

Index

- Advisory Board on Biodiversity and Genetic Resources at BMELV 229
- Africa 96, 182, 317
 elephants 315, 319–20, 323
- agency costs 344–5, 402
- Agenda 21 403
- agroecology 196
- agroecosystems 34, 81–3, 189–91
- Albani, M. 305
- albatross 309–10
- Andow, D.A. 149–50
- aquaculture 26, 81, 151, 197, 198–200, 204, 316
- Arrow, K.J. 80, 266, 276
- Asia 8, 96, 133, 189
 elephants 49, 79
- Australia 264, 341–4
 Aborigines and tribal rights 303, 324
- Atherton Tablelands – tree corridors 339
- buffel grass 377
- cactoblastis moth 376–7
- cane toads 23, 43, 376–8
- cattle grazing and red kangaroos 316
- Coles supermarket and Indigenous Food Fund 113–14
- common wallaroos 138
- Currumbin Wildlife Sanctuary 310–11
- European carp 23
- fairly penguins 309
- feral pigs 22, 37, 182, 383
- fire ants 377–8
- hand-fed animals and dependence on humans 310–11
- hare-wallabies 138
- hawksbill turtles 225
- indigenous food plants, late cultivation of 111–14
- kangaroos 304, 316, 324
 Eastern Grey 138
 Red 36–7, 138
 tree 49, 306, 312, 333, 339
 Western Grey 138
- Lamington National Park 247–9, 310
- livestock 132, 138, 140, 141
- Lone Pine Koala Sanctuary 311
- macadamia nuts 112–13
- mahogany glider 249
- Monkey Mia 311
- Moreton Island 311
- mosaic burning by Aborigines 22
- northern hairy-nosed wombat 49, 138
- O'Reilly's wild birds as tourist attraction 310
- Paluma National Park: Jourama Falls Section (Queensland) 249
- Parks and Wildlife Commission 343
- path dependence in developing indigenous plants for commercialization 56
- Phytophthora* (crown/root rot) 23
- Pinus radiata* (pine) 201
- prickly pears 376–7
- property rights in non-captive wildlife conservation 315
- Queensland Parks and Wildlife Service (Mon Repos Rookery) sea turtle conservation 310
- rabbits 383
- red river gums 102
- red-tailed black cockatoo 327, 342–4
- saltwater crocodiles 61, 225, 271, 320–21, 324, 332, 342–3
- shrub spinifex 138
- taipan snake 250
- turtles 225, 310

- Bacillus thuringiensis* (Bt) modified
crops 147, 151, 154–5, 157, 161,
164, 171, 173
pest and disease control, declining
effectiveness of 212, 218
bacteria 146, 211–12
Balmford, A. 194
Bandara, R. 80
Batie, S.S. 147, 158, 163, 171
Baumol, W.J. 159
Bennett, M. 196
Benson, D.E. 302–3, 336
bequest values 49, 306
Bergson, A. 31, 269
Bever, M. 389, 393, 400, 403, 404
Biggs, R. 149
bilateral agreements 224, 236
Binkley, C.S. 391
bio-industries 23–4, 45, 46, 91
biofuels 94–5, 115, 151
biological fitness 107
biological law of tolerance 135
biological stock conservation 70–75
biomes 34, 367
biophysical relationships 375–6, 378,
382, 386
biopolitics 321
biosafety regulations 158, 168, 170
Bishop, R.C. 76, 329
black rhinoceros 303
Blench, R. 120, 130
Boscolo, M. 392–3
Botswana 320
Okavango Delta 55
bounded rationality 68–9, 245, 258,
270, 372
Bowes, M.D. 391
Braat, L. 261
Brazil 98
Brennan, G. 227
Bromley, D.W. 323
Brown, R.P.C. 111
Brown, T.C. 177
Brundtland Report 62
Brush, S.B. 234–5, 237
built capital 364
Canada: Inuits and tribal rights
303
Cao, S. 378–9
capital accumulation and advances in
science and technology 45–7
carbon dioxide levels 75, 91, 188, 298,
392
Caring for the World 280
Cartagena Protocol 228
cattle *see* livestock
cereals 41–2, 94–6, 107, 109, 111, 115
rice 33, 45–6, 75, 155, 192–3, 205
wheat 41–2, 44, 45–6, 96, 112, 192–3,
205
see also corn (maize)
Cerneau, M.M. 323
certification schemes 171
Chapin III, F.S. 182
Chiarolla, C. 233
Chicago School of Economics 222
China 44, 96, 98, 201, 341
Bacillus thuringiensis (Bt) cotton
147, 154
desertification 375, 378–80, 387–8
genetically modified organisms
(GMOs) 147–8, 155, 160–61,
171
Grain for Green Project 16, 379–80,
382
livestock 134, 136
State Forest Administration 378, 380
Ciriacy-Wantrup, S.V. 76, 78–9, 84,
139–40, 252, 283, 304, 315
Clark, C. 126, 304–5, 349, 353–4
Clark, J.M. 12, 47, 216
classification of genetic resources stock
and ecosystems 5–6, 19–39
determinants of changes 22–6
economic trade-offs involved in
transformation of ecosystems
31–3
germplasm in the wild 22–6
Millennium Ecosystem Assessment
26–30
monetary values of ecosystem
services 29
natural capital 19–20, 35
nature, classification and value of
ecosystems 26–33
organisms as assets or pests
(liabilities) 35–8
partitions of biosphere,
determination of status of 34–5

