

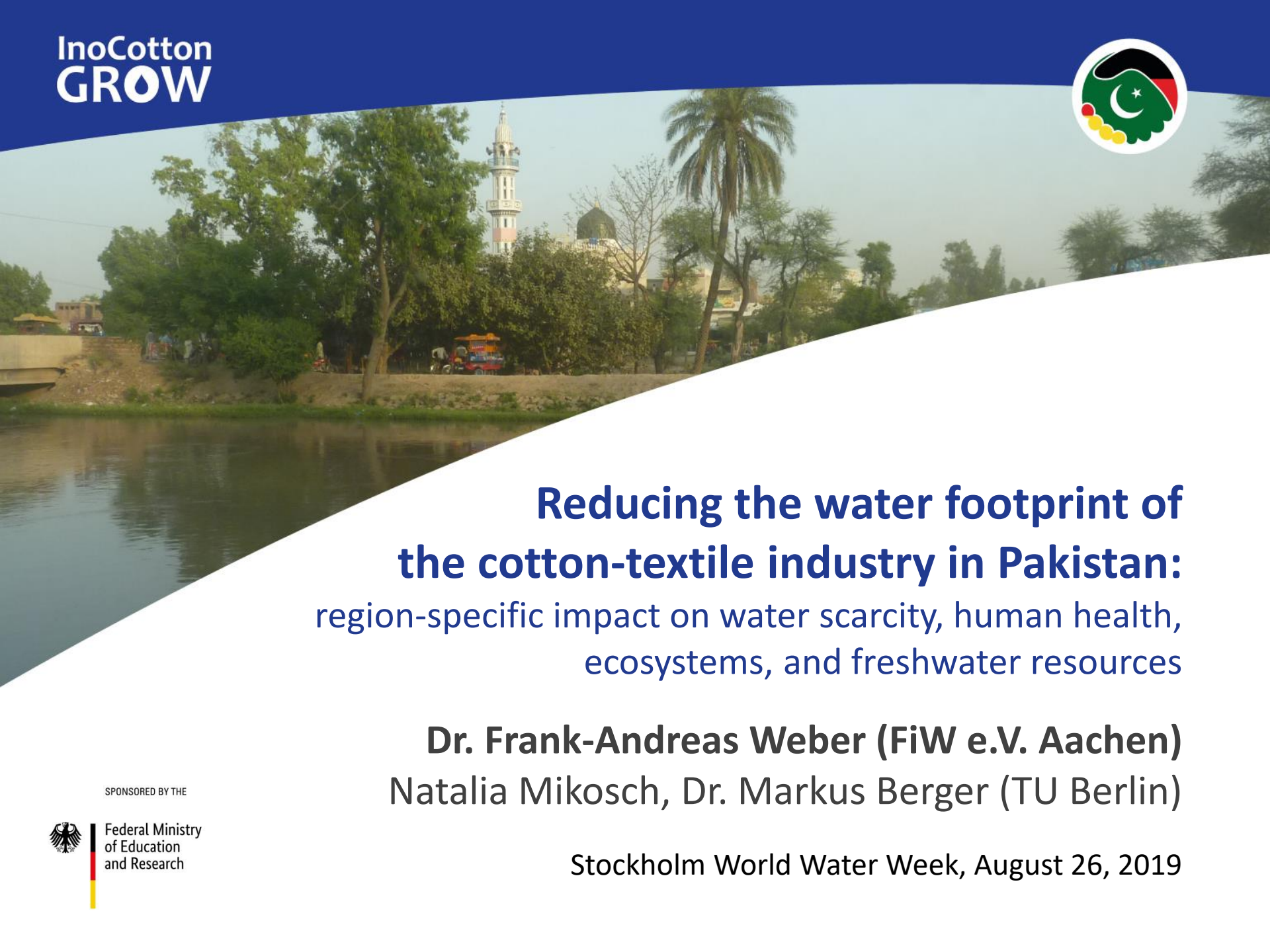


InoCotton GROW

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Reducing the water footprint of the cotton-textile industry in Pakistan:

region-specific impact on water scarcity, human health,
ecosystems, and freshwater resources

