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The practice of participatory research and gender analysis in natural resource management

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Abstract

Stakeholder participation is expected to improve the efficiency, equity, and sustainability of natural resource management research and development (R&D) projects by ensuring that research reflects users' priorities, needs, capabilities, and constraints. Use of participatory methods and tools is growing rapidly; however, there is little systematic evidence about what participation actually means in practice, or about what difference it makes. Based on an inventory of 59 self-described participatory R&D projects in the area of natural resource management, this article characterizes the typical project and analyzes how stakeholders are selected, how they participate in the research process, and what their involvement means for project costs and impacts. The results suggest that, while projects are generating a range of direct and indirect benefits for participants, more careful attention needs to be paid to achieving equitable impacts. Current practices may lag behind best practices in key areas, such as power sharing and participant selection, and may therefore be missing important contributions from women and other marginalized groups.

Keywords: Natural resource management research; Stakeholder participation; Gender; Impact assessment; Sustainable development.

1. Introduction

The use of participatory methods has increased dramatically in natural resource management over the past decade, largely because of the recognition that sustainable natural resource management cannot be achieved without involving the individuals and communities who make decisions about how resources are used (Pretty and Ward, 2001; Ribot, 2002). The participation of resource users and other stakeholders is important not only in the management of resources, but also in research oriented toward the generation of information and innovations that shape how resources are understood and exploited (Pound et al., 2003).

There is extensive literature on participatory approaches and a growing number of case studies of their use in natural resource management (e.g., Hinchcliffe et al., 1999; Pretty, 1995; Pretty and Hine, 2001; Pound et al., 2003), yet it is difficult to form a coherent overview of this body of work, much of which is unpublished. Nonetheless, some guiding principles and best practices have been identified for how best to do participatory research in natural resource management (Ashby, 2003; Vernooy and McDougall, 2003).

There has been little systematic analysis to date about precisely how participatory research methods are being used in natural resource management research projects.[1] This article begins to fill the gap by providing a comparative analysis of 59 participatory natural resource management research projects. The article looks at who is doing participatory research in natural resource management, where, how and with what observed or expected impacts. Projects are analyzed in terms of the type of participation they engage, how they select participants, and whom they target as beneficiaries. The actual and/or potential costs and benefits associated with incorporating user participation are also analyzed.

The results of the analysis are useful not only for characterizing current practices with regard to participatory

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[1] Research is defined here as a process through which problems are identified (the design stage), solutions are found and tested (testing stage), and as a result the target group adopts a technology or other type of innovation (dissemination stage). Therefore, a project must include at least one of these stages of innovation in order to be considered a research project.

research and diversity analysis in natural resource management research, but also for highlighting priority areas where current practice lags behind best practice, and for identifying issues for future research. Such analyses are critical if the incorporation of user perspectives and participation is going to fulfill its promise as a means of improving the efficiency, equity, and impact of natural resource management research.

This article is organized as follows: Section 2 provides some background on participatory research in agriculture and natural resource management. Section 3 describes the data collection process, and characterizes the projects in the inventory. Section 4 looks at the role of users in projects, including types of participation, methods for participant selection, and the targeting of beneficiaries. Section 5 focuses on analysis of diversity among stakeholders, with special reference to gender. Section 6 looks at costs and benefits of using participatory research and diversity analysis, as reported by projects. Section 7 concludes with a discussion of the main findings in light of the guiding principles for best practice in participatory research in natural resource management.

2. Participatory research in agriculture and resource management

Participatory research emerged as a recognized methodology in the 1970s but it was not until the 1990s that it began to gain ground in agricultural and natural resource management research, largely as a result of the recognition that past research efforts were failing to achieve expected impacts on poverty and on the environment (Ashby, 2003). New technologies were available, but were not being adopted, often because they were simply not appropriate, given the priorities and constraints of intended users. There are many tools and methods for involving stakeholders in the research process; however, it is more useful to think of participatory research in terms of its objectives rather than the specific tools, since a given tools can often be used for different purposes.

The incorporation of end-users in order to better design and target research is often referred to as functional participation, since its goal is to increase the effectiveness of conventional research processes. An example is participatory varietal selection, where crop breeders ask farmers to evaluate different varieties, either on experiment-station plots on through on-farm trials, according to farmers' own criteria. The outcomes of participatory varietal selection repeatedly reveal differences between what breeders think farmers want and what farmers actually want. The fact that this happens even with experienced breeders is testimony to the diversity of criteria that farmers use when deciding whether or not to plant a particular variety. Participatory plant breeding, in which farmers participate in breeding decisions or even make their own crosses, implicitly recognizes that in some social and ecological environments, impact may be higher with a diverse range of cultivars rather than a single uniform super-variety (Ceccarelli, 1994). When participatory research focuses on building stakeholders' individual and collective capacity to innovate as well as on developing specific technologies, it is referred to as empowering participation.