- taxonomy to assist economic analysis 21–2
- The Economics of Ecosystems and Biodiversity (TEEB) 19–20, 26–31
- Clements, F.E. 178
- climate change and global warming 46, 75, 104, 108, 352
- club goods 227
- co-evolution 120, 140, 169–70
- Coase, R.H. 222
- coefficients of concern for future generations 68–9
- Columbus, C. 44
- Commission on Genetic Resources for Food and Agriculture 226
- commodification 173
- common-pool resources 217
- communal management/governance 323
- communitarianism 185
- community and public incentives 328
- comparative advantage 50, 123, 280, 283, 285–90, 298
- compensation
 - aggregate amounts and distribution 234–5
 - economic incentives for wildlife conservation on private lands 333, 336, 340, 341
 - valuing and sustaining natural ecosystem services 366
 - when others use heritage germplasm 233, 234
 - wild biodiversity and natural ecosystems: conservation and loss 251–2, 271–2
 - see also* willingness to accept compensation (WAC)
- consumer sovereignty 195
- consumer surplus, loss of 105–6
- convenience foods 93, 111
- Convention on Biological Diversity (CBD) 12, 15, 224–5, 236, 319, 323
- Convention on International Trade in Endangered Species (CITES) 15, 225, 319, 320, 321, 323
- Conway, G.R. 7, 81–3, 85, 86, 189–91, 204
- coral reefs 29, 102
- corn (maize) 44, 96, 150–51, 173, 205
 - genetically modified organisms (GMOs) 157, 169
 - human developed and modified ecosystems 192–3, 196
- cost of replacement method 372–5, 381–2
- cost-effectiveness 109, 114, 263–4, 274–5
- Costanza, R. 259, 275, 363–5, 367–9, 371, 382–3
- Craft, A.B. 252
- crop yields 81–3, 180, 190–91
- crops and socio-economics of biodiversity loss and change 7–9, 91–115
 - demand, changes in and genetic loss 92–6, 99
 - demand and potential economic benefits of germplasm conservation 104–6
 - economic growth and macroeconomic factors 99–101
 - existing food crop germplasm, loss of 92–9
 - harvesting methods 96–7
 - high yielding varieties (HYVs) 96
 - indigenous food crop varieties in Pacific Islands 110–11, 114, 115
 - indigenous food plants in Australia 111–14
 - intensification 102
 - land-saving (land-sparing) agroecosystems and biodiversity loss 101–3, 114
 - livelihood and income dependence 106
 - market extension including increased international trade 97–9
 - methods for crop germplasm conservation (e.g. gene banks) 108–10
 - mixed cropping 196
 - predictable environmental or ecological changes (e.g. climate change) 106–7
 - public policy and economic priorities for crop germplasm conservation 103–7

- supply-side influences 96–7, 99
- varieties of crops 97
- see also* cereals; oil palm
- cross-breeding 121, 150
- cross-fertilization 108, 155
- cross-pollination 170–71
- Crothwaite, J. 336–7
- cultural services 365–6

- Daly, H.E. 6, 62, 69, 71, 73
- David, P.A. 124
- Dawkins, R. 68
- DDT resistance 212
- De Groot, R. 367
- De Haas, Y. 131–2
- Deane, P. 351
- decoupling 3, 24, 34–5, 110, 121, 133–6, 140, 197
- deforestation 75
- Denison, E.F. 351, 353
- desertification 375, 378–80, 387–8
- diamond-water paradox 382
- discount rates 349, 355
- discounting 183, 185
- diseases 35, 104, 135, 191
- see also* pest and disease control
- DNA 74, 146, 231
- domesticated species 25–6, 101
- drop-off effect 249, 258, 274
- drought-resistance 107
- Durand, G. 183

- economic growth, macroeconomic
 - factors and biodiversity loss 99–101
- economic incentives for wildlife
 - conservation on private lands 15, 16, 327–46
 - Australia 341–4
 - Australia: red-tailed black cockatoo 327, 342–4
 - Australia: saltwater crocodile eggs 332, 342–3
 - compensation 333, 336, 340, 341
 - financial incentives 335–40, 344
 - government intervention 333–4, 335
 - grants 340, 344
 - habitat restoration and protection 335, 338–40
 - loans 344
 - market failures and usefulness of markets 332, 333–5
 - mobility of wildlife 327, 333–4
 - non-use values 327, 333, 337, 339, 341, 345
 - payment for ecosystem services (PES) 327, 335
 - private property rights and free markets 330–32
 - prohibition on consumptive wildlife use and/or on habitat destruction 340, 345
 - public interest 329
 - public leasing of private land 336
 - public policies 336
 - social conflict 332
 - Sri Lanka: Asian elephant 328, 333–4, 341
 - subsidies 335, 336, 337–40, 344
 - taxation concessions 336, 340, 344
 - trespass laws 336
 - use values 330–31, 333, 336, 337, 341, 345
 - consumptive 334
 - net 344
 - non-consumptive 331, 334
 - economic regret 77–8
 - economic valuation 182–6, 246–52, 256, 259–61, 262–3
 - collective 334
 - see also* total economic value
- economics and spatial aspects of ecosystem use 14, 16–17, 386–405
 - land sharing and land sparing 387–9
 - see also* selective logging and orangutan conservation
- Ehrlich, P.R. 350
- elephants
 - African 315, 319–20, 323
 - Asian 49, 79
- end-uses 94–5, 97, 192
- endangered species 120, 138, 141, 303, 319
 - see also* Convention on International Trade in Endangered Species (CITES); rare breeds
- Engels, F. 72
- environmental externalities 102, 158, 195