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Natalia Mikosch, Dr. Markus Berger (TU Berlin)

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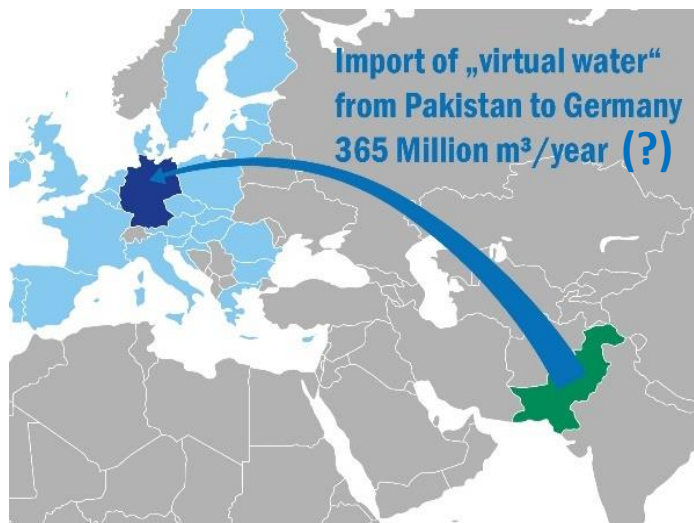
Federal Ministry
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Stockholm World Water Week, August 26, 2019

COTTON-TEXTILE PRODUCTION IN PAKISTAN



COTTON-TEXTILE VALUE CHAIN

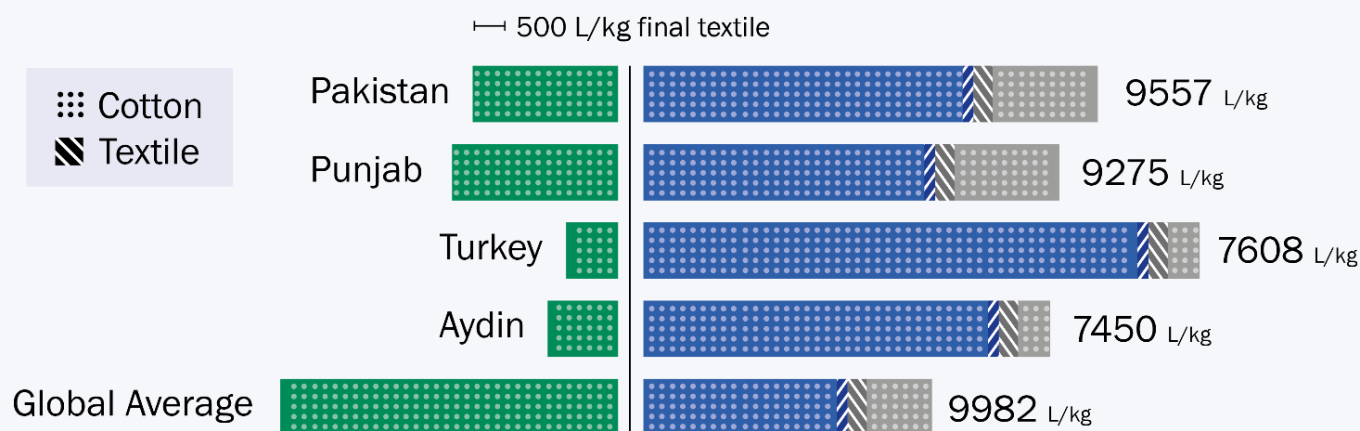


	Germany	Pakistan
Population	82 million	208 million
Cotton Production	-	1.8 million tons
People employed in Cotton Textile-Retailing Value Chain	94'000	> 25 million
Import of Textiles and Clothing	42 Billion EUR (1.3 Billion EUR directly from Pakistan)	
Turnover of Textile Retailing Business	63 Billion EUR	-

UN-SDG 6 “Clean Water and Sanitation” and related Targets in 2015 (UN-STAT 2018, <https://unstats.un.org/sdgs/>)

6.1.1 Population using safely managed drinking water	99.2 %	35.6 %
6.3.2 River water bodies with good ambient water quality	35.1 %	No data
6.4.2 Level of water stress	41.5 %	102.5 %
3.9.2 Mortality due to unsafe water and sanitation per 100,000 population	0.6	19.6
2.1.1 Prevalence of undernourishment	<2.5%	19.9%

