ICT AS A KEY FOR ENVIRONMENTAL SUSTAINABILITY, ENERGY CONSERVATION AND TO MITIGATE CHEMICAL POLLUTION IN THE INDUSTRIES

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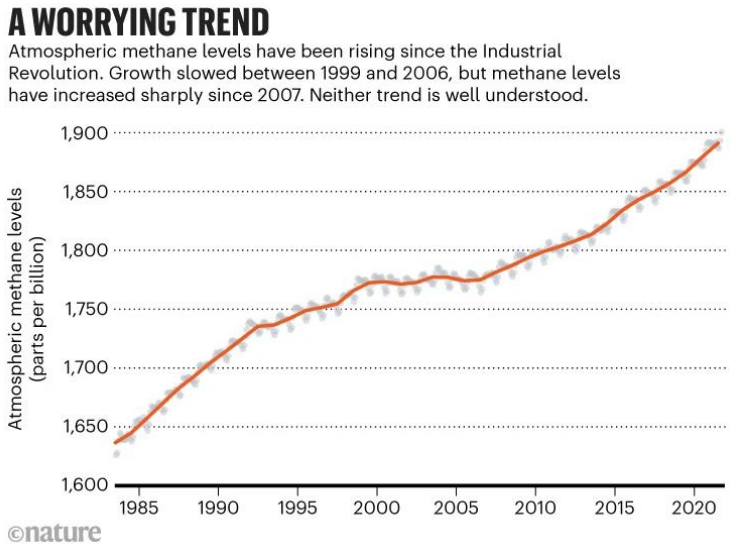
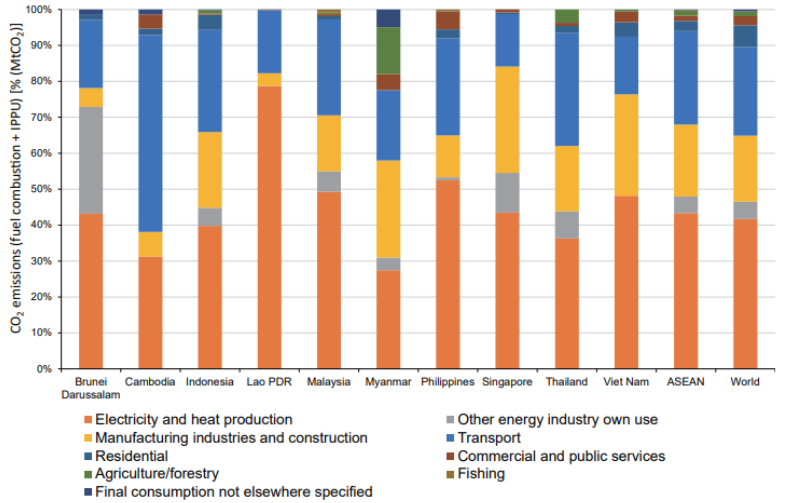
Content:

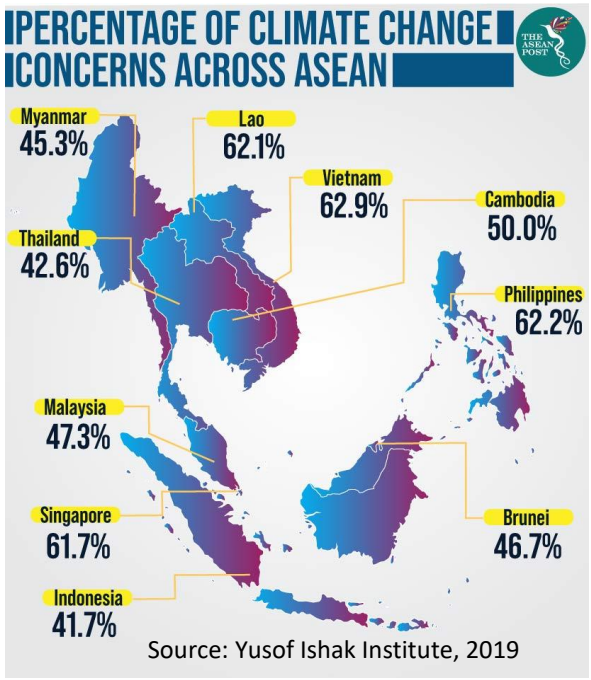
Background

- Atmospheric levels of all GreenHouse Gases(GHG) have reached record highs, according to a study by the World Meteorological Organization (WMO), which scientists say means the world is "heading in the wrong direction."
- The WMO found there was the biggest year-on-year jump in methane and other pollutant gas concentrations in 2020 and 2021 since systematic measurements began almost 40 years ago.
- ASEAN's GHG emissions have continued to rise due to increasing energy-related CO_2 emissions and GHG emissions from fossil fuel combustion(1,485 $MtCO_2$) and land use and forestry (965 $MtCO_2eq$).
- Air pollution will lead to affect the country's (ASEAN) energy sector, GDP, human health/behaviour and sustainable ecosystem.





