

Index

- Accounting stance: defined, 55
ADAB, 167
Adams, R.M., 82
Agriculture: in ancient Hawaii, 140–141; in Java, 177–184; in Northern Thailand, 170–171; and social institutions, 81–89
Agroforestry: defined, 120; economic analysis of, 126; in Java, 183; in Northern Thailand, 170–171; and sustained site productivity, 122–123; use of in watershed management, 119–129
Ahmed, S., 124
Ahupuaa, 135–143; defined, 135
Alienation: of watershed communities, 148–153
Alii: defined, 134
Alii nui: defined, 134
Alley cropping, 122
Ambuklao Reservoir, Philippines, 195
American Society of Civil Engineers, 196
Analytical framework for watershed management: application of, 25–30; major elements of, 17–25; role of, 30; three dimensions of, 17, 30
Analytical unit of account: and role of policy, 72–73
Annexation: in watershed communities, 148–152
Arago, J., 142
Armstrong, C.L., 35, 37
Baguio City, Philippines, 191–193
Bailey, F.G., 148
Bajracharya, D., 147
Banawat, S., 163
BAPPEDA, East Java, 187
Barrau, E.M., 183
Barron, R.J.W., 47
Barth, F., 85
Baseflow, defined, 45
Baseline data: need for, 88–89
Baumol, W.J., 64
Benefit-cost analysis (BCA): of alternative land-use plans, 25; described, 58–59; “traditional,” 72, 76
Benefits: distribution of, 207–208; in project analysis, 67–68
Bengawan Solo River Basin, 183
Bhutan, 151
Binga Reservoir, Philippines, 195
Biophysical aspects of watersheds, 4
Biophysical effects of land uses, 33–49
Biophysical information for watershed assessment: geology and terrain, 48; hydrologic behavior, 48–49; soils, 48
Bishop, R.C., 76
Blaikie, P., 4, 112, 208
Bosch, J.M., 41, 42
“Bottom-up” planning, 172
Bottral, A., 97, 109
Boughten, W.C., 38
Boundaries: natural versus sociopolitical, 86; as an obstacle to integrated

- Boundaries (*continued*)
 watershed management, 86; role of in watershed management, 7–9; setting of appropriate, 61–62; watershed and political in Hawaii, 134–136, 138–139
- Bower, B.T., 17, 64, 66, 69
- Bowonder, B., 3
- Brewbaker, J.L., 124
- Briones, N.D., 191
- Bromley, D.W., 93, 96
- Brooks, K.N., 49, 61, 153, 155
- Brown, L., 3
- Buffer strips, 40–41
- Bujra, A.S., 148
- Bureau of Mines and Geosciences, Philippines, 193
- Burma, 87
- Campbell, A., 141
- Carroll, M., 19
- Carrying capacity: defined, 14
- Case studies: Hawaii, 133–143; Hindu-Kush Himalayas, 145–156; Java, 177–188; Northern Thailand, 170–171; outlined, 13–14
- Cassava, 128
- Cernea, M.M., 11, 166
- Chambers, R., 109
- Chanphaka, U., 163
- Chao Phraya Watershed, Thailand, 163
- Chapman, E.C., 161
- China, 85
- Chow, V.T. 196
- Christanty, L., 123
- Chunkao, K., 19
- Ciriacy-Wantrup, S.V., 96
- Citanduy River Basin, 183
- Clark, W.C., 98
- Class relations: as an obstacle to integrated watershed management, 87
- Cloud forest, 43
- Cohen, J.M., 166
- Cohen, R., 148
- Common property resource management, 11–12
- Community organization: and local participation, 97–98, 210–211
- Community participation, 98–99, 108–109
- Conway, G.R., 182
- Corpuz, E.B., 126
- Cost-benefit analysis. *See* Benefit-cost analysis
- Cost-effectiveness analysis: described, 59
- Coward, E.W., 109
- “Critical” lands: in Java, 182
- Crouch, B.R., 167
- Cruz, W., 10
- Culler, R.C., 47
- Dangler, E.W., 35, 37
- Deforestation: in the Hindu-Kush Himalayas, 147; in Northern Thailand, 162
- Degradation: prevention of in watersheds, 123
- Depletion: defined, 96
- deVries, E., 180
- Discount rate: choice of in economic analysis, 64; and time horizon, 64
- Discounting, 63–64; defined, 63
- Distribution of water yield, 43–46
- Distributional policies, 78–79
- Dixon, J.A., 49, 61, 64, 66, 69, 77
- Domingo, I.L., 122
- Donner, W., 162
- Dorner, P., 94
- Downstream management practices, 23–25
- Drew, D., 82
- Dunn, F.L., 85
- Earle, T.K., 135, 136, 138
- Easter, K.W., 60, 115, 153, 155
- Eckholm, E.P., 3, 147
- Ecology, in the Himalayan region, 146
- Economic analysis: of agroforestry, 126; defined, 55; role of in watershed management, 212; types of, 58–61; of a watershed project, 53–69
- Economic logic: of the watershed as a management unit, 53
- Economic policies: effect on watersheds, 71, 211
- Edelman, C.H., 180
- El Swaify, S.A., 35, 37
- Environmental degradation: in the Hindu-Kush Himalayas, 148
- Environmental issues: awareness of in the Hindu-Kush Himalayas, 155–156
- Erosion, 3, 35–38; causes of, 35–38; in forests, 37–38; gully, 37; by land use, 35–38; in Northern Thailand, 162; prevention of, 35–38, surface, 35
- Erosion control: role of agroforestry in, 120–121