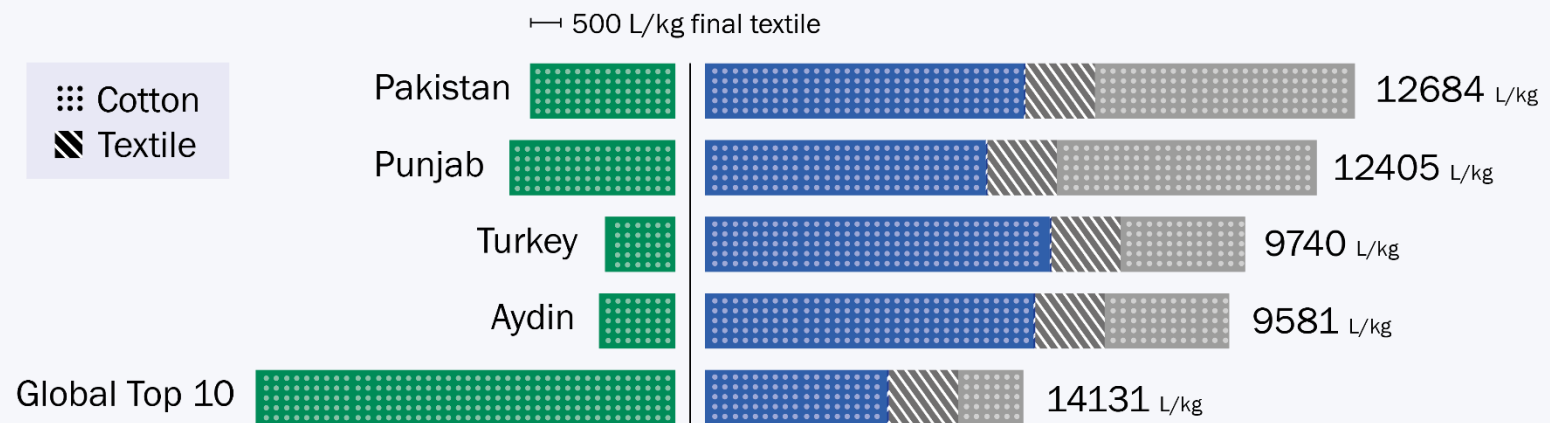
VOLUMETRIC WATER FOOTPRINT: AVAILABLE DATA



Water Footprint per kilogram of final textile
Based on Mekonnen & Hoekstra (2011); Earlier data by Champaign et al. (2006)

Conversion	Raw Cotton → Cotton Lint	Cotton Lint → Final Textile
Product Fraction	0,35	0,95
Value Fraction	0,79	0,99