ASEAN country-wise sectoral share of CO_2 emissions in 2018.
Source: Authors with data from IEA (2020).



Source: Yusof Ishak Institute, 2019

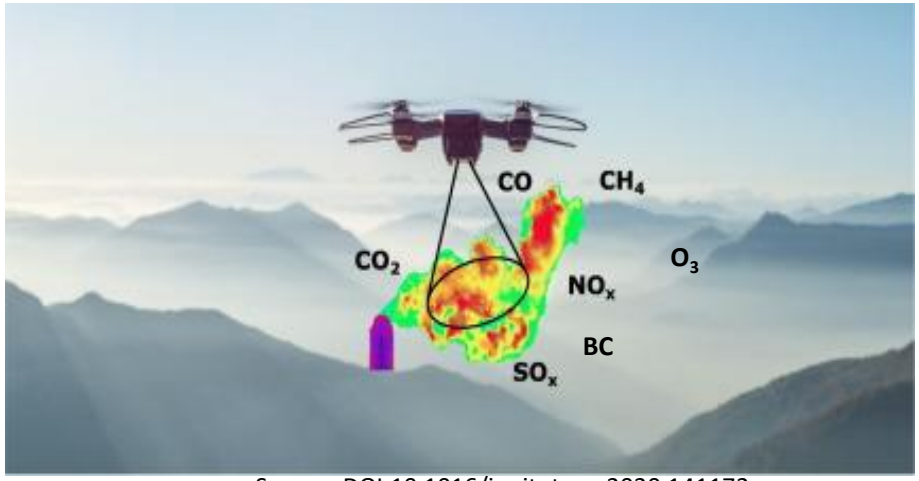
Targets:

1. The aim is to develop an integrated technology to analyze air pollutants and mitigate them in chemical industries for energy conservation and sustainable development in ASEAN countries.

2. This study also demonstrates the feasibility of air pollutants (CO_2, CO, CH_4, O_3, Black Carbon(BC)) vertical profiling using multi-copter UAV in urban/ industrial areas and provides valuable information to study the evolution of these air pollutants in the surface layer.

Who are potential team members:

- Universities that produce students in Mechatronic, Computing and Informatics, Chemical Engineering.
- Local Industries/government bodies whose outcomes of this project could be useful for their businesses.
- Government units who are looking into promoting Industry 4.0