Since the need to work with rather than control diversity is fundamental in sustainable management of natural resources (McDougall and Braun, 2003), empowering participation would be expected to be the norm. One way to empower users is to train them individually in specific skills needed to understand and experiment with specific technologies and management practices. More generalized methodologies have also been developed to systematize both capacity building and interaction between stakeholders and scientists (Braun, Thiele and Fernandez, 2000). The local agricultural research committee[2] (Ashby et al., 2000) or the Mother-Baby trial method (Snapp, 1999) focus on training a small number of farmers per community in basic principles of experimental design, and supporting them to carry out experiments on their own land, interpret the results and in some cases even formulate recommendations. Research-oriented farmer field schools combine experimentation with education in areas ranging from pest ecology to group dynamics (van de Fliert and Braun, 2002; van de Fliert et al., 2001). Less structured are the literally thousands of land, forest or watershed management groups that have sprung up around the developing world (Pretty and Ward, 2001), usually with support from external R&D organizations that provide training and support in areas such as negotiation, facilitation or monitoring and evaluation.

3. The project inventory

3.1. The data

To get a better idea of who is doing what in participatory research for natural resource management, over 500 questionnaires were sent out between October 1999 and May 2000. The main sources for potential cases were:

- The World Bank data base of approximately 400 community natural resource management projects;
- A Natural Resource Institute (NRI) sponsored workshop on participatory research in natural resource management;
- Applications (130) for small grants from the Participatory Research and Gender Analysis (PRGA) Programme;
- Approximately 200 participants at the PRGA Programme workshops;

[2] http://www.ciat.cgiar.org/catalogo/producto.jsp?codigo=P214.

- Cases submitted for inventory through the PRGA Programme's listservs;
- A review of the literature on participatory research and natural resource management; and
- Recommendations from experts in the fields of natural resource management, participatory research and gender.

A total of 59 usable responses were received. The main reason for this seemingly low response rate is that the initial 500 cases contacted included both participatory natural resource management research and participatory natural resource management projects. The survey instrument was designed to distinguish between projects that had a research component and those that were engaged solely in resource management. Non-research projects would not be able to answers the questions, and would therefore not complete the survey.

Thus, the cases on which this analysis is based constitute a self-designated, self-selected subset of projects doing participatory research in natural resource management. While we attempted to get as representative a sample as possible, several possible biases should be acknowledged. Given that a Future Harvest[3] programme did the data collection, affiliated projects may be over-represented in the sample. Because the survey was done via email or fax and in English, it is also likely that the results are biased towards projects with access to good telecommunications technology and English-speaking staff.[4] Finally, it is important to stress that the data collected in this survey represent a self-assessment of each project.

3.2. *Anatomy of a participatory natural resource management research project*

According to the inventory, participatory natural resource management research projects are found throughout the developing world. Africa has the most projects in the inventory (38%), followed by Asia (34%), Latin America and the Caribbean (22%) and the Middle East (5%).

The common perception of participatory research projects is that they are small, site specific and involve a researcher working intensively with a handful of farmers. According to the inventory, projects in fact work at a range of scales from subcommunity to national (Table 1). The most common scale is community (31%), which is interesting because it is a social/institutional rather than a biophysical unit. A quarter of the projects worked at multiple scales. The median project works with 1,000 beneficiaries in an area of 677 km^2.

Projects work on a variety of resources and technologies, where technology is broadly defined to include institutional innovations (such as those described in Section 2), as well as more conventional biological, chemical, or mechanical inventions. The most common resource across all projects is soils; nearly half the projects worked on soil-related topics (Table 2). Water was the second most common resource, followed by forests and biodiversity. As expected, the priority given to different resources varies across geographical regions. Reflecting their participatory focus, institutional/organizational innovations were the most common technology on which projects reported working, followed by agronomic practices in Africa and agroforestry in Asia and Latin American and the Caribbean (Table 3).

Perhaps more important than their specific resource or technology focus is the fact that half the projects in the inventory reported working on more than one resource or technology. This is consistent with the fact that farmers and other resource users generally take a more integrated, holistic view of the natural environment than researchers or development workers, who are accustomed to breaking it down along sectoral and disciplinary lines. The average project in the inventory was developing 2.4 different types of technologies directed at 1.9 types of resources (Table 4). The number of technologies that a project works with varies significantly by scale, but the number of resources does not.