IMPROVED GREY WATER FOOTPRINT



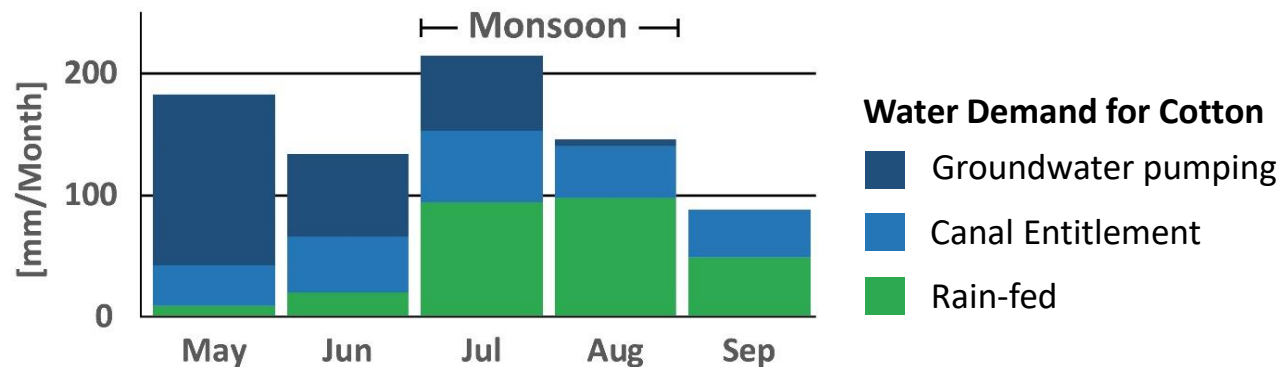
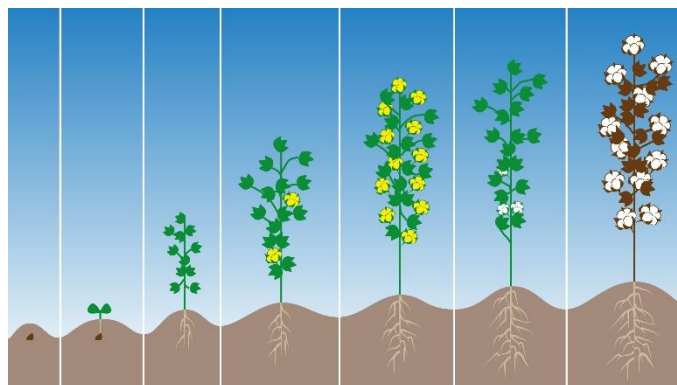
Water Footprint per kilogram of final textile
Based on Mekonnen & Hoekstra (2011); Grey WF by Mikosch et al. (2019)

- **Cotton farming:** improved (still crude) estimate for nitrate leaching
- **Textile processing:** improved (still crude) estimate with respect to Zero Discharge of Hazardous Chemicals (ZDHC) foundational standard

IMPACT ASSESSMENT: CAUSE-EFFECT CHAINS

	Water Scarcity	Water Pollution
Human Health	<p>Impact of water scarcity on salinization, loss of yield, and malnutrition?</p>  <p>© FIW</p>	<p>Impact of water pollution on drinking water quality?</p>  <p>© FIW</p>
Ecosystem Damage	<p>Impact of water scarcity on damage to freshwater ecosystems?</p>  <p>Kalhor et al (2016): Kotri BarRage</p>	<p>Impact on river water quality and toxicity to aquatic ecosystems?</p>  <p>© FIW</p>

WATER FOOTPRINT OF COTTON



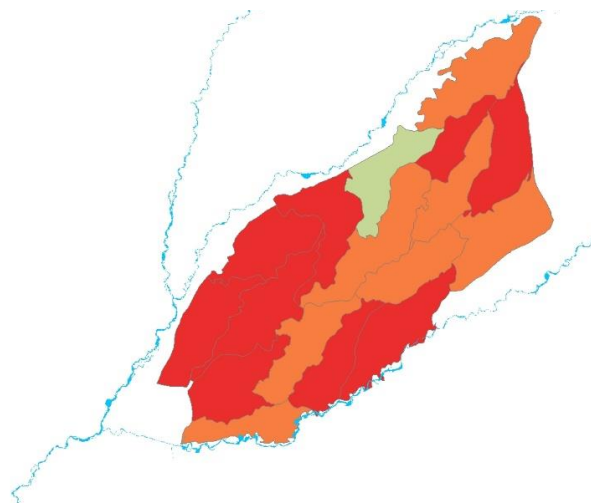
WATER SCARCITY FOOTPRINT OF COTTON

Jan > Feb > Mar > Apr > May > Jun > Jul > Aug > Sep > Oct > Nov > Dec



Water Deprivation Indices (WDI):

Freshwater consumption-to-availability considering cotton and all competing food crops (calibrated SWAT model by Becker et al. 2019)