- environmental spillovers 48, 158,
192–3, 199–200
- Erickson, J.D. 304
- Ervin, D.E. 147, 158, 163, 171
- ethanol production 151
- European ‘Age of Discovery’ 42, 44–5,
56–7
- European Union 41, 120, 141
 Patent Office 223, 229
- eutrophication of waterways 102, 188
- exclusion costs 334
- existence values 49, 306, 320, 332, 333
- exotic species 23, 127, 201, 375, 377–8
- expected values, status quo and
 conservation preferences 79–81
- extinction 344–5, 352–4
 livestock 120, 121, 127–9, 138
 property rights in non-captive
 wildlife and biodiversity
 conservation 304–5, 307, 316,
 318
- fall-back options 75
- Farber, S. 369
- farm-holiday sector 311, 329
- Feindt, P.H. 13, 221, 225, 231, 236
- feral pigs 22, 37, 182, 383
- fertilizers 45–6
 crops and socio-economics of
 biodiversity loss and change
 96–7, 102
 human developed and modified
 ecosystems 180, 182, 187,
 190–91, 193, 195
 organic 182
- fires 285, 298
- fish and fisheries 23, 142, 211, 306,
 309, 316, 332
 see also aquaculture
- Fisher, A.C. 80
- food
 conversion ratios 141–2
 fruits 109–10
 potatoes 44, 169
 poultry 142, 211
 security 139
 soya beans 44, 94–5, 169
 tomatoes 44, 169
 see also crops; fish and fisheries;
 livestock
- Food and Agriculture Organisation
 (FAO) 21, 24, 25, 109, 130
 Worldwatch List 120
- forestry 75
 REDD schemes 380
 sustainable forest management
 (SFM) 392
 see also selective logging and
 orangutan conservation;
 silviculture
- France 269
- Franzel, S. 196
- free-riding 54, 177, 266–7, 335
- Freese, C.H. 304
- fruits 109, 110
- fungi/fungal diseases 23, 154, 211
- game-against-nature scenarios 104
- García-Fernández, C. 392
- Garnett, T. 194, 204
- gene banks 108–10
- General Agreement on Tariffs and
 Trade (GATT) Uruguay Round
 223
- genetic diversity 106
 loss 91, 191
- genetic engineering advances and
 genetically modified organisms
 (GMOs) 9–10, 11, 48, 53, 146–73,
 237, 264
 biodiversity loss: ecological processes
 149–54
 biological erosion counteraction
 157
 biosafety regulations 158, 168, 170
- cisgenic organisms 146
- co-evolution, lack of 169–70
- commercial markets 162
- cross-breeding 150
- cross-fertilization 155
- cross-pollination 170–71
- economic factors and nature of
 development and marketing
 160–64
- gene flows 150, 153
- genetically engineered organisms
 (GEOs) 148
- herbicide resistance 147, 155–7, 173
- hybridization 150, 153–4
- industrial-type agriculture 162

- intensification or extension of
 - agriculture, aquaculture or silviculture 150–51
- interspecies competition and resistance 155–7
- legal liability 160, 171–2
- long-term biodiversity change, processes involving 150–53
- overhead costs 162, 165–6
- patents/patent walls 160–61, 165–6, 169
- pest resistance (reduced pesticide) 147, 151, 156–7, 171, 173
- precautionary principle 158–9
- selective breeding and biodiversity loss 153–4
- social conflicts and knowledge imperfections 170–71
- social criterion 159–60
- stock of genetic material 151
- stress tolerance 151
- support from economic theory 164–9
- trade-off between attributes 154–5
- transaction costs 161–2, 167–8, 172
- transgenic organisms 146, 149, 150, 153, 157, 170
- type I and type II errors 158
 - see also Bacillus thuringiensis* (Bt) modified crops; intellectual property rights in human developed genetic material
- genetic introgression 122
- genetic resources *see* classification of genetic resources stock and ecosystems; germplasm
- genetic stock *see* socio-economic processes transforming genetic stock and altering ecosystems; sustainable development and changes in genetic stock and ecosystems
- genome (unit of germplasm) 21, 146
- geographical extension of human contacts and migration 30, 43–5
- Germany 172
 - Luneberg Heath 119
- germplasm 43, 44, 45, 51, 74, 91, 98, 153, 317–18
 - crop conservation 92–9, 103–110 genome 21, 146 heritage 4, 73, 220, 226, 232–4, 236, 239 natural 19–20
- Ghana 388
- Global Environment Facility (United Nations) 383
- Global Food Policy Report of IFPRI* (2013) 192
- globalization 98, 120–22, 126, 127–30, 140, 351–2
- Godden, D. 226–7
- government intervention 333–4, 335
- Gowdy, J. 7, 183
- grants 340, 344
- Green Revolution 24
- greenhouse gas emissions 45–6
- gross domestic product (GDP) 59, 100, 367–8, 369, 370, 381, 382
- Gustavsson, J. 103
- Hall, B.H. 227
- Hall, C.A.S. 304
- Hammond, K. 122
- Harhoff, D. 227
- Harting, J.E. 352
- ‘headstart’ programmes 311
- heat stress 104
- heat-tolerance 107
- Heisenberg principle 258
- Heisey, P. 166
- herbicides 187, 205, 212
 - glufosimate 173
 - glyphosphate 156–7, 173, 212
 - resistance 147, 155–7, 173
- heritage agrobiodiversity 237
- heritage biodiversity 151–2
- heritage capital 4, 35
- heritage germplasm 4, 73, 220, 226, 232–4, 236, 239
- heritage stock 114
- Hiemstra, S.J. 141
- Hodgkin, T. 108
- Hof, J.G. 389, 393, 400, 403, 404
- Holocene era 42, 43, 56, 91, 111, 114, 115, 189
- Honolulu 29
- Horsup, A. 138
- Howarth, R. 369
- human capital 71, 72, 364

- human developed genetic material
see intellectual property rights in human developed genetic material
- human developed and modified ecosystems 7, 10–11, 177–206
 abiotic components 178–9, 187–8
 agroecology 196
 aquaculture 197, 198–200, 204
 attributes and value 189–97
 biotic components 178–9, 187–8
 concept of ecosystem 178–80
 economic valuation 182–6
 extension versus intensification 201–3
 external inputs/human effort 187
 functioning of altered ecosystems 186–9
 high external resource-using agroecosystems 189–91
 hydroponics 197
 non-use value 183
 on-site preparation 187–8
 organic agriculture 194–6, 206
 permaculture 196–7
 resilience and resistance 180–82, 204, 205
 silviculture (managed forestry) 197–8, 200–201, 204
 single monetary values 184–6
 sustainable agricultural intensification 192–4, 204–6
 total economic value 183–4, 204
 use value 183
- Husson, S.J. 283, 296–7, 299, 394–5
- hybridization 96, 150, 153–4, 229, 237
- hydroponics 197
- hypothetical games against nature:
 precaution does not always favour conservation 76–8
- hysteresis (lack of reversibility) 79–81, 125
- impossibility theorem 276
- income factors 4, 79–80, 100, 106, 115, 192
- India 211, 388
- indigenous food crop varieties in Pacific Islands, loss of 110–11, 114, 115
- indigenous food plants in Australia 111–14
- indigenous land rights 303, 324
- Indonesia 46
 palm oil 50, 54
- Industrial Revolution 3
- insecticides 212
- insects 212
 pests 154, 376–8
- institutional considerations 50–56
- intellectual property rights in human developed genetic material 12–13, 51–3, 160–61, 169, 220–39
- anti-commons 231–2
- biotechnological knowledge/research and development (R&D) 221
- biotechnological patents (biopatents) 220, 223, 226–32
- economic development 222
- genetically modified organisms (GMOs) 228
- germplasm 224
- heritage germplasm 220, 226, 232–4, 236, 239
- knowledge about new biotechnology as non-rival but excludable commodity 227
- ‘layering’ 225, 236
- market concentration, barriers to entry and new plant varieties 228–9
- markets extension 222
- new plant varieties 223
- patent blocking of research and patent thickets 231–2
- patent law 221
- policy development 221–6
- political support 221
- private property rights 220
- restrictive market behaviours and biotechnology patents 228
- self-interest 222, 227–8, 232
- social and economic value of market structures 222
- technological progress 222, 228
- transaction costs 231–2, 236, 237
- value of knowledge revealed 228
- wasteful duplication and concentration of research effort 229–31