Virtually all projects are collaborative efforts between different types of R&D organizations; however, in general one organization took the lead on research aspects of the

Table 1. Scale of projects

Project Scale	Number of projects
Sub-community	3
Community	18
Watershed	9
Regional/national	8
Other/multi-scale	15
All projects	59

Table 2. Number of projects working on the resource, by region

Resource	Asia	Africa	Latin Am & Car	Middle East	World	Percent of all projects
Soil	7	12	6	2	27	47
Water/watersheds	6	7	2	3	18	31
Bio-diversity	2	4	7	1	14	24
Forest	4	7	6	0	17	29
Irrigation	4	1	1	0	6	10
Fisheries	1	0	1	0	2	3
Coastal Resources	1	1	1	0	3	5
Rangelands	0	1	0	2	3	5
Human capital	3	0	0	0	3	7
Land/systems	1	6	2	0	9	15
Other[a]	6	1	2	1	9	17

[a] Other includes wildlife, habitats, medicinal plants, feed, and livestock.

[3] Future Harvest is a network of international agricultural research centers (www.futureharvest.org).

[4] Some responses in Spanish were received and translated.

Table 3. Number of projects using a technology, by geographic location and use of gender analysis

Technology	Asia	Africa	LAC	Middle East	World	Percent of All Projects ($n = 56$)
Agronomic practice	5	9	6	3	23	40.4
Agroforestry	6	5	8	1	23	36
Fertilizer	0	4	1	1	6	10.7
In situ conservation	2	4	5	1	12	21.4
Institutional/ Organizational	11	14	8	2	34	60
IPM	3	2	1	0	7	13
Mechanical cropping	4	1	0	1	6	10.9
Mechanical-irrigation	1	0	0	0	1	1.8
Pesticides	0	1	1	0	2	3.6
Crop or plant varieties	2	4	3	3	12	21.4
Soil conservation practices	0	2	1	1	4	7
Other*	2	4	3	1	14	18

* Other includes communications packages, tree domestication and *circa situ* conservation, culture, management training, flora inventory, livestock technologies, beekeeping, carpentry and artesania.

Table 4. Average number of resources and technologies per project, by project scale

Project Scale	Average number of resources per project (sd)	Average number of technologies per project[a] (sd)
Sub-community (n = 3)	1.3 (.58)	1.7 (1.15)
Community (n = 18)	2.17 (1.41)	2.4 (2.44)
Watershed (n = 9)	2.3 (1.41)	3.1 (1.83)
Regional/national (n = 8)	1.8 (.89)	2.0 (1.85)
Other/multi-scale (n = 15)	1.9 (.83)	2.5 (1.55)
All projects (n = 59)	1.9 (1.13)	(2.4) (1.88)

[a] Differences in number of technologies by scale are statistically significant (p value < .1 in Pearson Chi square).

project. Future Harvest centres took the lead in 37% of projects, followed by NGOs (16%), universities (12%) and national agricultural research institutes (9%). As mentioned earlier, some of this Future Harvest-dominance may be the result of a bias in response rate. Nonetheless, these data do not suggest that non-governmental organizations (NGOs) and, particularly, national agricultural research institutes are playing a leading role in participatory natural resource management research. Given their focus on adaptive research, these organizations might be expected to be leaders in participatory natural resource management. Since they are often involved in projects but not in a lead role, they may be in a learning phase with respect to participatory research methods.

The projects in the inventory are all relatively recent, with the oldest beginning in 1988. Half began after 1996. While there was likely some bias in the response rate towards ongoing projects, the fact that projects are recent is also consistent with the relative novelty of both participatory approaches and natural resource management research in general. The average project lasts 4.2 years.

4. The role of users in participatory natural resource management research

The impact of user participation is affected by both the role that participants play in the research process, and by the specific characteristics of the participants themselves.

4.1. Types of participation

To better understand the role that users play in the research process, respondents were asked about the types of participation that they used at different stages of the innovation process, based on a typology adapted by Lilja and Ashby (1999) and McDougall and Braun (2003). In this typology, the innovation process is divided into 3 stages: design, testing and dissemination. Each stage consists of activities; there are a total of 16 activities in the innovation process.[5] The type of participation is based on who makes the key decision in the innovation process, and five different types of participation can be distinguished:

- *Conventional (or contractual)*. Scientists make decisions alone without organized communication with other stakeholders. Scientists own the process, though they may contract other stakeholders to perform specific tasks.
- *Consultative*. Scientists make the decision alone after organized communication with other stakeholders identified by scientists. Scientists know about stakeholders' opinions, preferences and priorities, but they may or may not let this information affect their decisions. The decisions are not made together with stakeholders nor are they delegated to them.
- *Collaborative*. Power is shared between scientists and other stakeholders. Stakeholders know about each other's opinions, preferences and priorities via organized two-way communication. No party has a right to revoke the shared decision.
- *Collegial*. The decision is made by local stakeholders collectively in a group process or by individuals who are involved in organized communication with scientists. Local stakeholders know about scientists' opinions, preferences, proposals and priorities through organized

[5] See Table 5 for the 16 activities.

