



**Skyfarming:**  
Multi-story  
crop production to  
improve food security?

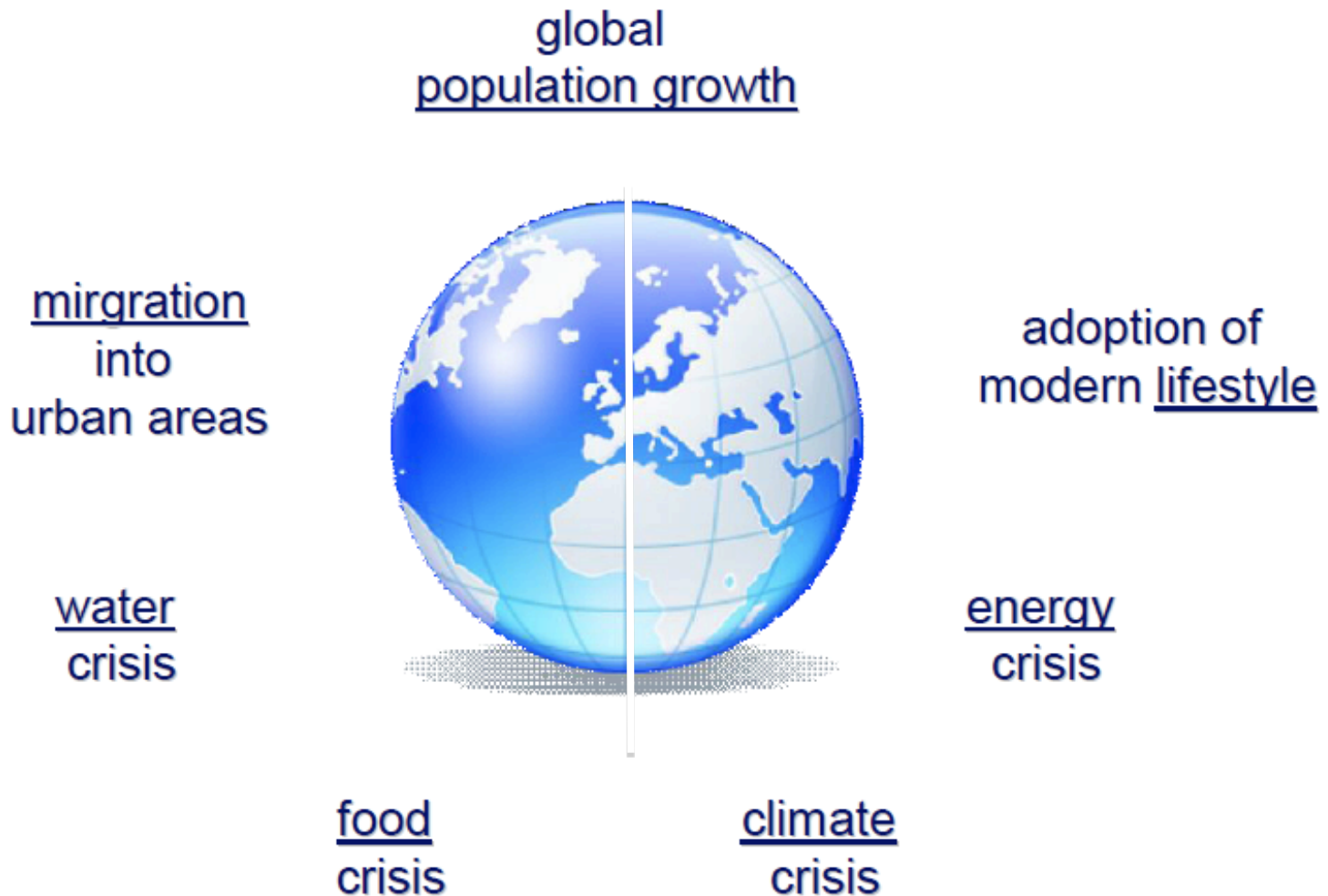


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# The Future of Farming

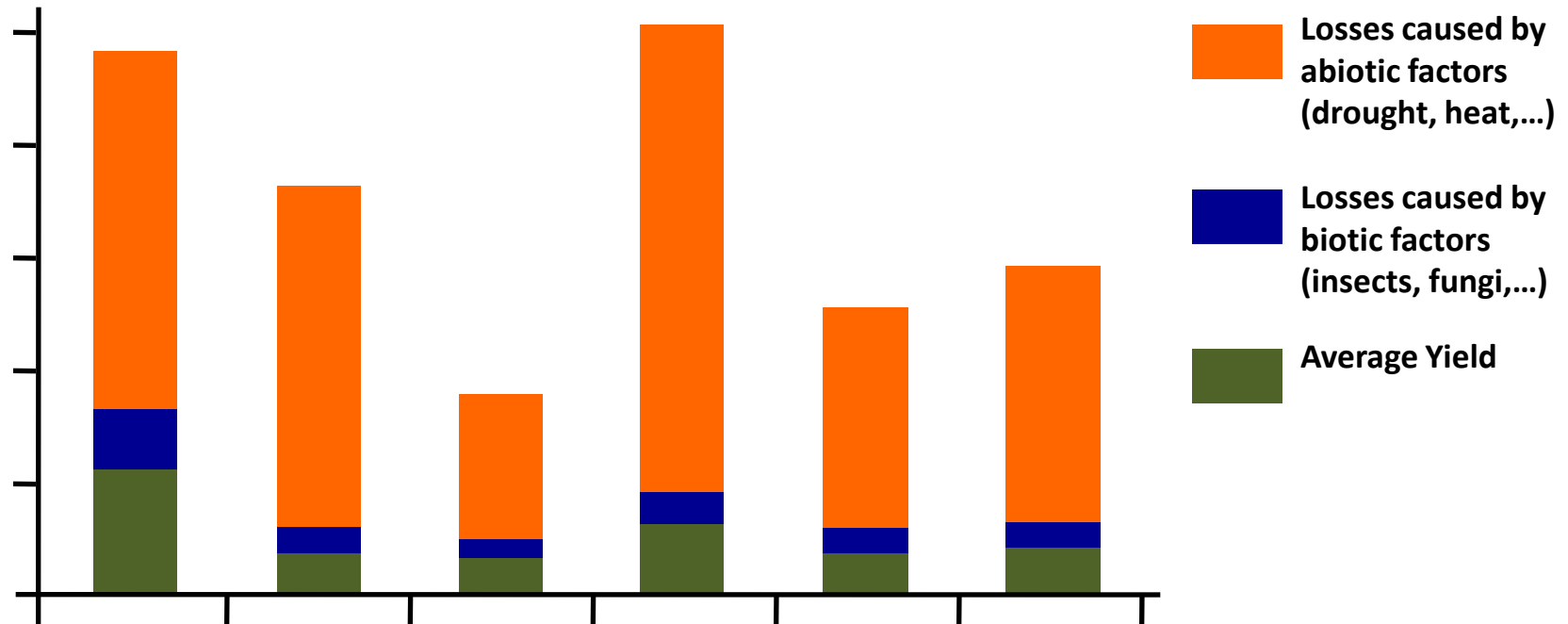
<http://www.youtube.com/watch?v=GpsVrNExujQ&feature=related>

# Our world is changing because.....



# Stress causes dramatic harvest losses

Yield (kg/ha)



**Stress reduces harvests dramatically: cereals appear to suffer particularly from abiotic stress caused by heat, cold, drought or the oxygen deficiency that results from stagnant water or compacted soil. The potential harvest (total column length) is partly compromised by insect pests, plant diseases and competition from weeds. However, abiotic factors are responsible for the lion's share of harvest losses.**

