

Supplementary materials

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S1: Data parameters extracted and coded as nodes, cases, and classifications

a

Nodes	
★	Name
[-]	Adaptation
	Constraints
	Focal area
	Strategies
	Type
	Exposure
[-]	Impacts
	Biodiversity
	Diseases
	Economic
	Feeds
	Food security
	Heat stress
	Livestock numbers
	Performance
	Product quality
	Reproduction
	Water and other natural resource
	Implications
	Knowledge gaps
	Livestock purpose
[-]	Production system
	Description
	Research needs

b

Cases	
★	Name
	Geoeconomic group
	Geographic area
	Research method
	Source of data
	Species focus
	Study type
	Topical focus

c

Source Classifications	
★	Name
[-]	Reference
★	Name
	Reference Type
	Author
	Year
	Title
	Publisher
	Type of Work

S2: Publications included in the analysis (n=126)

N	Author	Title	Year of Publication	Publisher/ Journal	Geo-economic Group	Geographic area	Production Systems classification
1	Ahmed, et al.	The impact of climate changes on livestock sector: Challenging experience from bangladesh	2013	Asian Journal of Animal and Veterinary Advances	Developing	Bangladesh	Not specified
2	Ahmed, et al.	Climate change concern to cattle feed in Bangladesh	2012	Journal of Animal and Veterinary Advances	Developing	Bangladesh	Extensive Cattle
3	Alam & Ai-Amin	The impacts of climate change on animal health and economy: A way forward for policy option	2011	Asian Journal of Animal and Veterinary Advances	Developing	Global	Not specified
4	Ayal & Leal	Farmers' perceptions of climate variability and its adverse impacts on crop and livestock production in Ethiopia	2017	Journal of Arid Environments	Developing	Ethiopia	Mixed crop-livestock
5	Banik, et al.	Climate Change: Impacts on Livestock Diversity in Tropical Countries	2015	Livestock Production and Climate Change	Developing	Global	Tropical area
6	Berhe, et al.	The effects of adaptation to climate change on income of households in rural Ethiopia	2017	Pastoralism-Research Policy and Practice	Developing	Ethiopia	Agropastoral and Mixed
7	Bett, et al.	Effects of climate change on the occurrence and distribution of livestock diseases	2017	Preventive Veterinary Medicine	Developing	East Africa	Not specified
8	Chauhan, et al.	Impact of climate change on livestock production: A review	2014	Journal of Animal Research	Developed	India	Not specified
9	Chingala, et al.	Determinants of smallholder farmers' perceptions of impact of climate change on beef production in Malawi	2017	Climatic Change	Developing	Malawi	Extensive Cattle

10	Clarke, et al.	Climate change perceptions, drought responses and views on carbon farming amongst commercial livestock and game farmers in the semiarid Great Fish River Valley, Eastern Cape province, South Africa	2012	African Journal of Range & Forage Science	Developing	South Africa	Semi-arid and Arid Areas
11	Cohen, et al.	Evaluation of the effects of climate change on forage and livestock production and assessment of adaptation strategies on the Canadian prairies	2002	A Report to The Prairie Adaptation Research Collaborative Canadian Climate Change Action Fund	Developed	Canada	Pasture/Grazing based
12	Cooper, et al.	Potential impacts of climate change on veterinary medicinal residues in livestock produce: An island of Ireland perspective	2015	Trends in Food Science and Technology	Developed	Ireland	Not specified
13	Cox, et al.	A Survey-Based Assessment of Cattle Producers' Adaptation to Climate Change in British Columbia, Canada	2015	Rangeland Ecology & Management	Developed	Canada	Ranching
14	Craine, et al.	Climate change and cattle nutritional stress	2010	Global Change Biology	Developed	United States	Intensive Pasture
15	Crimp, et al.	Managing Murray-Darling Basin livestock systems in a variable and changing climate: Challenges and opportunities	2010	Rangeland Journal	Developed	Australia	Rangeland
16	Das, et al.	Impact of heat stress on health and performance of dairy animals: A review	2016	Veterinary World	Developed	Global	Not specified
17	Debela, et al.	Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia	2015	Springerplus	Developing	Ethiopia	Agro-pastoralism
18	Derner, et al.	Vulnerability of grazing and confined livestock in the Northern Great Plains to projected mid- and late-twenty-first century climate	2017	Climatic Change	Developed	United States	grazing and confined livestock systems
19	Descheemaeker, et al.	Climate change adaptation and mitigation in smallholder crop–livestock systems in sub-Saharan Africa: a call for integrated impact assessments	2016	Regional Environmental Change	Developing	Sub-saharan Africa	Mixed crop-livestock
20	Descheemaeker, et al.	Effects of climate change and adaptation on the livestock component of mixed farming systems: A modelling study from semi-arid Zimbabwe	2016	Agricultural Systems	Developing	Zimbabwe	Mixed crop-livestock

