

RESEARCH APPROACHES FOR MAXIMISING KNOWLEDGE GAIN AND ADOPTION

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ABSTRACT

This study describes research approaches for maximising gain and adoption of knowledge in the field of natural resources. Specifically, it examined the concept of participatory research, devised ways for creating the conditions required for local initiative and involvement, and investigated the opportunities for developing research partnerships. It also identified the factors that facilitate access to and use of knowledge and technologies and developed generalisable guidelines for implementing the research approaches. The study was based on the review of literature complemented with a survey in Iceland. Data from the two sources were qualitatively analysed. The study showed that community participation and partnership with researchers and government/industry is vital for improving a gain in knowledge and adoption of approaches based on that knowledge. Incorporation of adoption into the research process, property rights, knowledge and information exchange and availability of infrastructure for extension work were important for facilitating adoption. The guidelines developed emphasised building a community base, research partnerships and the research base. The importance of participation in improving the efficiency of natural resources research is inferred and the higher levels of participation that actively involve a range of stakeholders are preferred. Community participation, partnership between community, researchers and government/industry, modes of funding and integration of adoption into the research process were critical for improving the efficiency of research for sustainable solutions. Community initiatives should therefore be supported by scientists, government and industry. Research institutions should incorporate participatory approaches in the criteria for rewarding scientists.

1. INTRODUCTION

The need to fulfil human demands continues to increase pressure on natural resources. Currently, adverse environmental problems such as land degradation provide sufficient evidence of unsustainable land use and lack of co-ordinated natural resources management (NRM). As the basis of both human livelihood and ecosystem health, which are inextricably linked, promotion of sustainable management and sustainable use of natural resources both in the short-time and in the long-time perspective is of crucial importance.

Studies and experiences (Land and Water Australia, 2006; Asenso-Okyere & Davis, 2009) have shown that knowledge is the foundation of sustainable NRM and development. Apart from securing commitment and strengthening the capacity of stakeholders, the accumulation and application of knowledge provides a gateway for creating opportunities for growth, besides promoting poverty reduction and hence enabling development. The use of indigenous knowledge in the quest for human welfare has thus gained increasing importance over time but still remains insufficient in some respects because of the complex and interdisciplinary nature of the currently emerging problems. Research programmes mostly in universities and research institutes have therefore kept playing a major but sometimes complementary role in the generation of knowledge for development.

1.1 The need for more knowledge on sustainable natural resources management

Although research activities have generated an immense body of knowledge for management of natural resources, the impact especially in industry and at the grass roots and regional levels is generally still below desired levels. Such views were expressed, for instance, at a conference organised by the International Food Policy Research Institute (IFPRI) held in Addis Ababa, Ethiopia, in 2008, which recognised and emphasised the importance of knowledge and innovation in the pursuit of agricultural development for growth and the reduction of poverty (Asenso-Okyere, Davis & Aredo, 2008). At this conference it was noted that agricultural research output still has a low impact partly because the scientists work in isolation from other stakeholders.

There also exists a large gap between the availability of knowledge and its effective application in decision making (Serageldin, Husein, Martin-Brown, Ospina & Damlamian, 1998). The knowledge that is available is largely disciplinary which makes it often difficult to apply in a wider socio-economic and interdisciplinary context. The knowledge available is also commonly perceived to be hypothetical and theoretical instead of focusing on the needs of end users with the aim of facilitating action and/or social change. The end users thus find it difficult to use such knowledge. However, there is an increasing awareness about the importance of research approaches that employ new ways to organise and manage research (Camp-

bell & Schofield, 2007; McWilliam & Jessop, 2005). Such a step would help to improve the relevance of research and would also enhance knowledge adoption by the end users.

1.2 Research funding and the returns on investment

Enormous financial resources are committed to research and development programmes aimed at improving the management of natural resources. Research in this area is generally supported by public funding but financial support by private organisations has dramatically increased in the high-income countries. In Australia, for example, applied research investment involves hundreds of organisations and billions of dollars are committed every year towards this cause (Campbell & Schofield, 2007).

Globally, investment in agricultural research amounted to \$40 billion in 2000. Out of this 59% was public investment while the private sector provided 41% of the total investments (Beintema & Stads, 2008). High-income countries continued to have the highest investments in agricultural research compared to the low-income countries. The total public investment in agriculture grew from \$16 billion in 1981 to \$23 billion in 2000, representing an increase of 47%. The private sector in the low-income countries only accounted for 4% of the total private sector investment in agricultural research in this period.

