References

Agrawal, A. 1995. Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, 26 (3): 413–439.

Agrawal, A. 2003. Sustainable governance of common-pool resources: context, methods and politics. *Annual Review of Anthropology,* 32: 243–262.

Agrawal, A. 2005. *Environmentality: technologies of government and the making of subjects.* Durham, UK, Duke University Press.

Allison, E.H. & Ellis, F. 2001. The livelihoods approach and management of small-scale fisheries. *Marine Policy*, 25(5): 377–388.

Alverson, D.L. 1972. Science and fisheries management. *In* B.J. Rothschild, ed. *World fisheries policy. Multidisciplinary views*, pp. 211–218. Seattle, USA and London, University of Washington Press.

Anderson, J.D. & Mees, C.C. 1999. *The performance of customary marine tenure in the management of community fishery resources in Melanesia.* Final Technical Report submitted to DFID. London, Marine Resources Assessment Group Ltd (available from www.fmsp.org.uk).

Andrew, N., Béné, C., Hall, S.J., Allison, E.H., Heck, S. & Ratner, B.D. 2007. Diagnosis and management of small-scale fisheries in developing countries. *Fish and Fisheries,* 8: 277–240.

Armitage, D., Plummer, R., Berkes, F., Arthur, R.I., Charles, A., Davidson-Hunt, I., Diduck, A., Doubleday, N., Johnson, D., Marschke, M., McConney, P., Pinkerton, E. & Wollenberg, L. 2008. Adaptive co-management for social–ecological complexity. *Frontiers in Ecology and the Environment.* In press.

Armitage, D., Berkes, F. & Doubleday, N. 2007. *Adaptive co-management: collaboration, learning and multi-level governance.* New York, USA, Blackwell.

Arnstein, S.R. 1969. A ladder of citizen participation. *Journal of the American Institute of Planners,* **35(**4): 216–224.

Arthur, R.I. & Garaway, C.J. 2004. Creating understanding and ownership of collaborative research results through 'learning by doing'. *STREAM Journal,* 3(1): 1–2.

Arthur, R.I. & Garaway, C.J. 2006. *Role of researchers in support of fisheries co-management*. IIFET 2006 – Rebuilding Fisheries in an Uncertain Environment. Cornvallis, or USA, International Institute for Fisheries Economics and Trade.

Bailey, C. & Jentoft, S. 1990. Hard choices in fisheries development. *Marine Policy*, 14(4): 333–344.

Baird, R.C. 1996. Toward new paradigms in coastal resource management: linkages and institutional effectiveness. *Estuaries*, 19(2A): 320–335.

Barbier, E., Acreman, M. & Knowler, D. 1997. *Economic valuation of wetlands: a guide for policy makers and planners.* Gland, Switzerland, Ramsar Convention Bureau.

Bavinck, M., Chuenpagdee, R., Diallo, M., van der Heijden, P., Kooiman, J., Mahon, R. & Williams, S. 2005. *Interactive governance for fisheries: a guide to better practice.* Centre for Maritime Research (MARE), Delft, Netherlands, Eburon Academic Publishers.

Begossi, A. 1992. The use of optimal foraging theory in understanding of fishing strategies – a case from Sepetiba Bay (Brazil). *Human Ecology*, 20(4): 463–475.

Begossi, A. 1996. Use of ecological methods in ethnobotany: diversity indices. *Economic Botany*, 50(3): 280–289.

Béné, C. 2003. When fishery rhymes with poverty: A first step beyond the old paradigm on poverty in small-scale fisheries. *World Development*, 31(6): 949–975.

Béné, C. 2006. *Small-scale fisheries: assessing their contribution to rural livelihoods in developing countries.* FAO Fisheries Circular No. 1008. Rome, FAO.

Béné, C. G. Macfadayen & Allison, E.H. 2007. *Increasing the contribution of small-scale fisheries to poverty alleviation and food security*. FAO Fisheries Technical Paper No. 481. Rome, FAO.

Berkes, F. 1989. *Common property resources. Ecology and community-based sustainable development*. London, Belhaven Press.

Berkes, F. 1993. Traditional ecological knowledge in perspective. *In* J.T. Inglis, ed. *Traditional ecological knowledge: concepts and cases*, pp. 1–9. Ottawa, Canadian Museum of Nature/International Development Research Centre.

Berkes, F. & Folke, C. 1998. *Linking social and ecological systems. Management practices and social mechanisms for building resilience*. Cambridge, UK, Cambridge University Press.

Berkes, F. 1999. *Sacred ecology. Traditional ecological knowledge and resource management*. Philadelphia, PA, USA and London, Taylor and Francis.

Berkes, F. 2004. Rethinking community-based conservation. *Conservation Biology,* 18(3): 621–630.

Berkes, F. 2005. Commons theory for marine resource management in a complex world. *In* N. Kishigami and J.M. Savelle, J.M., eds. Indigenous use and management of marine resources. *Senri Ethnological Studies*, 67: 13–21.

Berkes, F. & Folke, C. 2000. *Linking social and ecological systems: management practices and social mechanisms for building resilience*. 2nd edition, Cambridge, UK, Cambridge University Press. 459 pp. Originally published in 1998.

Berkes, F., Mahon, R., McConney, P., & Pomeroy, R.S. 2001. *Managing small-scale fisheries: alternative directions and methods.* Ottawa, IDRC (available at http://www.idrc.ca/booktique).

Bianchi, G., Cochrane, K. & Vasconcellos, M. In press. *Implementing the ecosystem approach to fisheries. In* P. Wrammer, ed. *Fish, trade and development*. Royal Swedish Academy of Agriculture and Forestry.

Biggs, S.D. 1990. A multiple source of innovation model of agricultural research and technology promotion. *World Development*, 18(11): 1481–1499.

Bilharz, S. & Moldan, B. 1995. *Report of the scientific workshop on indicators of sustainable development*, Wuppertal, Germany, 16–17 November 1995. Paris, Scientific Committee on Problems of the Environment (SCOPE).

Blaikie, P., Brown, K., Stocking, M., Tang, L., Dixon, P. & Sillitoe, P. 1997. Knowledge in action: local knowledge as a development resources and batteries to its incorporation in natural resources research and development. *Agricultural Systems*, 55(2): 217–237.

Brown, K. 2002. Innovations in conservation and development. *Geographical Journal,* 68(1): 6–17.

Brown, K., Tompkins, E. & Adger, W.N. 2001. *Trade-off analysis for participatory coastal zone decision making.* Norwich, UK, University of East Anglia, Overseas Development Group.

Brown, M. & Wyckoff-Baird, B. 1994. *Designing integrated conservation and development projects.* Washington, DC, Biodiversity Support Programme, World Wide Fund for Nature.

Bryan, T.A. 2004. Tragedy averted: the promise of collaboration. *Society and Natural Resources,* 17: 881–896.

Butterworth, D.S. & Punt, A.E. 2003. The role of harvest control laws, risk and uncertainty and the precautionary approach in ecosystem-based management. *In* M. Sinclair & G. Valdimarsson, eds. *Responsible fisheries and the marine ecosystem*. pp. 311–319. Wallingford, UK, CABI Publishing and Rome, FAO.

Calheiros, D.F., Seidl, A.F. & Ferreira, C.J.A. 2000. Participatory research methods in environmental science: local and scientific knowledge of a limnological phenomena in the Pantanal wetland of Brazil. *Journal of Applied Ecology,* 37: 684–696.

Capak, S.M. 1993. The 'environmental justice' frame: a conceptual discussion and an application. *Social Problems,* 40(1): 5–24.

Castello, L. 2004. A method to count Pirarucu Arapaima gigas: fishers, assessment and management. *North American Journal of Fisheries Management,* 24: 379–389.

Chambers, R. 1997. *Whose reality counts? Putting the first last.* London, Intermediate Technology..

Charles, A.T. 1998. Living with uncertainty in fisheries: analytical methods, management priorities and the Canadian ground fishery experience. *Fisheries Research,* 37: 37-50.

Charles, A.T. 1994. Towards sustainability: the fishery experience. *Ecological economics*, 11: 201–211.