- see also* International Treaty on Plant and Genetic Resources for Food and Agriculture
intensification 102, 150–51, 192–4, 201–6
interest rates *see* natural capital, loss of and interest rates
intergenerational equity issues 185
International Convention for the Protection of New Varieties of Plants 223
International Treaty on Plant and Genetic Resources for Food and Agriculture (ITPGRFA) 12, 220, 224–5, 232–7, 239, 318
 compensation 233–5
 facilitated access to plant genetic resources 235–6
 heritage germplasm 232, 233–4
 sovereign rights of national governments over plant genetic resources 235, 236
International Union for the Protection of New Varieties of Plants (UPOV Convention) 12, 223, 225–6, 231, 234, 236
interspecies competition and resistance 155–7
invasive species 352, 377
Ireland: potato blight 75
irrigation 10, 96, 102, 187
IS-LM macroeconomic model 355–6, 358–9
Isaacs, J.C. 304
IUCN Red List of Threatened Species 284
- Jenkins, G. 108
Juma, C 196
Just, R.E. 147, 150–51, 153, 163
- Kaldor–Hicks criterion 35–8, 159, 186, 250–51, 254–5, 269, 306–7, 377
Karmer, R. 381
Kenya: Western Kenyan Integrated Management project 383
Keynes, J.M. 72, 360
Kirchmann, H. 195
know-how of value 137
Krall, L. 7
- Kruger, M. 218
Krutilla, J.V. 69, 391
Kumar, P. 26–8, 30, 179
- Laird, S.A. 252
land ethic 331
land use allocation and opportunity
 cost minimization of wild species conservation in natural habitats 14, 279–300
 comparative advantage theory 280, 283, 285–90, 298
 economic cost 281
 landscape features 293, 297–8
 minimum viable population (MVP) 281–2, 284–98
 negative externality costs 297–8
 oil palm production 282, 285, 294, 297–8
 opportunity costs 281
 absolute 280
 comparative 283
 minimum private 294, 298
 private 282–3, 288–9, 290, 291–3
 relative 280, 297–8
 relative marginal 290
 social 282, 293
 orangutan conservation in Borneo and Sumatra 280–81, 284–6, 291, 293, 294–9
 orangutan densities per square kilometre 294–8
 political pressure 291–2
 private economic benefit 287–8
 profit foregone per square kilometre 295
 relevant conceptual issues 281–3
 size of area 293
 timber and logging 285
 trade-off function between
 population level and use of land for commercial production 286–8, 291–2, 296–9
 umbrella species 282–3
 land-saving (land-sparing)
 agroecosystems 101–3, 114, 387–9
landrace plant varieties 235–6
Lei, Z. 238
Leitch, H.W. 122
Lindenmayer, D.B. 391

- Lindner, B. 227–30
 liquidity preference 357–9
 Liu, B. 154
 livestock and socio-economics of
 biodiversity loss 9, 119–42
 biotechnology 122
 Brahman, Brangus and Indian cattle 140
 breed substitution 123
 buffalo 133
 cattle 133, 134, 138, 140, 142
 co-evolution 120, 140
 consequences of livestock husbandry for wild biodiversity loss 137–8
 cross-breeding 121
 dairy cattle and feed-lot beef cattle 134
 decoupling 121, 133–6, 140
 densities 191
 development interventions 122
 diversity of livestock, reduced 123
 economic globalization 120–22, 126, 127–30, 140
 elimination of local breeds 130, 132
 endangered breeds 120, 141
 exotic breeds 127
 extinction 120, 121, 127–9, 138
 feed for livestock 94–5
 food security, impacts of livestock husbandry on 139
 genetic introgression 122
 grazing 119, 137–8
 hobbyists and enthusiasts 141
 imports, availability and price of 123
 initial choices of species 126
 market extension 120–22, 123, 126, 127–30, 133, 140
 multi-purpose breeds of livestock, loss of 131–3
 natural disasters 122
 pastoralism 137–8
 pigs 121, 123, 127, 134, 136–7, 142
 political instability 122
 poultry 123, 134
 productivity and environmental tolerance 134
 proximate causes of breed losses and processes involved 121–3
 rare breeds 120, 133, 141
 regional-specific breed 127
 Schwabisch Hall (Swabian-Hall) pig 127
 sheep 138
 specialized breeds 122, 123, 131
 Swanson dominance effect 123, 124–7, 136–7
 Swanson's lock-in or path-dependence effect 121, 124, 125–6, 131, 134, 140
 tastes and demands, changing 123
 technological development 120–21, 122, 126, 131, 132, 137
 uniformity of livestock 123
 Vietnam: disappearance of local pig breeds 121, 136–7
 loanable funds theory 355–8
 loans 344
 lock-in 91–2, 121, 124, 125–6, 131, 134, 140
 long-term biodiversity change, processes involving 150–53
 Lu, M. 154–5
 maize *see* corn
 Malaysia 50, 390
 Malthus, T. 72
 man-made capital 35
 Margolis, J. 69
 mariculture 316
 market extension 49–50, 97–9, 120–23, 126–30, 133, 140, 318
 market failures 48, 49, 304, 306, 308, 315, 332–5
 market systems 3, 47–50, 111
 maximin gain/minimax loss 63, 66, 76–8
 Meijaard, E. 391
 microbes 49, 135
 migration (mobility) of wildlife 139, 308–10, 322, 323, 327, 333–4
 Millennium Ecosystem Assessment 26, 29–30
 cultural services 27–8
 human developed and modified ecosystems 179–80
 natural resource depletion and economic activity/investment 351–3, 360
 provisioning services 27–8