Table 5. Types of participation by stage of innovation process at which they are used

Activity and stage	Conventional	Consultative	Collaborative	Collegial	Farmer Experimentation
Design	Percent of projects using this type X participation in activity Y[a]				
R1 Who decides what is the target group or clientele at the research initiation stage? (*n* = 49)	20	41	27	8	4
R2 Who decides what are the topics, opportunities or the problems at the diagnosis stage? (*n* = 48)	4	35	46	8	6
R3 Who decides what is the most important problem or opportunity that has been identified for research? (*n* = 95)	9	23	49	15	4
R4 Who decides what are the available solutions and relevant information about the problem or opportunity? (*n* = 90)	9	30	49	12	0
R5 Who decides that the available solutions are not adequate and more information needs to be sought or generated to reach a potential solution? (*n* = 88)	13	31	40	16	0
R6 Who decides what is the relative importance of solutions that have been identified? (*n* = 89)	5	23	52	14	7
R7 Who decides which solutions are worth testing? (*n* = 87)	2	23	58	12	5
Testing					
T8 Who decides what is the target group or clientele for evaluating the potential innovations or technology options? (*n* = 41)	10	29	41	12	7
T9 Who decides whether to do the testing on farm or on station or both? (*n* = 77)	19	33	39	3	6
T10 Who decides what aspects of innovation or technology option are important to evaluate? (*n* = 78)	10	31	43	12	5
T11 Who decides what is the yardstick for measuring what is an acceptable solution or not? (*n* = 85)	5	33	47	9	7
T12 Who decides what is recommended to other farmers? (*n* = 84)	2	20	51	17	10
Diffusion					
D13 Who decides what is the target group or clientele for awareness building, validation and dissemination of tested innovation or technology options? (*n* = 40)	3	35	30	25	8
D14 Who decides when, to whom, and in what way to promote awareness of solutions and publicize information about it? (*n* = 81)	5	37	37	12	10
D15 Who decides when, to whom, and in what way to supply new inputs needed for adoption? (*n* = 79)	3	42	37	11	8
D16 Who decides when, to whom, and in what way to teach new skills needed for adoption? (*n* = 78)	5	30	53	10	3

[a] Rows may not all sum to the same number because some projects reported using more than one type at a single stage while others did not do all stages.

two-way communication, and they may or may not let this information affect their decision. When this type of participatory research is initiated, a scientist may be facilitating the collective or individual decision-making of other stakeholders or may have already built that capacity.

- *Farmer (or stakeholder) experimentation*. Farmers or other non-scientist stakeholders make decisions individually or in a group without organized communication with scientists.

The vast majority of projects in the inventory report that they do consultative or collaborative research in each stage and activity (Table 5).[6] Relatively few projects report collegial participation at any stage, which suggests that while researchers and other stakeholders sometimes share decision-making power, non-researchers are rarely in control of the process. It is interesting to note that researchers tend to maintain control in the initial decision about how

[6] It is important to point out that these data include both completed and ongoing projects. To the extent that expected and actual participation differ, the data would be biased toward the former. There is, however, no systematic relationship between them as there are examples of both in the cases.

Table 6. Correlations between type of participation used at different stages of the research process (Kendall's tau-b coefficients/Prob > |R| under Ho: Rho = 0/N = 25)

	R2	R3	R4	R5	R6	R7	T8	T9	T10	T11	T12	D13	D14	D15	D16
R1	**0.600**	0.490	0.335	0.547	0.317		0.569	0.518		0.382	0.466	0.582			
	0.001	0.008	0.072	0.003	0.088		0.002	0.006		0.038	0.012	0.002			
R2		**0.686**	0.433	0.338	0.449		0.452	0.503			0.322				
		0.000	0.019	0.068	0.015		0.014	0.007			0.079				
R3			**0.679**	0.505	*0.750*	0.417	0.593	0.517	0.479	0.394	0.508			0.353	0.363
			0.000	0.006	*0.000*	0.025	0.001	0.006	0.010	0.032	0.006			0.055	0.049
R4				0.513	*0.794*	0.596	0.407	0.494	0.518	0.347	0.505			0.356	0.331
				0.006	*0.000*	0.001	0.028	0.008	0.005	0.060	0.006			0.054	0.073
R5					**0.612**	0.310	**0.665**	0.566	0.577	0.445	0.431	0.480			0.333
					0.001	0.096	**0.000**	0.003	0.002	0.016	0.020	0.009			0.072
R6						0.525	0.434	0.501	0.569		0.382			0.562	
						0.005	0.019	0.007	0.002		0.038			0.002	
R7							0.347	0.411	**0.651**	0.441	0.574	0.457	0.349	0.562	0.515
							0.061	0.028	**0.000**	0.017	0.002	0.019	0.059	0.002	0.005
T8								**0.645**	0.365	0.536	0.524	**0.644**	0.517	0.452	0.442
								0.001	0.048	0.003	0.004	**0.000**	0.005	0.014	0.016
T9									0.422	0.549	**0.620**	**0.625**	0.540	**0.634**	0.451
									0.023	0.003	**0.001**	**0.001**	0.004	**0.001**	0.016
T10										**0.645**	0.467	0.431	0.451	0.456	0.557
										0.000	0.011	0.019	0.014	0.013	0.003
T11											**0.602**	0.568	*0.772*	**0.640**	*0.730*
											0.001	0.002	*0.000*	**0.001**	*0.000*
T12												0.547	0.494	*0.705*	**0.665**
												0.003	0.007	*0.000*	**0.000**
D13													*0.730*	**0.678**	0.570
													0.000	**0.000**	0.002
D14														*0.761*	*0.761*
														0.000	*0.000*
D15															**0.809**
															0.000