Charles, A.T. 2001. *Sustainable fishery systems.* Oxford, UK, Blackwell Science. Fish and Aquatic Resources Series. .

Choudhury, K. & Jansen, L.J.M. 1999. *Terminology for integrated resources planning and management*. Rome, FAO.

Christensen, M.S., Soares, W.J.M., Silva, F.C.B. & Barros, G.M.L. 1995. Participatory management of a reservoir fishery in Northeastern Brazil. *Naga*, 18(2): 7–9.

Cochrane, K.L., ed. 2002. *A fishery manager's guidebook. Management measures and their application.* FAO Fisheries Technical Paper No. 424. Rome, FAO.

Collie, J.S. & Walters, C.J. 1991. Adaptive management of spatially replicated groundfish populations. *Canadian Journal of Fisheries and Aquatic Sciences*, 48: 1273–1284

Corbridge, S., ed. 2002. *Development: critical concepts in the social sciences.* 6 Volumes. London, Routledge.

Cordell, J. & McKean, M.A. 1992. Sea tenure in Bahia, Brazil. *In* D.W. Bromley, ed. *Making the commons work: theory, practice and policy*. San Francisco, CA, USA, ICS Press.

Cortner, H.J. 2000. Making science relevant to environmental policy. *Environmental Science & Policy*, 3: 21–30.

Daan, N., Christensen, V. & Cury, P., eds. 2004. Quantitative ecosystem indicators for fisheries management. *ICES Journal of Marine Science*, 62(3):316–614. Paris, IOC-UNESCO and Copenhagen, ICES.

Dalton, T.M. 2005. Beyond biogeography: a framework for involving the public in planning in US marine protected areas. *Conservation Biology*, 19(5): 1392–1401.

Darwall, W., Emerton, L., Allison, E.H., McIvor, A. & Bambaradeniya, C. 2007. *A toolkit for integrated wetland assessment.* Cambridge, UK, Freshwater Biodiversity Assessment Programme, World Conservation Union (IUCN).

Ellis, F. & Allison, E.H. 2004. *Livelihood Diversification and Natural Resource Access. Natural Resource Access Project, Livelihoods Support Programme.* Contract No: PE 4/173-GCP/INT/803/UK. Rome, FAO.

Ellis, F. & Biggs, S.D. 2001. 'Evolving Themes in Rural Development 1950s-2000s, *Development Policy Review*, 19(4): 437–448.

Emerton, L. & Bos, E. 2004. *Value: counting ecosystems as water infrastructure.* Gland, Switzerland, IUCN.

Engels, A. 2005. The science-policy interface. *Integrated Assessment Journal*, 5(1): 7–26

Fafchamps, M., ed. 2003. *Rural poverty, risk and development.* Cheltenham, UK, Edward Elgar..

Fanning, L., Mahon, R., McConney, R., Angulo, J., Burrows, F., Chakalall, B., Gil, D., Haughton, M., Heileman, S., Martinez, S., Ostine, L., Oviedo, S., Parsons, S., Phillips, T., Santizo Arroya, C., Simmons, B. & Toro, C. 2007. A large marine ecosystem governance framework. *Marine Policy,* 31: 434–443.

FAO. 1995. *Fisheries management.* FAO Technical Guidelines for Responsible Fisheries. No. 4. Rome.

FAO. 1996. *The precautionary approach to capture fisheries and species introduction.* FAO Technical Guidelines for Responsible Fisheries No. 2. Rome .

FAO. 1999. *Indicators for sustainable development of marine capture fisheries.* FAO Technical Guidelines for Responsible Fisheries. No. 8. Rome.

FAO. 2003. *Fisheries management 2. The ecosystem approach to fisheries.* FAO Technical Guidelines for Responsible Fisheries No. 4. Rome.

FAO. 2005a. *Report of the FAO/WorldFish Center Workshop on Interdisciplinary Approaches to the Assessment of Small-Scale Fisheries*, Rome, 20–22 September 2005. FAO Fisheries Report No. 787. Rome.

FAO. 2005b. *Reducing fisherfolk's vulnerability leads to responsible fishing new directions in fisheries 1: a series of policy briefs on development issues***.** Rome, Sustainable Fisheries Livelihoods Programme (available at www.sflp.org).

FAO. 2006. *Contribution of fisheries to national economies in West and Central Africa. New directions in fisheries 3: A Series of Policy Briefs on Development Issues***.** Sustainable Fisheries Livelihoods Programme, Rome. www.sflp.org.

FAO. 2007. *Increasing the contribution of small-scale fisheries to poverty alleviation and food security***.** FAO Fisheries Technical Paper No. 481. Rome.

Faysse, N. 2006 Troubles on the way: an analysis of the challenges faced by multi-stakeholder platforms. *Natural Resources Forum***,** 30(3): 219–229.

Finlayson, A.C. & McCay, B.J. 2000. Crossing the threshold of ecosystem resilience: the commercial extinction of the Northern cod. *In* F. Berkes & C. Folke, eds. *Linking social and ecological systems,* pp. 311–339. Cambridge, UK, Cambridge University Press.

Flinterman, J.F., Teclemariam-mesbah, R., Broerse, J.E W. & Bunders, J.F.G. 2001. Trans-disciplinarity: the new challenge for biomedical research. *Bulletin of Science, Technology and Society*, 21(4): 253–266.

Floistad, B. 1990. *The International Council for the Exploration of the Sea (ICES) and the providing of legitimate advice in fisheries management.* Lysaker, Norway, Fridtjof Nansen Institute.

Folke, C. 2006. Resilience: the emergence of a perspective for social-ecological systems analysis. *Global Environmental Change*, 16(3): 253–267.

Folke, C. Berkes, F. & Colding, J. 2000. Ecological practices and social mechanisms for building resilience and sustainability. *In* F. Berkes, C. Folke & J. Colding. *Linking social and ecological systems*, pp. 414–437. Cambridge, UK, Cambridge University Press.

Francis, J. & Torell, E. 2004. Human dimensions of coastal management in the Western Indian Ocean region. *Ocean and Coastal Management*, 47(7–8): 299–307.

Freeman, M.M.R., Matsuda, Y. & Ruddle, K., eds. 1991. Adaptive marine resource management systems in the Pacific. Reading, UK, Harwood Academic Publisher. Reprinted from *Resource Management and Optimization*, 8(3/4).

Fulton, E.A., Smith, A.D.M. & Punt, A.E. 2005. Which ecological indicators can robustly detect effects on fishing? *ICES Journal of Marine Science*, 62: 540–551.

Funtowicz S. & Ravetz, J.R. 1990. *Uncertainty and quality in science for policy.* Dordrecht, Netherlands, Kluwer Academic Press.

Gallopin, G.C. 2002. Planning for resilience: scenarios, surprises and branch points. *In* L.H. Gunderson & C.S. Holling, eds. *Panarchy. Understanding transformations in human and natural systems*, pp. 361–394. Washington, DC, Island Press and London, Corvelo.

Garaway, C.J. & Arthur, R.I. 2004. *Adaptive learning: a practical framework for the implementation of adaptive co-management – lessons from selected experiences in South and Southeast Asia.* London, Marine Resources Assessment Group Ltd.

Garaway, C.J. & Esteban, N. 2003. *Increasing MPA effectiveness through working with local communities: guidelines for the Caribbean*. London, Marine Resources Assessment Group Ltd.

Garaway, C.J., Arthur, R.I., Chamsingh, B., Homekingkeo, P., Lorenzen, K., Saengvilaikham, B. & Sidavong, K. 2006. A social science perspective on stock enhancement outcomes: Lessons learned from inland fisheries in southern Lao PDR. *Fisheries Research*, 80: 37–45.

Garcia, S.M. 1994. The precautionary principle: its implications in capture fisheries management. *Ocean & Coastal Management*, 22: 99–125.

Garcia, S.M. 1997. Indicators for sustainable development of fisheries. *Proceedings of the Workshop on Land Quality Indicators and Their Use in Sustainable Agriculture and Rural Development*, pp. 131–162. 25–26 January 1996. Rome, FAO.