21	Fang, et al.	Frozen soil change and adaptation of animal husbandry: A case of the source regions of Yangtze and Yellow Rivers	2011	Environmental Science and Policy	Developed	China	Agropastoral
22	Feleke, et al.	Determinants of adaptation choices to climate change by sheep and goat farmers in Northern Ethiopia: the case of Southern and Central Tigray, Ethiopia	2016	Springerplus	Developing	Ethiopia	Extensive
23	Forman, et al.	Climate change impacts and risks for animal health in Asia	2008	Revue Scientifique Et Technique-Office International Des Epizooties	Developing	Asia	Extensive-smallholders
24	Franzluebbers	Climate change and integrated crop-livestock systems in temperate-humid regions of north and South America: Mitigation and adaptation	2014	Climate Change Impact and Adaptation in Agricultural Systems	Developing	South America	Mixed crop-livestock
25	Gale, et al.	The effect of climate change on the occurrence and prevalence of livestock diseases in Great Britain: a review	2009	Journal of Applied Microbiology	Developed	United Kingdom	Not specified
26	Galvin, et al.	Climate variability and impacts on east African livestock herders: The Maasai of Ngorongoro Conservation Area, Tanzania	2004	African Journal of Range and Forage Science	Developing	Tanzania	Pastoral system
27	Gaughan & Cawdell-Smith	Impact of climate change on livestock production and reproduction	2015	Climate Change Impact on Livestock: Adaptation and Mitigation	Global	Global	Not specified
28	Gethings, et al.	Asynchrony in host and parasite phenology may decrease disease risk in livestock under climate warming: Nematodirus battus in lambs as a case study	2015	Parasitology	Developed	United Kingdom	Small ruminants/Pasture
29	Ghahramani & Moore	Climate change and broadacre livestock production across southern Australia. 2. Adaptation options via grassland management	2013	Crop & Pasture Science	Developed	Australia	Broadacre/rangelands
30	Gilbert, et al.	Climate change and avian influenza	2008	Revue Scientifique Et Technique-Office International Des Epizooties	Global	Global	Intensive Poultry
31	Giridhar & Samireddypalle	Impact of climate change on forage availability for livestock	2015	Climate Change Impact on Livestock: Adaptation and Mitigation	Global	Global	Grazing

32	Godber, et al.	Livestock and food security: vulnerability to population growth and climate change	2014	Global Change Biology	Global	Global	Not specified
33	Hall & Wreford	Adaptation to climate change: The attitudes of stakeholders in the livestock industry	2012	Mitigation and Adaptation Strategies for Global Change	Developed	United Kingdom	Not specified
34	Hansen	Heat Stress and Climate Change	2011	Comprehensive Biotechnology, Second Edition	Developed	Global	Not specific
35	Harrison, et al.	Management options for dairy farms under climate change: Effects of intensification, adaptation and simplification on pastures, milk production and profitability	2017	Agricultural Systems	Developed	Australia	Intensive-Pasture based
36	Henry, et al.	Livestock production in a changing climate: adaptation and mitigation research in Australia	2012	Crop & Pasture Science	Developed	Australia	Extensive grazing system
37	Herrero, et al.	Climate change and pastoralism: Impacts, consequences and adaptation	2016	Revue Scientifique Et Technique-Office International Des Epizooties	Global	Global	Pastoral system
38	Herrero, et al.	Livestock and the Environment: What Have We Learned in the Past Decade?	2015	Annual Review of Environment and Resources	Global	Global	Not specified
39	Hoffmann	Climate change and the characterization, breeding and conservation of animal genetic resources	2010	Animal Genetics	Global	Global	Not specified
40	Hou	Adaptation of mixed crop-livestock systems in Asia	2014	Climate Change Impact and Adaptation in Agricultural Systems	Developing	Asia	Mixed crop-livestock
41	Hou, et al.	The perception and adaptation of herdsmen to climate change and climate variability in the desert steppe region of northern China	2012	Rangeland Journal	Developed	China	Pastoral system
42	Howden, et al.	Climate change and Australian livestock systems: Impacts, research and policy issues	2008	Australian Journal of Experimental Agriculture	Developed	Australia	Sector-wide
43	Hristov, et al.	Climate change effects on livestock in the Northeast US and strategies for adaptation	2017	Climatic Change	Developed	United States	Sector-wide

