ISSN: 0973-4929, Vol. 14, No. (1) 2019, Pg. 03-06

Current World Environment

www.cwejournal.org

Natural Processes of Plants to Maintain a Cool Environment and Aerobic Conditions

SARWOKO MANGKOEDIHARDJO

Department of Environmental Engineering, Sepuluh Nopember Institute of Technology (ITS), Surabaya, Indonesia.

Article History

Published on 23 April 2019

Various natural disasters sourced land and oceans in many places on the face of the earth has been much to release lives and damage the material. The cause may be pure natural dynamics, as does the evolution of the continental and oceanic formations millions of years ago. Natural dynamics can also be triggered by human activities, such as climate change due to global warming, caused by the use of energy and material for life activities. These events are networks of causes and effects, so complex, that it is difficult to identify which of the webs are deciding.[1] The pretense of finding the decisive cause is less wise and can lead without real effort. As earth dwellers who are able to work to change the world, humans need to position themselves in the assumption that the natural disaster is triggered by human activities. Human effort should focus on reducing disaster and its impact. This paper addresses several greening approaches of action to the solution of the problem.

The environment is dynamic in nature, which can be expressed in the following general basic life reactions: name nME+ $C_6H_{12}O_6 + 6O_2 \leftrightarrow 6CO_2 + 6H_2O$ + nME (1), and nME + $C_6H_{12}O_6 \leftrightarrow 3CO_2 + 3CH_4$ + nME (2). The first equation shows the process under aerobic conditions while the second is anaerobic. Regarding notation, the nME is the number (n) of materials and energy (ME) available in the environment. This can be in the form of harmful substances and also substances needed for living things. Concerning environmental temperature, anaerobic processes have a global warming potential of 21 times greater than the aerobic process.[2]

Global warming that has taken place certainly not only caused by the anaerobic process. The event comes from the complexity of the activities of life in the long run. Whatever the cause, and the way in which

CONTACT Sarwoko Mangkoedihardjo prosarwoko@gmail.com Department of Environmental Engineering, Sepuluh Nopember Institute of Technology (ITS), Surabaya, Indonesia.

Doi: http://dx.doi.org/10.12944/CWE.14.1.02

global warming occurs, efforts must be made to reduce it, at least slowing down. On a small spatial scale, cooling the air temperature of a closed room, both living space or collective activity space, is quite easy and affordable financially. Air-conditioning placement is one of the ways technology-based processes to cool space. However, this method is not practical even if it does not make sense for an open space, in the form of an urban area for example. Cooling the open space temperature requires the application of natural process-based methods. This is addressed to the essential processes and results of greenspace.

The essence of the need for greenspace is very clear and tangible. This is based on the fact that only plants are the only living things capable of producing oxygen. In line with the process of plants that work in bright days about 12 hours to prepare oxygen, all living things including plants themselves use oxygen throughout the day of light and darkness for 24 hours. That means plants work in about half of the cycle time of a whole day's life to produce aerobic environmental conditions. That is the essence of greenspace for open spaces such as urban areas.

In ideal aerobic environmental conditions, there is no methane gas product. Thus, aerobic conditions only have a global warming potential of around 5% from anaerobic conditions that produce methane gas. These aerobic conditions must be maintained to the maximum, which in this review uses the essence of greenspace in the broadest application.

At least the following list is an effort to intensify greenspaces, at various scales, to prepare and maintain aerobic environmental conditions. The first six lists are an attempt to condition the aerobic air environment, which is directly generated from the process of greenspace. The rest needs to be considered an effort to maintain aerobic conditions in the land and water environment, both directly and indirectly.

First is the arrangement of the variable area of the city, the area of greenspace, topography, and the quality of the type of vegetation. There is a positive relationship between the city area and the area of greenspace.[3] Similarly, topography determines the distribution of greenspace.[3-5] The type of vegetation needs to get special attention, especially for the condition of existing greenspace. In the past, planting plants based on socio-cultural aspects, and for cooling, cities needed scientific studies on the ability to absorb carbon dioxide (CO_2).

Second is the study of the effects of land use and terrain on the effects of cooling green areas in urban areas. Commercial areas were found to interfere with the cooling flow of the park, while other types of urban areas expanded the cooling of the park more effectively. The hypothesis is the result of differences in geometric and thermal properties and anthropogenic heat release between commercial and other areas. The effective use of the cooling effect of a greenspace must be included in urban design that considers land use and topography.[5]

The third is exploring the orientation of the distribution of greenspace. It was found that the E-W orientation is cooler than N-S.[6] The findings are based on differences in plant species. Even though theoretically the N-S orientation is cooler than E-W,[7] where each tree in the N-S orientation gets the same ray treatment compared to E-W. This needs to get deep attention to be able to determine the criteria for greenspace orientation in aspects of solar radiation and differences in plant species.

Fourth is to determine greenspace area estimation. To date, it has been carried out through regulatory/legislative policies. Implementation is generally defined by the area of greenspace, generally in the range of 20%-40% of an urban area. The calculation of the needs of greenspace based on CO_2 uptake has been carried out,[7] but going forward, the calculation of greenspace still requires consideration from the point of view of the ability of plants to process each of the various nME substances (see equations 1 and 2 above).

The fifth is considering a different greening strategy for building height. It is very interesting and urgent for cities with high buildings. The results of a study in Hong Kong revealed that greening of roofs is not effective for human thermal comfort near the ground.[8] The use of tall trees is also recommended to be applied rather than grass because it is more effective in cooling the environment. However, it should be noted that the definition of tall trees can be translated as planting at various building heights.

