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Tackling air pollution and extreme climate changes in China: Implementing the Paris climate change agreement

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ABSTRACT

China still depends on coal for more than 60% of its power despite big investments in the process of shifting to nuclear, solar and wind power renewable energy resources alignment with Paris climate change agreement (Paris CCA). Chinese government through the Communist Party Central Committee (CPCC) ascribes great importance and commitment to Paris CCA legacy and history landmark implementation at all levels. As the world's biggest carbon dioxide emitter, China has embarked on "SMART" pollution and climate changes programs and measures to reduce coal-fired power plants to less than 50% in the next five years include: new China model of energy policies commitment on CO₂ and greenhouse gas emissions reductions to less than 20% non-fossil energy use by 2030 without undermining their economic growth, newly introduced electric vehicles transportation benefits, interactive and sustained air quality index (AQI) monitoring systems, decreasing reliance on fossil fuel economic activities, revision of energy price reforms and renewable energy to less energy efficient technologies development. Furthermore, ongoing CPCC improved environmental initiatives, implemented strict regulations and penalties on local companies and firms' pollution production management, massive infrastructures such as highways to reduce CO₂ expansion of seven regional emissions trading markets and programs for CO₂ emissions and other pollutants are being documented. Maximizing on the centralized nature of the China's government, implemented Chinese pollution, climate changes mitigation and adaptation initiatives, "SMART" strategies and credible measures are promising. A good and practical example is the interactive and dynamic website and database covering 367 Chinese cities and providing real time information on environmental and pollution emissions AQI. Also, water quality index (WQI), radiation and nuclear safety monitoring and management systems over time and space. These are ongoing Chinese valuable and exemplary leadership in Paris CCA implementation to the global community. Especially to pragmatic and responsible efforts to support pollution and climate changes capacity development, technology transfer and empowerment in emissions surveillance and monitoring systems and "SMART" integrated climate changes mitigation packages in global Sustainable Development Goals (SDGs) context, citizenry health and wellbeing.

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1. Introduction

China was part of the landmark Paris climate change agreement that set a course for our planet and future generations to move away from fossil fuels in the long term. Paris climate change agreement (Paris CCA) marks a collective responsibility, promise and robust milestone and paradigm shift into local/national adoption and implementation of Climate Change Mitigation and Adaptation (CCMA) framework (United Nations Framework on Climate Change (UNFCCC), 2015). China is part of the landmark Paris climate change agreement (Paris CCA) that sets a course for our planet and future generations, and

plans to implement Paris CCA policies and regulations, priorities, action plans and programs to reduce hazardous emissions from coal-fired power plants by 50% over the next five years and towards achieving the goals of less than 1.5 °C, development of renewable energy in the context of sustainable development and poverty alleviation by 2020. The landmark agreement legacy sets new opportunities in promoting pro-active climate change resilience and culture, innovative mitigation partnerships and pathways in moving forward global greenhouse gas emissions reduction, renewable energy development and contextual sustainable socio-economic development (United Nations Framework on Climate Change (UNFCCC), 2015). (See Fig. 1.)

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Fig. 1. A woman self-protection from air pollution and winter climate in Beijing, PR China (December, 2015)

Previous studies have been demonstrated that air pollution consequences have significant deleterious, complex and unpredictable impacts on climate change and health of local and global populations. Man-made and natural hazing processes on the climate and environment are responsible for the rising air pollution resulting climate change (Zhao et al., 2016b; Li et al., 2016a). In China, fossil fuels, coal-mining, coal-burning factories or other coal-related usage and or vehicle emissions impacts are increasing greater air pollution frequency and pattern variations. In addition, these pollutants varied in nature and extend from industrial hazards, dust storms and forest fires, and other chemical or volatile forms production, emissions and storage (Zhao et al., 2016b; Li et al., 2016a; Sabel et al., 2016). It has been documented that increasing pollution and climate changes have been associated with increasing likelihood of respiratory or cardiometabolic diseases, reduction of the quality of life, increasing years with disability (LYD) and disability adjusted life years (DALY) and premature deaths in most vulnerable populations (United Nations Framework on Climate Change (UNFCCC), 2015; Zhao et al., 2016b; Li et al., 2016a; Sabel et al., 2016; Coulibaly et al., 2016). However, China still depends on coal for more than 60% of its power despite big investments in shifting to solar, nuclear and wind power renewable energy sources development and implementation process.

