Effect of Biomass on Wind Reduction Pattern in BITS Pilani Dubai Campus

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***Abstract*—**Wind velocity readings within and outside the campus (barren desert land), will give us an idea in wind reduction facilitated by the tree biomass available in campus and also the net difference from the graphs from the effectiveness of the tree along with the buildings, where the wind velocity readings within the inside perimeter of the college campus to the outside velocity ratio gives us the wind reduction ratio (R) , in the presence and absence of biomass.

***Keywords*—** Barren desert, biomass, reduction ratio ,wind velocity

I. Introduction

THE effect of wind patterns on biomass growth have been well documented. The ideal scenario of the reduction of wind pollution and soil erosion would be well recognized through the cultivation of trees to mitigate such effects[1][2][4]. While considering a desert ecosystem, the scenario of the potential huge winds and sandstorms raging across the biomass of this sensitive ecosystem could thus purport the real need of biomass , apart from man made structures in tackling such issues.[3]

The ideal man made structure in an urban ecosystem within the desert is conceived with the location of the university campus, where theres biomass planted inside (major trees are angiosperms that are grouped to eudicots containing *Azadirachta indica[8], Delonix regia[7], Millingtonia hortensis[5] and Conocarpus lancifolius[6]*). These trees have good biomass and carbon sequestering rates and are hence, useful in the conduction of this experiment to determine the wind reduction potential of these trees along with the buildings in the campus.

For the purpose of conducting this area of study, a simple blueprint of the university was drawn up and the resulting areas demarcated to six different sectors, three sectors containing buildings on the inside of the campus fence, while the other 3 sectors consisted of biomass stretch on the inside of the campus fence. A rough blueprint of the university campus is illustrated in Fig. 1.

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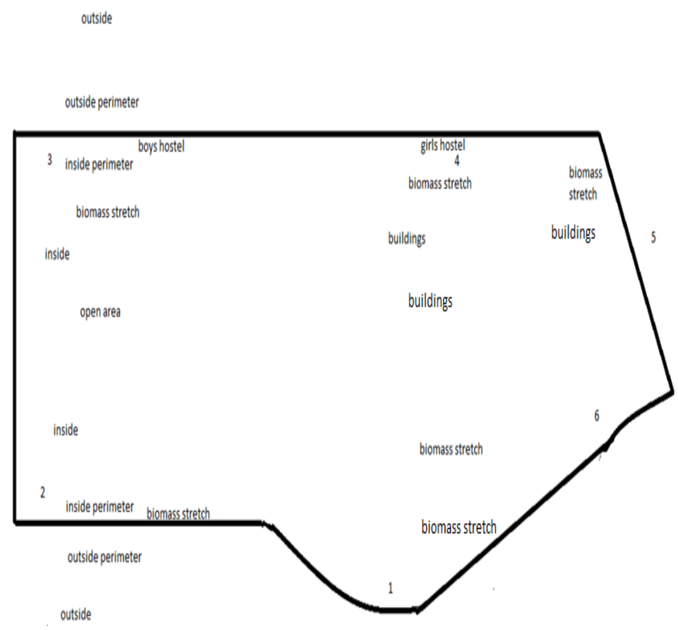

Fig. 1 Blueprint of the university biomass and building locations with sector markings

The sectors that would have buildings immediately after the fence and then biomass, and the sectors that have biomass first, and then buildings are clearly distinguishable by the fact that sectors 3,4 and 5 are those sectors that have buildings coming first, while 1,2 and 6 are those sectors with biomass first. The possibility of wind reduction would be comparably higher among the buildings than the biomass, but the difference can be noted by the graphical representations of the data using the digital anemometer.

The wind reduction ratio,(R_0) for the sectors with buildings, and (R_1) for the sectors with biomass are noted and tabulated for a duration for 12 weeks, with each week's average Reduction ratio taken for all the sectors. Now the ratio is devised and formulated using the equation, R= wind velocity on the inside perimeter/ wind velocity on the outside of the campus. This gives us a vivid description on the reduction potential of the biomass or buildings and what we can face in everyday lives in these ecosystems with structures built on deserted areas. From the ratio, it can be deduced that, when it goes towards 1, there's almost no difference accounted for the wind velocity speeds inside or outside, hence proving the fact that winds can clearly face no resistance and wind pollution and soil erosion would turn out to be a major issue.