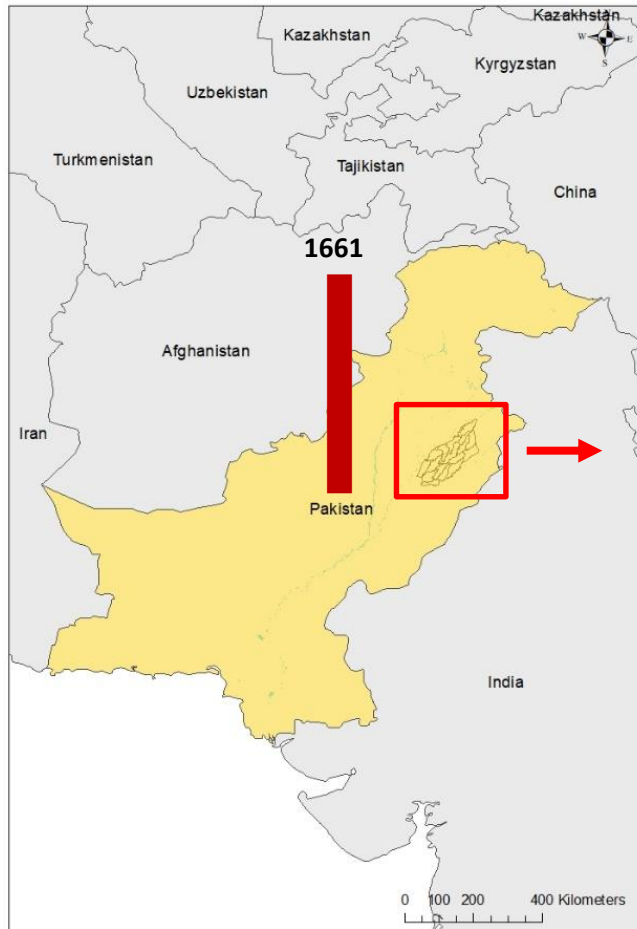


 < 0.01 0.01- 0.2- 0.4- 0.6- 0.8- > 0.99

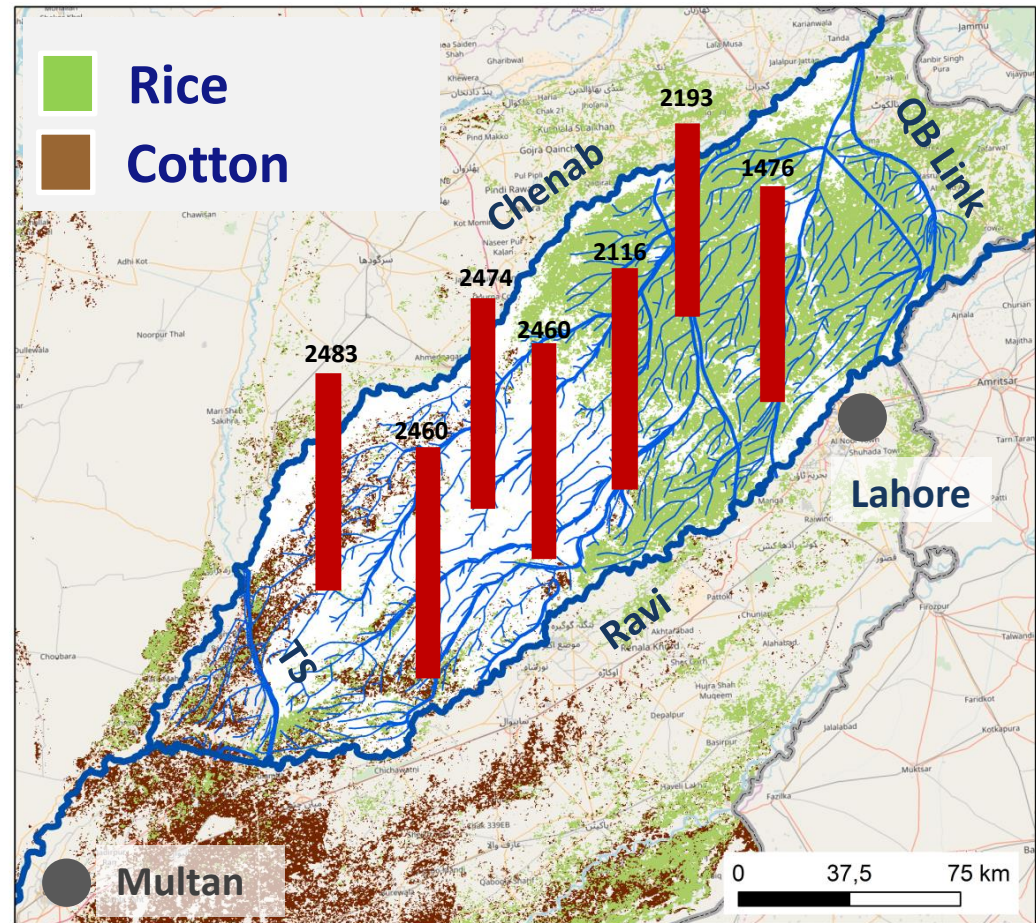
Mikosch et al. (2019)