- Ethnic minorities, 89; in Northern Thailand, 161-162
- Ethnic relations: as an obstacle to integrated watershed management, 87
- European Economic Community, 75
- Evenson, R.E., 166
- Ex-ante and ex-post analysis: described, 60-61
- Extension: in Northern Thailand, 166-172; role of in watershed management, 159-173
- Extension agents: and participation by communities, 211
- Extension education, 107
- External policies affecting watershed management, 211
- Externalities: defined, 53
- FAO, 183, 185
- Financial analysis, 64; defined, 55
- Fire protection: in watershed management, 38
- Flooding: and forest cover, 46
- Fog forest, 43
- Ford Foundation, 186
- Forest cover: and water quality, 42-43
- Forestry: managed use of, 127-128; roles in watershed management, 119
- Free-riders, 95
- Galvez, J.A., 105
- Geertz, C., 180, 184
- Gilmour, D.A., 43
- Gittinger, J.P., 64, 166
- GOI, 183
- Golden triangle, 161
- Great *Mahele*: in ancient Hawaii, 142
- Gregersen, H.M., 49, 61
- Groundwater: contamination of, 41. *See also* Water table
- Gurung, H., 147
- Haderlie, V.K., 184
- Hamilton, L.S., 40, 42, 43, 44, 46, 49, 61, 83, 127
- Handy, E.G., 135, 136
- Handy, E.S.C., 135, 136
- Hanson, R.L., 47
- Hatch, J.K., 166
- Hawaii, 14, 41, 133-143; ancient society and land use, 134-143; description of, 133; land-use regulations, 133; water rights in, 136-138
- Hewitt, L., 19
- Hewlett, J.D., 41, 42, 45
- Highland Agricultural and Social Development Project, 164-173
- Hill people: in Northern Thailand, 161-162
- Hindu-Kush Himalayas, 145-155; description of, 147; ecology of, 147
- Hitzhusen, F., 61
- Hoare, P.W.C., 105, 106, 126, 127, 161, 167, 171, 172
- Hoey, P.M., 171
- Holmes, J.W., 47
- Horticultural crops: in watersheds, 122
- Howe, C.W., 77
- Hufschmidt, M.M., 17, 64, 66, 69
- Human ecology: defined, 81; systems model of, 82-83
- Human social system: defined, 82; and natural ecosystem, 82-89; symbiotic relationships, 85
- Huntings Technical Services, 154
- Huxley, P., 120
- Hydrologic behavior, 48-49
- Hydrologic cycle, 7, 35
- ICRAF, 120
- Implementation, 103-117; effects of political structure on, 208; evaluation of, 109-112; failure of, 103-104; need for flexibility, 105; problems with in Java, 184-185
- Implementation issues: political, 112-114; socioeconomic and technical, 115-116
- Implementation tools, 19-21, 55-58, 68; examples of, 207; as "ways of doing things," 206; within a conceptual framework, 30
- Import policies, 75
- Incentives, 9; and institutions, 94-97; monetary, 106-107; role of in upper watershed areas, 155; types of, 73
- Indonesia. *See* Java
- Infiltration capacity, 46-47
- Input subsidies, 74
- Inputs: natural, and management, for watershed management, 21
- Institutional arrangements, 30, 117; defined, 91; and incentives, 94-97; for program implementation, 111; and success of watershed projects, 108; for watershed management, 17, 19-21,