Garcia, S.M. 2000. The precautionary approach to fisheries: progress review and main issues: 1995-2000. In *Current maritime issues and the Food and Agricultural Organization of the United Nations*, pp. 479–560. University of Virginia, Center for Oceans Law and Policy. The Hague, Netherlands, Martinus Nijhoff Publishers.

Garcia, S.M. 2008. Fisheries assessment and decision-making: towards an integrated advisory process. *In* G. Bianchi & H.R. Skjoldal, eds. *The ecosystem approach to fisheries*, pp. 158–196. Wallingford, UK, CABI, and Rome, FAO.

Garcia, S.M. & Charles, A.T. 2007. Fishery systems and linkages: from clockworks to soft watches. *ICES Journal of Marine Sciences*, 64: 580–587.

Garcia, S.M. & Grainger, R. 1997. Fisheries management and sustainability. A new perspective of an old problem. Developing and sustaining fishery resources. *In* D.A. Hancock, D.C. Smith, A. Grant & J.P. Beumer, eds. *The state of fisheries management*, pp. 631–654. Presented at the 2nd World Fisheries Congress (1994). Collingwood-Australia, CSIRO.

Garcia, S.M. & Reveret, J.P. 1991. Structure des pêches artisanales: paradigmes et méthodes de recherche. Une introduction. *In* J.R. Durand, J. Lemoalle & J. Weber, eds. *La recherche face à la pêche artisanale (Tome II). Colloques et séminaires*, pp. 253–268. Paris, ORSTOM.

Garcia, S.M. & Staples, D. 2000. Sustainability reference systems and indicators for responsible marine capture fisheries: A review of concepts and elements for a set of guidelines. In *Sustainability indicators in marine capture fisheries*. Special Issue. *Marine Fisheries Research*, 51: 385–426.

Garcia, S.M., Rey-Vallette, H. & Bodiguel, C. Which indicators for what management? The challenge of connecting offer and demand of indicators and reference points. *In* K. Cochrane & S.M. Garcia. *Handbook for fisheries management*, Chapter 12. Blackwell. In press.

Garcia, S.M., Zerbi, A., Aliaume, C., Do Chi, T. & Lasserre, G. 2003. *The ecosystem approach to fisheries.* FAO Fisheries Technical Paper No 443. Rome, FAO.

Gibbons, M. 1999. Science's new social contract with society. *Nature*, 402: 81–84.

Graham, J., Charles, A.T. & Bull, A. 2006. *Community fisheries management handbook*. Halifax, NS, Canada, Gorsebrook Research Institute, Saint Mary's University.

Gunderson L.A., Holling, C.S. & Light, S.S. 1995. *Barriers and bridges to the renewal of ecosystem and institutions.* New York, USA, Columbia University Press.

Halls, A.S., Arthur, R.I., Bartley, D., Felsing, M., Grainger, R., Hartmann, W., Lamberts, D., Purvis, J., Sultana, P., Thompson, P. & Walmsley, S. 2005. *Guidelines for designing data collection and sharing systems for co-managed fisheries. Part 1: Practical guide.* FAO Fisheries Technical Paper No. 494/1. Rome, FAO.

Haggan, N., Neis, B. & Baird, I.G., eds. 2007. Fishers' knowledge in fisheries science and management. *Coastal Management Sourcebooks 4*. Paris, UNESCO. .

Heck, S., Béné, C. & Reyes-Gaskin, R. 2007. Investing in African fisheries: building links to the Millennium Development Goals. *Fish and Fisheries*, 8(3): 211–226.

Hersoug, B.S., Jentoft, S & Degnbol, P. 2006. *Fisheries development: the institutional challenge.* Eburon, Delft, Netherlands.

Hilborn, R. & Walters, C.J. 1992. *Quantitative fisheries stock assessment: choice, dynamics and uncertainty.* New York, USA, Chapman and Hall.

Hoggarth, D.D., Abeyasekera, S., Arthur, R.I., Beddington, J.R., Burn, R.W., Halls, A.S., Kirkwood, G.P., McAllister, M., Medley, P., Mees, C.C., Parkes, G.B., Pilling, G.M., Wakeford, R.C. & Welcomme, R.L. 2006. *Stock assessment for fishery management – a*

framework guide to the stock assessment tools of the Fishery Management Science Programme (FMSP). FAO Fisheries Technical Paper No 487. Rome, FAO.

Holling, C.S. 1978. *Adaptive environmental assessment and management.* Chichester, UK and London, Wiley.

Holling, C.S. 1986. The resilience of terrestrial ecosystems: local surprise and global change. *In* W.C. Clark & R.E. Munn, eds. *Sustainable development of the biosphere*, pp. 292–317. Cambridge, UK, Cambridge University Press.

Holling, C.S. 1987. Simplifying the complex – the paradigms of ecological function and structure. *European Journal of Operational Research*, 30(2): 139–146.

Holling, C.S. 2000. Theories for sustainable futures. *Ecology and Society*, 4(2): 7 (available at http://www.consecol.org/vol4/iss2/art7).

Holling, C.S., Berkes, F. & Folke, C. 2000. Science, sustainability and resources management. *In* F. Berkes, C. Folke & J. Colding, eds. *Linking social and ecological systems. Management practices and social mechanisms for building resilience*, pp. 342–361. Cambridge, UK, Cambridge University Press.

ICSF (International Collective in Support of Fishworkers). 2006. *Report of the Workshop on Emerging Concerns of Fishing Communities: Issues of Labour, Trade, Gender, Disaster Preparedness, Biodiversity and Responsible Fisheries.* Fortaleza, Brazil, 4–6 July 2006. Chennai, India, International Collective in Support of Fishworkers.

Isaac, V.J., Ruffino, M.L. & McGrath, D. 1998. In search of a new approach to fisheries management in the middle Amazon. *In* F. Funk, J. Heifetz, J. Ianelli, J. Power, T. Quinn, J. Schweigert, P. Sullivan & C.I. Zhang, eds *Fishery stock assessment models for the 21st century*. Proceedings. Fairbanks, AK, USA, Alaska University, School of Fisheries and Ocean Sciences, Alaska Sea Grant College Program.

Jasanoff, S. 1994. *The fifth branch: science advisers as policymakers.* Cambridge, MA, USA, Harvard University Press.

Jasanoff, S. 2004. Science, truth and democracy. *Studies in History and Philosophy of Science,* **35A(1): 149–157.**

Jentoft, S. 2000. Legitimacy and disappointment in fisheries management. *Marine Policy*, 24(2): 141–148.

Jentoft, S. 2006. Beyond fisheries management: the phronetic dimension. *Marine Policy,* 30: 671–680.

Jentoft, S. & McCay, B. 2003. The place of civil society in fisheries management: a research agenda for fisheries co-management. *In* D.C. Wilson, J.R. Nielsen & P. Degnbol, eds. *The fisheries co-management experience. Accomplishments, challenges and prospects*, pp. 293–305. London, Kluwer Academic Publishers.

Johannes, R.E. 1981. *Words of the lagoon. Fishing and marine lore in the Palau district of Micronesia***.** Berkeley, CA, USA, University of California Press.

Johannes, R.E., ed. 1989. *Traditional ecological knowledge: a collection of essays.* Gland, Switzerland and Cambridge, UK, IUCN.

Johnson, D.S. 2006. Category, narrative and value in the governance of small-scale fisheries. *Marine Policy*, 30: 747–756.

Jomo, K.S. & Fine, B. 2005. *The new development economics. Post Washington consensus neo-liberal thinking.* London, Zed Books.

Kalikoski, D.C. & M. Vasconcellos. 2007. The role of fishers' knowledge in the co-management of small-scale fisheries in the estuary of Patos Lagoon, Southern Brazil. *In* B. Haggan, B. Neis, & I.G. Baird, eds. *Fishers knowledge in fisheries science and management*, pp. 289–312. Paris, UNESCO Publishing.

Kebe, M. & Tallec, F. 2006. *Contribution of fisheries to national economies*. DFID/FAO Sustainable Fisheries Livelihoods Programme, Regional Support Unit Publication, Cotonou, Benin. 66 pp. (available at www.sflp.org/fr/007/pub8/docs/Integration_of_the_fisheries_sector.pdf).