44	Huho & Ngaira	Pastoralism and the changing climate in the arid northern Kenya	2011	Livestock: Rearing, Farming Practices and Diseases	Developing	Kenya	Pastoralism
45	Johannesen, et al.	Livestock management at northern latitudes: Potential economic effects of climate change in sheep farming: Potential economic effects of climate change in sheep farming	2013	Ecological Economics	Developed	Norway	Grazing
46	Joshi,et al.	Herders' perceptions of and responses to climate change in Northern Pakistan	2013	Environmental Management	Developing	Pakistan	Agro-pastoralism
47	Kabubo-Mariara	Climate change adaptation and livestock activity choices in Kenya: An economic analysis	2008	Natural Resources Forum	Developing	Kenya	Extensive
48	J. Kabubo-Mariara	Global warming and livestock husbandry in Kenya: Impacts and adaptations	2009	Ecological Economics	Developing	Kenya	Mixed crop livestock
49	Kachergis, et al.	Increasing flexibility in rangeland management during drought	2014	Ecosphere	Developed	United States	Rangelands
50	Kadzere, et al.	Heat stress in lactating dairy cows: A review	2002	Livestock Production Science	Developed	United States	Pasture/Grazing based
51	Key & Sneeringer	Potential Effects of Climate Change on the Productivity of U.S. Dairies	2014	American Journal of Agricultural Economics	Developed	United States	Rangelands
52	Kimaro & Chibinga	Potential impact of climate change on livestock production and health in East Africa: A review	2013	Livestock Research for Rural Development	Developing	East Africa	Sector-wide
53	Koluman Darcan & Silanikove	The advantages of goats for future adaptation to Climate Change: A conceptual overview	2017	Small Ruminant Research	Developing	Global	Extensive
54	Kuczynski, et al.	Impact of global climate change on the health, welfare and productivity of intensively housed livestock	2011	International Journal of Agricultural and Biological Engineering	Global	Global	Intensive-Confined
55	Lia,et al.	Econometric analysis of the impacts of climate change on the livestock production in qinghai province	2013	Chinese Journal of Population Resources and Environment	Developed	China	Grazing-Grassland based
56	Lin, et al.	Strategies for preventing heat stress in poultry	2006	World's Poultry Science Journal	Global	Global	Not specified

