

## **AFFORESTING AS A WAY TO ELIMINATE HAZE AND TO PREVENT VIRUS SPREADING**

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### **ABSTRACT**

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Haze problem causes serious health risk and facilitates the spreads of many kinds of viruses. Traditional manners such as reducing vehicle uses and biomass burning etc. don't work that well as it is expected. More effective ways to address haze problem are urgently in need. By investigations and analysis, haze contains many vital elements plants growth, such as nitrogen and sulfur, and absorbing them as the fertilizers for forests or other ecological systems would be a more effective way to tackle the haze problem.

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### **INTRODUCTION**

Haze problem is a significant health risk factor in megacities today. There are different types of haze constituents according to the particle diameters, i.e. etc.  $PM_{10}$ ,  $PM_{2.5}$  and  $PM_1$

Summarizing some environmental functions of forests, such as water transparency, harmful gases absorption and adsorption and dissolution effects of soils and water, it can be concluded that forests and other ecological systems can effectively absorb the haze while turning them into the nutrition of it continuously. To be specific, soils dissolves the electrolytes in haze which contain N, K, S etc.

The plants absorb these as their fertilizers as well as the haze in the air directly; the rainfalls brought by afforesting would wash the haze down further; therefore haze would be quickly eaten by these ecological systems and turn them into life again. Utilizing afforesting, haze can be eliminated in an environment friendly and constructive way. Not only haze can be absorbed, but also the environment be more habitable, and the spreads of many kinds of viruses would also be more controlled.

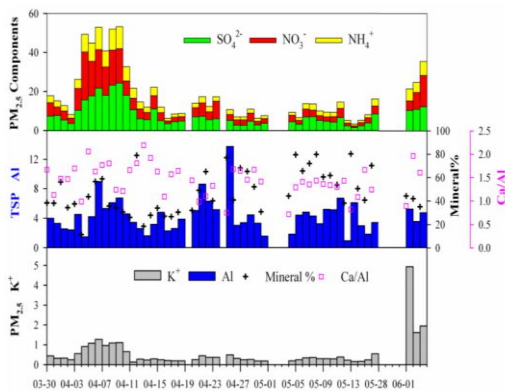
**METHODOLOGY**

**The composition of haze**

Haze problem is a significant health risk factor in megacities today. There are different types of haze constituents according to the particle diameters, i.e. etc. PM<sub>10</sub>, PM<sub>2.5</sub> and PM<sub>1</sub>

Amongst these kinds of particles, PM<sub>2.5</sub> is relatively stable to suspend in the air, they are hard to agglomerate due to their surface energy. PM<sub>2.5</sub> mainly comes from anthropogenic sources, such as coal burning, vehicle emission, etc.

By chemical analyzing, as fig 1 shows, 77% of PM<sub>2.5</sub> mass consists of SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, and NH<sub>4</sub><sup>+</sup>, and there is also remarkable amount of K+ in total PM<sub>2.5</sub>. Besides, the total haze also contains CO, As other mineral particles, dust and biomass burning products etc.



**Fig 1** Chemical analyzing of SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, and NH<sub>4</sub><sup>+</sup>

TABLE 1 shows Time series of (a) SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, and NH<sub>4</sub><sup>+</sup> concentration (µg m<sup>-3</sup>) in PM<sub>2.5</sub> (b) Al concentration (µg m<sup>-3</sup>) the fraction of mineral aerosol, and the elemental ratio of Ca/Al in the total suspended particles (TSP) (c) K<sup>+</sup> in PM<sub>2.5</sub> during the whole study period. In Liu et al., 2016 as shown in Table 2, PM<sub>2.5</sub> the compositions in Urumqi are various kind of irons that constitute inorganic salts, and their major compositions are SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, Na<sup>+</sup>, Cl<sup>-</sup> and NH<sub>4</sub><sup>+</sup>, and the concentrations of them is obviously higher in heating period than that in non-heating period. And the fact that the concentration of SO<sub>4</sub><sup>2-</sup> is remarkably positive related to the haze concentration implies that coaling burning should be a major source of the haze in Urumqi, and coaling would therefore lead to haze in other cities.