The investments in NRM research in general and in agriculture in particular have yielded substantial benefits in some concrete projects. The *World Development Report 2008* indicates that, on average, there is a 43% return on agricultural research investments in some developmental projects in developing countries (World Bank, 2007). Despite such relatively high returns, the investments continue to be relatively low/moderate. Most of these investments have taken place in developing countries where agriculture forms the most important basis of human livelihoods, and there is a need to better link the need for appropriate knowledge, research and strategies for full use of such knowledge.

As funding generally is limited, it would be important for researchers to make the most out of the investments in natural resources research by maximising knowledge benefits and ensuring adoption of the most useful technologies by end users. However, only a small part of the real potential of research benefits is actually tapped in developing countries. The reasons include dwindling financial support and inability of research institutions, both locally and abroad, to effectively transfer developed and useful knowledge and technology to the end users themselves (Holloway & McWilliam, 2005). Some of the barriers to adoption of new useful technologies are that: (1) technologies are often developed without the advice/involvement of end users and therefore can be inappropriate for them; (2) the technologies may not be fully developed and hence not ready for adoption; (3) the mechanisms of technology transfer by extension agents may not be appropriate due to weak links between researchers, extension agents and end users. Researchers often think that it is not their responsibility to transfer

technologies and hence do not consider actual knowledge adoption during the development of new technologies (Holloway & McWilliam, 2005).

In other cases, knowledge is guarded because of patents and financial interests. The technology developers do not always want to transfer their products to end users in developing countries and instead want to sell them technological solutions on the international market for financial gain. But such end users often cannot afford the technology even though it might be suitable for their needs.

1.3 Objectives and approaches of this study

The aims of this study were to develop approaches for organising research in order to meet the knowledge needs for sustainable management of natural resources. Specifically, the study sought to:

1. Examine the concept of participatory research approaches with a view of improving research efficiency by maximising knowledge gain.
2. Devise ways to create the conditions necessary for local initiative and involvement for improved benefit of research to end users.
3. Investigate opportunities for developing partnerships between community, researchers and other stakeholders for maximising research benefits to end users.
4. Identify the factors that facilitate access to and use of appropriate knowledge and technologies by end users mechanism.
5. Develop guidelines for implementing participatory research to improve the efficiency of natural resources research for maximising benefits to end users.

To achieve these objectives, two different approaches were used:

- 1 An extensive literature review was carried out to explore research approaches for increasing knowledge gain and adoption.
- 2 A case study was carried out in Iceland to complement data from the literature review.

A survey was carried out to get the local view on participatory research as a means of improving research efficiency. The 22 respondents to the study were farmers, landowners, researchers (scientists), landcare officers and other staff of the Soil Conservation Service (SCS) of Iceland, agricultural advisors, and staff of the Iceland Forestry Service. Semi-structured interviews guided by a checklist (Appendix 1) were conducted to collect the primary data. Both the secondary and primary data were qualitatively analysed. The survey was conducted in Eastern Iceland, the headquarters of the SCS at Gunnarsholt, at a landcare field day in South Iceland, and the Agricultural University of Iceland at Keldnaholt.

This study on approaches for improving knowledge gain and utilization was intended to be broad in scope with the aim that results would not be limited to any specific geographical location.

2. FACTORS AFFECTING THE NEED AND EFFICIENCY OF APPLIED RESEARCH IN NATURAL RESOURCES MANAGEMENT

Apart from generating new knowledge, applied research is characterised by the notion of enabling change, solving real problems, developing new opportunities and providing support to innovation (Campbell & Schofield, 2007). One of the key features of applied research is that as much importance has to be attached to the use of the knowledge as to its generation. Applied research approaches emerged because of the need for research to solve existing problems and provide tangible benefits to end users. As a result, there was a shift in focus from basic research to applied research in order to increase the practical relevance of research. Despite this shift, there should be no need within the research community in general to create an unnecessary gulf between applied research and basic research as both can benefit from each other and basic research can for instance be used to invent new methods and approaches which can be effectively used in applied research and vice versa.

The need to improve knowledge gain and adoption is motivated by the increasing demand for natural resources to meet human needs and environmental challenges posed by developmental activities. There is a concern for the health of the earth's resources, most notably land (Lackey, 2001). Anthropogenic factors and natural processes have both contributed to degradation of land resources, for example through deforestation, excessive use of artificial fertilisers, overgrazing, land fragmentation and increasing desertification. The possibilities for reversing this trend lie within control of the drivers of these processes. Some of the main drivers affecting the need and efficiency of applied research for the sustainable management and restoration of natural resources are discussed below.