??? > **0.8** ??? > *0.7–0.8* ??? > **0.6–0.7**

the target group and clientele are defined and in the diffusion stage when decisions are made about dissemination on a wider scale.

It is also worth noting that many projects used more than one type of participation at a given stage. For example, one project gathered information on pest management via quantitative production surveys and via focus group interviews. Another used both researcher-managed and farmer-managed experimental plots to test soil management practices. We do not know why multiple types were used. One explanation is that researchers were triangulating, using multiple methods to cross check results. While this is generally viewed as good practice in research, it might be problematic in this case unless there is a process in place for reconciling differing outcomes. Conflicting outcomes may mean that one method was better than the other and gave the correct answer, but they may also reflect fundamental differences in the way different stakeholders understand and interpret natural resources management.

Since the data in Table 5 include all projects that reported working at a particular stage, they do not let us see how participation varies between research activities and stages within a specific project. To get a better idea of intra-project variation in type of participation, a matrix of correlation coefficients for activities was calculated for the 16 activities in the research process. These coefficients tell us how the type of participation used in one activity is related to the type used in another. A high correlation between two activities means that if a certain type of participation is used in one, it is very likely that it is also used in the other.

According to these data, the strongest correlations are found in the latter stages of the research process (Table 6). At the end of the testing stage (T11–T12) and throughout the dissemination stage (D13–D16), projects tend to use the same type of participation in all activities. In earlier stages of the research process, the correlations among activities are much lower, which means that projects jump from one type of participation to another as they move from activity to activity. This does not suggest a truly collaborative process, but rather one where scientists decide when and how they share their authority.

4.2. Selection of participants

Managing natural resources is fundamentally about power relations, about who decides who has access to resources, and how those resources will be used (Vincent, 2003). Therefore, the specific characteristics of the participants involved in participatory research processes, as individuals and as representatives of social, cultural or economic groups within communities, would be expected to influence the priorities, processes and outcomes. While we do not know exactly who the participants were in the inventory projects, we do know how they were selected, and this can tell us quite a bit about who they are likely to be.

Participant selection in participatory research is similar to sample selection in a survey — it determines what information is gathered, how robust the results will be, and to what extent they can be extrapolated. Random samples of populations are generally desirable in quantitative surveys; however, participatory research generally relies on self-selection (volunteers) or on purposive selection of participants based on efficiency criteria such as possession of specific knowledge, skills or status in the community. Sometimes researchers themselves decide what criteria they want, and other times it is left up to the community to nominate participants.

These selection methods might be expected to produce participants who not only find it easier to participate in research, but also make a qualitative difference to the process because of their above-average education, technical skills, leadership ability, or people skills. Voluntary self-selection is attractive in that it is likely to identify the most qualified and committed participants, but it is also the approach which is probably the least pro-active and most susceptible to gender bias and/or elitism. The better-off are the most likely to be aware of opportunities and to have the time and self-confidence to participate.

Community nomination of participants may be susceptible to the same kinds of biases unless specific criteria are agreed upon that promote the inclusion of disadvantaged groups. The ability of the community to identify appropriate participants may also depend on its ability to make collective decisions. If it is perceived that participation in a project will bring with it material or social benefits, community leaders may nominate their allies. In one project in Africa, it was discovered that most of the participants were relatives of the village chief, so in the following year more objective criteria were set for participation.

The selection of participants can also be hampered by an incomplete understanding of who the stakeholders are in a project. For example, a project in Colombia that sought to stimulate the adoption of conservation practices in riverine areas selected its participants among the owners of land adjacent to the waterways. Researchers overlooked the fact that those areas were also used by landless farmers to gather animal feed. As a result, the land-management plans developed by the researchers and landowners, which called for restricting access to certain areas, had significant negative impacts on the landless. They responded by burning the protected areas (Ravnborg et al., 1996).