- regulatory services 27–8
- supporting services 27–8
- valuing and sustaining natural
 - ecosystem services 363, 365–6
- wild biodiversity and natural
 - ecosystems loss 261
- minimum viable population (MVP)
 - 281–2, 284–98, 307, 391–3, 400–401
- mixed goods 306, 319
- mixed land-use 392, 394
- modified ecosystems *see* human
 - developed and modified ecosystems
- monetary values 184–6
- moral or ethical sentiments 250
- Moran, D. 246, 253
- Muir-Leresche, K. 303
- multilateral access 235–6
- mutations 23
- Myers, N. 351
- Myrdal, G. 125

- national parks and protected areas 304, 318
 - Kruger (South Africa) 315, 320
 - Lamington (Australia) 247–9, 310
 - Paluma (Australia) 249
- natural capital 19–20, 35, 72, 177, 363–6
- natural capital, loss of and interest
 - rates 15, 349–61
 - aggregate economic activity and investment 350–53
 - biological capital 349
 - discount rates 349, 355
 - education 351–3
 - exploitation 349, 354–5
 - extinction 352–4
 - GDP 349, 350
 - globalization 351–2
 - interest rate as exogenous variable (microeconomic model) 350, 353–5, 359
 - IS-LM macroeconomic model 355–6, 358–9
 - liquidity preference 357–9
 - loanable funds theory 355–8
 - macroeconomic considerations 355–60
 - market size 351
 - open access 353–5
 - substitution 354
 - technological progress 351–3, 357–8
- natural ecosystem services *see* valuing and sustaining natural ecosystem services
- natural habitats/ecosystems *see* land use allocation and opportunity
 - cost minimization of wild species conservation in natural habitats; wild biodiversity and natural ecosystems: conservation and loss
- Nelson, R.H. 303
- neoclassical welfare economics 269, 275
- Neolithic Revolution 189
- New Zealand 22, 130
- Nigeria 50, 130
- Niskanen, W.A. 267
- nomadism (transmigration) 139
- non-captive wildlife *see* property rights in non-captive wildlife and biodiversity conservation; selective logging and orangutan conservation
- non-governmental organizations (NGOs) 14, 324, 329, 335, 339
- livestock 133, 141
- property rights in non-captive wildlife conservation 309
- valuing and sustaining natural ecosystem services 379, 380–81
- wild biodiversity and natural ecosystems: conservation and loss 267–8, 275
- non-use values 49, 183
 - economic incentives for wildlife conservation on private lands 327, 333, 337, 339, 341, 345
 - livestock 119, 141
 - property rights in non-captive wildlife and biodiversity conservation 305–8, 310–12, 319–20, 322–3
 - wild biodiversity and natural ecosystems: conservation and loss 256–9, 263

- Nordhaus, W. 75
 Norgaard, R.B. 170
 North America 120, 332
 see also Canada; United States
 nuisance value 317
 nutrient
 loads 191
 loss 179–80, 187–8, 190, 195
 recycling 182
- oil palm production 45–6, 50, 130, 267,
 282, 285, 294, 297–8
 selective logging and orangutan
 conservation 390–91
- Olson, M. 266
- open access 230, 237, 239, 313–14, 316,
 318, 322, 353–5
- opportunity costs 172, 254–5, 263–4,
 305–7, 391
 see also land use allocation and
 opportunity cost minimization
 of wild species conservation in
 natural habitats
- option values 306
- Oram, J.A. 223
- orangutans 45, 78–9, 284
 see also land use allocation and
 opportunity cost minimization
 of wild species conservation
 in natural habitats; selective
 logging and orangutan
 conservation
- organic agriculture 194–6, 206
- Organisation for Economic
 Co-operation and Development
 (OECD) 223
- organisms as assets or pests (liabilities)
 35–8
- Ostrom, E. 323
- overhead costs 102
- Pacific Islands 96
- Papua New Guinea 21, 110, 312
- parasites 49, 211
- Pareto, V. 47
- Pareto's criterion 62, 83, 159, 266
 see also Kaldor–Hicks criterion
- partitions of biosphere, determination
 of status of 34–5
- Pascual, U. 35, 183
- pastoralism 137–8, 342
- patents 217
 backlogs 238
 biotechnology (biopatents) 220, 223,
 226–32
 examiners, shortage of 238
 patent walls 160–61, 165–6, 169
 trolls 238–9
 see also intellectual property rights
 in human developed genetic
 material
- path-dependence 56, 114, 121, 124,
 125–6, 131, 134, 140
- pathogens 23
- pay-offs 77–8, 104
- payments for provision of ecosystem
 services (PES) 270–72, 327, 335,
 379–81
- Payne, J. 390
- Pearce, D.W. 6, 68, 246, 253, 369
- Pearson, L. 340
- peatland 45, 46
- penguins 309–10, 313
- permaculture 196–7
- pest and disease control: declining
 effectiveness 11–12, 210–19
 antibiotics/antimicrobials resistance
 211, 214
 control techniques 210
 economic nature of increased
 biological resistance 212–16
 monopoly and regulation of use
 of technique that declines in
 effectiveness 216–17, 218
 social choice problems 210–12
 social deadweight loss 213–15
 ‘superbugs’ 211
 user costs 210, 211, 212–14
- pest resistance 147, 151, 156–7, 171,
 173
- pesticides 46, 96, 97, 187, 193
- Phalan, B. 101, 388
- Phifer, P.R. 148, 150, 153
- physical capital 71, 72, 351
- Pigou, A. 185
- pigs 121, 123, 127, 134, 136–7, 142
 feral 22, 37, 182, 383
- Plant Breeder's Rights (PBR) 226, 227,
 231
- Plant Genetic Resources (PGRs) 236