Keeley, J. & Scoones, I. 2000. Knowledge, power and politics: the environmental policy-making process in Ethiopia. *Journal of Modern African Studies,* 38(1): 89–120.

Kooiman, J., Bavinck, M., Jentoft, S. & Pullin, R., eds. 2005, *Fish for life: interactive governance for fisheries*, Amsterdam, Amsterdam University Press.

Lankford, B. & Watson, D. 2007. Metaphor in natural resource gaming: insights from the River Basin Game. *Simulation & Gaming*, 38(3): 421–442.

Lauck, T., Clark, C.W., Mangel, M., & Munro, G.R. 1998. Implementing the precautionary principle in fisheries management through marine reserves. *Ecological Applications,* 8(1) (Special issue): S72–S78.

Lebel, L. 2006. The politics of scale in environmental assessment. *In* W.V. Reid, F. Berkes, T.J. Wilbanks & D. Capistrano, eds. *Bridging scales and knowledge systems: concepts and applications in ecosystem assessment*, pp. 37–57. Washington, DC, Island Press.

Lee, K. 1993. *Compass and gyroscope. Integrating science and politics for the environment.* Washington, DC, Island Press.

Mace, P. 1997. Developing and sustaining world fisheries resources: The state of science and management. A keynote presentation. *In* D.A. Hancock, D.C. Smith, A. Grant & J.P. Beumer, eds. *Developing and sustaining world fisheries resources***:** *the state of science and management*, pp. 1–22. Collingwood, Australia, CSIRO.

Mahon, R., Bavinck, M. & Roy, R. 2005. Governance in action. *In* J. Kooiman, M. Bavinck, S. Jentoft & R. Pullin, eds. *Fish for life. Interactive governance for fisheries*, pp. 351–374. MARE Publication Series No. 3. Amsterdam, University of Amsterdam Press.

Mahon, R. McConney, P. & Roy, R. 2008. Governing fisheries as complex adaptive systems. *Marine Policy*, 32: 104–112.

Mahon, R., Almerigi, S., McConney, P., Parker, C. & Brewster, L. 2003. Participatory methodology used for sea urchin co-management in Barbados. *Ocean and Coastal Management,* 46: 1–25.

McAllister, M.K., Peterman, R.M. & Gillis, D.M. 1992. Statistical evaluation of a large-scale fishing experiment designed to test for a genetic effect of size-selective fishing on British Columbia pink salmon **(***Oncorhynchus gorbuscha***).** *Canadian Journal of Fisheries and Aquatic Sciences*, 49: 1294–1304.

Mikalsen, K.H. & Jentoft, S. 2001. From user-groups to stakeholders? The public interest in fisheries management. *Marine Policy*, 25(4): 281–292.

Millennium Assessment. 2005. *Ecosystems and human well-being. Synthesis.* Washington, DC, Island Press.

Morgan, P. & Taschereau, S. 1996. *Capacity and institutional assessment: frameworks, methods and tools for analysis.* Ottawa, CIDA Policy Branch, Canadian International Development Agency..

Neiland, A.E. 2004. Fisheries development, poverty alleviation and small-scale fisheries: a review of policy and performance in developing countries since 1950. *In* A.E. Neiland & C. Béné, eds. *Poverty and small-scale fisheries in West Africa*, pp 189-208. Boston, MA, USA, Kluwer Academic Publishers.

Neis, B. & Felt, L.F., eds. 2000. *Finding our sea legs.* St. John's, NL, Canada, Institute of Social and Economic Research.

O'Riordan, T. & Stoll-Kleemann, S. 2002. Deliberative democracy and participatory biodiversity. *In* T. O'Riordan, ed. *Biodiversity, sustainability and human communities. Protecting beyond the protected*, pp. 87–112. Cambridge, UK, Cambridge University Press.

Oakerson, R.J. 1992. Analysing the commons; a framework. *In* D.W. Bromley, ed. *Making the commons work; theory, practice and policy*, pp. 41–59. San Francisco, CA, Institute of Contemporary Studies.

Olsson, P., Folke, C. & Berkes, F. 2004. Adaptive co-management for building resilience in social-ecological systems. *Environmental Management*, 34: 75–90

Ostrom, E. 1990. *Governing the commons. The evolution of institutions for collective action. Political economy of institution and decision.* Cambridge, UK, Cambridge University Press.

Ostrom, E. 2005 *Understanding institutional diversity.* Princeton, NJ, USA, Princeton University Press.

Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B. & Policansky, D. 1999. Sustainability – revisiting the commons: Local lessons, global challenges. *Science*, 284(5412): 278–282.

Panayotou, T. 1988. *Management concepts for small-scale fisheries. Economic and social aspects.* FAO Fisheries Technical Paper No. 228. Rome, FAO.

Pahl-Wostl C. 2002. Towards sustainability in the water sector – the importance of human actors and processes of social learning. *Aquatic Sciences*, 64(4): 394–411.

Peterman, R.M. & McAllister, M.K. 1993. A brief overview of the experimental approach to reducing uncertainty in fisheries management – an extended abstract. *Canadian Special Publication in Fisheries and Aquatic Science*, 120: 419–422.

Pomeroy, R.S & Rivera-Guieb, R. 2006. *Fishery co-management: a practical handbook.* Cambridge, MA, USA, Ottawa, and Wallingford, UK, CABI Publishing in collaboration with IDRC.

Prigent, M., Rochet, M.J., Bertrand, J., Carpentier, A., Coppin, F., Delpech, J.P., Fontenelle, G., Foucher, E., Mahé, K., Rostiaux, E. & Trenkel, V.M. 2007. *Comparing fishers perceptions and scientific descriptions of recent trends in the Easter Channel ecosystem and fisheries.* ICES CM 2007/O:05. Copenhagen. 18 pp.

Raakjaer-Nielson, J.K. 2003 An analytical framework for studying compliance and legitimacy in fisheries management. *Marine Policy*, 27: 425–432.

Ribot, J. 2006. Choose democracy: environmentalists' socio-political responsibility. Editorial. *Global Environmental Change*, 16: 115–119.

Rockloff, S.F. & Lockie, S. 2006. Democratisation of coastal zone decision-making for indigenous Australians. Insights from stakeholder analysis. *Coastal Management*, 34(3): 251–266.

Rondinelli, D.A. 1993. *Development projects as policy experiments: an adaptive approach to development administration.* New York, USA, Routledge.

Ruddle, K. 1994. Local knowledge in the future management of inshore tropical marine resources and environments. *Nature and Resources*, 30(1): 28–37.

Ruddle, K. & Johannes, R.E., eds. 1989. *Traditional marine resource management in the Pacific Basin: an anthology.* Jakarta, UNESCO/RPSTSEA. 410 pp.

Sainsbury, K.J. 1988. The ecological basis of multispecies fisheries and management of a demersal fishery in tropical Australia. *In* J.A. Gulland, ed. *Fish population dynamics.* **Second edition.** Chichester, UK, Wiley.

Salancik, G.R. & Pfeffer, J. 1974. The bases and use of power in organizational decision-making: the case of a university. *Administrative Science Quarterly*, 19: 453–473.

Schellnhuber, H.J., Cramer, W., Nakicenovic, N., Wigley, T. & Yoke, G. 2006. *Avoiding dangerous climate change.* Cambridge, UK, Cambridge University Press.

Scott, J.C. 1998. *Seeing like a State: how certain schemes to improve human condition have failed***.** New Haven, CT, USA, Yale University Press.

Sen, A.K. 1999. *Development as freedom.* Oxford, UK, Oxford University Press.

Seixas, C.S. & Berkes, F. 2003. Dynamics of social-ecological changes in a lagoon fishery in southern Brazil. *In* F. Berkes, J. Colding & C. Folke, eds. *Navigating social-ecological systems*, pp. 271–298. Cambridge, UK, Cambridge University Press.

Sharp, R. 1995. Organising for change: People power and the role of institutions. *In* J. Kirby, P. O'Keefe, L. Timberlake, eds. *The Earthscan Reader in Sustainable Development*, pp. 309–327. Earthscan, London.