	SO <sub>4</sub> <sup>2-</sup>		NO <sub>3</sub> <sup>-</sup>		Cl <sup>-</sup>		NO <sub>2</sub> <sup>-</sup>		F <sup>-</sup>	
	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP
Spring	6.61	9.56	2.98	3.51	4.07	4.95	0.98	1.59	0.32	0.59
Summer	2.37	5.61	1.76	1.85	1.08	2.99	0.29	0.39	0.16	0.18
Fall	23.04	25.72	8.89	5.62	12.06	10.86	0.58	3.22	0.11	0.3
Winter	80.88	135.53	10.23	16.88	17.42	23.83	0.12	0.21	-	-
Mean	28.23	41.22	5.97	6.65	9.13	9.49	0.53	1.54	0.2	0.35
Heating	37.14	52.73	7.34	8.22	11.16	12.58	0.57	0.57	-	-
H/N*	15.65	9.39	4.16	4.44	10.35	4.2	1.97	1.47	0	0
	NH <sub>4</sub> <sup>+</sup>		Na <sup>+</sup>		Ca <sup>+</sup>		K <sup>+</sup>		Mg <sup>2+</sup>	
	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP
Spring	3.57	3.29	1.52	2.47	3.11	7.27	0.56	0.83	0.26	0.47
Summer	1.26	2.88	0.48	0.56	1.72	3.59	0.21	0.37	0.13	0.16
Fall	13.02	12.31	4.09	4.27	2.69	8.31	1.81	2.04	0.24	0.5
Winter	19.64	22.73	8.5	9.43	1.03	6.52	1.4	1.86	0.21	0.62
Mean	9.92	10.61	3.71	4.32	2.14	6.59	1.03	1.31	0.21	0.45
Heating	12.2	13.11	4.75	5.37	2.27	7.36	1.25	1.61	0.24	0.55
H/N*	9.68	4.55	9.9	9.59	1.32	2.05	5.94	4.36	1.85	3.44

**Table 1** The concentrations of ions in Urumqi(µg m<sup>-3</sup>)

	Concentrations of particles (µg m <sup>-3</sup> )		Total concentrations of 5 major ions(µg m <sup>-3</sup> )		ratio*(%)		Total concentrations of 3 major anions(µg m <sup>-3</sup> )		Ratio*(%)	
	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP	PM <sub>2.5</sub>	TSP
Spring	69.2	174	19.2	24.34	28	14	13.99	18.45	20	11
Summer	58.8	91.3	6.96	13.9	12	15	5.21	10.46	8.9	11
Fall	164.8	263.6	61.05	58.15	37	22	43.99	42.19	27	16
Winter	259.7	428.5	137.25	213.63	53	50	108.53	176.24	42	41
Mean	139.5	239.7	57.13	73.46	41	31	43.76	58.43	31	24
Heating	165.5	289	73.32	92.76	44	32	56.2	73.98	34	26

**Table 2** The Total concentrations of 5 major ions (SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, Cl<sup>-</sup>) and three major anions (SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>) in four seasons and in heating period.

Moreover, since these ions of PM<sub>2.5</sub> i.e SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, Na<sup>+</sup>, Cl<sup>-</sup> and NH<sub>4</sub><sup>+</sup> are all highly hygroscopic, the water or vapor in the air would be easily adsorbed/absorbed onto these aerosol particles and hence the haze-fog would be formed. These particles part as the condensation nuclei for haze-fog.

The health risk effects of haze have been well recognized, there are plenty of studies about it. Besides, viruses are such little things that they are extremely easy to cling onto haze particles and hence can spread further in the air. 2019-nCov is by no exception. What's more, for PM<sub>2.5</sub> the size of it also makes it easy to be inhaled by the human being, even mask can't protect people from inhaling them.