2.1 The goal of sustainability

The World Commission on Environment and Development (1987), also known as the Brundtland Commission, defined sustainable development as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs". The report values the satisfaction of human needs and the continuity of human coexistence with the natural life support systems in conditions that are healthy to both the individual components and the whole system beyond the foreseeable future. It noted that achievement of this goal is hindered by technological limitations.

The economy, environment and society are the three pillars of sustainability (Klöpffer, 2003). To meet its needs, society in general uses the environmental resources to produce goods and

services that have both social and economic value. The linkages between these elements are productive and sustainable when usage does not exceed the carrying capacity of the environment. Due to the ever increasing human population and perhaps extravagance in consumption, natural resources are too often being used beyond sustainable levels. Imbalances in the biogeochemical cycles indicate that limits of some resources are already being surpassed and the negative implications can become vicious. There is for example a close link between poverty, environmental degradation and population growth (World Commission on Environment and Development, 1987). This implies that it is almost impossible to solve one problem without tackling the others.

Previously, developmental organisations, environmentalists and population agencies have often employed counterproductive avenues to achieve goals, leaving the question of sustainability unanswered. Governments have tried different instruments to facilitate developmental activities for minimising environmental consequences. The benefits realised from these programmes barely match expectations. This was not because natural resources users and managers were against it but just that there is a lack of comprehensive understanding of how the objectives can be met simultaneously.

The institutional setups for managing natural resources are varied. Improvement in the efficiency of using these resources therefore requires that the owners and stewards of the land take/play an active role. In management of land resources for example, land owners, stewards and farmers have by themselves developed knowledge and technology to solve some of the problems in land management. While the benefits of these initiatives have been widely acknowledged in the past few decades, studies have revealed that local knowledge, and indigenous knowledge in particular, is not sufficient for addressing some of the current complex problems. Allen and Kilvington (1999) for example reported that complex environmental problems are difficult to solve using simple solutions generated from skewed stakeholder perspectives. They observed a need and already a gradually evolving desire among stakeholders to work together in order to benefit from the different viewpoints of people and also the diversity of various information sources.

2.1.1 The multiple interacting factors to consider

A number of interacting factors complicate knowledge needs and strategies for the management of natural resources. These include food security, climate change and poverty. These main issues discussed below are in turn driven by a multitude of other interrelated factors, increasing the complexity of achieving sustainability goals.

Food security

In the *Millennium Development Goals Report* (United Nations, 2009), there is a call for robust ways of increasing the availability of food. This includes increasing production and devising

policies to reduce the impact of high food prices on the living conditions of the poor. The proportion of undernourished people in the world was about 16% in the middle of this decade. Public spending in agriculture-based countries as a share of their agricultural GDP is small and stood at only 4% in 2004 (World Bank, 2007). The World Development Report paints an uncertain future for agriculture despite past successes in meeting the steadily increasing demand for food. It noted that more than 800 million people have remained food insecure and this proportion even rose by 1% in 2008. Yet previous agricultural developments have already left a huge environmental footprint.

Doubts about future knowledge adoption rates just exacerbate the situation because there is a need to: increase agricultural production to feed the projected world population in the near future which is expected to rise to around 9 billion by 2040, enhance food security to all as soon as possible, and clean or diminish the environmental footprint of agriculture.

Climate change

Global warming is already having a discernible impact on local climate over most of the world, prolonging dry periods in already dry areas and creating heavier rainfall or even floods where and when it rains. Thus climate change is already affecting the livelihood of people, the health of ecosystems, and endangering some plants and animals. Global carbon dioxide emissions have drastically increased by 30% from 1990 despite efforts to limit the release of greenhouse gases as expounded in international agreements such as the Kyoto protocol (United Nations, 2009).

There is much new knowledge required for adaptation to the environmental and ecosystem changes brought about by climate change. The same applies to means of mitigating climate change by the restoration of land quality, responding to the fact that land degradation has been one of the major sources of greenhouse gases accounting for up to 30% of the emissions (World Bank, 2007).