Silva, P. 2006. *Exploring the linkages between poverty, MPA management and the use of destructive fishing gear in Tanzania.* World Bank Research Policy Working Paper 3831 (available at http://ssrn.com/abstract=922957).

Sinclair, M. & Valdimarsson, G. 2003. *Responsible fisheries in the marine ecosystem*. Wallingford, UK, CABI Publishing and Rome, FAO.

Smith, I.R., Pauly, D. & Mines, A.N. 1983. *Small-scale fisheries of San Miguel Bay, Philippines: options for management and research*. ICLARM Technical Reports 11.

Stiglitz, J.E. 2006. *Making globalization work.* London, Allan Lane.

Strand, R. 2003. The uncertainty and complexity of managing uncertainty and complexity. *In* A. Guimaraes Pereira, M. Aquera Cabo & S. Funtowicz, eds. *International Workshop on Interfaces Between Science and Society. Collecting experience for good practice.* Milan, Italy, 27–28 Novembre 2003. Book of abstracts: 67. European Communities.

Strigl, A.W. 2003. Science, research, knowledge and capacity building. *Environment, Development and Sustainability*, 5: 255–273.

Sutton, R. 1999. *The policy process: an overview.* Working Paper 118. London, Overseas Development Institute.

Toth, F.L. 2001. *Participatory integrated assessment methods. An assessment of their usefulness to the European Environmental Agency (EEA).* Technical Report 64. Copenhagen, EEA.

Toth, F.L. 2003. State of the art and future challenges for integrated environmental assessment. *Integrated Assessment*, 4: 250–226.

UNEP (United Nations Environment Programme). 2005. *Reference manual on the integrated assessment of trade-related measures: the agriculture sector.* Geneva.

Wade, R. 1987. The management of common property resources: collective action as an alternative to privatization or state regulation. *Cambridge Journal of Economics*, 11(2): 95–107.

Walker, B., Holling, C.S., Carpenter, S.R. & Kinzig, A. 2004. Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, 9(2): 5 (available at http://www.ecologyandsociety.org/vol9/iss2/art5/).

Walmsley, S., Howard, C. & Medley, P. 2005. *Participatory stock assessment (PARFISH) guidelines.* London, Marine Resources Assessment Group Ltd.

Walters, C. 1980. Systems principles in fisheries management. *In* R.T. Lackey & L.A. Nielsen, eds. *Fisheries management*, pp. 167–183. New York, NY, USA, Halsted Press.

Walters, C. 1986. *Adaptive management of renewable resources.* New York, USA, McGraw-Hill.

Wilson, D.C. & Delaney, A.E. 2005. Scientific knowledge and participation in the governance of fisheries in the North Sea. *In* T.S. Gray, ed. *Participation in fisheries governance. Review: methods and technologies in fish biology and fisheries, 4*, pp. 319–341. Dordtrecht, Netherlands, Springer.

Wilson, D.C., Raakjaer, J. & Degnbol, P. 2006. Local ecological knowledge and practical fisheries management in the tropics: a brief. *Marine Policy*, 30: 794–801.

Wilson, J.A., Acheson, J.M., Metcalfe, M. & Kleban, P. 1994. Chaos, complexity and community management of fisheries. *Marine Policy*, 18(4): 291–305.

World Bank/UNDP/CEC/FAO. 1992. *A study of international fisheries research*. Policy and Research Series 19. Washington, DC, World Bank.

ANNEX 1

Glossary

Adaptive management An iterative management approach in which management policies are treated as experiments from which managers can learn. It deals with unpredictable interactions between people and ecosystems as they co-evolve. It is an inductive approach to progressive knowledge accumulation and management optimization. Stimulating social and institutional learning, it emphasizes the importance of *feedbacks* in shaping policy (from Berkes and Folke, 2000).
A management approach that explicitly recognizes the occurrence and potential consequences of uncertainties resulting from incomplete knowledge and adopts strategies and methods aimed explicitly at "learning by management", progressively reducing uncertainties and risk.

Adaptability The ability to change (or be changed) to fit changed circumstances (Wikipedia, January, 2008)

Advocacy Trying to influence public and political opinion to gain support for a particular change (Graham, 1971, p. 124)

Artisanal fisheries A term of Latin origin with a socio-economic foundation. It tends to imply a simple, individual (self-employed) or family type of enterprise (as opposed to an industrial company), most often operated by the owner even though the vessels may sometimes belong to the fishmonger or some external investor, with the support of the household. The term has no obvious reference to size but tends to have the same connotation of relatively low levels of technology and this may not always be the case. See: *Small-scale fisheries*.

Assessment An assessment is both *the action or an instance of assessing* and its result. *It is the process of gathering and documenting information* (appraisal is sometimes used as synonym but look at definition below) as well as *the amount assessed* (Webster online dictionary, http://www.m-w.com/dictionary/assessment, 2007). *It is the process of documenting, usually in measurable terms, knowledge, skills, attitudes and beliefs* (http://en.wikipedia.org, 2007). To form a *judgment about something* (a person, a situation, a patrimony) *based on an understanding* (Encarta, 2007). A judgment made by a scientist or scientific body on the state of a resource, a stock, a fishery (e.g. its size, potential, state, trend) usually for the purpose of passing advice for management (modified from Cooke, 1984). An assessment of a situation might be undertaken before (*ex-ante*), during (concurrent) or at the end/after (*ex-post*) of a project or an intervention. These phases are compressed when the assessment becomes recurrent and integral part of the decision-making process.
See: *Appraisal; Baseline assessment; Conventional assessment; Integrated assessment; Pre-assessment*

Attribute An abstraction belonging to or characteristic of an entity. A construct whereby objects or individuals can be distinguished.

Appraisal A stage in formal decision methods (following the evaluation stage). The objective of the appraisal stage is for the decision-maker to develop insight into the decision and determine a clear course of action. Much of the insight developed in this stage results from exploring the implications of the formal decision model developed during the formulation stage (Wikipedia, June 2005)

Baseline assessment Provides the basis for future monitoring and performance assessment

Collaborative research *A relationship between equal partners in a research process. It usually involves a partnership between a traditional research institution like a university and one or more community partners* (Graham, 1971, p. 72). Collaborative research may improve credibility and legitimacy.

Criterion
1. In common dictionaries: a criterion is the ideal in terms of which something can be judged. A basis for comparison. A reference point. A benchmark against which other things can be evaluated.
2. In a sustainability indicators framework: a property of interest when considering the principle. In a complex system perspective, a criterion is a property of a component (in this case, the resource). In order to monitor the state of the resource base, for instance, it is necessary to monitor abundance, composition and variability. Criteria can therefore be considered as second order principles that add meaning and operational value to a principle without being a direct measure of performance (i.e. objectives cannot be expressed in terms of criteria). They also often provide the level at which indicators can be meaningfully aggregated, integrated.

Component A part that combines with other parts to found something bigger.

Conventional assessment Refers to the process of assessing resources from the Cartesian/Newtonian positivist and reductionist paradigm (assuming equilibrium, reversibility and predictability) using quantitative methods to advise centralized governments bureaucracies. It is distinguished from integrated assessment.

Conceptual framework A structure built from a set of concepts linked to a planned or existing system of methods, behaviors, functions, relationships and objects. A conceptual framework is used in research to outline possible courses of action or to present a preferred approach to a system analysis project. (Wikipedia, November 2007)

A conceptual framework for SSF assessment, therefore, articulates the ideas, concepts and mental images that are used to construct the operational framework. It is useful as a reference, or metaphor, for all the disciplines involved. If described in simple terms, it can also serve to articulate the interaction with other stakeholders.

See: *Operational framework*

Diagnosis Defined originally as the process used to recognize a condition by its outwards signs and symptoms using various diagnostic procedures (e.g. rapid assessment), it is taken now as including analysis of the causes of these symptoms (Wikipedia). The conclusion reached through these processes is called a *diagnosis*.