As the world's biggest carbon emitter, China plans to reduce hazardous emissions from coal-fired power plants by 50% over the next five years (Zhao et al., 2016b; Coulibaly et al., 2016). In recent times, China has seen extremely high levels of air pollution, particularly coal-reliant north east zone and industrial heart of the country. Following criticisms that authorities were not doing enough to protect citizens' health, the government has stepped up in issuing health advisories and promised to take action to address pollution and second ever pollution red alert (Coulibaly et al., 2016; Zhang et al., 2016). Red means hazardous air pollution for three consecutive days. Air quality levels higher than 300 are considered hazardous and other related for climate, health, socio economic and environmental and consequences. A red alert is the highest of a four-level alert system instituted two years ago. The other colors are blue, yellow, and orange. It triggers advisory and warning system to residents to avoid outdoor activity, schools and classes' closure, odd-even license plate number traffic restrictions on vehicle use and sometimes forcing the closure of highways because of poor visibility, factories production and construction works restrictions, and importantly usage of personal protective equipment such as wearing air filtering face masks and running air purifiers in their homes (Wang et al., 2016b).

According to the World Health organization, particulate matter (PM)_{2.5}, ozone (O₃), nitrogen dioxide (NO₂) and sulfur dioxide (SO₂) are type of indoor or outdoor pollution involving fine particles less than 2.5 µm (0.0025 mm) in diameter; a second type, PM₁₀, is of coarser particles with a diameter of up to 10 µm. They often consist of fragments that are small enough to reach the lungs or, in the smallest cases, to cross into

the bloodstream as well. A build-up of PM_{2.5} in the lungs has been associated with respiratory and cardiovascular illnesses, soft tissues and mental damages as major public health concern and burden among the most vulnerable elderly and children population (http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2005; Anger et al., 2015; Ministry of Environmental Protection, PR China, 2016).

The article examines local and national strategic integration of China greenhouse gas emissions and air pollution reduction policies and regulations, priorities, action plans and programs in line with the Paris CCA now and by 2020. It also pinpoints practical and accountable efforts of the Chinese government through the Communist Party Central Committee (CPCC) and related national agencies great importance to lead Paris CCA legacy and history landmark implementation commitment at all levels. Hence, galvanizing and fostering momentum in global community climate changes and pollution imperatives towards green and health environment and planet protection for future generations, contextual global SDGs accomplishments, and citizenry wellbeing.

1.1. Strengthening Paris CCA, air pollution, climate policy and regulations

Robust and effective local, government and all stakeholders' commitment and investment, sustainable policy direction, legal and governance framework under the UN climate conference (COP21), UN Framework Convention on Climate Change, short- and long-term Paris CCA outcomes is vital. Enabling and promoting smart and innovative climate change resilience through innovative policy decisions, regulations guidelines and financing mechanisms in strengthening country adaptation capacity to deal with climate change impacts and aptitude to recover from climate damage and harm (United Nations Framework on Climate Change (UNFCCC), 2015; Wang et al., 2016b; http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2005; Anger et al., 2015; Ministry of Environmental Protection, PR China, 2016). Extreme pollution and climate events insurance facility and policy, quick governments financing and national allocation on emergency pollution to climate change preparedness, strengthening surveillance and response, increasing awareness and education, and longer-term adaptation capability are imperative. The establishment of Chinese automated, real time and effective massive pollution monitoring systems has potential to measure, analyze and report daily air quality, air and GHG emissions fluctuations, and emerging consumption has been established in 362 cities including Beijing, Shanghai, Guangdong, Tianjin, Shandong, Guangzhou and Shenzhen, Hong Kong managed by the Ministry of Environmental Protection, PR China (<http://datacenter.mep.gov.cn/>) (Ministry of Environmental Protection, PR China, 2016). Moreover, increasing housing efficiency with good air exchanges technology facilities rather than heater dwellings in house biomass burning, and reduction of transportation system are also leading examples. Similarly, the recent China People's Political consultative conference resulted in the adoption 13th five year plan. The adoption comprised serial steps and practical measures implementation such as: shrinking of noxious gas emissions growth (18% reduction in carbon intensity by 2020), increasing clean energy production and consumption efficiency by installing 25% sustainable energy capacity worldwide, developing non-fossils fuels resources shared consumption by 2020, ongoing expansion of forest and vegetation biomass and its industry structure policies and reforms, while taking into account industrialization and urbanization needs (Ministry of Environmental Protection, PR China, 2016; Official Beijing government, RedAlert' Over Air Pollution Huffington Post BEIJING, 2015).