The single most common method of participant selection among the projects in the inventory was community selection on the basis of specific skills (29%), followed by self-selection (17%), and researcher selection on the basis of skills (6%). Another 44% of projects used multiple methods, mainly combinations of these three.

Only 2% of the projects selected participants exclusively on the basis of equity criteria. Another 25% of the projects used equity as one of several criteria. These results suggest that if in fact marginalized groups are less likely to be identified by these types of selection methods, then these groups will be excluded from most participatory natural resource management projects.

5. Use of diversity analysis

Diversity analysis, also known as gender and/or stakeholder analysis, involves characterizing and analyzing heterogeneity within stakeholder groups. The study shows that 72% of projects used diversity analysis as a way to better understand and involve their target populations in research. For example, a careful diversity analysis should have identified the landless as key stakeholders in the Andean conservation project mentioned above. While there is some variation, use of diversity analysis among projects in the inventory appears to be relatively high (greater than 60%) across all geographical areas, major categories of resources and technologies, types of organizations, and scales and sizes of project.

The relative prevalence of diversity analysis stands in sharp contrast to the findings of the previous section that reported that few projects used selection criteria designed to obtain participation of diverse groups such as women or the poor. In order to get a better understanding of how and why projects were using diversity analysis, respondents who reported using diversity analysis were asked to identify which type(s) they used.[7] The three types of analysis are:

- *Diagnostic*. Diversity differences in the client group(s) for the research are described, and different problems or preferences are diagnosed. This information is not taken into account in priority setting, design of solutions for testing or their evaluation and adoption. Diagnostic analysis may come to the conclusion that gender or other differences are not important criteria for designing the research; or it may identify differences as an obstacle to adoption of technical solutions for specific client groups.

[7] See Lilja et al. (2000) for details about the gender typology.

- *Design-oriented*. In addition to describing gender and other differences in the client group with respect to their problems and preferences, different R&D paths are designed that take into account diversity-based constraints, needs and preferences. Design-oriented analysis may result in different technologies being developed and adopted for specific groups, and these may require different dissemination approaches.
- *Transfer-oriented*. In addition to describing diversity differences in the client group with respect to their problems and preferences, different adoption and dissemination paths are designed to overcome access to and adoption of a given technology known/assumed to be of similar importance to different groups. Transfer-oriented analysis results in the same technologies being disseminated to different client groups in different ways.

Transfer oriented diversity analysis is the most common (45%), followed by diagnostic and design (28% each). The prevalence of transfer-oriented analysis among projects suggests that women and other marginalized groups are not being considered until technologies have already been identified and tested and are ready for dissemination. This would be consistent with their relatively low levels of participation in the research process, and may mean that these groups are expected to adopt innovations that may not be appropriate for their specific needs and constraints. Even worse, where the outcomes of natural resource management research projects are new rules about who can use resources and how, groups that are left out of the research process may actually be hurt.

6. Benefits and costs of participatory research and diversity analysis

Because of the nature of participatory research, projects can generate both direct and indirect benefits (Johnson et al., 2003; Lilja and Aw-Hassan, 2003). Direct benefits are those that result from participation itself, while indirect benefits derive from the outputs produced by the research. The former we term process outcomes, and the latter, technology impacts. Projects were asked to estimate the incidence of different types of outcomes and impacts.

It is worth pointing out that 46% of projects did systematic impact assessment and 69% did some form of monitoring and evaluation (Table 7). Most of the monitoring and evaluation (91%) was participatory and, in three-quarters of the cases, it resulted in changes in the way the project was implemented. There were significant differences between implementing institutions in terms of their use of monitoring and evaluation and impact assessment. Only 21% of Future Harvest centres did impact assessment, compared to 62% of projects led by other type of institutions.

Table 7. Use of impact assessment, monitoring and evaluation (M&E)

	Impact Assessment Done?[a]	M&E Done?	M&E Participatory?	M&E Resulted in Changes?
	% Projects Answering Yes to Questions			
IARCs (*n* = 19)	21	74	93	75
Non-IARCs (*n* = 29)	62	66	89	69
NARS (*n* = 5)	22	40	100	0
NGO (*n* = 7)	57	71	80	60
University (*n* = 5)	60	100	100	100
Other (*n* = 8)	88	38	67	100
>1 (*n* = 4)	75	100	100	75
All (*n* = 48)	46	69	91	71

[a] Difference among all types of projects and among IARC and non-IARC projects was significant at level $p < .05$.

