

Properties	Outcome affected	Mechanism/Relationship	Example Sources
Bio-physical properties			
Global climate change; environmental change	Food security	Challenges to farmer livelihoods; effects on yield; uncertainty and instability in production, food supply, and food prices.	Calzadilla et al. 2013; Porter et al. 2014; World Bank 2007; Ringler et al. 2010
	Biodiversity	Multiple direct and indirect effects on species habitats, ranges, stressors, and extinction risks.	Staudt 2013; Fordham et al. 2011; Klausmeyer et al. 2011; Huston 2005
Soil types and fertility, soil erosion, topography	Food security	Direct effect on productivity, indirect effects on production costs and market prices; soil degradation, particularly reduced soil organic matter, affects quantity and quality of food production (e.g., increases susceptibility to drought stress and nutrient deficiencies, and increases susceptibility to pest and disease outbreaks). Soil contamination directly affects food quality (e.g. arsenic in rice) and human health.	Lal 2009; Khan et al. 2010; Scherr 1999
	Biodiversity	Biodiversity influenced directly via soil quality feedbacks on belowground biodiversity and the soil microbiome, and indirectly through soil fertility effects on net primary productivity, and/or increased fertilizer use to maintain yields on degraded soils.	Postma-Blaauw 2010; McDaniel et al. 2014; Tilman et al. 1996; Mozumder and Berrens 2007
Water availability (and safety)	Food security	Strong contributor to malnutrition reduction (as indicator of overall health environment); importance in agricultural production.	Hanjra and Qureshi 2010; Smith and Haddad 2015; Armah et al. 2011; Turrall et al. 2011; Khan et al. 2010
	Biodiversity	Agricultural impacts on hydrologic cycles and water quality can directly threaten biodiversity.	Zedler 2003; Geng et al. 2015; Gleick 1998
Amount and diversity of natural vegetation	Food security	Connected to dietary diversity and wild collection; provides ecosystem services to agriculture (e.g., pollination, pest control).	Belanger and Johns 2008; Chappell et al. 2013; Lira et al. 2009; Power 2010
	Biodiversity	Forest degradation and fragmentation leads to loss of wild biodiversity.	Godar et al. 2015; Savilaasko et al. 2013; Melo et al. 2013;

			Grau et al. 2013; Fearnside 2005
Agrobiodiversity	Food security	<p>Dietary diversity tied very strongly to food security directly, and to nutritional quality of diets such as reductions in hidden hunger/micronutrient deficiencies, as well as to decreased risk of crop failure and increased ecosystem services (see also references for diversity in natural vegetation).</p> <p>Crop diversity can increase the stability and reduce vulnerability of both agricultural yields and farm incomes in the face of both market and biophysical perturbations to farming systems. The stabilizing/risk reducing outcome of increased agrobiodiversity (from within-crop genetic diversity, to diversified cropping patterns), is likely to be of increasing importance with increasing climate and market instability.</p>	Abson et al. 2013; Belanger and Johns 2008; Burlingame and Dernini 2012; Di Falco and Perrings 2003; Di Falco and Chavas 2006; Di Falco and Chavas 2009; Di Falco et al. 2010; Ericksen 2008; Fraser 2003; Frison et al. 2011; Johns and Eyzaguirre 2006; Liebman and Schulte 2015; Smith and Haddad 2015; Zimmerer 1998
	Biodiversity	A positive association between planned (agrobiodiversity) and associated (“wild”) biodiversity has been, according to Vandermeer et al. (2002), established “beyond credible doubt” for vertebrates, arthropods, and non-crop plants.	Liebman and Schulte 2015; Vandermeer et al. 2002
Pests and diseases	Food Security	Increased pest and disease pressure directly reduces crop yields.	Verberg et al. 2013; Matson et al. 1997
	Biodiversity	Wild biodiversity and agrobiodiversity reduce pest and disease pressure (e.g., by providing habitat for natural enemies, or by serving as “trap crops” for pests). Soil microbial diversity can suppress diseases.	Barthel et al. 2013; Bommarco et al. 2013; Matson et al. 1997; Garbeva et al. 2004
Social properties			
Trade agreements	Food security	<p>Highly contingent; often thought to be mediated via economic growth and access to cheaper food; however, connections between food prices and food security are contested</p> <p>Inequity and lack of appropriate redistribution within national contexts can hinder or eliminate theorized food security gains from international agricultural trade practices.</p>	Brown et al. 2014; FAO 2012; Wise 2009; Weis 2007; Tansey and Rajotte 2008; Haddad 2015; Otero et al. 2013; Heady 2010