- Institutional arrangements (*continued*)
207–208; for watershed management on Java, 187
- Institutions, 11–12, 91–101; for collective action, 108; defined, 91; in Northern Thailand, 162–164
- Integrated Rural Environmental Program, Indonesia, 185
- Integrated watershed management: as an approach to resource management, 6–12; implications for, 205–213; in Java 186–187. *See also* Watershed management
- Interdisciplinary approach: role of, 208–209
- Intertemporal policies, 75–76
- Irrigation: in Java, 182; in Northern Thailand, 170–171
- Ives, J.D. 147
- Jacobson, T., 82
- James, D.E., 64, 66, 69
- Jamieson, N.L., 88
- Java, 14, 177–188; agriculture in, 179–184; land use in, 179–182; physical setting of, 177; population in, 177, 182, 184
- Jayaraman, T.K., 103, 110, 114, 115
- Johnston, B.F., 98
- Johnston, C.D., 47
- Jones, P., 127
- Joshie, P., 43
- Kahuna*: defined, 134
- Kapu*: defined, 134; end of system, 141; examples of, 136, 141
- Karki, Y.B., 152
- Kauai, 135, 138
- Kelman, S., 108, 110, 111
- Keoprapan, B., 162
- KEPAS, 179, 181
- Kijar, S., 163
- King, P.N., 83
- Kipple, F.P., 47
- Konohiki*: defined, 134
- Koppel, B.M., 92
- Korten, D.C., 98
- Korten, F.F., 98, 99
- Krishnamra, J., 163
- Kruger, F.J., 43
- Kunstadter, P., 161
- Lamosangu-Jiri Road Project, Nepal, 153
- Lamrock, J.C., 167
- Land capability and sustainability analysis, 25
- Land tenure: defined, 94; effect on watershed management, 94; in Northern Thailand, 162–163; problems with in agroforestry, 127
- Land use: in Lower Agno River watershed, 193–194; in watersheds, 34
- Land use, upland: in Java, 179–182
- Land-use options for watershed management, 119–120
- Land-use patterns: cultural basis of, 89
- Land-use regulations: in Hawaii, 133–134
- Legal arrangements: as implementation tools, 106
- Legume trees, 124–125
- Lembaga Ekologi, Indonesia, 37
- Leucaena: use in agroforestry systems, 125
- Leys, C., 150
- Lipton, M., 108
- Lo, A., 35
- Local participation in watershed management, 11; importance of, 210–211; in Java, 185–186; in planning, 166–170
- Loi*, 137
- Lower Agno River watershed, 191–204; description of, 191–194; disturbances in, 193–194; land uses of, 193–194
- Luna wai*: defined, 136
- MacDicken, K., 124
- MacGregor, R., 61
- Macroeconomic policies: effects of on watershed management, 71, 78–79
- Madura, 182
- Mae Chaem, 8
- Mae Chaem Watershed Development Project, 19
- Makaainana*: defined, 134
- Management system: within a conceptual framework, 30
- “Marginal” agricultural areas: on Java, 182
- Markets: access to, 128
- Mass wasting, 35
- Mathur, H.N., 43

- Mauch, S.P., 147
 Mazmanian, D.A., 112, 113
 McKean, M.A., 11
 McKerchar, A.I., 45
 Megahan, W.F., 43
 Meister, A.T., 64, 66, 69
 Mendoza, R.C., 126
 Menneg KLH, 186
 Menzies, A., 140
 Messerli, B., 87, 147
 Messerschmidt, D., 152
 Mickelwait, D.R., 166
 Middleton, J., 148
 Migration: in Java's uplands, 181
 Mine tailings, 193-194; disposal of, 202, 204
 Mining operations: pollution caused by, 191, 193-194, 202-204
 Mitchell, C., 49
 Moddie, A.D., 147
Moku: defined, 135
 Monetary incentives: use of, 106-107
 Morss, E.R., 166
 Mosley, M.P., 37
 Muljadi, D., 182
 Multiple objective decision making, 54
 Myrick, R.M., 47