There is a need to build research and development (R&D) on climate changes and pollution mitigation and adaptation approaches and strategies on the changing pattern and dynamics in infectious diseases, zoonoses and emerging epidemics ecology, operational landscape and framework based on strategic climate partnership for resource mobilization, capacity development, climate mitigation and adaptation as well as renewable energy across China (United Nations Framework on Climate Change (UNFCCC), 2015; Coulibaly et al., 2016; Wang et al.,

2016b; Anger et al., 2015; Ministry of Environmental Protection, PR China, 2016). Developing a better understanding of the contribution of multiple climate stressors and determinants, and extreme weather events is vital in meaningful implementation of effective and sustainable greenhouse gas emissions reduction vulnerability and creative low carbon technology development (United Nations Framework on Climate Change (UNFCCC), 2015; Ministry of Environmental Protection, PR China, 2016). It should be emphasized that the success of this implementation relies on shared commitment and investment alignment of climate change strategic value, perspective and outcome to contextual national Chinese government health and environmental protection priorities and programs. Such improvements in local and national climate change preparedness, resilience and response strategy are significant footsteps in China global climate change policy alliance, Chinese future global health initiatives on SDGs and global governance (United Nations Framework on Climate Change (UNFCCC), 2015; Wang et al., 2016b; http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2005; Ministry of Environmental Protection, PR China, 2016; Official Beijing government, RedAlert' Over Air Pollution Huffington Post BEIJING, 2015).

China global leadership has been established in bridging the benefits of progressive and sustainable clean energy through monumental reforms, Paris CCA compliance and regulations on potential growth areas of Chinese economy. These include energy and environmental protection policies and laws, national Chinese green carbon programs and future carbon markets opportunities in reducing air pollutants and associated carbon emissions, lowering health risk and monitoring healthcare. These implemented pollution and climate changes smart response and management have immense potential to accrue multi-sectorial and trans-disciplinary investment benefits, strengthening real time (automated/digital), effective, scalable, transferable and sustainable both air pollution and emerging threats and epidemics indices surveillance and monitoring, continuous early warning alert systems and timely risk communication systems overtime and space.

1.2. Evidence-based climate and air pollution surveillance-response implementation

Contextual gathering and analysis of data and information from surveillance and monitoring system is capital for evidence-based decision making climate change mitigation and adaptation local and national policy and regulations guidelines (United Nations Framework on Climate Change (UNFCCC), 2015; Zhao et al., 2016a). Noteworthy that climate and air pollution change consequence has significant impact on increasing emerging infectious and chronic diseases emergence and transmission dynamics, deepening food and nutrition insecurity and widening inequity, while constraining socioeconomic development and growth (Zhao et al., 2016b; Li et al., 2016a; Zhang et al., 2016).

China has successfully established an automated, real time and effective massive pollution monitoring system to measure, analyze and report daily air quality, air and GHG emissions fluctuations, and emerging consumption in several major cities such as Beijing, Shanghai, Guangdong, Tianjin, Shandong, Guangzhou and Shenzhen, and Hong Kong managed by the Ministry of Environmental Protection, PR, China (<http://datacenter.mep.gov.cn/>). Sustained, automated, robust and effective pollution and climate factors surveillance offer great opportunities for early detection of variations above the threshold or standards levels, increasing investigation of potential threat (s) sources, timely preparedness and community engagement as well as designing appropriate and sustainable solutions. The interactive and dynamic Chinese environmental protection website covers 367 Chinese cities and provides timely information on environmental and pollution emissions consequence, air quality index (AQI), protection and prevention measures including laws and regulations, assessment and standard values (certification), water quality index, pollution and environmental policies and programs impacts monitoring including import and export, radiation and nuclear safety

management and monitoring systems over time and space (Sabel et al., 2016; Ministry of Environmental Protection, PR China, 2016).