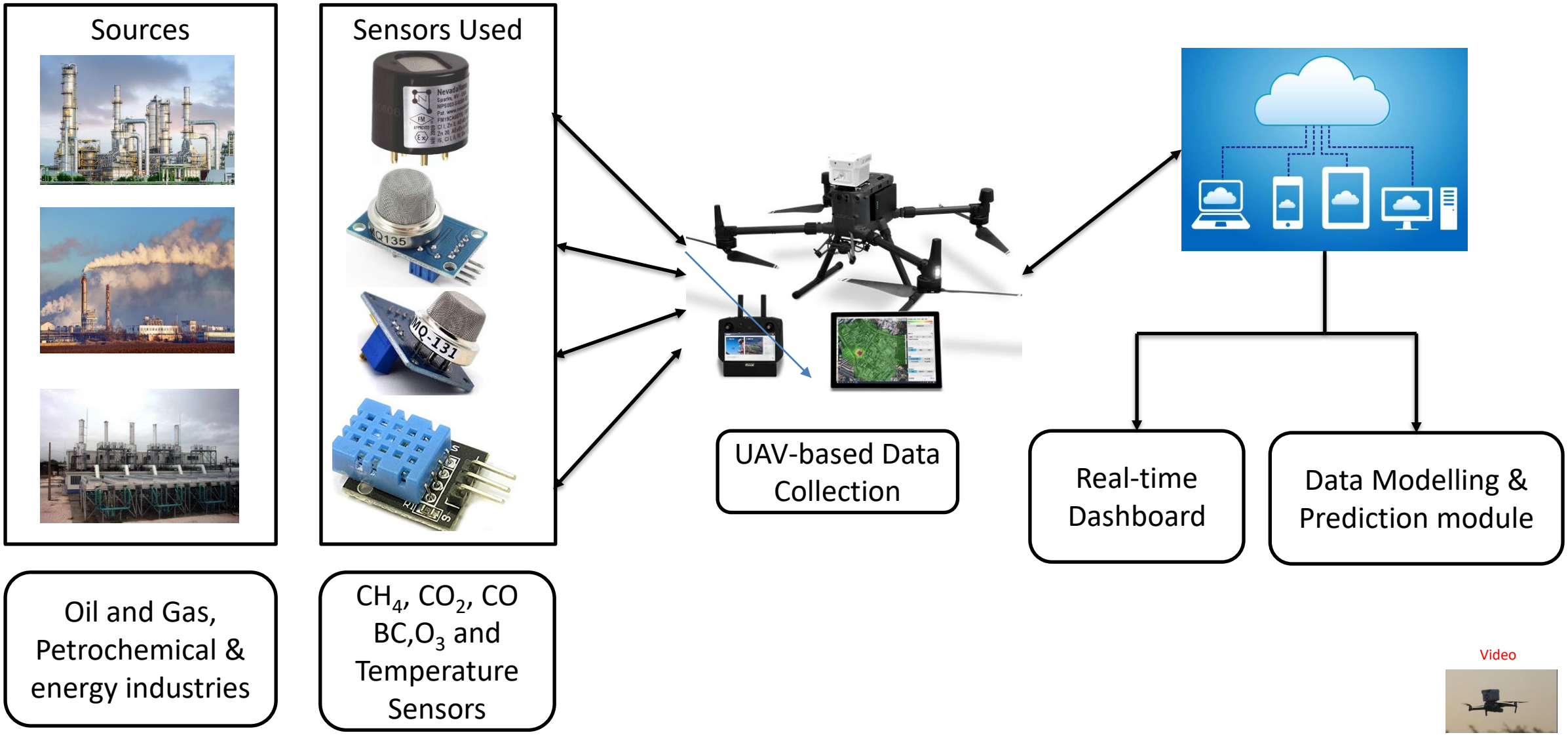
Source: DOI:10.1016/j.scitotenv.2020.141172

Proposed Method:

- **Our proposed method consists of three basic stages:**
  - **Data Collection Method – this stage has further three substages:**
    - **identifying data sources,**
    - **planning the sensors and IoT technology and**
    - **actual data collection method.**
  - **Data Storage - many ways data can be stored - temporarily in the SD card built-in the drone and later it can be transferred to any cloud storage**
  - **Data Analytical Model - Different machine learning algorithms are required to analyse CH_4, CO_2, CO, BC and O_3. We might use a combination of certain deep learning algorithms such as Long Short-Term Memory (LSTM), and Recurrent Neural Network (RNN) to develop a prediction model for different gases and their impacts on society.**
  - **It is illustrated in Fig. 1 on the next slide. Planned to use a drones for collecting the data because it is the most preferred data collection method due to safety, vast data required and vertical profiling. Planning to collect data through satellite also for accuracy comparison.**

Proposed Method:

Fig. 1 Proposed Architecture of the Integrated Technology



Video

Proposed Method:

Data Sources:

As per the ASEAN center of energy report 2022, Brunei is the second (9000 kWh) top energy consumption per capita in 2020. The main source of energy is fossil fuel. So, we consider including the following three industrial and nearby residential zones for data collection:

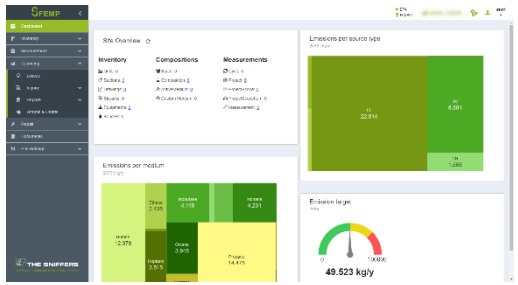
- Oil and Gas industries and the nearby residential zones
- Petrochemical industries and the nearby residential zones
- Energy industries and the nearby residential zones
- It can be extended to some other ASEAN countries