 Nair, P.K., 121, 125, 126
 Nakuina, E., 137
 Nam Pong Reservoir, Thailand, 66
 Nation-states: and incorporation of minority groups, 148
 National Power Corporation, Philippines, 194, 195, 199-201
 Nationalization: effects of in the Hindu-Kush Himalayas, 152
 Nationalization Act of 1957, Nepal, 152
 Natural ecosystem: defined, 82; and human social system, 82-89
 Natural resources: as objectives or constraints, 77
 Natural resources degradation: causes of, 93
 Natural system-social system interactions, 82
 Nelson, G.C., 10
 Nelson, M., 61
 Nepal, 14, 96
 N-fixing trees: in agroforestry systems, 124
 Nicholson, N.K., 62

 Nitrogen, 124
 Nizamsagar Reservoir, India, 3
 Nobe, K., 93
 Nordhoff, C., 142
 Norgaard, R.B., 82

 Obstacles to integrated watershed management: social and behavioral, 86-88
 Off-site effects, 21-23, 67-68
 O'Loughlin, C.L., 38, 120
 Olson, M., 108
 On-site effects, 21, 67-68
 On-site resource utilization and management practices, 23
 Opportunity cost: of capital, 64; in watershed management, 73
 Organizational arrangements, 117; defined, 91; in Java, 186-187; for watershed management, 207-208
 Organizational problems for watershed management, 21
 Organizations: for collective action, 95; defined, 93; for watershed management, 97-98
 Organizations, government: in Northern Thailand, 163-164

 Pacardo, E., 125
 Pakistan, 153-154
 Palanisami, K., 60
 Panday, K., 155
 Papua New Guinea, 94
 Participatory approaches, 98-99; obstacles to, 99
 Payuan, 126
 PCARRD, 126
 Pearce, A.J., 41, 45
 Peck, A.J., 47
 Pei, Sheng-ji, 85
 Perrens, S.J., 49
 Philippines: 14, 122, 128; case study of soil erosion in, 191-204
 Pickering, K., 185
 Planner-planee relationship, 92; as an obstacle to integrated watershed management, 87-88
 Political factors in watershed management, 211-212
 Political problems in watershed management, 10
 Popkin, S.L., 95, 108

- Population: in Java, 177, 182
 Population growth: effect of on watersheds, 3; in Java, 184
 Portlock, N., 140
 Price supports, 74-75
 Primary regions: defined, 92
 Privatization: role of in watershed management, 11
 Probability: use of in economic analysis, 67
 Problem census technique, 167-170
 Process of watershed management, 18-19
 Productive and protective uses of watersheds, 33
 Program implementation: forestry example, 111-112; key points for, 116-117.
See also Implementation
 Property rights, 11
 Property value approach, 66
- Rachie, K.O., 126
 Rachlan, 185
 Rajani, B., 163
 Ramana, K.V., 3
 Rambabu, 43
 Rambo, A.T., 40, 82, 92, 171
 Ramsay, D.M., 182
 Randall, A., 53
 Rao, T. Hanumantha, 3
 Regional impacts: of projects, 61
 Research. *See* Watershed management research
 Reservoirs: calculation of effects of sedimentation on, 198-199
 Resettlement: in Indonesia, 184
 Resource conservation, 96-97; defined, 96
 Resource management actions, 105; as "things to be done," 206
 Rieger, H.C., 147
 Riggs, F.E., 61
 Roads: impact of in upland watersheds, 153
 Rodney, W., 150
 Romm, J., 86, 95
 Roose, E.J., 37
 Roth, A.D., 19
 Royal Forest Department (Thailand), 162
 Ruandej Srivardhana, 66
 Runge, C.F., 11
- Sabatier, P.A., 112, 113
 Sajise, P.E., 92
 Salinization, 47
 Sandalwood, 142
 San Roque Multipurpose Project (SRMPP) in the Philippines, 191-204; description of, 194
 Schultz, T.W., 72
 Schweithelm, J., 43
 Seckler, D., 93
 Secondary regions: defined, 92
 Sedimentation: defined, 38; effects of, 40; estimation of losses due to, 196-198; estimation of in the Philippines, 195-196; extent of, 3; minimization of, 40-41
 Sedimentation rates: calculation of, 198-199
 Semargern, Y., 163
 Sensitivity analysis: in economic analysis, 67; example of use of, 201
 Serrano, R.C., 116
 Sfeir-Younis, A., 61, 73
 Sharma, M.L., 47
 Sheng, T.C., 162
 Shifting cultivation: in Northern Thailand, 162
 Sind project: effects of, 154
 Singh, B., 43
 Slope stability: role of trees in, 120-121
 Small, L.E., 109
 Smith, D.D., 35
 Social considerations in the watershed management plan, 88-89
 "Social economic" test, 9
 "Social" factors in watershed management, 81
 Social forestry project: in Java, 186
 Social rate of return, 9
 Social rate of time preference, 64
 Social systems and natural systems: parallels between, 83-86
 Socioeconomic issues, 9-12, 205
 Soil erosion. *See* Erosion
 Southgate, D., 61
 "Sponge effect," 43
 Storm events: and flooding, 45-46
 Stormflow: average, 43; defined, 45
 Stream response: to a single rainfall event, 45
 Subsidies, 9, 155; use of in program implementation, 107