Health and environmental protection advocacy and mitigation for societal and economic benefits underscore all nations especially developing countries to understand the significant role in strengthening their health systems preparedness, surveillance and monitoring systems, prevention and management capacity to respond quickly and effectively to environmental urgency and public health threat. Local and national climatic, meteorological and air quality pollution surveillance data and database are essential in forecasting of potential scenarios which are the cornerstone in cost-effective and preparedness, enhanced strategic climate change and pollution mitigation and adaptation programs and activities. This is vital in generating climate change knowledge and information for public evidence-based preparedness and response (United Nations Framework on Climate Change (UNFCCC), 2015; Ministry of Environmental Protection, PR China, 2016; Kan et al., 2012 Jul). Moreover, in alerting and protecting citizens' health should be considered when local PM_{2.5} readings of 25 µg per cubic meter as the maximum safe level (Wang et al., 2016b; http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2005; Kan et al., 2012 Jul; Meng et al., 2012; Li et al., 2015). Long-term exposure to high levels of dangerous particulate matter in smog of PM_{2.5}, PM₁₀, NO₂ and ozone has been linked to high health risks and illnesses including chronic diseases including cardiovascular and respiratory diseases (Kan et al., 2012 Jul; Meng et al., 2012). For example in China, the meteorological authorities informed its citizenry on worse weather conditions including heavy smog dirty air over the cities bordered to the south and east by heavily polluting industrial areas, coal-powered industries and heating systems during the cold winter season are expected to exceed 500 µg per cubic meters according to the World Health Organization (Kan et al., 2012 Jul). For example, some parts of neighboring Henan and Hebei regions in China were still seeing heavy pollution, with levels of the PM_{2.5} pollutant surpassing 300 µg per cubic meter in December 2015. Also, more than 30 cities in China, environmental ministry statement issued red alerts on severe/heavy pollution that spread across social media include Tianjin as well as smaller surrounding Puyang, Xinxian, Dezhou, Handan, Xintai, Langfang, Hengshui, Xinji, Anyang and other cities (http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2005; Kan et al., 2012 Jul; Huang et al., 2012 Jul 15; Ren et al., 2015 Jun).

As the Chinese government has embark and proactive and robust policies and initiatives to deal with the increasing public health pressure and burden of particulate pollution measured at almost 30 times the recommended level since heavy smog at the end of November, 2015. Carbon fossil fuels emissions reduction policies from industrial firms and cities have shown to have potential in increasing health benefits by decreasing the years of Chinese population and global community life without climate/pollution-related ailments or disability and increasing life expectancy over time worldwide (Ministry of Environmental Protection, PR China, 2016; Zhao et al., 2016a; Kan et al., 2012 Jul; Huang et al., 2012 Jul 15). Appropriate preventive guidelines and emergency measures on rural and urban pollution and climate change mitigation, renewable energy scenario will be capital to secure population health and wellbeing beyond 2020 (Ministry of Environmental Protection, PR China, 2016; Official Beijing government, RedAlert' Over Air Pollution Huffington Post BEIJING, 2015; Zhao et al., 2016a; Kan et al., 2012 Jul). These have been put in place to minimize indoor and outdoor pollution and extreme weather activity exposure, restrictions on vehicle(s) use and housing energy efficiency management, carbon dependent factories production and construction, displacement and resettlements including regular inspection, water and environmental sanitation, violation and penalty fines, and punishments (Meng et al., 2012; Qiu et al., 2016 Feb; Li et al., 2015; Shi et al., 2015 Jan 29; Hu et al., 2015 Nov; Tang et al., 2016). All these Chinese Paris CCA response measures and activities have further future implications and offer additional opportunities in improving health, while

investing in innovative global health solutions and initiatives (http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2005; Meng et al., 2012; Qiu et al., 2016 Feb; Li et al., 2015; Qiao et al., 2015 May; Vidal, 2015 Dec 18).