6.1. Beneficiaries

Before looking at the specific benefits and costs associated with participatory natural resource management projects, it is useful to look at who the intended beneficiaries of the projects were. Beneficiaries include all people expected to benefit from the outputs of the project, not just those who participate directly in it. Of all projects, 95% reported that their intended beneficiaries were either the community in general or farmers in particular. Of these projects, 26% also reported targeting women, and 18% reported targeting the poor. No project reported targeting women or the poor exclusively. This is consistent with earlier findings regarding participant selection and diversity analysis, and suggests that these groups are not likely to receive a large share of the direct benefits of participation. Whether they benefit indirectly via the innovations produced by the projects will depend on how well their needs, constraints, and priorities are reflected by the actual project participants.

6.2. Process outcomes[8]

The incorporation of potential beneficiaries as participants in the innovation process can affect the efficiency of the research process itself. The interaction with researchers may affect the participants as well, both at the individual and community levels, by building social and human capital.

6.2.1. Impact on the research process

Participation was hypothesized to affect the research and technology generation process in four potential ways:

[8] To reduce bias associated with speculation, impacts are based on the responses of 13 projects that had either completed their activities or were expected to complete them in 2000.

- Feedback links are formed or strengthened between participants and researchers.
- Researchers and/or research institutes change their priorities; e.g., identification of problems, solutions or beneficiaries groups.
- Researchers and/or research institutes change their practices; e.g., use of participatory tools institutionalized.
- Changes occur in the pattern of diffusions of technologies, e.g., faster adoption or higher adoption ceilings.

Forming of feedback links and changing research priorities were the most common impacts on the research process, with 62% of projects reporting them. Changes in the rate or extent of adoption were reported by 54% of projects. Only 38% reported a change in research practices at their research programme or system level, suggesting a relatively low level of institutionalization of participatory research as a result of the projects. This contrasts somewhat with high levels of institutionalization documented in case studies of success stories in participatory research in agricultural and natural resource management (Johnson et al., 2003; Lilja and Erenstein, 2002).

6.2.2. Human capital impact

As a result of involvement in the research process, the following human capital impacts were hypothesized to occur among participants:

- The development of specific agricultural or project skills through training.
- The strengthening of general analytical skills and problems solving capacity.
- The empowerment of participants to address problems outside the context of the specific project.

Projects in the inventory were more likely to report general human capital impact, such as strengthening of analytical capacity and empowerment, than the development of specific, project-related skills. Specific skills were developed in 54% of the projects; and general analytical capacity and empowerment were reported by 69%. These results support the assertion that there are equity issues involved in selecting participants because they benefit directly from participation itself.

6.2.3. Social capital impact

Incorporating users in the research process was expected to have the following potential impact on social capital:

- New organizations formed;
- Internal organizational capacity strengthened;
- Capacity of community to work with external organizations strengthened; and
- Conflict reduced.

In general, the incidence of social capital impact is lower than the other types of process outcomes. The most common social capital outcome was the strengthening of organizational capacity (62%). New organizations were established in 46% of the projects, and the same percentage observed an improvement in the communities' ability to work with outside external organizations. Conflict reduction was reported by 31% of the projects as a result of their activities.

Given the considerable time and effort required for groups to consolidate and become mature enough to generate significant and fundamental innovations in the way natural resources are managed (Pretty and Ward, 2001), the fact that nearly half of these projects report establishing new organizations suggests that their real impacts are unlikely to be felt for some time. More problematic is that fledgling organizations will need support to achieve their potential, and the short time frames of the projects do not suggest that this support will be provided as part of the project.

6.3. Technology impacts

While the previous section focused on process outcomes, this section focuses on the impacts of the final technologies and other innovations produced by the projects. Respondents were also asked whether they had observed any of the following socio-economic or environmental impacts:

- Adoption rates
- Production increases
- Increased income
- Effects on welfare/poverty
- Equity effects
- Environmental impact

The projects reported as follows: 73% observed adoption; 82% observed environmental impact; 64% reported income increases associated with adoption; while only 27% reported production increases. These findings suggest that natural resource management technologies generate benefits by reducing costs, rather than increasing production. Another 45% observed equity effects, defined as improvements in resource distribution, while 27% reported effects on poverty and or welfare.

6.4. Costs of using participatory research and diversity analysis

The costs and cost effectiveness of participatory research and diversity analysis have not, until recently, been the subject of systematic analysis (Johnson et al., 2003). While the cost-effectiveness issue was not addressed directly, respondents were asked whether they thought that incorporation of these approaches affected costs. It is hypothesized that the costs of participatory research would be higher than for conventional research, especially at the beginning, since project staff need to acquire new skills. Moreover, the cost of interacting with the beneficiaries is an additional cost compared to conventional research. In the long run, however, some of the research costs could be transferred to the beneficiaries as they become involved in the research, contributing their time, skills and resources. It is also to be expected that benefits would accrue earlier than in conventional research, which would affect the overall rate of return.