In addition, haze also reflects too much sunlight which is an effective and economic way to kill the viruses. For this reason, solving the haze problem is essential to prevent the virus spreading, especially to prevent the fierce 2019-nCov.

**The ecological effects of forests**

Researches have shown many ecological benefits of forest. Forest consists of various kinds of plants and animals. And there are a lot of air pollution removal effects of these lives.

Plants themselves have purification effects to the air. The carbon fixation of plants via photosynthesis has been well know, more CO<sub>2</sub> can be fixed from this process and the global warming can therefore be modified. However, plants can also absorb many gaseous pollutions such as NO<sub>x</sub>. From (Huang et al., 2012) Conferta and Ivy have significant absorption effects to NO<sub>x</sub>; Kaffir lily has some sterilization functions; Areca palm can remove toluene and xylene; The bamboo palm and Rubber Plant both have abilities to remove formaldehyde; Dracaena can remove trichloroethylene; In similar fashions, plants can remove many types of air pollutants by adsorption and absorption.

Soils, in some extend, could also purify the air. Soils consist of mineral material, organic material, air and water. Many kinds of electrolyte dissolved into the soil. When plants live in, these electrolytes can provide a variety of elements, such as K, Ca, N, C, P, Fe, Al, S etc. The electrolytes containing these elements can be absorbed by the plants and then be used to its growth. According to (Fujii et al., 2005) the better of PM<sub>2.5</sub> are different kinds of ions which contain the elements needed for plants. Used by the plants, the soil could resolve more electrolytes from the air, including these ions of PM<sub>2.5</sub>, and then be absorbed by the plants as their fertilizers. In this way, soils can decrease the haze in the air and convert them into nutrition for plants (The Top 10 Plants for Removing Indoor., 2009)

In another respect, forest also has a good function to the environment. Water is the essence of all lives on the earth. However, the inland area is far away from the sea and it is hard for the sea from water to travel into the inland via evaporation alone. If this is always the case, there would be no life far away from the sea. In contrary, lives are abundant in the inland, rains come regularly and forests expanded continuously without human's overdevelopment. Why is this? There must be some links between forests and rainfall.

In fact, forests are not only consumers of water, but also promoters of water. When they drink the water from the sea, the transpiration effects would send parts of the water they've absorbed up to the sky. As these streams accumulate and cool down at high altitudes, clouds formed consequently and then travel further into the inland. This mechanism makes water spread into the inland and animate those areas. And the increases of rainfalls in Lanzhou could verify this: Lanzhou is a dry place nearly twenties years ago and sand storms came frequently that time. However, as the enhancement of afforestation these years in Lanzhou, the rainfalls is becoming more and more frequently and there are much less sand storms.

In summary, forests can make the water distribution on the earth more balanced and increase the rainfalls around. Like a fountain, forests throw the water into adjacent areas. In that way, if the ground is not too much hardened, the forests would expand and the haze would be quickly absorbed by the forest under the rainfall. Forests are vital to our environment balance and habitability, and they can absorb the haze as their fertilizers.

### **Afforesting as a way to eliminate haze as well as to reduce 2019-nCov virus transmission**

As the forests make the environment more alive, haze can be absorbed by them in at the same time.

Firstly, plants can absorb and adsorb many harmful gases and aerosols, such as Ivy and Conferta which can absorb NO<sub>x</sub> they can absorb and adsorb the harmful haze naturally (Adamec., 2002).

Secondly, the dissolution effects of soils and rains can also swallow the haze into the soil. Since there are many kinds of particles containing multifarious elements, for example, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, and NH<sub>4</sub><sup>+</sup>, containing nitrogen and sulfur, the absorbed haze can be used by the plants and therefore more haze can be absorbed into the soil continuously. In this way, haze may be eliminated infinitely as well as be reused.