Importantly, since the adoption of the Paris CCA by Chinese government and promising robust and practical actions to address not only climate changes but also air pollution levels have been improved. These new Chinese government proactive and evidence-based climate change mitigation and adaptation approaches, measures and guidelines aimed at providing, protecting and securing its citizenry and global community (United Nations Framework on Climate Change (UNFCCC), 2015; Wang et al., 2016b; United Nations Framework on Climate Change (UNFCCC), 2015; Shi et al., 2015 Jan 29; Hu et al., 2015 Nov; Qiao et al., 2015 May; Vidal, 2015 Dec 18; Long et al., 2016). As well as substantial commitment and funding have to be mobilized and should be directed to the most vulnerable Chinese cities and counties. Moreover, to support partnerships between China, developed and developing countries in capacity development, time-series pollutants and air/water quality health impact assessment and monitoring, clean and renewable energy technology transfer and technical assistance. (United Nations Framework on Climate Change (UNFCCC), 2015; Ministry of Environmental Protection, PR China, 2016; Li et al., 2016b; Mellouki et al., 2016 Feb; Macmillan et al., 2016). Building and integrating clean and resilient pollution and climate change policies and mitigation strategies in line with local/national priorities, programs and action plans are imperative in promoting sustainable health and food security, health and wellbeing (United Nations Framework on Climate Change (UNFCCC), 2015; Ministry of Environmental Protection, PR China, 2016; Official Beijing government, RedAlert' Over Air Pollution Huffington Post BEIJING, 2015; Zhao et al., 2016a; Wang et al., 2016a; Mellouki et al., 2016 Feb; Macmillan et al., 2016).

2. Conclusions

The Chinese government has embarked on robust and comprehensive policies options and programs opportunities including international partnerships and collaborations (China–Africa, China–US, China–Europe, China–the Caribbean, China–Asia-Pacific) to reduce greenhouse gas emissions using joint and integrated efficient and effective experiences in energy enhancements approaches and action plans. These ongoing achievements include the integration of, digitalization of air pollution and climatic surveillance threshold(s) and indices, air quality monitoring stations to early alarm alert and communication systems in guiding city to national knowledge-informed climate changes mitigation and adaptations policies and relevant measures in all sectors and all levels. Furthermore, the ongoing expansion of new energy and renewable energy policies, and expansion of the biomass of its forests in reducing carbon dioxide exposure, urbanization of electric cars/vehicles transport services mitigation including reduction of private car usage benefits compared to petrol or diesel and technology enhanced heat housing efficiency. Further research support in climate changes indices modeling and models under different scenarios are needed in preparedness and emergency response in disaster situations towards improved sustainable programs/projects outcomes, monitoring and evaluation of effectiveness for global health security and prosperity.

2.1. Moving forward in mitigation and adaptation programs and actions implementation in China

Chinese government through the Communist Party Central Committee (CPCC) ascribes great importance to Paris CCA legacy and history landmark. China is committed and has embarked on practical objectives and actions in Paris CCA implementation at all levels including individual, local community, county and provincial government, stakeholders and global community through:

- 1) Boosting collective partnerships, participative collaboration and coordination mechanisms in promoting and crystallizing concerted Paris CCA implementation at all levels such as "China's new oil policies and regulations, energy price and gas laws" and development of less energy efficient technology and processes.
- 2) Promoting advocacy and mitigation in effective climate resilient policy and regulation, decision-making process with wide policy-makers, public–private partnerships, collaborative and public communication initiatives such as ambitious new "China's coal-burning polluters and pollutants/hazards and strengthening transportation regulations".
- 3) Galvanizing sustained climate resilience leadership momentum, resources mobilization and investments to fight the deleterious health, ecological and environmental impacts.
- 4) Improving community engagement and participation in climate mitigation and adaptations management as well as integrated consensus development policy, governance and programs framework standards and strategies
- 5) Strengthening community-based climate education and environmental protection programs in building climate change awareness, resilience and culture on responsibility and liability for compensation.
- 6) Developing and integrating climate change early warning and surveillance programs in enhancing climate and air quality index, timely exchange of knowledge and sharing lessons learnt such as new "China global health development model".
- 7) Building comprehensive climate change and air pollution related capacity and training, and empowerment in boosting clean low emissions facilities, and in strengthening energy consumption adjustments in shared environmental and socio-economic outlooks and productivity.
- 8) Institutionalization of climate forecasting, planning, monitoring and evaluation review delivery progress mechanism at all levels to reducing global warming to less than 1.5 °C by 2020.
- 9) Sharing the benefits of open access air quality, pollution and climate changes monitoring, climate technology transfer and renewable energy development experiences, compliance and best practices worldwide.
- 10) Towards community-based climate changes entrepreneurship and programs ownerships in mitigating inequality of vulnerability and attaining of universal health coverage, SDGs, green environment and global prosperity.

Competing interest

Authors declare no conflict of interest.

Author's contribution

ET conceived, gathered relevant literature and wrote the primary draft of the manuscript. ET, WDQ and ZKN provide addition information and insights. All authors read and approved the final version of the manuscript.

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