Sample Petrochemical Industry

Sample diesel power generator

Data Analysis:

- The collected data can be compared with satellite data for accuracy
- A real-time dashboard will be created to display the gas concentration, zone and relative altitude
- A data visualization map can be created
- Produce a real-time 2D and 3D gas concentration map
- Machine learning algorithms can be used to apply to the collected data and predict the future gas concentrations
- Energy conservation model development

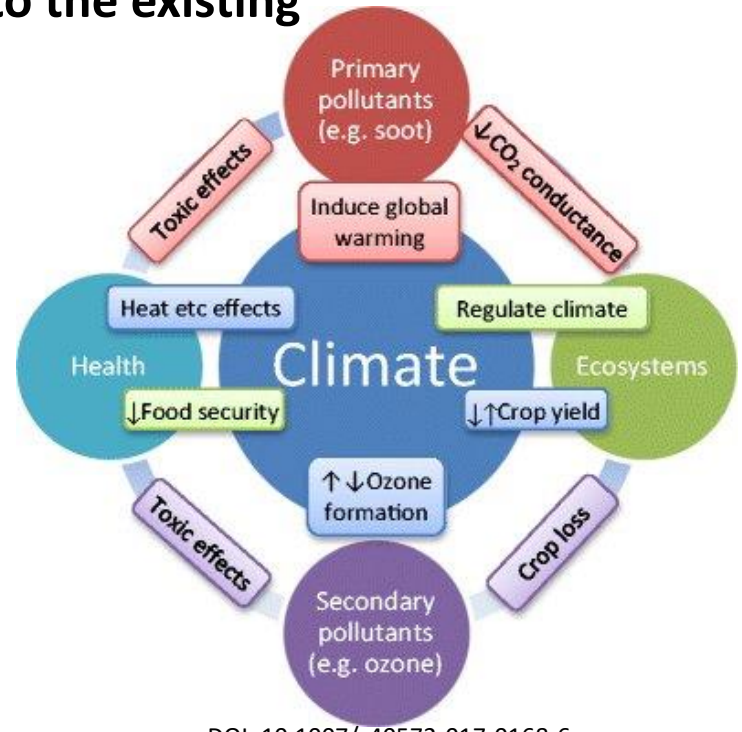


Source: Sniffers.com

Impact:

1. Scientific and technological

- Education: Knowledge dissemination among ASEAN countries.
- Collaboration: Knowledge gained from this project should be applicable to similar projects elsewhere e.g., ASEAN, Japan, China, Korea, etc.
- Relevance to existing projects: The visual IoT concept may be combined to the existing S4D Mapper to create an even wider monitoring network for rural areas.
- Findings can be applied in other application areas, for examples
    - Impact on industry 4.0
    - Impact on other research areas
    - Impact on the social field



