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“Resilience of agricultural systems against crises”

## Skyfarming – Staple Food Production in Cities – Light *vs* Energy Demand

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### Abstract

Multi-level indoor plant production systems, also referred to as vertical farming or skyfarming systems are drawing more and more attention. In the context of climate change and population increase accompanied by greater risks of global food shortage, such systems could secure food production particularly in mega cities and take pressure off arable land. Additionally, such systems minimise water and nutrient use if build as closed circulation systems *e.g.* with biogas production from crop residues and its use for thermal regulation. However, even though plenty of design studies for vertical farming concepts exist, the total energy demand for plant growth and the potential output in terms of yield biomass in such systems is largely unknown. Supplying light to the plants assumedly having the greatest share of the total energy requirements for such a facility, we calculated the efficiency of high end light emitting diodes (LEDs) of different colours in terms of emitted quantum per electrical watt and linked the results with a parametric model for the quantum demand of rice. The results showed that there are several potential ways to meet the theoretical energy demand for light supply in an artificial environment, depending to a large extend on the plant's physiological responses to illumination duration and light quality. In order to further develop the model, we designed and constructed a semi-closed chamber system allowing control of temperature, vapour pressure deficit, light intensity and quality (ratio of blue, green and red wavelengths) and the measurement of canopy gas exchange parameters. Those experimental data will also help optimising the basic light management in a closed plant production system such as reflection rate from surfaces and rate of direct versus diffuse light. Preliminary results of growth experiments will be shown and possibilities for increasing the radiation use efficiency in closed plant production systems will be discussed.

**Keywords:** Artificial lightning, energy demand, light emitting diodes, rice, sky farming, vertical farming