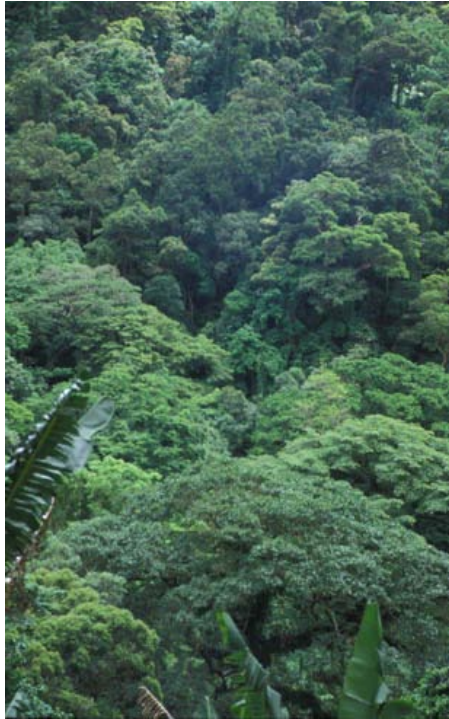
# Land-use change forecasted subject to increased food demand

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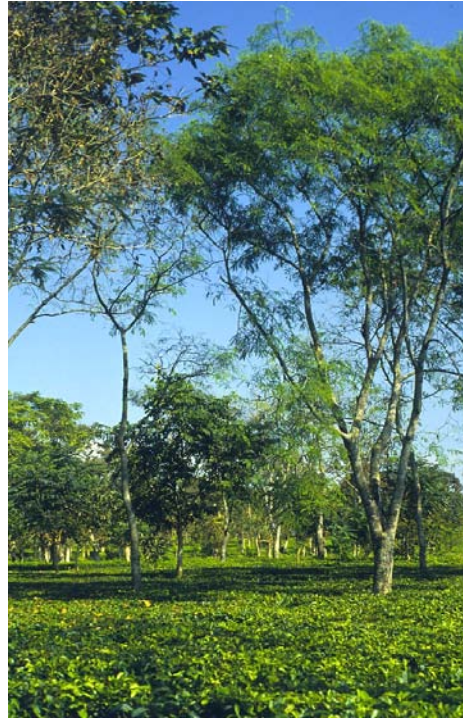
	Arable land (10 <sup>9</sup> ha)	Pasture land (10 <sup>9</sup> ha)	Irrigated area (10 <sup>6</sup> ha)	Fertiliser (10 <sup>6</sup> t)		Pesticides (10 <sup>6</sup> t)
				N	P	
<b>2000</b>	1.54	3.47	280	87	34.3	3.75
<b>2020</b>	1.66	3.67	367	135	47.6	6.55
<b>2050</b>	1.89	4.01	529	236	83.7	10.10

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Agriculture worldwide has a price in the form of environmental degradation and the decline of nature and landscape values.