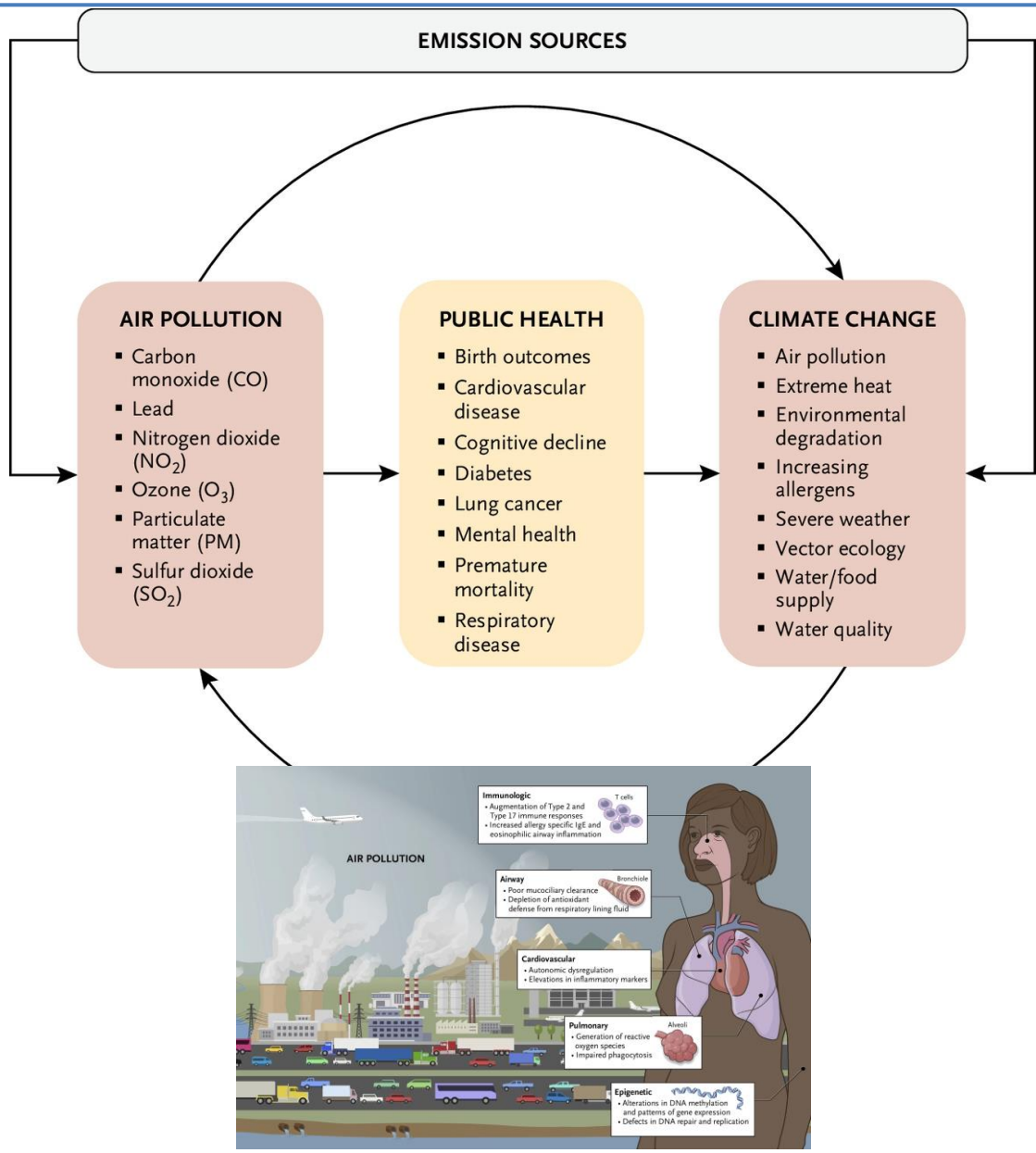
DOI: 10.1007/s40572-017-0168-6

Impact:

2. Societal:

Improve **public health** (Every organ system, including the kidneys, lungs, heart, and brain, may be affected by air pollution and climate change)

- ❑ Reduce **greenhouse gases** by taking proper mitigation methods
- ❑ Control **climate change** affects both infectious and noncommunicable diseases through extreme temperature and weather events (e.g., hurricanes, floods, droughts)
- ❑ **Socioeconomic** impact on ASEAN countries