- Plant Variety Rights (PVR) 226, 227, 231
- political lobbying 53–4, 166, 222, 225, 229, 239, 266–7
- pollution 352
- polyculture 97
- poplar trees and lignin content 154–5
- population growth 4, 72, 100, 115, 192
- Porceddu, E. 108
- Posner, J.R. 159, 186
- Possingham, H.P. 391
- potatoes 44, 169
- potential Paretian improvement
 - criterion *see* Kaldor–Hicks criterion
- poultry 142, 211
- precautionary principle 49, 84, 158–9
- pressure groups 321
 - see also* non-governmental organisations; special interest groups
- principal–agent problems 380, 382
- Principe, P. 253
- Principle of Justice (Rawls) 62–7, 83–4
- prisoner’s dilemma problem 212
- private goods 49, 73, 245, 306
- private lands *see* economic incentives for wildlife conservation on private lands
- production functions 188–9
- propagative material 73–4
- property rights in non-captive wildlife and biodiversity conservation
 - 14–15, 16, 17, 302–24
 - commercial rights to wildlife on private lands 316–17
 - extinction 304–5, 307, 316, 318
 - global rights to trade in wildlife 317–21
 - importance and context 302–5
 - indirect use value 305
 - landholding size 315
 - market extension 318
 - market failures 304, 306, 308, 315
 - market value 316, 318
 - migration (movements) of wildlife 308–10, 322, 323
 - national parks and protected areas 304, 318
 - non-use values 305–8, 310, 311, 312, 319–20, 322, 323
 - marginal 306, 308
 - non-marketable 306
 - open access 313, 314, 316, 318, 322
 - opportunity costs 305–7
 - rebound effect 309–10, 314–18
 - recreation and tourism 309–12, 317, 320
 - total economic value 302, 304, 305–8, 322
 - use values 303–4, 305–8, 312, 319, 322
 - consumptive 311–15, 316, 318–19, 320–21, 322, 323
 - direct 305–6
 - indirect 305
 - marginal 308
 - marketable 306
 - non-consumptive 310–11, 313, 317, 320
 - user costs 308, 313–15, 322
- provisioning services 27–8, 365–6
- Prudente, C. 390
- public goods 49, 212, 333, 371
 - excludable 227
 - pure 48, 306, 369
 - wild biodiversity and natural ecosystems: conservation and loss 245, 250, 254, 257, 265, 266
 - see also* quasi-public goods
- public interest groups 166, 237–8, 329
- public policies 103–7
- Putz, F.E. 392
- Qaim, M. 147, 153
- Quandt, R.E. 159
- quasi-public goods 245, 250, 254, 257
- Raidt, J. 238
- Rao, V.R. 108
- rare breeds 120, 133, 141
 - see also* exotic species
- Rawls, J.R. 62–7, 85
- rebound effect 309–10, 314–18
- recreation and tourism
 - ecotourism 334, 402
 - farm-holiday sector 311, 329
 - property rights in non-captive

- wildlife and biodiversity
conservation 309–12, 317, 320
- wild biodiversity and natural
ecosystems: conservation and
loss 249, 250, 254, 256, 261,
262–3, 273, 274
- recreational hunters 329
- Redpath, S. 331
- reduced impact logging (RIL) *see*
selective logging
- regulating services 27–8, 365–6
- Renfrew, C. 115
- research and development (R&D)
71–2, 238, 239
- resilience and resistance 180–82, 204–5,
402
- revealed preference methods 59, 256
- Ricardo, D. 97, 128, 280, 290
- rice 33, 45–6, 75, 155, 192–3, 205
- Rijksen, H.D. 391
- Ringler, C. 192–3, 205
- risk-taking/risk-aversion 70, 76, 79, 81,
155
- Romano, D. 305
- Romer, P. 125
- royal albatross 309
- Russia 47
- safe minimum populations 139–40
- safety-first approach 66–7, 78–9, 84
- Sagoff, M. 179, 204
- Sahara Desert 205
- Sahel 106
- Salles, J.-M. 256–7, 261, 269
- Samoa: taro blight 75, 83
- scarcity 71, 72
- Schimmelpfennig, D. 166
- Scholes, R.J. 149
- Schröter, M. 180
- Schumpeter, J. 12, 47, 216, 218
- Scott, L. 211–12
- Seasholes, B. 303
- Second Report on the State of the
World's Plant Genetic Resources
for Food and Agriculture* 109
- selective breeding and biodiversity loss
153–4
- selective evolution 210
- selective logging and orangutan
conservation 200, 386, 388–403
- background information 390–92
- deforestation in Borneo and
Sumatra 390–91
- density of forest species and logging
profitability 394–7, 400
- dominant land-use policy 394
- illegal logging 402
- intensity of logging 393–4
- light-to-moderate selective logging
401
- minimum viable population (MVP)
391, 392–3, 400–401
- multiple use or dominant use of
forest 392, 394, 402–3
- oil palm production 390–91
- optimal land use sensitivity to
changed parameters 399–400
- resilience and robustness of habitats
402
- solution to problem 397–9
- spatial optimization 393, 396, 400
- sustainable forest management
(SFM) 392
- umbrella species 393
- self-interest 41–2, 54, 216, 267, 329
- intellectual property rights in human
developed genetic material 222,
227–8, 232
- self-regulating systems 205
- shadow price 370–71
- Shand, H. 120
- silviculture (managed forestry) 151,
197–8, 200–201, 204
- Simpson, R.D. 252, 253
- Singleton, I. 78–9, 294, 391
- Sist, P. 403
- Skonhofs, A. 316–17
- slash-and-burn agriculture 190, 194–5
- Smith, A. 128, 205, 382
- Smith, C. 139
- Snippe, J. 358
- social capital 364
- social conflict 170–71, 251, 332
- social costs 371
- social deadweight loss 213–15
- social valuation 185
- social welfare function 31–2, 94, 203,
276
- social welfare indifference curves
(Bergson-type) 201–2