Dimension
1. The magnitude of something in a particular direction (e.g. length or width or height). One of three Cartesian coordinates that determine a position in space. A magnitude or extent.
2. The highest level subdivisions of a system. The classical (UN) sustainable development framework recognizes three dimensions: Pressure, State and Response and criteria and indicators will be identified in this typology.

Domain A knowledge area of interest. A territory over which rule or control is exercised. The set of values of the independent variable for which a function is defined (*range?).* A particular environment

Evaluation The act of ascertaining or fixing the value or worth of something. An appraisal of the value of something. A judgment (or a process leading to a judgment) on the quality, importance, amount or value of something (compiled from various dictionaries).
A stage in formal decision methods. The objective of the evaluation stage is to produce a formal recommendation (and its associated sensitivities) from a formal model of the decision situation *(*Wikipedia*).*

Ecological systems Refers usually to the natural environment (Berkes and Folke, 2000, p. 4). It includes the fishery resources, other resources, their habitat, the web of interrelationships and their general environment. Taken as synonym of ecosystem.

Ecosystem A system of complex interactions of populations between themselves and with their environment. The joint functioning and interaction of populations and environment in a functional unit of variable size. In modern use, conceived as comprising a natural and a human subsystem even though the boundaries between the two might be somewhat artificial. Berkes and Folke (2000) use the term social-ecological system.

Feedback In complex systems, *any behaviour that may reinforce (positive feedback) or modify (negative feedback) subsequent behaviour* (Berkes and Folke, 2000: 6)

Fisher A person who fishes. The term does not include those who process or market fish.

Fishworker Men, women, children and elders involved in harvesting, processing and marketing of fish (International Conference of Fishworkers and their Supporters held in Rome, 1984).

Fisherfolk The whole population associated with fish-related activity in a particular location. Also called fisherpeople.

Governance The activity or process of governing. A condition of ordered rule. Those people charged with the duty of governing. The manner, method, system by which a particular society is governed (McGlade, 1999). Governance is undertaken at strategic (policy) as well as operational (management) levels

Indicator

1. A *device for showing the operating condition of some system. A signal for attracting attention. A number or ratio (a value on a scale of measurement) derived from a series of observed facts. Can reveal relative changes as a function of time*.
2. In the sustainable development framework, variable attributes of the criteria that can be used to track the state (represent trends) of a system component and the degree of implementation of the principle, the performance of governance. Indicators are directly connected to operational objectives. They convey a simple, useful message but may aggregate more than one element of information. In relation to the criteria listed above, indicators could be: (i) biomass and catch rates (for abundance); (ii) species diversity and average trophic level (for composition); (iii) coefficient of variation of catch or biomass (for variability).

Indigenous knowledge *Local knowledge held by indigenous peoples, or unique to a given culture or society* (in Berkes and Folke, 2000, p. 4). Taken as a synonym of traditional knowledge and traditional ecological knowledge (TEK) although there is no reason to limit traditional knowledge to its ecological dimension.

Integrated *Not segregated. Resembling or formed (united,* blended) into a unified whole. Introduced into another entity* (example: an integrated assessment and advisory process or an integrated assessment and management process).

Integrated assessment An interdisciplinary process of synthesizing, interpreting and communicating knowledge from diverse scientific disciplines in order to provide relevant information to policy-makers on a specific decision problem (Toth, 2001)
The process of assessing whole and dynamic complex fishery systems in their environment using quantitative and qualitative methods to advise centralized and decentralized government bureaucracies as well as self-governing communities. For a development see Garcia, 2006.
See: *Conventional assessment.*

Integration *The act of combining into an integral whole.* The more integrated the representation, the closer to a system representation.

Interdisciplinarity A typical trait of holistic approaches in science and other fields. The act of drawing from two or more academic disciplines, integrating their insights in pursuit of a common goal and to develop a greater understanding of a single subject, or solutions to a single problem that is too complex or wide-ranging to be dealt with using the knowledge and methodology of just one discipline. Attacking a subject from various angles and methods, eventually cutting across disciplines and forming a new method for understanding of the subject. It may be seen as a remedy to the effects of excessive specialization. It draws its excellence from and feeds it back to the component disciplines.

Interdisciplinarity (cont.)	Examples of interdisciplinary fields are: nanotechnology, computer science, bioinformatics, ecological economics. Interdisciplinarity is sometimes understood as different from multidisciplinarity (in which many different disciplines examine simultaneously their respective objects and combine their conclusions) and transdisciplinarity (which becomes necessary when the concept or method cannot be understood from within a single discipline and requires the input of many disciplines to be understood and the boundaries between disciplines dissolves. Ethnography, is a transdiscipline, combining insights from psychology, philosophy, sociology (compiled from www.wikipedia.com).
Local knowledge	In the specific case of coastal communities, *the body of information developed by those with a local connection to the ocean, whether living by the sea or earning a living from the sea* (Graham, 1971).
Monitoring	To watch and check something (e.g. indicators, activities) carefully over a period of time, sometimes keeping a record of it, usually to check if changes fit with expectations. In fisheries, the observation of fishing activities by the fishery police (as part of the monitoring, control and surveillance [MCS] programme) to check compliance with regulations and provide emergency assistance.
Operational framework	The articulation of a process or series of actions for achieving a result (in this document, an integrated assessment). A framework ready to be used or being in effect or in operation (compiled from various dictionaries).
Participatory research	*A research approach in which local people decide on the research priorities and questions, collect and own information and decide on how it will be used*. (Graham 1971, p. 66). The term collaborative research is also used. See *Collaborative research*.
Pre-assessment	Equivalent to framing, scoping or preliminary appraisal (Chapter 3, section *Overall framework*), *it may be a process of collecting and generating fairly complex information.* In this document, however, a pre-assessment is a rapid assessment of the likely parameters of the assessment itself, before starting it, involving little or no computations and no generation of new knowledge. Its purpose is to help in optimizing the main assessment process. Parameters examined include: availability of data; institutional capacity; seriousness of the issue; scope for participation, etc.
Principle	The highest level of reference in the sustainable development framework. A principle is an expression of human wisdom. It is a statement conventionally taken as a fundamental "truth" or law as a basis for reasoning and action. It can be based on subjective arguments (e.g. ethics, values and traditions) as well as objective falsifiable ones (scientific knowledge). Agreed principles of relevance for fisheries can be found in the FAO Code of Conduct for Responsible Fisheries. They provide the justification for selecting criteria and indicators. They provide the basis for selection of high level conceptual objectives with which they are often confused.

Problem identification and analysis
A process of isolating the issues contained within a larger policy issue *with the view to* defining a problem, analysing it root causes and identifying possible solutions to choose from (constructed from Graham, 1971, p. 121).

Resilience
1. *The ability to recover from (or to resist being affected by) some shock or disturbance* (www.wikipedia.com). *The buffer capacity or the ability of a system to absorb perturbations* (Holling *et al*., 1995) It reflects the capacity of a system to stay or return in its original steady state. *This traditional definition concentrates on stability near an equilibrium steady-state, where resistance to disturbance and speed of return to the equilibrium are used to measure resilience*.
2. *The measure of the amount of change or disruption that is required to transform a system from being maintained by one set of mutually reinforcing processes and structures to a different set of processes and structures (*www.wikipedia.com). *The magnitude of disturbance that can be absorbed before a system changes its structure by changing variables and processes that control behaviour* (Holling *et al*., 1995). This definition emphasizes conditions far from steady-states, where instabilities can flip a system into another regime of behaviour, i.e. to another stability domain.
3. Connected to (ii) the capacity for renewal of a social-ecological system in a dynamic environment, adapting to change so as to maintain or modify as appropriate essential functions (e.g. productivity, livelihoods). Connected to knowledge-building and the building of learning capabilities in institutions and organizations.

Small-scale fisheries
A term of English origin with a technological foundation. It tends to imply the use of a relatively small size gear and vessel. The term has sometimes the added connotation of low levels of technology and capital investment per fisher although that may not always be the case. See: *Artisanal fisheries*.