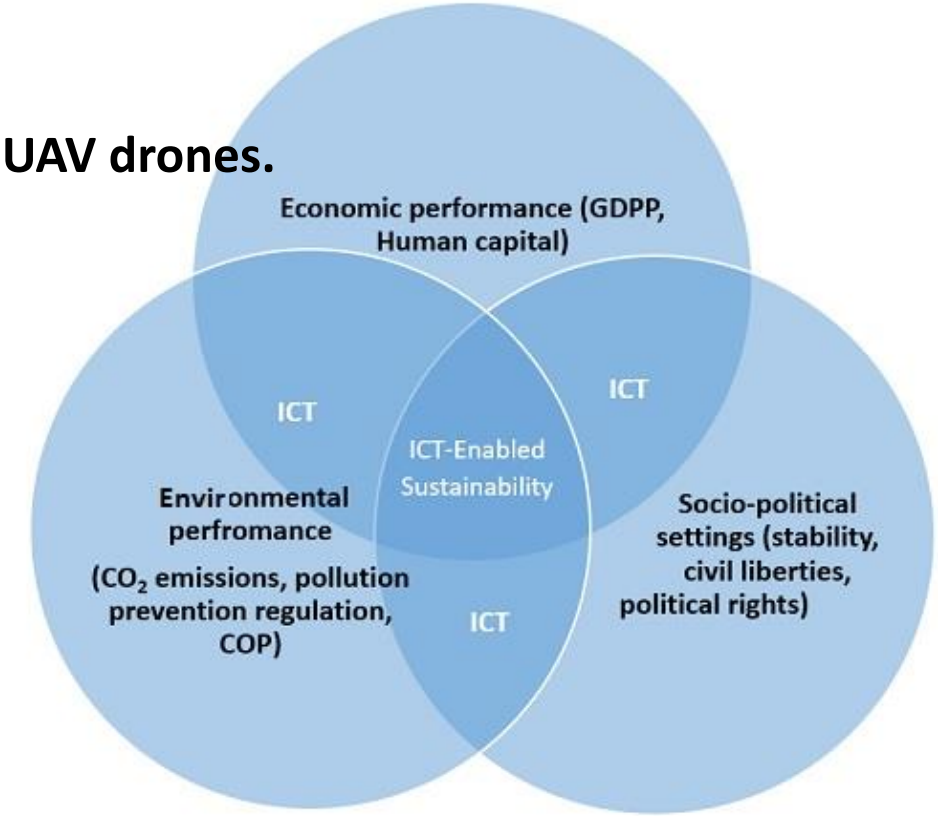


Source:https://doi.org/10.1056/EVIDra2200068

Impact:

3. Collaborative:

- System for risk, Disaster and emergency management.
- Environment monitoring and management system deploying UAV drones.
- Decision support system with AI implementation.
- Sustainable trends in the system.
- The solution to minimize the pollution in the industries.
- Proper validation for the complete system with alerts.
- Intelligent data capture network and Smart sensors network



Source: Sustainability 2022, 14, 8651

Output/Outcome:

- Enhance a better understanding of air pollution effects in urban/ industrial areas, particularly ASEAN region.
- Based on the data analysis we can alert industries and government bodies such as Brunei Darussalam National Climate Change to take the necessary steps to mitigate the air pollution
- We improve the public awareness
- Train human resources by conducting workshops and seminars
- Regional data collection is important for long-term study and useful for ASEAN/global model improvement

Conclusion:

- The project has the potential to tackle gas pollution uncertainty not only by providing access to information and knowledge, personal awareness and participation, among others, which ultimately contribute to better preparedness and response, including the possibility of transformation in the face of climate change.
- The proposed energy conservation model will be helpful to industries and ASEAN countries
- AI and Networking technologies for sustainable development goals
- Sustainable consumption and production (sustainable development)
- Awareness creation/raising
- Research development and education
- Technology transfer and other Socioeconomic benefits

REFERENCES

1. Majd, A. Ashraf, E. Troubitsyna and M. Daneshtalab, " Using Optimization, Learning, and Drone Reflexes to Maximize Safety of Swarms of Drones," 2018, IEEE Congress on Evolutionary Computation (CEC), 2018, pp.1-8, DOI: 10.1109/CEC.2018.8477920.
2. Q.Cui, P. Liu, J. Wang and J. Yu, " Brief analysis of drone swarms communication," 2017 IEEE International Conference on Unnamed Systems(ICUS), 2017, pp. 463-466, DOI: 10.1109/ICUS.2017.8278390.
3. D.Murugan, A. Garg, T. Ahmed and D. Singh, "Fusion of Drone and satellite data for precision agriculture monitoring," 2016 11th International Conferences on Industrial and Information Systems(ICIIS), 2016, pp.910-914, DOI: 10.1109/ICIINF.2016.8263068.
4. Justyna Jońca & Marcin Pawnuk & Yaroslav Bezyk & Adalbert Arsen & Izabela Sówka, 2022. "Drone-Assisted Monitoring of Atmospheric Pollution—A Comprehensive Review," Sustainability, MDPI, vol. 14(18), pages 1-31, September. DOI:10.3390/su141811516
5. Burgués, J.; Marco, S. Environmental chemical sensing using small drones: A review. Sci. Total Environ. 2020, 748, 141172.
6. Cheng Wu, Ben Liu, Dui Wu, Honglong Yang, Xia Mao, Jian Tan, Yue Liang, Jia Yin Sun, Rui Xia, Jiaren Sun, Guowen He, Mei Li, Tao Deng, Zhen Zhou, Yong Jie Li, Vertical profiling of black carbon and ozone using a multicopter unmanned aerial vehicle (UAV) in urban Shenzhen of South China, Science of The Total Environment, 801, 2021, DOI:10.1016/j.scitotenv.2021.149689.

Thank You