57	Liu, et al.	Herdsmen's Adaptation to Climate Changes and Subsequent Impacts in the Ecologically Fragile Zone, China	2013	Advances in Meteorology	Developed	China	Pastoral system
58	Liu, et al.	Heat Stress in Dairy Cattle Alters Lipid Composition of Milk	2017	Scientific Reports	Developed	Australia	Not specified
59	Mader, et al.	Potential climate change effects on warm-season livestock production in the Great Plains	2009	Climatic Change	Developed	United States	Intensive confined
60	Maiti, et al.	Adapting to climate change: Traditional coping mechanism followed by the Brokpa pastoral nomads of Arunachal Pradesh, India	2014	Indian Journal of Traditional Knowledge	Developing	India	Pastoral system
61	Maiti, et al.	Climate change awareness among the livestock rearers of east coast of India	2016	Indian Journal of Animal Sciences	Developed	India	Extensive
62	Marshall, et al.	Vulnerability of the livestock industry in eastern Australia	2017	Sustainability Science	Developed	Australia	Pasture/Grazing based
63	Martin & Magne	Agricultural diversity to increase adaptive capacity and reduce vulnerability of livestock systems against weather variability - A farm-scale simulation study	2015	Agriculture Ecosystems & Environment	Developed	France	Sector-wide
64	Martin, et al.	How much climate change can pastoral livelihoods tolerate? Modelling rangeland use and evaluating risk	2014	Global Environmental Change	Developing	Morocco	Pastoral system
65	Martinsohn & Hansen	The Impact of Climate Change on the Economics of Dairy Farming - a Review and Evaluation	2012	German Journal of Agricultural Economics	Developed	Global	Intensive
66	McKeon, et al.	Climate change impacts on northern Australian rangeland livestock carrying capacity: a review of issues	2009	Rangeland Journal	Developed	Australia	Rangeland
67	Megersa, et al.	Impacts of climate change and variability on cattle production in southern Ethiopia: Perceptions and empirical evidence	2014	Agricultural Systems	Developing	Ethiopia	Pastoral system
68	Megersa, et al.	Livestock Diversification: an Adaptive Strategy to Climate and Rangeland Ecosystem Changes in Southern Ethiopia	2014	Human Ecology	Developing	Ethiopia	Pastoral system

69	Moore & Ghahramani	Climate change and broadacre livestock production across southern Australia. 3. Adaptation options via livestock genetic improvement	2014	Animal Production Science	Developed	Australia	Rangelands
70	Mu, et al.	Adaptation to climate change: changes in farmland use and stocking rate in the U.S	2013	Mitigation and Adaptation Strategies for Global Change	Developed	United States	Rangeland
71	Muchuru & Nhamo	Climate change and the African livestock sector: Emerging adaptation measures from UNFCCC national communications	2017	International Journal of Climate Change Strategies and Management	Developing	Africa	Sector-wide
72	Ness	Tibetan nomads facing an uncertain future: Impacts of climate change on the Qinghai-Tibetan Plateau	2012	Community, Environment and Disaster Risk Management	Developing	Tibet	Pastoral system
73	Nardone, et al.	Effects of climate changes on animal production and sustainability of livestock systems	2010	Livestock Science	Global	Global	Sector-wide
74	Naskar, et al.	Strategies to improve livestock genetic resources to counter climate change impact	2015	Climate Change Impact on Livestock: Adaptation and Mitigation	Global	Global	Sector-wide
75	Notenbaert, et al.	Targeting, out-scaling and prioritising climate-smart interventions in agricultural systems: Lessons from applying a generic framework to the livestock sector in sub-Saharan Africa	2017	Agricultural Systems	Developing	Sub-saharan Africa	Mixed crop-livestock
76	Opiyo, et al.	Determinants of perceptions of climate change and adaptation among Turkana pastoralists in northwestern Kenya	2016	Climate and Development	Developing	Kenya	Pastoral system
77	Ou & Mendelsohn	An analysis of climate adaptation by livestock farmers in the Asian tropics	2017	Climate Change Economics	Developing	Asia	Sector-wide
78	Oyekale	Impacts of climate change on livestock husbandry and adaptation options in the arid sahel belt of West Africa: Evidence from a baseline survey	2014	Asian Journal of Animal and Veterinary Advances	Developing	West Africa	Sector-wide
79	Özkan, et al.	Challenges and priorities for modelling livestock health and pathogens in the context of climate change	2016	Environmental Research	Developed	Europe	Sector-wide