WATER SCARCITY FOOTPRINT OF COTTON

Basemap: OpenStreetMap CC-BY-SA 2.0



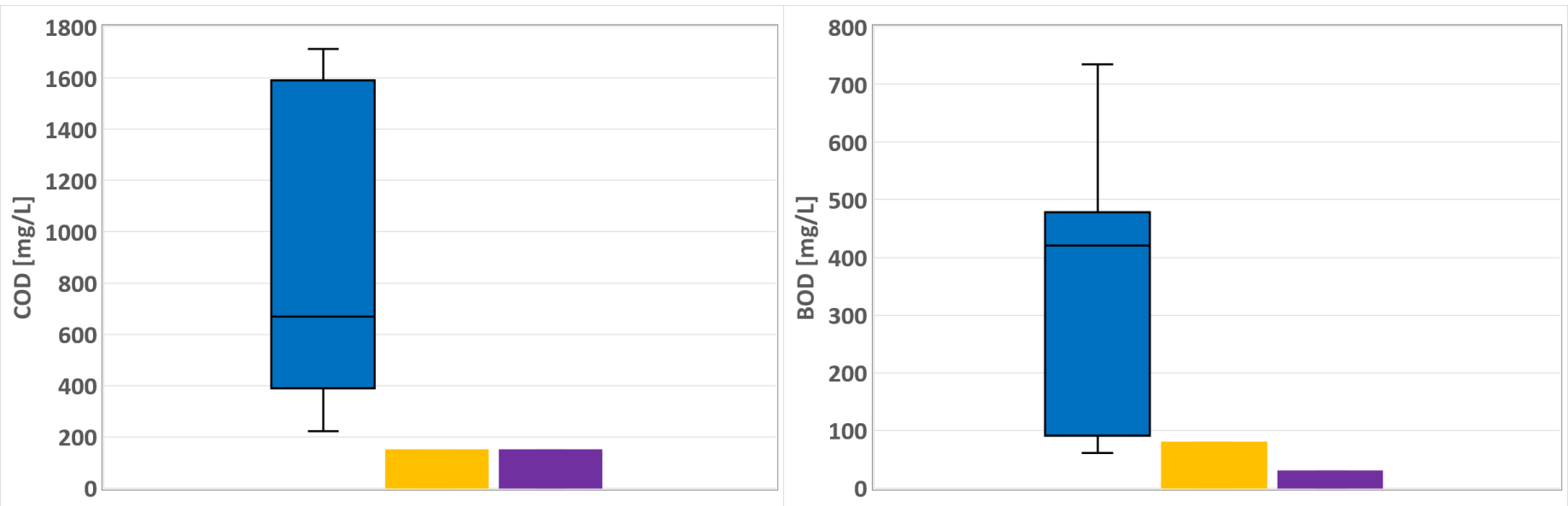
Basemap: OpenStreetMap CC-BY-SA 2.0






Mikosch et al. (2019): Figures per kg of raw cotton
Land use map by Usman et al. (2018)