**Pristine forest**



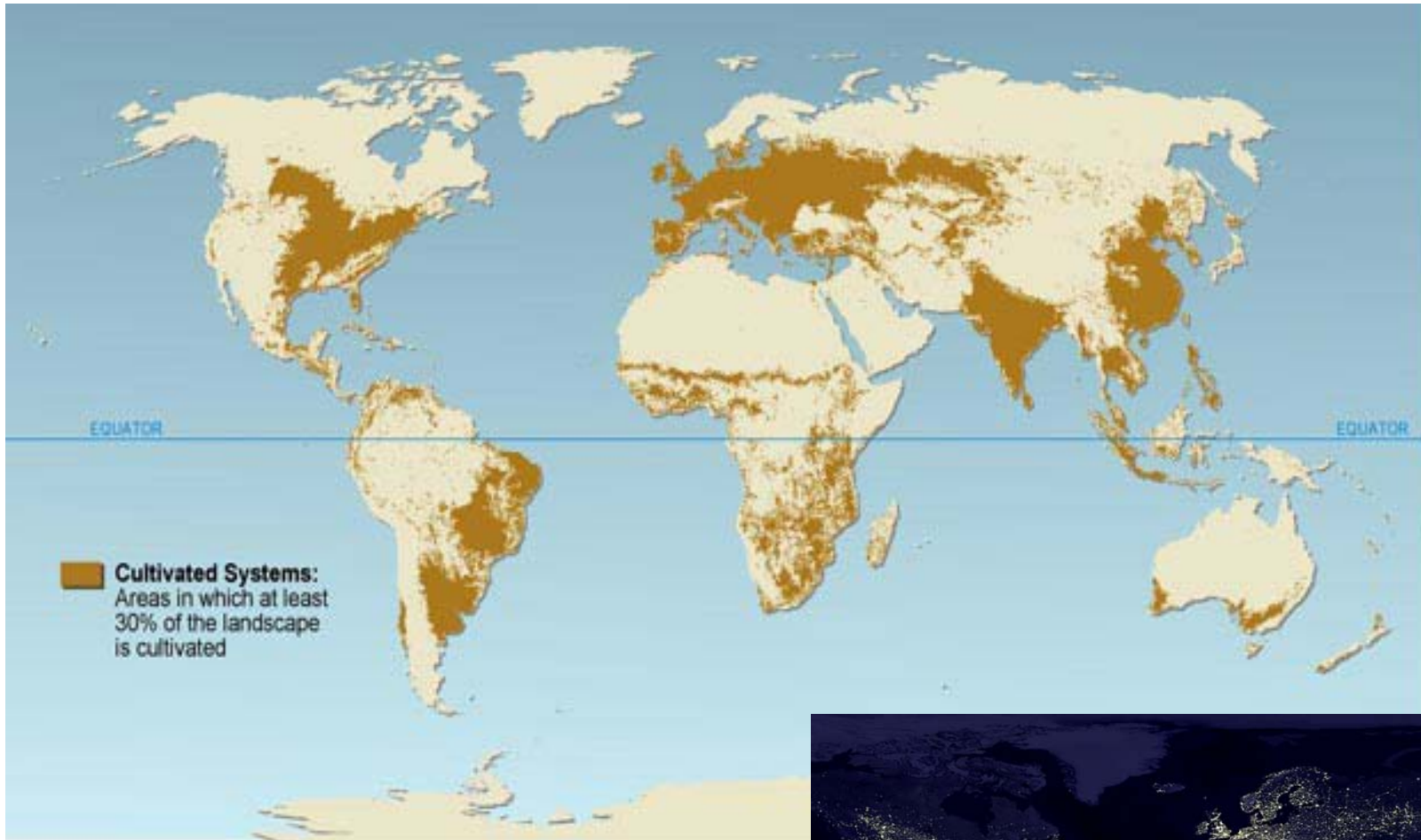
**Shaded tea**



**Rubber plantation**

**Decreasing structural and biological diversity.  
Consequence on ecosystem services and functions unknown.**





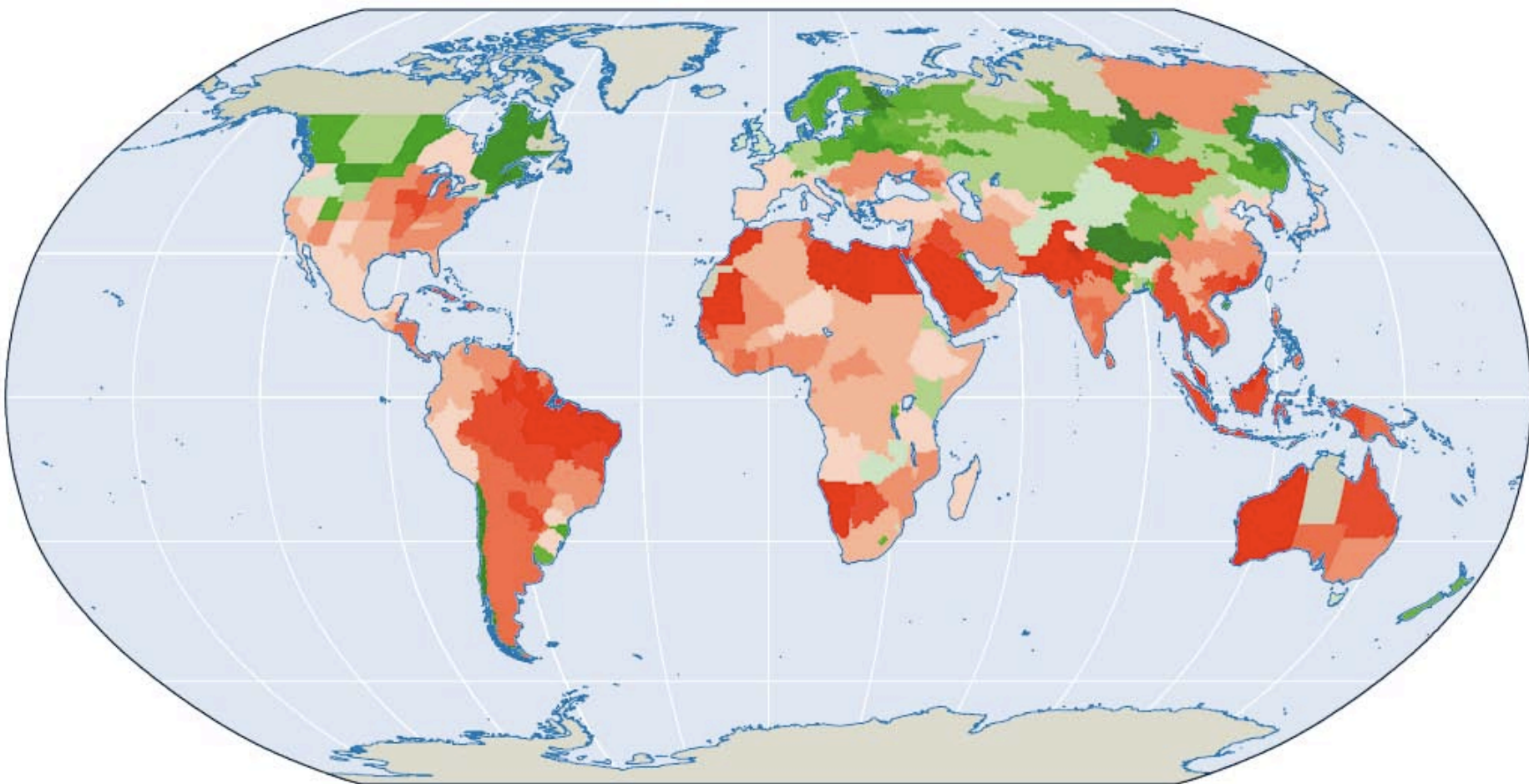
**Trade-off between  
crop land and urbanisation**

# Environmental constraints for rainfed farming

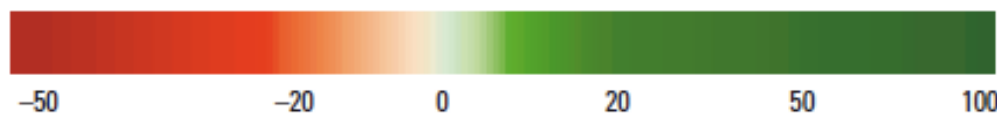
Region	Area							
	total 10 <sup>6</sup> ha	with constraints		to cold	to dry	to wet	to steep	poor soils
		10 <sup>6</sup> ha	%	in %				
Europe	586	199	34.0	4.8	0.05	0.0	9.0	20.2
Russian Federation	1,677	1,140	68.0	44.5	1.9	0.0	1.9	19.7
Africa	2,990	2,013	67.3	0.0	47.4	0.04	2.5	20.2
Latin America/Caribbean	2,049	1,241	60.6	0.3	19.1	3.5	9.1	24.9
Asia	3,112	2,107	67.7	3.7	42.2	5.0	9.0	9.1
North America	2,139	1,529	71.5	35.9	14.0	0.0	3.2	18.5
Oceania	848	630	74.3	0.1	58.6	3.9	1.2	10.5
<b>World</b>	<b>13,400</b>	<b>8,859</b>	<b>66.1</b>	<b>13.2</b>	<b>26.5</b>	<b>2.0</b>	<b>4.6</b>	<b>19.8</b>



# Climate change will depress agricultural yields in most countries by 2050 given current agricultural practices and crop varieties



Percentage change in yields between present and 2050



No data

Source: Müller and others 2009

# Possibilities to increase **4F** production:

1. increase of productivity per unit area
2. prevention of exhaustive cultivation
3. development of new cropping areas
4. reclamation of degraded land
5. „Skyfarming“?