Besides, forests produce more food using the energy from the sun. In these processes, i.e., photosynthesis etc., the energy from the sun would be fixed into the plants and then be converted into different kinds of foods. Since the energy can't be created or be annihilated naturally, the temperature would simultaneously be cooling down by the forests through their photosynthesis so that people would not need air conditioners anymore which produce more heats in whole as they reduce temperature locally.

The forests make the environment that people live in more comfortably (Trees May Tell., 2016). Moreover, forests build up homes for various kinds of animals, including bats, pangolin, masked civet, insects, and birds etc. When forests bloom, these animals would live into forests and no longer have to survive in cities

where they are hard to live. And this not only benefits those animals, but also keeps the viruses of those animals. Just like 2019-nCov case, the viruses probably come from bats or pangolin. If these animals live in cities, the viruses inside them would be readily to attack human. But when they go back into the forests, the shields of the nature would keep our human safe, and the interactions between thousands of kinds of lives in the forests may also eliminate many kinds of harmful viruses before they are born by natural selections. For example, 2019-nCov can live long on stainless steels and plastics, but live much short in organic materials like clothes, therefore they would die out in few hours if they were born in forests. In this respect, forests can prevent the viruses spreading (Trees and the Water Cycle).

Several studies also showed that influenza viruses live longer in smooth surfaces, and those organic materials from plants can also expedite the death of the viruses (Wenxiang et al., 2005).

Different kinds of viruses have different resistances and sensitivities to various kinds of environment. In literatures, influenza viruses are sensitive to heat and low PH, sensitive to diethyl ether due to their envelopes. For this reason, the acetic acid and alcohol generated naturally in forests may also kill these viruses, including 2019-nCov. 2019-nCov, SARS and influenza viruses are all coronavirus (Pirtle et al., 1999).

In addition, the haze mainly comes from the burning of coal and biomass etc., and these things are corpses of living creatures after all. So it should be a better way to turn the haze into lives again rather than to constrain the using of vehicles, and afforesting is a perspective way to manage this.

Generally, forests can purify the air, absorb the haze as the nutrition for plants, make homes for various animals, lower the environment temperature, prevent the spreads of some kinds of viruses. Afforesting is an environmentally friendly and healthy method to eliminate haze. It achieves many things at one stroke to afforest.

### **CONCLUSION**

The source of haze is well-known today, i.e., coal burning, biomass burning and vehicle emission etc. Unfortunately, a majority of them is necessary for the development of our human right now. On the other hand, it is not effective to eliminate haze by cutting down their emissions only. Just like the cases in many areas of China today, the haze is still remaining while all cars, factories and biomass burning etc. are stopped. Stopping emission alone doesn't work well as expected, hence it is necessary to find ways to absorb those haze to solve this haze problem.

According to the discussions above, afforestation can not only make the environment more habitable, but also absorb the haze. Plants themselves absorb and adsorb the haze; soils resolve the haze and make them into the fertilizers of the plants; rainfalls brought by the forest wash the haze from the air. In a word, forests may eat the haze and turn them into nutrition for the lives in it. In this way, haze was turned into lives again and people can use vehicle in ways not that limited as the haze can be eliminated in an environmentally friendly way. The forests and other ecological systems may also prevent the spreading and the creation of many novel diseases via their selection effects and complex environment (acids, alcohol and organic matters etc.).

Nowadays haze problem is a serious health risk to people, it does harm to people directly as well as facilitates the viruses spreading. The uncontrollability of the 2019-nCov infecting partly comes from the haze in those cities. If more ecological systems such as forests can be grown, our environment would be much more habitable and the haze would be eaten by these ecological systems. In this way, the case of 2019-nCov in Wuhan would be much less likely to happen.

Haze essentially comes from dead creatures, because those burning things which generate haze radically originates from dead animals and plants etc. In this sense, afforestation is a constructive way to eliminate haze that turning these dead creatures into lives again.

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