Stakeholder
Someone affected (positively or negatively) by an activity, or someone who can influence the process of impact of an activity. Broadly defined, stakeholders in fishery regimes include fishers, the fishing industry and institutions involved in the management system, all those who rely on fishery habitats for a living and those interested in conservation of fishery resources and habitats (taken from PARFISH, Walmsley, Howard and Medley, 2005)

Standard
A criterion, indicators and reference value can become a standard when formally established and enforced by an authority and on the basis of which constraining action can be taken (modified from Garcia, 1997).

Surprise
In complex systems behavior, an unexpected change. An outcome that differ from expectations not only quantitatively but qualitatively and may lead to a management crisis (Holling, 1986). A surprise may result from a yet uncovered emergent property of the system. It may also result from the brutal release of the unseen accumulation of minor ecological or social consequences of management under a triggering factor or beyond some tolerable threshold.

Threshold The point where a system flips from one equilibrium to another (Berkes and Folke, 2000, p. 6). The level of an indicator at which the risk of the system to move out of the agreed limits is reached and action is needed (threshold reference point, Garcia, 1994).

Traditional knowledge *A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission {about the relationship of living beings (including humans) with one another in their environment}* (Berkes, 1999, p. 8). Also called traditional ecological knowledge (TEK).
See also: *Indigenous knowledge; Local knowledge*.

Universal *Of wide scope or applicability. Related to, affecting, or accepted by the whole world. Relating, affecting or including everyone in a group or situation. Used or understood by everyone. Applicable to all situations or purposes.*

Versatile *Having a wide variety of skills. Able to move freely in all directions. Competent in many areas and able to turn with ease from one thing to another.* In fisheries, a useful property for an approach, method or model, allowing it to be easily used under various circumstances. Synonym: flexible.

Vulnerability
1. *Susceptibility to attack or/and injury*. A vulnerable ecosystem, species, fishery or human community can easily be modified and eventually damaged in terms of its composition, structure, functions and utility.
2. In fisheries, a multidimensional concept qualifying the relationship between SSF and their political, economic, social or natural environment. *Vulnerability research covers a complex, multidisciplinary field including development and poverty studies, public health, climate studies, security studies, engineering, geography, political ecology and disaster and risk management.* (www.wikipedia.com).

Verifiers They are the elements to used calculate and/or verify the value of indicators and add meaning to them. They include the procedures needed to determine whether the conditions expected for the validity of the indicators are fulfilled. For catch rates, they would include catch and effort data as well as scientific survey data.

References

Berkes, F. 1999. Sacred ecology. *Traditional ecological knowledge and resource management*. Philadelphia, PA, USA and London, UK, Taylor and Francis.

Berkes, F. & Folke, C. 2000. *Linking social and ecological systems: management practices and social mechanisms for building resilience*. 2nd edition. Cambridge, UK, Cambridge University Press. Originally published in 1998.

Cooke, J.G. 1984. Glossary of technical terms. *In* R. May, ed. *Exploitation of marine communities*. Berlin, Germany, Springer-Verlag.

Garcia, S.M. 1994. The precautionary principle: its implications in capture fisheries management. *Ocean & Coastal Management*, 22: 99–125.

Garcia, S.M. 1997. Indicators for sustainable development of fisheries. *Proceedings of the Workshop on Land Quality Indicators and Their Use in Sustainable Agriculture and Rural Development*, pp. 131–162. 25–26 January 1996. Rome, FAO.

Garcia, S.M. 2006. *Fisheries assessment and decision-making: towards an integrated advisory process.* Paper presented at the Nordic Council Conference on Implementing the Ecosystem Approach to Fisheries, 26–28 September 2006, Bergen, Norway. Wallingford, UK, CABI, and Rome, FAO.

Graham, J., Charles, A.T. & Bull, A. 2006. *Community fisheries management handbook*. Halifax, NS, Canada, Gorsebrook Research Institute, Saint Mary's University.

Holling, C.S. 1986. The resilience of terrestrial ecosystems: local surprise and global change. *In* W.C. Clark & R.E. Munn, eds. *Sustainable development of the biosphere*, pp. 292–317. Cambridge, UK, Cambridge University Press.

Holling, C.S. Schindler, D.W. Walker B.W. & Roughgarden, J. 1995. Biodiversity in the functioning of ecosystems: an ecological synthesis. *In* C. Perrings *et al. Biodiversity loss: economic and ecological issues*. Cambridge, UK, Cambridge University Press.

McGlade, J.M. 1999. Ecosystem analysis and the governance of natural resources. *In* J.M. McGlade, ed. *Advanced ecological theory*, pp. 308–336. London, Blackwell Science.

Toth, F.L. 2001. *Participatory integrated assessment methods. An assessment of their usefulness to the European Environmental Agency (EEA).* Technical Report 64. Copenhagen, EEA.

Walmsley, S. Howard, C. & Medley, P. 2005. *Participatory stock assessment (PARFISH) guidelines.* London, MRAG Ltd.

ANNEX 2

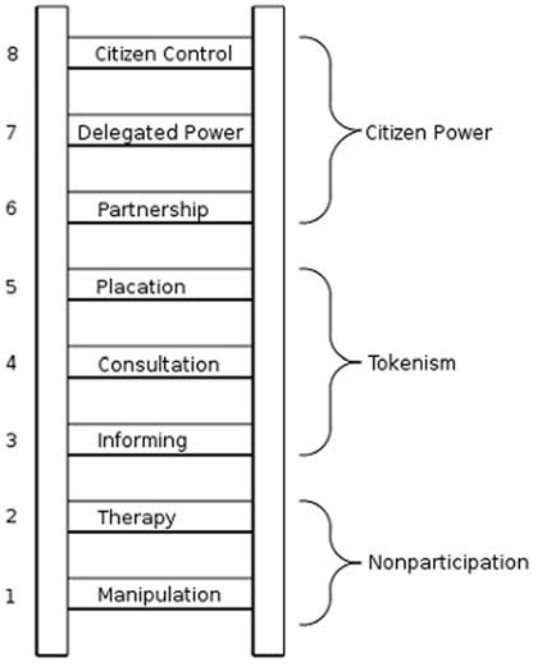
Participation

In the assessment as well as in the monitoring and evaluation processes, participation can provide an empirical check of the models used by scientists to represent the real world. It can also provide a check of the social acceptability of management options and of the legitimacy of their evaluation. In traditional systems' thinking, participation can therefore be seen as a control regulating the quality of the process of interaction between societal demand and scientific supply (Checkland, 1981).

The term "participation" covers a variety of decision-making and information-sharing arrangements. Arnstein's (1969) original "ladder of citizen participation" (Figure A2.1) illustrates the full range of decision-making arrangements found in practice, from those where citizens' needs are "cured" (or poverty "alleviated"), to situations where the people affected by projects and policies are those who make the decisions, with advisory input from external "experts".

To paraphrase Arnstein's (1969) own words: The bottom two rungs of the ladder describe levels of "non-participation" that have been contrived to substitute for genuine participation. Their real objective is not to enable people to participate in planning or conducting programmes, but to enable power holders to "educate" or "cure" the participants. Rungs 3 and 4 progress to levels of "tokenism" that allow the have-nots to hear (3) and to have a voice (4), but only under conditions where they lack the power to ensure that their views will be heeded by the powerful. When participation is restricted to these levels, there is no follow-through, no "muscle", hence no assurance of changing the status quo. Placation (rung 5) is simply a higher level tokenism because the ground rules allow have-nots to advise, but retain for the power-holders the continued right to decide.

FIGURE A2.1
Ladder of participation



Further up the ladder are levels of citizen power with increasing degrees of decision-making clout. Citizens can enter into a partnership (rung 6) that enables them to negotiate and engage in trade-offs with traditional power holders. At the top, under delegated power (rung 7) and with citizen control (rung 8), the directly-concerned citizens obtain the majority of decision-making seats, or full managerial power. It must be noted, however, that people in the lower rungs of participation have nonetheless some power of subverting what the powerful are attempting to achieve without their concern, either through non-compliance or circumventing the measures, ultimately affecting their outcomes. This is indeed one of the powerful reasons for promoting participation.