- Surrogate market approaches, 66
- Survey-based valuation techniques, 66
- Sutadipradja, E., 113, 114, 183
- Sweet, C.F., 166
- Swidden cultivation: in Northern Thailand, 171
- Symbiotic relationships, 85
- Taungya method of reforestation, Java, 183
- Technical assistance: in watershed management, 107
- Tenure rights of upland farm families, Java, 181
- Tergast, G.C.W. Chr., 180
- Terraces: and erosion control, 121-122
- Terracing programs: in Java, 183-185
- Thailand, 75, 87, 106, 128; case study in, 170-173
- Thailand, Northern, 159-173; description of, 159-161; social setting in, 161-162
- Thayer, W.W., 137
- Thomson, J.T., 94, 95
- Time horizon: setting of, 62-63
- Time preference of consumption: defined, 63
- Timing of water yield, 43-46
- Tolley, G.S., 61
- Tongyai, P., 163
- "Top-down" approaches, 11
- Transactions cost, 12, 68
- Transmigration: in Indonesia, 184
- Travel-cost approach, 66
- Trustrum, N.A., 49
- Turner, R.M., 47
- Uhlig, H., 161
- Uncertainty, 67; institutional, 96-97
- Underdevelopment: in upland watershed communities, 150, 153-154
- Unit of account: in policy analysis, 72
- United States, 75
- Universal Soil Loss Equation, 35-37
- Uphoff, N., 98, 166
- Upland farmers: attitudes of, 128-129
- Upland watersheds: role of agroforestry in, 126-129; and watershed community, 145
- Upper Solo River Basin, Indonesia, 92
- Upper watershed: and class differences, 87
- USAID, 183
- User participation, 11
- Valuation: of marketed and nonmarketed effects, 64-66; of sediment damage, 196-198; of watershed plan inputs and outputs, 64-67
- Vancouver, G., 137
- Van Den Beldt, R., 124
- Van Lill, W.S., 43
- Van Wyk, D.B., 43
- Wai*, 137-138
- Wallace, M., 96
- Water: importance of in Hawaiian language, 137-138
- Water pollution: by chemicals, 41
- Watershed approach: and rural development projects, 6
- Watershed communities: and agroforestry, 125-126; and balance within resource base, 154; defined, 145; in the Hindu-Kush Himalayas, 145-156; isolation of, 145; relation between lowlanders and, 146
- Watershed integration: as an ecological, biophysical, and social process, 156
- Watershed management: activities and tasks, 23-25; in ancient Hawaii, 138-140; conceptual framework for, 17-30; effect of economic policies on, 9-10; in Hawaii, 14; in the Hindu-Kush Himalayas, 145-156; in Java, 177-188; local participation in, 11; organization for, 97-98; in the Philippines, 191-204; as a planned system, 19-23; political problems in, 10-11; process of, 18-19; socioeconomic issues in, 9-12; in Thailand, 159-173
- Watershed management plan: example of estimation of costs of for analysis, 201
- Watershed management research: agenda for, 208-210
- Watersheds: defined 4; as secondary regions, 91-93; as the unit of account, 73, 78
- Water table: changes in, 46-48; effects of tree cover on, 46-48; recharge of, 46

- Water yield of streams: determinants of, 42; effects of forest cover on, 42; timing or distribution of, 43-46
- Wells, G.J., 172
- Wichaidit, W., 162
- Wicht, C.C., 47
- Wiersum, K.F., 90, 121
- Wischmeier, W.H., 35
- With project analysis: example of in the Philippines, 198-201
- With-and-without analysis: defined, 59-60; example of in the Philippines, 195-203
- Without project analysis: example of in the Philippines, 195-198
- Wongsprasert, S., 161
- World Bank, 152
- Wronski, E.B., 47
- Yost, R.S., 35
- Zadroga, F., 43
- Ziemer, R.R., 38, 104, 115, 120