POLLUTION: UNTREATED TEXTILE WASTEWATER

RESULTS OF 9 COMPANY SURVEYS

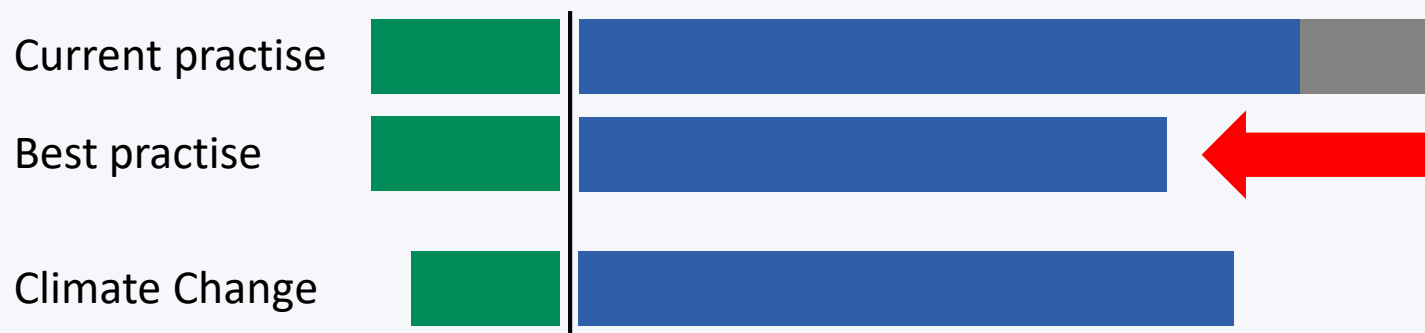


-  Box-Plot of Wastewater Compositions (n=9)
-  Pakistan National Emission Standard
-  Zero Discharge of Hazardous Chemicals (ZDHC) - Foundational

POLLUTION: UNTREATED TEXTILE WASTEWATER

Recipe for Textile Processing		ZDHC not implemented		ZDHC Foundational	
		Effluent conc. (arbitratry) [µg/L]	Total Human Toxicity	Effluent conc. (Foundational) [µg/L]	Total Human Toxicity
Dye	Dyestuff: 15 kg dye / t cotton fixation 70%	Direct blue 6 1.04E+05	0.16 DALYs per ton lint cotton	Direct blue 15 1.04E+05	0.00064 DALYs per ton lint cotton
MSRL substances	Chlorophenols	8.0E+05		0.5	
	Dyes - Azo	5.0E+05		0.1	
	Flame Retardants	8.0E+03		5.0	
	Glycols	1.0E+09		50.0	
	Halogenated Solvents	8.6E+06		1.0	
	VOC	1.2E+07		1.0	

WATER-FOOTPRINT UNDER BEST-PRACTICE (GIVEN REGIONAL CLIMATIC CONDITIONS)



OPTIONS FOR INTERVENTIONS IN PAKISTAN

	Options for intervention	WF	Contribution to UN-SDGs
Cotton	• Advanced irrigaton techniques (drip irrigation)	➔	7 AFFORDABLE AND CLEAN ENERGY
	• Flexible irrigation scheduling (controlled deficit irrigation)	➔	2 ZERO HUNGER
	• Certified cotton: reduced fertilizer and pesticide application	⬇	3 GOOD HEALTH AND WELL-BEING 6 CLEAN WATER AND SANITATION 15 LIFE ON LAND
Textile	• Water-efficient textile machinery	➔	7 AFFORDABLE AND CLEAN ENERGY
	• Advanced dyestuff and process chemicals	⬇⬆	6 CLEAN WATER AND SANITATION 6 CLEAN WATER AND SANITATION 12 RESPONSIBLE CONSUMPTION AND PRODUCTION
	• Installation and operation of WWTPs	⬇	3 GOOD HEALTH AND WELL-BEING 6 CLEAN WATER AND SANITATION 7 AFFORDABLE AND CLEAN ENERGY 15 LIFE ON LAND

CONCLUSION

1. Water Footprint Tool online:

<http://wf-tools.see.tu-berlin.de/wf-tools/inoCotton/#/>

2. WF as a Steering Indicator

- Installation of **functioning wastewater treatment** has a main impact on reducing grey water footprint
- For **achieving UN-SDGs**, other indicators are also important:
For example, lower cotton WF in competition with food crops
- **Environmental authorities in Pakistan** are currently not in a position to assure compliance with existing wastewater standards

3. Awareness Raising: Brands, Retailers, and Consumers

- Integration of the WF concept into **textile labels**?
- **12-min Documentary Video** available on YouTube

COOPERATION PARTNERS

German Partners



Turkish Partners



Pakistani Partners





**InoCotton
GROW**

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آپ کی توجہ کے
لئے آپ کا شکریہ۔

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