Although it is envisaged that the assessment framework is embedded within some form of power-sharing arrangement for resource

TABLE A2.1
A typology of participatory research and assessment with fishing communities

Type of participation	Main characteristics of research relationships
Induced or coerced	Scientists define the research or management agenda, fishworkers are paid or co-opted to participate
Extractive, passive or contractual	Scientists or extension agents define the research agenda, fishworkers provide data or resources for scientists to study.
Consultative	Fishworkers define the problem, researchers develop solutions
Collaborative	Fishworkers and scientists participate in different stages of the research
Collegiate	Scientists and fishworkers work together to strengthen both formal and informal knowledge systems.
Advisory	Fishworkers define their own problem-solving agendas. Scientists/ extension agents retain an 'on demand' advisory role.

Source: modified from Biggs, 1989 and Allison, 2002.

management, this cannot be considered a prescription in all cases and a prerequisite to the IAA process. The principles for "participatory research" are detailed in Table A2.1. Induced and extractive approaches prevail in much of the conventional rapid rural appraisal (RRA). While emerging from RRA, the participatory rural appraisal (PRA) prescribed for use in SSF, in line with the principles of this framework (Pido *et al*., 1997), corresponds more to consultative, collaborative and collegiate approaches. Advisory participation may be the most realistic alternative for assessments in situations where scientific capacity is absent or too expensive to mobilize. The difference between conventional and really participative assessment is illustrated in Table A2.1.

Many assessment activities claim to adopt participatory research approaches, such as PRA. The use of PRA tools implies "broad" participatory goals by enabling rural people to explore their own visions and solutions to environment and development problems. The aim is for local people to become creative analysts and performers of research, rather than passive or reactive respondents (Chambers, 1992), yet "doing a PRA" is frequently regarded as a rather simple way of generating a lot of information quickly. The simplicity of the techniques belies the more complex political and social context in which interactions between researchers and local people take place. Local people are often seen as all-too-willing participants without their own agendas. What they say is frequently regarded as a statement of fact, rather than a product of an encounter that is always set within relations of power (Cornwall, Guijt and Welbourn. 1993). Unless they are informed by a strong theoretical grounding in the social sciences and rigorous application of ethnographic research methodology, the "results" of PRA studies are likely to be of little use in informing policy and management. This should not be interpreted as discouraging the use of PRA tools, but as encouraging their more reflective and rigorous application.

Part of the problem with inappropriate use of PRA is that it is now virtually compulsory to use participatory research and development approaches. This has been called the "tyranny of participation" and does not consider the potential pitfalls of indiscriminate and inappropriate use of participatory techniques (Cooke and Kothari, 1998). PRA has become a banner under which all research that involves visiting villages or talking to local people is grouped. Use of PRA in this "extractive" way can be damaging. The tools of PRA are designed to elicit responses on peoples' problems, needs, hopes and aspirations. The "appraisal" is supposed to be only one part of a broader development process that "empowers" local people by enabling them to take some measure of control over the factors that affect their lives. If PRA exercises are not followed up by action to deal with identified problems and needs, expectations can be raised by researchers who lack the means – or even the intention – of fulfilling them. "PRA research" carried out in this manner poses significant ethical problems. The same could be said of application of this diagnostic framework if it is de-linked from subsequent management action.

TABLE A2.2
Differences between conventional and participatory research and assessment

	Conventional research	Participatory research
Purpose	To collect information for diagnosis, planning and evaluation	To empower local people to initiate action
Goals of approach	Predetermined, highly specified	Evolving, in flux
Approach	Objective, standardized, uniform, blueprint to test hypothesis, linear	Flexible, diverse, local adaptation, change is encouraged, iterative
Modes of operation	Extractive, distance from subject, focus on information generation,	Empowering, participatory, focus on human growth
Decision-making focus	External, centralized	Local people, with or without a facilitator
Methods and techniques	Highly structured focus, precision of measurement, statistical analysis (modelling)	Open-ended, visual, interactive, sorting, scoring, ranking, drawing
Researcher/facilitator role	Controller, manipulator, expert, dominant, objective	Catalyst, facilitator, visible initially, invisible later on
Role of local people	Sample, targets, respondents, passive, reactive	Generators of knowledge, active participants, creative
Ownership of results	Results owned and controlled by outsiders who may limit access to others	Results owned by local people, new knowledge resides in people
Output	Reports, publications, possible policy changes	Enhanced local action and capacity, local learning, cumulative effect on policy change, results may however not be recorded

Sources: Narayan, 1996 (from Pomeroy and Rivera-Guieb, 2006: Box 7.3).

Toth (2001) distinguishes two approaches to integrated assessment: mathematical modelling and participatory methods. However, the French school of integrated assessment has also developed participatory modelling (called Companion Modelling) in which stakeholders are directly involved in the design and use of multiagent models used for simulations as well as role games (see Bousquet and Lepage 2004; Gurung, Bousquet and Trébuil, 2006; and http://www.cirad.fr/ur/index.php/green_en/formations/jdr/jdr). A large array of participatory integrated assessment methods have been developed during the past few decades to satisfy the demand emerging from various segments of society (Toth, 2001).

REFERENCES

Allison, E.H. 2002. Sustainable management in the African Great Lakes: science for development? *Aquatic Ecosystem Health & Management*, 5(3): 313–325.

Arnstein, S.R. 1969. A ladder of citizen participation. *Journal of the American Institute of Planners,* 35(4): 216–224.

Biggs, S.D. 1989. Resource-poor farmer participation in research: a synthesis of experience from nine national agricultural research systems. *OFCOR Project Study No 3*. The Hague, International Service for National Agricultural Research (ISNAR).

Bousquet, F. & Le Page, C. 2004. Multi-agent simulations and ecosystem management: a review. *Ecological Modeling,* 176: 313–332.

Chambers, R. 1992 Rural appraisal: rapid, relaxed and participatory. *IDS Discussion paper No. 311*. Brighton, UK, Institute of Development Studies. .

Checkland, P. 1981. *Systems thinking. Systems practice.* Chichester, UK, Wiley. .

Cooke, B. & Kothari, U. 2001. *Participation: the new tyranny?* London, Zed Books. .

Cornwall, A. Guijt, I. & Welbourn, A. 1993. Acknowledging process: challenges for agricultural research and extension methodology. *IDS Discussion Paper No. 333*. Brighton, UK, Institute of Development Studies.

Gurung, T.R., Bousquet, F. & Trébuil. G. 2006. Companion modeling, conflict resolution and institution building: sharing irrigation water in the Lingmuteychu Watershed, Bhutan. *Ecology & Society*. 11(2): 36 (available at http://www.ecologyandsociety.org/vol11/iss2/art36/)

Narayan, D. 1996. What is participatory research? *In* World Bank. *Towards participatory research*, pp. 17–30. Washington, DC, World Bank.

Pido, M.D., Pomeroy, R.S. Garces, L.R. & Carlos, M.B. 1997. A rapid appraisal approach to evaluation of community-level fisheries management systems: framework and field application at selected coastal fishing villages in the Philippines and Indonesia. *Coastal Management*, 25: 183–204.

Pomeroy, R.S. & Rivera-Guieb, R. 2006. *Fishery co-management: a practical handbook.* Cambridge, MA, USA, CABI Publishing in collaboration with IDRC.

Toth, F.L. 2001. *Participatory integrated assessment methods. An assessment of their usefulness to the European Environmental Agency (EEA).* Technical Report 64. Copenhagen, EEA.

Conventional assessment frameworks do not provide an adequate basis for informed management decisions and development planning of the small-scale fisheries (SSF) subsector. Normative management frameworks and approaches have been developed as an evolution of conventional fisheries management, such as the 1995 FAO Code of Conduct for Responsible Fisheries and the ecosystem approach to fisheries. Yet, the assessment frameworks required to operationalize these alternative management approaches have not been fully developed, at least for SSF.

The integrated assessment and advisory (IAA) framework presented in this document begins to address this need. The document presents the conceptual basis of the IAA process, introduces the framework and places the assessment within the broader planning and management cycle. The IAA framework presented here results from the synergistic efforts of FAO and the WorldFish Center, with collaboration from individuals leading both research and practical assessment and management programmes related to SSF.

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