- socio-economic processes transforming
 - genetic stock and altering ecosystems 6, 41–57
 - capital accumulation and advances in science and technology 45–7
 - geographical extension of human contacts and migration 43–5
 - government failure to reduce open access to resources 55
 - institutional considerations 50–56
 - labour mobility and market system expansion 54
 - large organizations: shared decision-making responsibility between several individuals 54–5
 - market systems, their extension and biodiversity loss 47–50
 - path dependence 56
 - political structures and special interest groups 53–4
 - property rights in new genetic material 51–3
 - supermarket chains and fast food outlets 51
- soil
 - erosion 182, 187, 195, 196
 - fertility 196
 - nutrient loss 179–80, 182
 - salinity 102, 190
 - science 46
- Soini, K. 131–2
- South Africa 218, 305, 323
 - Kruger National Park 315, 320
- sovereign rights of national governments over plant genetic resources 235
- soya beans 44, 94–5, 169
- spatial aspects *see* economics and spatial aspects of ecosystem use
- spatial optimization 393, 396, 400
- special interest groups 222, 225, 329
- specialization 97–8, 122, 123, 131
- Sri Lanka 310, 311
 - Asian elephant 306, 312, 328, 333–4, 341
- standardization of products 94, 123
- stated preferences 59, 256–7, 263
- subsidies 141, 270–71, 335–40, 344, 380, 383
- substitution 72, 123, 255, 313, 354
- supermarkets 51, 93–4
- supply chains 83, 85, 93, 97
- supporting services 27–8, 365–6
- sustainable development and changes in genetic stock and ecosystems 6–7, 59–86
 - agroecosystems: properties 81–3
 - alternative views about natural resource conservation and achievement of sustainable development 61–2, 71–3
 - biological conservation and sustainable development 70–75
 - coefficients of concern for future generations 68–9
 - error about requirement for sustainable development and indeterminate decisions 65–6
 - expected values, status quo and conservation preferences 79–81
 - hypothetical games against nature: precaution does not always favour conservation 76–8
 - maximin gain (minimax loss) 63, 66, 76–7
 - minimax loss (maximin gain) 77–8
 - minimax regret strategy 77–8
 - model limitations and assessment of proposed objectives 66–8
 - precautionary principle 76–81
 - Principle of Justice (Rawls) 62–7, 83–4
 - safety-first approach 66–7, 78–9, 84
 - strong conditions for sustainable development 71
 - sustainability as a concept 61
 - uncertainty 69–70, 76–81
 - weak conditions for sustainability 71
 - well-being 62, 66–7, 70, 72, 75, 83–4
 - zero-sum game 76–8
- sustainable forest management (SFM) 392
- Swanson dominance effect 121, 123, 124–6, 131, 134, 136–7, 140
- Swanson, T.M. 121, 124–7, 134, 141, 316–17, 352
- Swarna Nantha, H. 267

- Tansley, A.G. 178
- taxation concessions 270–71, 336, 340, 344
- technological progress 3, 218, 237, 265, 351–3, 357–8
- human developed and modified ecosystems 204–5
 - intellectual property rights in genetic material 222, 228
 - livestock 120–21, 122, 126, 131, 132, 137
 - natural capital, loss of and interest rates 351–3, 357–8
- ten Brink, P. 261
- Ten Kate, K. 252
- The Economics of Ecosystems and Biodiversity (TEEB) 19–20, 26–7, 28–30, 31, 177, 364
- Thirgood, S. 331
- Thrall, P.H. 19–20
- Tietenberg, T. 62, 65, 349
- tillage, reduced 147, 151, 205
- Toman, M. 259
- tomatoes 44, 169
- Tonga 111
- total economic value 254–6, 333
- human developed and modified ecosystems 183–4, 204
 - property rights in non-captive wildlife and biodiversity conservation 302, 304, 305–8, 322
- tradable permits and environmental offset systems 270–71
- trade-offs 31–3, 154–7, 259, 272, 368, 392
- population level and use of land for commercial production 286–8, 291–2, 296–9
- Trade-Related Aspects of Intellectual Property Rights (TRIPS) 12, 223, 225, 226, 234, 236
- transaction costs 49, 54, 318, 343–4
- intellectual property rights in human developed genetic material 232, 236, 237
 - wild biodiversity and natural ecosystems: conservation and loss 254, 265, 267
- Trauger, D.L. 304
- trespass laws 336
- tribal groups/lands 110–15, 251–2, 303, 324
- Tscharntke, T. 101, 103
- turtles 309–10, 321, 323
- Uchida, E. 379–80
- uncertainty 49, 84, 264
- and concepts of sustainability and sustainable development 69–70, 76–81
 - genetically modified organisms (GMOs) 155
 - human developed and modified ecosystems 185
 - land use allocation and opportunity cost minimization of wild species conservation in natural habitats 291
 - property rights in human developed genetic material 238–9
 - radical 126
 - valuing and sustaining natural ecosystem services 372
- United Kingdom
- fish/fisheries 332, 334
 - Industrial Revolution 351
 - natural resource depletion and economic activity/investment 352
 - raptors 331
 - Rare Breeds Survival Trust 133
 - red grouse 331
 - Yorkshire Moors 119, 183
- United Nations (UN) 53, 115, 380
- Development Project (DP): Civil Society Organizations and Participation Programme 120
 - Johannesburg Earth Summit (2002) 403
 - Millennium Declaration 403
 - Rio Earth Summit (1992) 403
- United States
- American Livestock Conservancy 133
 - feral pigs 22
 - fishing rights 332
 - genetically modified organisms (GMOs) 157, 158, 161, 163, 166, 169