Almost half the respondents (46%) felt that participatory research did indeed increase the costs of doing research, while 33% felt that it decreased costs. The category 'do not know' (20%) includes two types of responses: those who said that costs first increased and then decreased, without indicating a net effect, and those who did not answer because there was not an appropriate counterfactual for comparison.

According to the data, using diversity analysis had less impact on costs than participatory research. Over half of respondents (55%) who used it said it did not affect costs, while 23% said that it increased costs, and 3% said it decreased costs. Another 19% were not able to answer the question. Since the projects in the inventory all involved stakeholder participation in the research process, these results must be interpreted as the marginal costs of using diversity analysis in a process that is already participatory, not as the cost of doing diversity analysis in general. Neither should they be interpreted as the costs of actively trying to incorporate diverse and/or marginalized stakeholders into the research process, since few of these projects appear to have done that.

7. Discussion: Closing the gap between current and best practice

The previous sections analyzed specific aspects of participatory natural resource management research projects and identified their consequences for a range of project impacts. Now, we compare and contrast those findings with five basic principles for good practices in participatory research for natural resource management identified by Vernooy and McDougall (2003: 136–137). The goal of this section is to take a step back from the details of project design and management, and look at the extent to which the overall orientation of the projects is consistent with the fundamental objectives for which participation in natural resource management research is sought.

Principle 1. The research reflects a clear and coherent common agenda (or set of priorities) among stakeholders and it contributes to partnership building.

Several findings suggest that projects may not fully achieve a clear and coherent common agenda. First, as the analysis of types of participation showed, projects tend to jump around from one type to another, meaning different decisions are made by different people. While research is not a linear process, decisions made at one stage affect what happens at others, so a lack of consistency in decision-making from one stage to the next could undermine stakeholders' sense of ownership of the process. Ceding decision-making authority to different stakeholders at different stages is not necessarily a bad thing, as long as it is part of a larger process that is clear and acceptable to all stakeholders.

Further, the way that participants are being selected suggests that the research agenda that emerges may not reflect all points of view, and may be particularly unrepresentative of priorities and concerns of marginalized groups. Methods exist to identify stakeholders and include them in group processes (Ravnborg et al., 1999; Edmunds and Wollenberg, 2002).

Principle 2. The research addresses and integrates the complexities and dynamics of change in human and natural resource systems and processes, including local understanding of these.

The projects in the inventory seem to have incorporated this principle. They tend to take an integrated approach to natural resource management, looking at multiple resources and developing biophysical and institutional innovations for improving their management. Over half the projects work at multiple scales or at scales defined by social rather than biophysical criteria.

Principle 3. The research applies the triangulation principle (i.e., multiple sources of information and methods) and links together various knowledge worlds.

The analysis of types of participation revealed that many projects used multiple methods to generate information, some more participatory and some less. What we do not know is how different types of information were reconciled, especially of they were contradictory. If conflicting opinions are explored jointly, they could end up strengthening and enriching the process. However, if researchers are using multiple methods to, in some sense, confirm the validity of the information and analysis provided by users, they will most likely end up undermining the process. Such problems can be avoided by discussing plans for data collection and analysis with stakeholders in advance, and even discussing what would happen in the case of conflicting results. Discussing the possibility of differing results when such an outcome is still hypothetical can be very useful since it focuses the discussion on what conflicting findings mean rather than whose results are right and whose are wrong.

Within the participatory approaches, the way that participants were selected and the way that diversity analysis was conducted suggest that insufficient attention is being paid to triangulation of opinion among local stakeholders themselves. Local stakeholders may be seen as a homogenous group, which is not usually the case.

Principle 4. The research contributes to concerted planning for the future and social change.

Even though institutional innovations were developed, the short time-frames of the projects and the fact that they appear not to address directly issues of power relations suggest that significant social change is unlikely to occur. In a sense, this lack of integration within broader local decision processes is the main shortcoming of the projects in the inventory. Many of the projects are well oriented and organized internally, building on solid methodologies for how farmers and researchers can work together in the context of specific research projects. What is missing is a clearer idea of how the products and capacities developed within the projects are expected to contribute to the broader ongoing development process.

Principle 5. The research process is based on iterative learning and feedback loops and there is a two-way sharing of information.

Projects report relatively high levels of human and, to a lesser extent, social, capital development. In most cases this is in the form of analytical capacity and empowerment, which is consistent with increased learning. While fewer than half of the projects did systematic impact assessment, 69% did some form of monitoring and evaluation and in 71% of the cases it led to changes in the project activities. This suggests that there is information sharing and learning going on in most of the projects. The challenge appears to be in consolidating and institutionalizing these processes in the broader context of research and development in which specific projects are carried out.

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