sector 1	sector 2	sector 3	sector 4	sector 5	sector 6
0.291	0.156	0.023	0.038	0.021	0.124
0.318	0.213	0.05	0.027	0.026	0.098
0.298	0.251	0.07	0.043	0.017	0.186
0.214	0.21	0.032	0.172	0.028	0.128
0.276	0.218	0.048	0.064	0.043	0.184
0.178	0.3	0.067	0.03	0.11	0.172
0.198	0.192	0.112	0.07	0.173	0.177
0.167	0.267	0.128	0.04	0.082	0.157
0.182	0.287	0.127	0.172	0.065	0.168
0.187	0.212	0.172	0.192	0.045	0.192
0.285	0.176	0.091	0.11	0.012	0.217
0.276	0.192	0.082	0.023	0.184	0.182

Fig 2 Tabulation of the wind reduction ratios given for all the sectors from averaging wind velocities over a period of 12 weeks

Individual sectors have their own different wind velocity readings on the outside of the campus that can be attributed to the different composition of buildings and biomass that are present on the periphery or on the inside of the campus.

It can be noted that in the sectors 3, 4 and 5, the ratios are lower than the ratios of 1, 2 and 6. This could've been anticipated as its expected that buildings and structures can withstand more wind pressure and thus, act as a barrier, but the close variation to the sectors covered by biomass, which is in turn surrounded by fencing, is indicative of the fact that biomass goes a long way in helping to reduce the wind flow from outside to inside the campus.

Within the biomass sectors, it also becomes noteworthy, when the sector 6 column readings are compared with sectors 1 and 2, that it has a much lower wind reduction ratio due to the presence of 2 biomass stretches that are more effectively adding to each other's reduction potential constructively. This enables us to set a very cost-effective method for soil preservation and terrestrial biosphere conservation in such sensitive ecosystems, rather than erecting loads of buildings, a critical outlook where more trees are planted for sequestering CO_2 would definitely being about changes in the atmospheric carbon pool, wind velocity, and possibly even temperature.

II. Choice of Sectors

The illustration of the comparison of sectors 2 and 3 are shown below as they are in parallel to the wind directions from the north or south. Thus, the wind reduction potential , would be more significant and accurate in those regions.

From the graph above, it can be clearly concluded that buildings have a great wind reduction potential due to its capacity to act as a barrier, in which the campus simulates open urban ecosystems in natural environments. The buildings have greater capacity than the biomass at the other end of the campus to stop wind erosion and pollution, but the difference is not exaggerated, and biomass does help a lot in the conservation of soil flora and fauna.

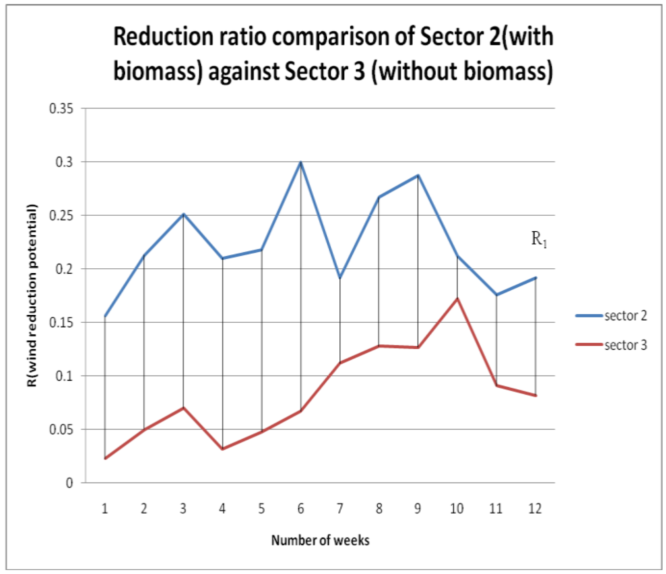

Fig. 3 Reduction ratio comparison of Sector 2(with biomass) against Sector 3 (without biomass)

III. Velocity Comparisons

The exact parameters for wind velocity difference brought about the buildings or biomass as barriers are better explained if the wind velocity from the heart of the campus from the sectors (inside the campus) is compared against the wind velocity measured outside the campus into barren land. Thus, sector 2 and 3 are again considered for this agenda, which can bring about clear elucidations in the role of these 'agents' as wind barriers.

The average wind readings in those regions (outside the campus and inside the campus) are plotted and the variation, analyzed. These readings are tabulated with the help of a digital anemometer.

sector 3-velocity(m/s)	
inside the campus	outside the campus
3.2	18.5
0.1	10.5
0.4	8.7
4.8	21.6
5.2	15.4
2.3	11.4
4.2	21.7
6.2	25.4
0.4	9.9
5.5	25
2.7	17.4
4.3	16.6

Fig 4- Comparison of wind velocity readings in m/s within the university campus (inside) against the exterior of the campus(barren land) in the absence of biomass