Flevoland, The Netherlands

# Farming in the sky:

We live vertically why not grow our food in a multi-storey building?



# Benefits from Skyfarming I:

## - **Multiplication of yield by:**

- optimal growth conditions (water, temperature, light, nutrients)
- year-round crop production
- no crop failures due to droughts, floods, frost, pests etc.,  
thus **1 indoor ha is equivalent to 5-7 outdoor ha** or more.

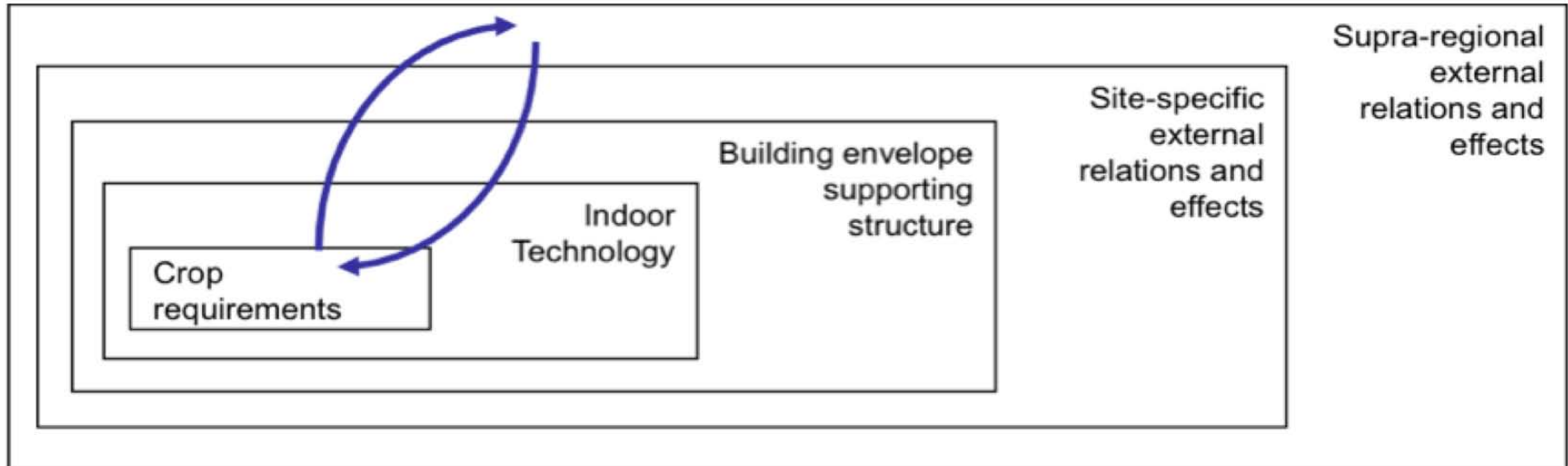
## - **Alleviation of environmental pollution by:**

- reduced input of mineral nutrients e.g. N and P into natural ecosystems
- efficient H<sub>2</sub>O-use by re-in feed of water transpired from crop
- reduced pesticides load
- returning farmland back to the natural landscape thus restoring ecosystem functions and services.

## Benefits from Skyfarming II:

- **Production where consumption takes place** (e.g. urban areas), i.e. short route of transport, reduced costs and CO<sub>2</sub>-emission (less tractors, plows, shipping).
- **Continuous production:** buffer price shocks in international crop commodity market.
- **Energetic use of by-products** e.g. straw, roots in directly integrated biogas plant, etc.
- **Reduced conflict over natural resources**, such as water and land etc.

# Skyfarming in a nutshell



System approach in Skyfarming – From the plant over the growth conditions and the terms of conveyance indoor the building envelope establish a relationship with the outside area. The system extends into the socioeconomic environment as well as the supra-regional connections in the potential target areas.





**Thank you for your attention!**