80	Panthi, et al.	Livelihood vulnerability approach to assessing climate change impacts on mixed agro-livestock smallholders around the Gandaki River Basin in Nepal	2016	Regional Environmental Change	Developing	Nepal	Mixed crop-livestock
81	Part, et al.	Prevalence rates of health and welfare conditions in broiler chickens change with weather in a temperate climate	2016	Royal Society Open Science	Developed	United Kingdom	Intensive/confined
82	Poudel	Factors associated with farm-level variation, and farmers' perception and climate change adaptation in smallholder mixed-farming livestock production system in Nepal	2015	International Journal of Environment and Sustainable Development	Developing	Nepal	Mixed crop-livestock
83	Prasad & Sejian	Climate change impact on livestock sector: Visioning 2025	2015	Climate Change Impact on Livestock: Adaptation and Mitigation	Developing	Global	Sector-wide
84	Punsalmaa, et al.	Adaptation measures to climate change in the Mongolian livestock sector	2013	Climate Adaptation Futures	Developing	Mongolia	Pastoral system
85	Reeves, et al.	Potential Climate Change Impacts on Four Biophysical Indicators of Cattle Production from Western US Rangelands	2017	Rangeland Ecology & Management	Developed	United States	Rangelands
86	Renaudeau, et al.	Adaptation to hot climate and strategies to alleviate heat stress in livestock production	2012	Animal	Developing	Global	Sector-wide
87	Reynolds, et al.	Livestock and climate change impacts in the developing world	2010	Outlook on Agriculture	Developing	Global	Sector-wide
88	Rojas-Downing, et al.	Pasture diversification to combat climate change impacts on grazing dairy production	2017	Mitigation and Adaptation Strategies for Global Change	Developed	United States	Pasture/Grazing based
89	Rojas-Downing, et al.	Climate change and livestock: Impacts, adaptation, and mitigation	2017	Climate Risk Management	Global	Global	Sector-wide
90	Rust & Rust	Climate change and livestock production: A review with emphasis on Africa	2013	South African Journal of Animal Sciences	Developing	Africa	Mixed crop-livestock
91	Salama, et al.	Different levels of response to heat stress in dairy goats	2014	Small Ruminant Research	Global	Global	Not specified

92	Sautier, et al.	Use of productivity-defined indicators to assess exposure of grassland-based livestock systems to climate change and variability	2013	Crop & Pasture Science	Developed	France	Pasture/Grazing based
93	Sautier, et al.	Assessing climatic exposure of grassland-based livestock systems with seasonal-scale indicators	2013	Climatic Change	Developed	France	Pasture/Grazing based
94	Sejian, et al.	Introduction to concepts of climate change impact on livestock and its adaptation and mitigation	2015	Climate Change Impact on Livestock: Adaptation and Mitigation	Global	Global	Sector-wide
95	Seo	Untold Tales of Goats in Deadly Indian Monsoons: Adapt or Rain-Retreat under Global Warming?	2016	Journal of Extreme Events	Developed	India	Extensive
96	Seo & Mendelsohn	Measuring impacts and adaptations to climate change: A structural Ricardian model of African livestock management	2008	Agricultural Economics	Developed	Africa	Extensive
97	Seo, et al.	Adapting to Climate Change Mosaically: An Analysis of African Livestock Management by Agro-Ecological Zones	2009	The B.E. Journal of Economic Analysis & Policy	Developing	Africa	Sector-wide
98	Seo, et al.	From beef cattle to sheep under global warming? An analysis of adaptation by livestock species choice in South America	2010	Ecological Economics	Developing	South America	Sector-wide
99	Shikuku, et al.	Prioritizing climate-smart livestock technologies in rural Tanzania: A minimum data approach	2017	Agricultural Systems	Developing	Tanzania	Mixed crop-livestock
100	Silanikove	The physiological basis of adaptation in goats to harsh environments	2000	Small Ruminant Research	Developing	Global	Extensive
101	Silanikove & Nazan	Impact of climate change on the dairy industry in temperate zones: Predications on the overall negative impact and on the positive role of dairy goats in adaptation to earth warming	2015	Small Ruminant Research	Developed	Europe	Temperate zone
102	Singh, et al.	Evaluation of Indian sheep breeds of arid zone under heat stress condition	2016	Small Ruminant Research	Developed	India	Arid Zone
103	Skuce, et al.	Animal health aspects of adaptation to climate change: beating the heat and parasites in a warming Europe	2013	Animal: an international journal of animal bioscience	Developed	Europe	Intensive
104	Soussana, et al.	Improving the use of modelling for projections of climate change impacts on crops and pastures	2010	Journal of Experimental Botany	Developed	Europe	Pasture/Grazing based