Sixth is the implementation of the individual scale of the on-site sanitation system. It can be focused on the application of wastewater evapotranspiration beds. Evapotranspiration bed is a piece of land where the upper part is overgrown with plants, whose function is to transpire wastewater in the field.[9] There are two types, namely evapotranspiration-infiltration bed and evapotranspiration bed. The first type makes the flow of wastewater largely divided into the air through plant transpiration and a small portion is infiltrated in the soil so that contamination of groundwater can be minimized. The second type produces groundwater protection from contamination of wastewater, which can be done by coating infiltration wells using waterproof material. This technology is highly recommended for regions with groundwater conditions for drinking water supply. The ability of the two types of evapotranspiration beds to protect the quality of groundwater coupled with the benefits of expanding micro-scale housing greenspace. Varieties of herbaceous plants and woody plants are capable of transmitting wastewater in amounts exceeding infiltration. Besides that, a variety of plants can process fluctuations in the quality of wastewater. Most evapotranspiration beds are in aerobic conditions so that the results of the biggest pollutant transformation are minerals and CO_2 gas. Both become ready inputs for existing plant needs.

Seventh is addressing aerobic conditions for soil. Many studies have shown (and many facts in the field show) that no plants live in watertight soil.[10] That is because plant roots need space to grow in search of food and water. Thus, the presence of plants maintains the soil layer is permeable. Permeable soil is, of course, a medium of air oxygen transfer, so that the aerobic conditions of the soil are maintained. This effort is very important for the region with a small difference in groundwater and river water, around 1-2 m, evaporation of groundwater can lift river salt to the surface layer of the soil. As a result, the permeability of the soil becomes small and is unable to undergo a cycle of overall infiltration and evaporation. Under these conditions, non-aerated soil can increase the air carbon footprint of the soil process.[11]

Eighth, last but not least is the effort to make water at the level of aerobic conditions. The influence of plants on the banks of the river mainly gives shade to river water from sun exposure. The effect of a shade of plants is the increase in air humidity over the river and the decrease in the temperature of air and river water.[12] High humidity and low air temperature above the river prevent evaporation of excessive river water so that it can prevent the loss of water from the river. Safeguarding river water quantity is the safeguarding of the river's ability to dilute the contaminants that enter it. Correspondingly, low water temperatures increase the dissolved oxygen (DO) in water. Furthermore, high DO increase the assimilation capacity of river water from its input by aeration. The potential for river odor is reduced due to a decrease in the potential for anaerobic conditions. Organic substances are oxidized to gas and released into the air. Oxidized inorganic substances become other forms dissolved or deposited in sediments. So, plants along the river maintain the ability of river water to carry out natural aerobic processing.

References

1. Bennington J.B. The Carbon Cycle and Climate Change. *Brooks/Cole, First Edition ISBN* 2009;1 3: 978-0-495-73855-8; ISBN 1 0: 0-495-73855-7. Canada.
2. Myhre G., Shindell D., Bréon F.M., Collins W., Fuglestvedt J., Huang J., Koch D., Lamarque J.F., Lee D., Mendoza B., Nakajima T., Robock A., Stephens G., Takemuraand T., Zhang H. (2013). Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker,T.F., D.Qin, G.K.Plattner, M.Tignor, S.K.Allen, J.Boschung, A.Nauels, Y.Xia,

V.Bexand, P.M.Midgley(eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY,USA.

3. Davies R. G., Barbosa O., Fuller R. A., Tratalos J., Burke N., Lewis D., Warren P. H. and Gaston K. J. City-wide relationships between greenspaces, urban land use and topography. *Urban Ecosystems.* 2008;11(3):269-287.
4. Mangkoedihardjo S. Topographical Assessment for Phytostructure Distribution. *Trends in Applied Sciences Research.* 2007;2(1):61-65.
5. Hamada S., Tanaka T. & Ohta T. Impacts of land use and topography on the cooling effect of green areas on surrounding urban areas. *Urban Forestry and Urban Greening*. 2013;12(4):426-434.
6. Oliveira S., Andrade H. & Vaz T. The cooling effect of greenspaces as a contribution to the mitigation of urban heat: A case study in Lisbon. *Building and Environment*. 2011;46(11):2186-2194.
7. Samudro G. and Mangkoedihardjo S. Water equivalent method for city phytostructure of Indonesia. *International Journal of Environmental Science and Technology*. 2006;3(3):261-267.
8. Ng E., Chen L., Wang Y. & Yuan C. A study on the cooling effects of greening in a high-density city: An experience from Hong Kong. *Building and Environment.* 2012;47(1):256-271.
9. Jung M., Reichstein M., Ciais P., Seneviratne S., Sheffield J., Goulden M., Bonan G., Cescatti A., Chen J., De Jeu R., Dolman A., Eugster W., Gerten D., Gianelle D., Gobron N., Heinke J., Kimball J., Law B., Montagnani L., Mu Q., Mueller B., Oleson K., Papale D., Richardson A., Roupsard O., Running S., Tomelleri E., Viovy N., Weber U., Williams C., Wood E., Zaehle S., Zhang K. Recent decline in the global land evapotranspiration trend due to limited moisture supply. *Nature.* 2010;467: 951–954. doi:10.1038/nature09396.
10. Schroth G. (2013). A review of belowground interactions in agroforestry, focusing on mechanisms and management options. pp. 5–34. doi:10.1007/978-94-017-0679-7_1.
11. Ludang Y., Jaya A., Inoue T. Microclimate conditions of the developed peatland in Central Kalimantan. *Journal of Applied Sciences.* 2007;7(18):2604-2609.
12. Broadmeadow S. & Nisbet T. R. The effects of riparian forest management on the freshwater environment: a literature review of best management practice. *Hydrology and Earth System Sciences.* 2010;8(3):286–305. https://doi.org/10.5194/hess-8-286-2004.