	Biodiversity	Complex; land-displacement literature growing; international trade is increasing invasive species.	Lenzen et al. 2012; Meyfroidt et al. 2013; Bax et al. 2003
Environmental agreements	Food security	The focus of REDD+, CBD, and Kyoto on increasing forest cover may reduce agricultural area and productivity; inclusion of agricultural soil carbon sequestration contracts can raise income and improve food security.	FAO 2013a; Antle et al. 2009; Corson and Macdonald 2012
	Biodiversity	Increase in conservation area may improve preservation of wild biodiversity; appropriate scale and community engagement needed for effective governance.	Hodge and Adams 2014; Ewers et al. 2009; Brannstrom 2001; McAfee and Shapiro 2010
Certification systems	Food security & biodiversity	Fair trade: documented multiple effects on farming systems, biodiversity, livelihoods, and food security; effects vary with the social and political institutions regulating fair trade schemes.	Bacon et al. 2008; Jaffee 2007; Jaffee and Howard 2009; Reynolds 2000
Financial regimes and multinational corporations	Food security	Investment and speculation can affect food prices and livelihoods.	Davis 2001; De Schutter 2010; IATP 2008
	Biodiversity	Largely speculative as a “financialization of biodiversity” is still in developmental and uncertain stage; could be mediated through investments in offsets and finances of conservation.	Doswald et al. 2012; Phelps et al. 2011; McAfee 1999
Research system	Food security	Privatization of agricultural research reduced support for research on low-input agricultural practices and subsistence models	IAASTD 2009; Sumberg et al. 2012a, b; Levidow et al. 2014
	Biodiversity	Determinants of innovation within agricultural research systems have led to technological systems favoring specialized, low-diversity agroecosystems.	Vanloqueren and Baret, 2009
Government policy	Food security	Many possible avenues of effect through effects on entitlements and underlying determinant variables.	da Silva et al. 2011; Lappé et al. 2013; Smith and Haddad 2000; 2015; Rocha 2009; Wise 2004
	Biodiversity	Affected directly by conservation policies and indirectly by many other policies (including agricultural policies).	Ceddia et al. 2013; Chopra et al. 2005; Soares-Filho et al. 2014
NGO programs social	Food security	Multi-faceted and variable ways in which civic engagement and civil society organizations can influence food security both	Abebaw et al. 2010; Seed et al. 2013; Wittman and

movements and civic engagement		positively and negatively. Can play a crucial role in mobilizing underprivileged groups to advocate for greater rights and increased access.	Blesh, 2015.
	Biodiversity	Social movements can play a crucial role in promoting biodiversity in regions of high inequality.	Perfecto and Vandermeer 2008; Wittman 2010
Equity and justice	Food security	Affects distribution, political effectiveness, access rights, and multiple other factors.	Haddad 2015; Friel and Baker 2009; Sen 1981; Sievers-Glotzbach 2014
	Biodiversity	Driving mechanisms/ underlying correlates unclear.	Holland et al. 2009; Mikkelsen et al. 2007
Political stability	Food security	Instability and conflict affects many elements of food security, from food supply to entitlements and rights.	FAO 2000; Ó Gráda 2009
	Biodiversity	Possible links little-explored; legacy of conflicts may have profound indirect effects.	Russell 2001; Smith et al. 2003; Hamilton et al. 2000
Migration and Demographics	Food security	Rural out-migration increases dependency on imported food subject to global price shocks; urbanization and changing food preferences affect global demand and supply.	Otero 2011; de Janvry and Sadoulet 2010; Regmi and Meade 2013
	Biodiversity	Habits of urban dwellers will highly influence biodiversity outcomes.	CBD 2012; McSweeney 2005
Food storage and distribution systems (imports/exports)	Food security	Grain reserves aim to address food price volatility associated with food imports and exports.	Murphy 2009; Gilbert 2011; Wright 2009; Brigham 2011; Headey 2010
	Biodiversity	Increased reliance on food imports may reduce pressure to expand agricultural land base, but increase deforestation in other regions.	Walker 2014; Melo et al. 2013; DeFries et al. 2010
Land tenure system and land availability	Food security	Food security depends on adequate land access for smallholder and domestic food supply systems.	HLPE 2013; Borras 2003; 2010; 2012; White et al. 2012; FAO 2013b; Young 1999; Assies 2009
	Biodiversity	Property rights regimes provide both structure and incentives for natural resource use and conservation.	Hodge and Adams 2014; Ostrom et al. 1999; McKean 2000; Merenlander et al. 2004; Brannstrom 2001; Wittman