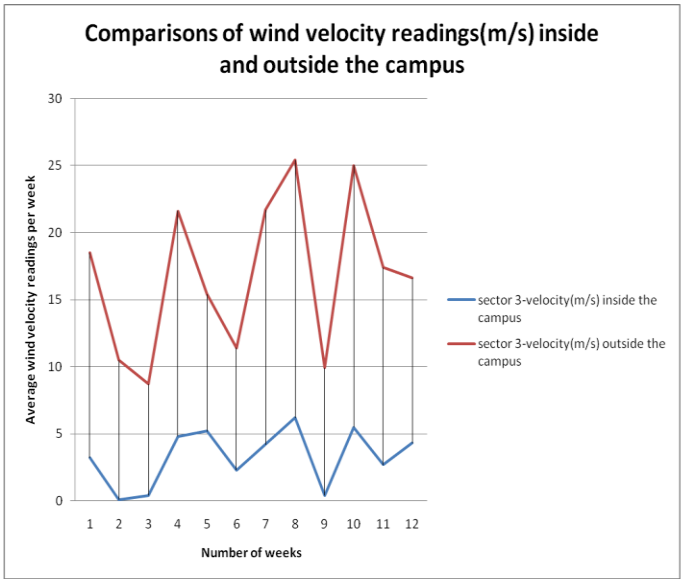

Fig 5 Comparisons of wind velocity readings(m/s) inside and outside the campus in sector 3

These readings are comparatively showing a vast variation, due to the area covered by the buildings and their actual heights generally being taller than trees (expected as the trees are only 10 years old). The buildings thus act as effective wind barriers and also, face the wind velocity at very high speeds.

sector 2-velocity(m/s)	
inside the campus	outside the campus
5	15.3
5.9	12.1
2.6	12.1
7.5	20.7
0.3	7.2
0.9	4.2
7.6	18.4
4.7	18.1
7.1	18.5
4.6	15.2
3.8	14.2
2.6	10.4

Fig 6 Comparison of wind velocity readings in m/s within the university campus(inside) against the exterior of the campus(barren land) in the presence of biomass

The differences are quite pronounced, but not so much as the buildings. But the trees , though covering a small basal area and having only limited height, like a maximum of 8m and minimum of approx. 4.5m, still offer a lot of resistance as the canopy is an integral part of the AGB in providing this wind barrier. This definitely, is a step in the right direction for cultivating more trees with the right biomass growth rates, and carbon sequestering potential, which is much more cost effective than erecting structures.

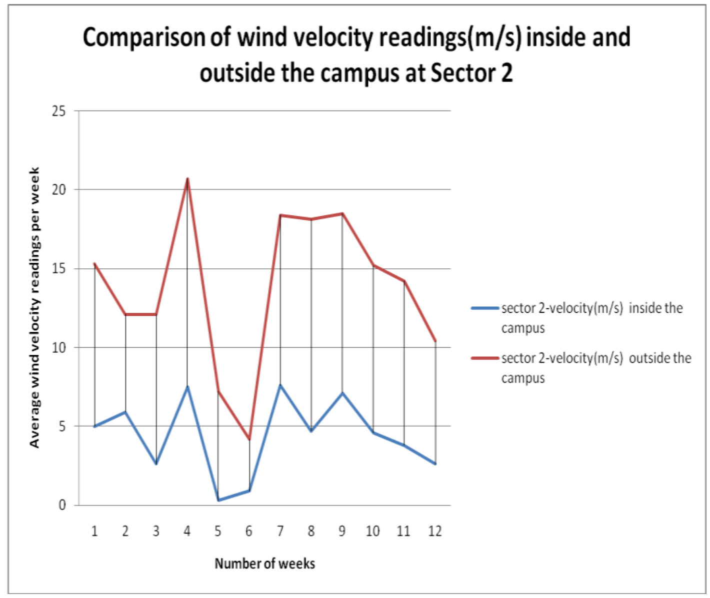

Fig 7 Comparison of wind velocity readings(m/s) inside and outside the campus at Sector 2

The co-existence of the trees along with buildings in a perfect harmony will synchronize the efforts to provide a more stead hardy resistance to wind pollution /erosion, and soil conservation.

IV. Conclusion

The wind readings tabulated are positive impacts and results of the usefulness of carbon reservoirs like trees, and also mitigating the changes brought about by urbanization in almost the same level as the concrete structures. More biomass stretches can constructively contribute to the effective wind reduction potential by afforestation and perhaps, rival the buildings!

Urban trees have a positive role to play in energy transfer and conservation between the buildings and the surroundings(due to heat reflected or conserved) and also this balance of conservation will result in reducing the atmospheric sink of CO_2 to a large extent and they'll be stored in trees. Though this process is short lived, as trees eventually die, the prospect of keeping the carbon as reservoirs rather than resources in this current industrialized world is a no-brainer.

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