- livestock 140
- Patent and Trademark Office 223
- pest and disease control 212
- property rights in human developed
 - genetic material 222–3, 226, 229, 232, 236
- property rights in non-captive wildlife conservation 302–3
- Supreme Court – *Diamond vs Chakrabarty* 223–5
- valuing and sustaining natural ecosystem services 377–8, 381
- urbanization 93, 110, 115, 121
- use values 225
 - consumptive 311–16, 318–23, 334
 - direct 305–6
 - economic incentives for wildlife conservation on private lands 330–31, 333, 336–7, 341, 345
 - human developed and modified ecosystems 183
 - indirect 305
 - livestock 119
 - marginal 308
 - marketable 306
 - net 344
 - non-consumptive 310–11, 313, 317, 320, 331, 334
 - property rights in non-captive wildlife and biodiversity conservation 303–8, 312, 319, 322
 - wild biodiversity and natural ecosystems: conservation and loss 254–6
- user costs 210–14, 308, 313–15, 322
- user-pays principle 221
- valuing and sustaining natural ecosystem services 14, 15–16, 363–83
 - absolute values 369
 - Australia: cane toad 376–8
 - Australia: fire ants 377–8
 - Australia: prickly pears 376–7
 - benefit or transfer value method 367
 - biophysical relationships 375–6, 378, 382
 - China: desertification 375, 378–80
 - cost of replacement method 372–5, 381–2
 - cost-side alternatives to demand-side methods 371–5
 - economic value 373–4
 - exotic species 375, 377–8
 - food and fibre 365–6
 - GDP 367–8, 369, 370, 381, 382
 - global flow of ecosystem values 367
 - global value 367–9
 - invasive species 377
 - macroeconomic accounting 370
 - microeconomic accounting 370
 - natural capital 363, 364–6
 - objective costs 371
 - payments for provision of ecosystem services (PES) 379–81
 - private costs 371
 - provisioning services 365–6
 - public goods 371
 - pure public goods 369
 - regulating services 365–6
 - restoration of ecosystems 375
 - subjective costs 371
 - types of ecosystem services 364–6
 - water supply 372–4
 - well-being 364–6
 - willingness to accept compensation 369, 371
 - willingness to pay (WTP) 366, 369–71, 381, 382
 - see also* economic valuation
- Van Huylenbroeck, G. 183
- Vasco da Gama 44
- vegetables 109, 110
- Vietnam 9, 121, 134, 136–7
- Vincent, J.R. 391, 392–3
- viruses 211
- Walsh, C. 227
- water 193
 - dams 102, 187, 188
 - eutrophication 102, 188
 - flows 75
 - harvesting 192
 - hydrological functioning 187–8
 - irrigation 10, 96, 102, 187
 - quality 188
 - run-off 102, 188
 - salinity 102

- scarcity 103
- supply 372–4
- Webb, G.J.W. 321, 342
- well-being 3–4, 62, 66–7, 70, 72, 75, 83–4
 - valuing and sustaining natural ecosystem services 364–6
 - wild biodiversity and natural ecosystems: conservation and loss 249, 259
- wetlands and swamps 28–9, 35
- whales 313, 319
- wheat 41–2, 44, 45–6, 112, 192–3, 205
- wild biodiversity and natural ecosystems: conservation and loss 13–14, 245–76
 - anthropocentric influences 264
 - bribes 267
 - compensation 251–2, 271–2
 - cost-effectiveness analysis 263–4, 274–5
 - density of biodiversity 249
 - direct maintenance by governments 270–71
 - drop-off effect 249, 258, 274
 - economic valuation 246–52, 256, 259–61, 262–3
 - environmental degradation 263
 - environmental externalities 265
 - expected value, marginal 254
 - extensions of property rights 271
 - extent of biodiversity 247
 - extent of modification 259–61
 - geographical location 249
 - government payments 271–2
 - government restrictions 271
 - ignorance or lack of knowledge 264
 - importance of biodiversity 248
 - Kaldor–Hicks (potential Paretian improvement) criterion 250–51, 254–5, 269
 - laws and regulations 270–71
 - local and global biodiversity 249
 - low-cost access 249
 - marginal value 254
 - market systems 265
 - natural changes 264
 - non-governmental organizations (NGOs) 267–8, 275
 - non-use values 256–9, 263
 - opportunity costs 254–5, 263–4
 - optimal size of protected area 250, 255
 - optimal transformation 261
 - payments for provision of ecosystem services (PES) 270–72
 - policy issues 268–72
 - political, administrative and institutional constraints/failures 265–7, 269, 275
 - private goods 245
 - property rights 265
 - proximity to population centres 249
 - public (civil) servants 267
 - public goods 245, 254, 257, 265, 266
 - public goods, pure 250
 - quasi-public goods 245, 250, 254, 257
 - rarity of ecosystem 247–8
 - recreation and tourism 249, 250, 254, 256, 261, 262–3, 273, 274
 - revealed preference methods (e.g. travel cost methods) 256
 - risk-taking 264
 - size of ecosystem/protected area 250
 - social conflict 251
 - social constraints 275
 - social and cultural influences 250
 - socio-economic reasons for socially detrimental alterations 264–8
 - stated preferences 256–7, 263
 - stated values 258, 273–4
 - substitutability of commodities 255
 - time preferences 265
 - total economic value 254–6
 - trade-off functions/values 259, 272
 - transaction costs 254, 265, 267
 - uncertainty 264
 - use values 254–5, 256
 - valuation of material benefits for new commercial purposes 252–4
 - well-being 249, 259
 - willingness to pay (WTP) 246, 249, 257–8
 - wildlife conservation *see* economic incentives for wildlife conservation on private lands; land use allocation and opportunity cost minimization of wild species conservation in natural habitats

- willingness to accept compensation (WAC) 185, 369, 371
 willingness to pay (WTP) 185, 218–19, 307, 338
 valuing and sustaining natural ecosystem services 366, 369–71, 381, 382
 wild biodiversity and natural ecosystems: conservation and loss 246, 249, 257–8
 Willis, A.J. 178–9
 Wilson, C. 249, 257, 309–11
 windfall gain 234
 Wolfenbarger, L.L. 148, 150, 153
 World Conservation Monitoring Centre 119–20, 139
 World Conservation Strategy 280
 World Trade Organization (WTO) 223, 226
 X-inefficiency 238
 yellow-eyed penguin 309–10
 zero-sum game 76–8
 Zhao, J.H. 147–8, 171
 Zheng, H. 380
 Zilberman, D. 158
 Zimbabwe 303–4
 zoning 270–71
 Zwahlen, C. 149–50