105	Speranza	Drought Coping and Adaptation Strategies: Understanding Adaptations to Climate Change in Agro-pastoral Livestock Production in Makueni District, Kenya	2010	European Journal of Development Research	Developing	Kenya	Agro-pastoralism
106	Thamo, et al.	Climate change impacts and farm-level adaptation: Economic analysis of a mixed cropping–livestock system	2017	Agricultural Systems	Developed	Australia	Mixed crop-livestock
107	Thornton, et al.	Vulnerability, climate change and livestock-research opportunities and challenges for poverty alleviation	2007	Journal of SAT Agricultural Research	Developing	Global	Sector-wide
108	Thornton & Gerber	Climate change and the growth of the livestock sector in developing countries	2010	Mitigation and Adaptation Strategies for Global Change	Developing	Global	Sector-wide
109	Thornton & Herrero	Climate change adaptation in mixed crop - livestock systems in developing countries	2014	Global Food Security-Agriculture Policy Economics and Environment	Developing	Sub-saharan Africa and South Asia	Mixed crop-livestock
110	Thornton & Herrero	Adapting to climate change in the mixed crop and livestock farming systems in sub-Saharan Africa	2015	Nature Climate Change	Developing	Sub-saharan Africa	Mixed crop livestock
111	Thornton, et al.	The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know	2009	Agricultural Systems	Developing	Global	Sector-wide
112	Tibbo & van de Steeg	Climate change adaptation and mitigation options for the livestock sector in the near east and North Africa	2013	Climate Change and Food Security in West Asia and North Africa	Developing	North Africa	Mixed crop-livestock
113	Tilahun, et al.	Community-based knowledge towards rangeland condition, climate change, and adaptation strategies: the case of Afar pastoralists	2017	Ecological Processes	Developing	Ethiopia	Pastoral system
114	Treydte, et al.	Rangeland forage availability and management in times of drought – A case study of pastoralists in Afar, Ethiopia	2017	Journal of Arid Environments	Developing	Ethiopia	Pastoral system

115	Van Dijk, et al.	Climate change and infectious disease: Helminthological challenges to farmed ruminants in temperate regions	2010	Animal	Developed	United Kingdom	Intensive/Temperate
116	Verschave, et al.	Cattle and Nematodes Under Global Change: Transmission Models as an Ally	2016	Trends in Parasitology	Developed	Global	Intensive
117	Wako, et al.	Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia	2017	Ecological Processes	Developing	Ethiopia	Pastoral system
118	Weindl, et al.	Livestock in a changing climate: Production system transitions as an adaptation strategy for agriculture	2015	Environmental Research Letters	Global	Global	Sector-wide
119	West, J. W.	Effects of heat-stress on production in dairy cattle	2003	Journal of Dairy Science	Developed	United states	Intensive
120	Wheeler & Reynolds	Predicting the risks from climate change to forage and crop production for animal feed	2013	Animal frontiers	Developed	Global	Sector-wide
121	White, et al.	The vulnerability of the Australian beef industry to impacts of the cattle tick (Boophilus microplus) under climate change	2003	Climatic Change	Developed	Australia	Rangeland
122	Wilkes, et al.	Is cross-breeding with indigenous sheep breeds an option for climate-smart agriculture?	2017	Small Ruminant Research	Developing	Mongolia	Extensive
123	Wolfe, et al.	Projected change in climate thresholds in the Northeastern U.S.: Implications for crops, pests, livestock, and farmers	2008	Mitigation and Adaptation Strategies for Global Change	Developed	United States	Mixed crop-livestock
124	Wu	The response of the distributions of Asian buffalo breeds in China to climate change over the past 50 years	2015	Livestock Science	Developed	China	Extensive
125	Zhang, et al.	Adaptation of herders to droughts and privatization of rangeland-use rights in the arid Alxa Left Banner of Inner Mongolia	2013	Journal of Environmental Management	Developing	Mongolia	Semi-arid and Arid Areas
126	Zougmore, et al.	Toward climate-smart agriculture in West Africa: A review of climate change impacts, adaptation strategies and policy developments for the livestock, fishery and crop production sectors	2016	Agriculture and Food Security	Developing	West Africa	Mixed crop-livestock