards and improvement in the quality of water available to all people regardless of social standing.

Infrastructural development at the local level is consciously made to be climate-resilient. Several investments are made to ensure that the infrastructure in both metropolitan assemblies are able to withstand the impact of climate events such as floods. As a result, little damage is caused by climate events to all forms of infrastructure in the two metropolitan assemblies.

## 8. CONCLUSION

As has been indicated, to prepare climate change risk assessments, a business as usual (BAU) and preferred socio-economic development scenarios must be created at the national level to reflect how such changes will play out in varied local contexts in BAU circumstances. These scenarios, as has further been explained, will facilitate understanding and appreciation of current vulnerability and future risks of climate change associated with the current socio-economic development pathways, as well as potential future pathways. Such an approach (socioeconomic scenarios narratives) constitutes an important tool for the exploration of long-term uncertainties and consequences of anthropogenic climate change and available response options. A more consistent use of socioeconomic scenarios would allow an integrated perspective on mitigation, adaptation and residual climate impacts and forward-facing policies.

The three scenario narratives: (1) *Ghana low road* and; (2) *middle road*, and (iii) *Ghana high road*, provide a localised conceptual framework based on the global Shared Socioeconomic Pathways (SSPs) as part of an overall scenario matrix architecture for developing and applying new integrated scenarios in climate change risk assessment and climate change policy making for Ghana and especially the two districts: Tamale and Sekondi-Takoradi. The narratives combine both inverse and forward-looking approaches in a complementary manner, beginning with defining an outcome space to be spanned, as well as identifying combinations of socioeconomic trends that are hypothesized to inform the imagination and conceptualization of a climate-shaped future and potential drivers of changes.

Taken together, the narratives could be applied as boundary conditions to inform studies in more specific geographical or sectoral contexts. Considering the fact that the SSPs, which have informed these narratives, are one part of a larger framework for scenario development, they also represent reference conditions for changes for which climate policy responses should be targeted. SSPs and the three scenario narratives should therefore be seen as hypothetical development pathways that serve as a starting point for climate-resilient development planning. The individual narratives may be extended in their applications to understand specific situations and associated needs. More importantly, perhaps, the narratives converge to provide insights into plausible or potential challenges to adaptation and mitigation and in that regard, climate change policy making for the two districts.

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# APPENDICES

Table AI: List of stakeholders and organisations

| S/N | Name                     | Sex    | Institution                                                         |
|-----|--------------------------|--------|---------------------------------------------------------------------|
| 1   | Mawuena Evamenam         | Male   | Greener Impact International                                        |
| 2   | Elliot Ansah             | Male   | Ghana Statistical Service                                           |
| 3   | Gabriel Asamoah          | Male   | PRUDENTIAL LIFE INSURANCE                                           |
| 4   | Joyce Gyekye             | Female | Ghana Broadcasting Corporation                                      |
| 5   | Ankomah Hesse Joy        | Male   | Environmental Protection Agency                                     |
| 6   | Evelyn Addor             | Female | EcoCare Ghana                                                       |
| 7   | Esther Mireku            | Female | EPA                                                                 |
| 8   | David Komla              | Male   | Sustraits                                                           |
| 9   | Kumi Sarfo Obed          | Male   | EPA                                                                 |
| 10  | Prof. Philip Antwi-Agyei | Male   | KNUST                                                               |
| 11  | Stella Okoh              | Female | EPA                                                                 |
| 12  | Eugene Kofi Tetteh       | Male   | University of Ghana                                                 |
| 13  | Prof. Chris Gordon       | Male   | IESS, University of Ghana                                           |
| 14  | Robert Bob Manteaw       | Male   | Foresight planners                                                  |
| 15  | Abena Apeaa Adu          | Female | Land Use and Spatial Planning Authority                             |
| 16  | Boamah Berlinda          | Female | Ministry of Trade and Industry                                      |
| 17  | Emmanuel AnkrahOdame     | Male   | Korle-Bu Teaching Hospital                                          |
| 18  | Patience Agyekum         | Female | Youth in Natural Resources and Environmental Governance Platform    |
| 19  | Dollita Okine            | Female | Sustraits                                                           |
| 20  | Vera Karikari Bediako    | Female | Ministry of Gender, Children and Social Protection                  |
| 21  | MaryJane Enchill         | Female | PMU                                                                 |
| 22  | Richard Sasu             | Male   | GSS                                                                 |
| 23  | Samuel Quaye             | Male   | Ministry of Local Government                                        |
| 24  | Samuel Dotse             | Male   | HATOF                                                               |
| 25  | Eric Kofi Afornorpe      | Male   | Ministry of Local Government Decentralization and Rural Development |
| 26  | Caesar Nyadedzor         | Male   | Ghana Health Service                                                |
| 27  | Winfred Nelson           | Male   | NDPC                                                                |
| 28  | Portia Adade Williams    | Female | CSIR-STEPRI                                                         |
| 29  | Wilhemina Quaye          | Female | CSIR-STEPRI                                                         |
| 30  | EfuaNyamekye Appiah      | Female | Youth Climate Council                                               |
| 31  | Chibeze Ezekiel          | Male   | Strategic Youth Network for Development                             |
| 32  | Joycelyn Smith           | Female | Ministry of Finance                                                 |
| 33  | Eric Assan               | Male   | EPA                                                                 |
| 34  | Prospera Anku            | Female | Ministry of Food and Agriculture                                    |
| 35  | Samuel Otoo              | Male   | EPA                                                                 |
| 36  | Bob Manteaw              | Male   | C3SS UG                                                             |
| 37  | Kingsley Agyemang        | Male   | Directorate of Crop Service                                         |

| S/N | Name                    | Sex    | Institution                     |
|-----|-------------------------|--------|---------------------------------|
| 38  | Thermutis Tollo Zogblah | Female | Environmental Protection Agency |
| 39  | Veronica Dzeagu         | Female | Three Trees                     |
| 40  | Solomon Yamoah          | Male   | SYND GHANA                      |
| 41  | Kwame Abrokwa           | Male   | FIDELITY BANK GHANA             |
| 42  | Isaac Kwabena Danso     | Male   | EPA                             |
| 43  | Marilyn Christian       | Female | EPA                             |
| 44  | Francis Frimpong        | Male   | Ghana Standards Authority       |
| 45  | Daniel Sowah            | Male   | Ministry of Trade and Industry  |
| 46  | Joyce Abena Annan       | Female | Foresight Planners Africa       |
| 47  | Bernard Asante          | Male   | UG                              |
| 48  | Ernestina Asigri        | Female | EPA                             |
| 49  | Anne Joy Dadzie         | Female | EPA                             |