			2009, 2010.
Access to infrastructure and agricultural inputs	Food security	Market and distribution infrastructure and access to agricultural inputs shape production systems, food system resilience, and food accessibility.	World Bank 2007; Sumberg et al. 2012b; IAASTD 2009; Patel et al. 2014; Bezner Kerr 2012; 2005
	Biodiversity	High input agricultural systems, especially at the agricultural frontier involving land clearing, impact biodiversity and landscape degradation; road infrastructure can shape advancement of the agricultural frontier.	Baletti 2012; Fearnside 2001; Matson et al. 1997; Barona et al. 2010
Political agency and rights	Food security	Citizen role in setting food policy affects food availability and distribution systems.	Edelman and Carwil 2011; Edelman 2008; Borras et al. 2008; Wittman et al. 2009; Wittman 2011
	Biodiversity	Political and social entitlements shape access and use of environmental resources and services.	Leach et al. 1999; Wittman et al 2010; Wittman and Blesh 2015
Education, Knowledge and Social Networks	Food security	Multiple benefits, including possible increases in agricultural productivity, agrobiodiversity, entitlements, maternal, and postpartum care, agency, nutritional knowledge.	Smith and Haddad 2015; Alderman and Headey 2014; Nuñez-Espinoza et al. 2014; Wittman and Blesh, 2015
	Biodiversity	Alters the normative underpinnings for biodiversity conservation; may increase agrobiodiversity and agroecological management practices.	Van Weelie and Wals 2002; García-Barrios et al. 2008; McAfee and Shapiro 2010; Wittman et al 2010
Gender equity/women's status	Food Security	Multiple benefits, including possible increases in agricultural productivity, entitlements, maternal, and postpartum care, agency, nutritional knowledge; increased say in household spending; increased productivity from equal access to resources	Alderman and Headey 2014; Agarwal 2015; Smith and Haddad 2000; 2015

	Biodiversity	Greater gender equality can play a critical role in maintaining biodiversity in forest ecosystems; alters the normative underpinnings for biodiversity conservation.	Van Weelie and Wals 2002; García-Barrios et al. 2008; Agarwal 2009; 1997; 1988; McSweeney 2005; Zimmerer et al. 2015
Affluence and capital assets	Food security	Income has multiple indirect effects on food security, as well as serving as a form of food entitlement.	Sen 1981; Smith and Haddad 2000; 2015
	Biodiversity	Affluence drives biodiversity-harming consumption through a variety of mechanisms.	Bradshaw et al. 2010; Holland et al. 2009; Weinzettel et al. 2013
Farm practices	Food security	Crop choice, diversification and farming type (for subsistence, local markets, and export) affect household and community food availability and price.	Seufert et al. 2012; Badgley et al. 2007; Connor, 2007; Dahal et al. 2009; Kasem and Thapa, 2011; Jones 2015; Jones et al 2014; Blesh and Wittman, 2015
	Biodiversity	Land management decisions, including deforestation at the agricultural frontier, affect both wild and on-farm biodiversity, particularly with negative effects of high input agricultural practices; crop rotation selection, use of organic nutrient amendments, reduced chemical inputs, and building soil organic matter reserves all impact planned and associated biodiversity.	Chappell et al. 2013; Frishkoff et al. 2014; IAASTD 2009; Power 2010; Norton et al. 2013; Phelps et al. 2013; Barona et al. 2010; Jarvis 2008; Blesh and Wittman, 2015

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