

S3: STEEPLE analysis

Table S1: Analysis of 21 international studies based on the STEEPLE framework

Study_ID	Sources	Social	Technical	Environmental	Economical	Policy	Legal	Ethical
S1	[40]	Population development	Digitisation	Organic farming	Income and economic growth	Regulations necessary in agriculture and forestry sector		Food security
		Wealth/Income	Advanced technologies (PtX, digitisation, biotechnologies)	Land/Soil	International trade			Food losses
		Domestic employments	Agriculture yield increase		Reduction of yields in agricultural sector			
		Knowledge	Chemicals		Reduction of agricultural land			
			Land		Knowledge			
			Lignocellulosic/Material					
S2	[41]		Residue and side products (wastes)					
					Competitive use		CO ₂ Tax	
S3	[2]				Knowledge			
		Behavioural change	Chemicals	Micropollutants	Income and economic growth	CO ₂ tax	CO ₂ tax	dietary change
		Wealth/Income		Ecosystem Services	Food prices			Consumption footprint
		Domestic employments		Yield development	Subsidies			Food security
S4	[42]	Agroecological perspective		Organic farming	Carbon prices			Food losses
		Public influence	Innovations along the value chain of wood (including products)	Climate change	Globalization and international economic development (oil price/exports)	Forest, environmental and nature conservation policies	Direction of economic, competition, tax, industry and agricultural policies	
		Environmental awareness	Innovations of the exploitation of fossil resources (non-conventional)	Biomass availability/forest structure	Domestic economic development	Support of the circular flow economy		
		Risk and innovation attitude			Supply and demand for wood	Support of local value chains		

		Willingness to pay for bio-based products			Willingness to invest in innovations	Regional planning and development (e.g. role of federal states and regional associations)		
		Voting behavior (supporting sustainable politics)			Focus on short term or long term-orientated profit			
					Site conditions (e.g. establishment of business, infrastructure)			
S5	[43]	Population development	Bioenergy		Income and economic growth			
		Food losses			Agriculture yields constant or increase			
		Wealth/Income			Residue and side-products (wastes)			
		Dietary habits						
		Residue and side-products (wastes)						
S6	[44]		Chemicals		Chemicals			
			Biorefineries					
S7	[45]		Biofuels		Cost competitiveness (sec. Energy carriers and chemicals)	CO ₂ Tax		Dietary change
			Biochemicals					
			Renewable energy share					
S8	[46]	Food security	Agriculture	Sustainable production in agriculture	Agriculture yield increase (sustainable intensification)	Waste hierarchy		Consumption footprint
		Residue and side-products (wastes)	Reducing dependency on fossil fuels	Land use competition	Land	Close alignment of policy, science and industry		resource scarcity
		Job creating	Product design	Marginal lands high on biodiversity	Residue and side-products (wastes)	Funding focus		
		Dietary habits	Certification	Ecosystem Services	Knowledge			
		Regional development (site specific solutions)			Global value chains			
S9	[47]	Use of biobased resources	Circular approaches	Origin food	Origin of biobased raw materials und economic structure			Consumption patterns (DE)
		Consumption patterns (DE)		Land use qualitative (DE)	Economic business model			

				Biodiversity				
S10	[48]	Job employment	Substituting by bio-based renewable resources and new valorisation of these bioresources	Biodiversity	Greater variety of highly productive and adapted crops	New forms of institutions and governance		Footprints
		Rural regeneration and revitalization	Cascade usage	Ecosystem Services	Improved and multi-functional production system and sustainable intensification à makes marginal land more productive and better connect farmers to markets	Knowledge transfer		Reduces wastage and reduced per-capita consumption
		Regional development (site specific solutions)	Increase longevity and repair	Avoiding critical products	Residue and side-products (wastes)			Consumption footprint
		Reduces wastage and reduced per-capita consumption	Introduction of 2 nd and 3 rd generation of bioresources (e.g. lignin, algae)	Integrated land use in multifunctional production systems which protect ecosystems and biodiversity				
			Knowledge transfer					
S11	[49]	Population development	Chemicals	Ecosystem services	Chemicals			Limit population development (ethical manner)
		Residue and side-products (wastes)	Substitutional effects of renewable energies	Animal based food	Primary energy demand			
		Primary energy demand	Carbon dioxide removal					
		Dietary habits	Increase in agricultural productivity					
			CO ₂ usage in industry					
S12	[50]	Population development	Biofuels	Ecosystem Services	Biological performance of food sector (livestock)	Agriculture		Income and economic growth
		Dietary habits	Renewable energy share	Perennial biomass	Increase in crop yields (specific)			
		Wealth/Income	Biomass supply		Cost development			
			Biochemicals					
S13	[51]	Labour right and decent work			Employment and rural development			Employment and rural development
		Food security			Fair competition in market			

		Regional development (local community)						
S14	[52]		Know-How	Yield development	Business and markets	R&D		
			Technological transfer			coordination of policy frameworks in different fields		
			Technological performance proper for existing systems					
			Availability of these technologies					
S15	[53]		Replacing of fossil based materials	Yield development	Construction	R&D		
			Construction		Chemicals	Market demand side innovation policies		
			Textile		Textile	coordination of policy frameworks in different fields		
			Transport equipment		Transport equipment			
S16	[54]	Dietary habits	Digitisation	Ecological footprint	Chemicals			
			Advanced technologies		Lignocellulosic/Energetic			
			Biofuels		Lignocellulosic/Material			
			Carbon sources		Yield development (crop specific)			
			Chemicals		Trade with biogenic raw materials			
			Land					
			Lignocellulosic/Energetic					
S17	[8]	Population development	Bioenergy	Yield development	International trade	R&D	Ban of energy crops	
		Dietary habits	GMO	Land	Organic farming	Ban of first generation fuels	International trade	
		Acceptance of monoculture agricultural structures	Breeding			Ban of monocultural energy crops		
						Sustainability criteria for import of biomass		
S18	[55]	Population development	Digitisation	Climate change	Income and economic growth			
		Urbanisation	Advanced technologies		Competitive use			
			Biofuels		Business and markets			
			Energy		Lignocellulosic/Material			

S19	[56]		Residue and side products (wastes)					
			Energy					
S20	[57]		Land		Organic farming			
			Perennial cropping systems		Private forests			
			Residue and side products		Land for food and feed decrease			
			Bioenergy					
S21	[58]		Chemicals					