Carbon trade could provide incentives for making land rehabilitation an economically viable activity, while at the same time meeting Millennium Development Goals, such as increasing food security and reducing poverty (Niamir-Fuller, Kelly & Biggs, 2009). As land use is a large factor in both emissions of greenhouse gases and in capturing misplaced carbon where land is properly managed actions at the local levels are a key issue. Local communities may not be using scientific knowledge for adaptation to climate change but they have in the past responded to climate variability and its associated adversities (Twinomugisha, 2009). This implies that local knowledge, both traditional and generated through participatory approaches, could have a strong role in developing strategies that are scientifically valid and locally relevant for adaptation to climate change and its mitigation. One of the areas where local knowledge can be explored is in the care of the land, which influences the amount of carbon in the soil and the atmosphere.

Poverty

Development for the poor has been recognised as the best option for achieving sustainable development (Kaur, 2005). It is also considered important for maintaining social stability and for minimizing the risk of conflict both within and possibly between countries sharing, for example, the same watershed or aquifers. The poor, most of whom are in developing countries, depend often almost directly on natural resources for developmental needs and persistent poverty actually affects the health of the resources themselves if measures of sustainability are not considered and applied at a local level. Integrated policies that embody local and international co-operation together with best practices in the utilisation of natural resources can thus provide a good starting point as long as there is an adequate body of knowledge to manage the resources.

There is a higher chance for research aimed at creating an impact on developmental issues like poverty reduction to attract funding and more so if participatory approaches are employed (Kaudia, 2003). It is also important to create avenues for bottom-up communication between the knowledge base (scientists) and the poor in order to find solutions that provide tangible results, and which can be applied to the local environment as it in fact is, but not only in theory. The strengthening of capacities and knowledge are therefore considered essential in accelerating the pace of change towards less poverty and in order to create economic opportunities for all. The natural environment also benefits because decreasing poverty is one of the most effective ways of preserving the environment.

2.1.2 Land health and research needs

Land health as a concept derives from ecosystem health which in turn is related to the notion of human health (Lackey, 2001). Land comprises a variety of ecosystems such as forests, wetlands, woodlands and grasslands and its health can be described in terms of the health of its constituent components such as forest health, rangeland health and grassland health. While human health may be a matter of the state of an individual human being, land health refers to the condition of the whole land just like ecosystem health which refers to the condition of the ecosystem as a whole.

Leopold defined land health as “the capacity for self-renewal in the biota” (Callicott & Freyfogle, 1999). If the land is to be used for agricultural production for generations to come, the continued good health of the land becomes a vital factor. Healthy land use is the basis of healthy agriculture and the quality of the products. The health of the land is intrinsically linked to the concept of sustainability. This means that the land has to be used in such a way that its health is in no way diminished in the short or long term, otherwise a vicious circle of degradation and environmental problems can be created. It is one of the main aims of natural resources managers to help farmers and stewards of the land to escape from such vicious downward spirals of degradation, and in many cases it can become possible to

effectively restore or improve drastically the health of the land and thus to increase sustainability.

The health of the land is a complex concept. It can be monitored by measuring various health parameters, such as pollution status, current nutrient status and nutrient quality of the soil, amount and acidity of rainfall, water quality, air quality, vulnerability of the land against various stress factors. In such a way, the “health” of the land can be assessed in much the same way as the health of a human being (Lackey, 2001). It is most often much more effective and less costly to prevent the land from degenerating, that is: It can be very expensive or almost impossible to restore land, water and soil quality once land health has deteriorated beyond a certain critical point. Thus it is for instance very difficult to save a lake which has already become heavily eutrophicated.

It is important to make the local people/end users aware of the possible dangers so that they can see and possibly counteract the signs of declining land health before the situation gets too serious. Unfortunately the scientists are often in little contact with the local stakeholders or only notified when the health of the land has degenerated to such an extent that remedial action is almost impossible. Because the health of the land is such a complex phenomenon, and because it depends on such many different factors, new interdisciplinary participatory research approaches are required in order to safeguard it and in order to ensure that some vital factors are not simply omitted during research and land restoration efforts.

2.2 Institutional issues

There are now new actors in natural resources research such as Non-Governmental Organisations (NGOs) and Community Based Organisations (CBOs) as opposed to the previous dominance by public institutions like universities and research organisations (Gauchan, Joshi & Biggs, 2003). Moles (2008) indicated that these new actors now also play important roles in determining research directions, a task which was almost the preserve of researchers a few years ago. The culture of planning, budgeting and implementing research only within the research organisations is changing. Establishment of inter institutional partnerships have become more beneficial than those within a research organisation because of the diversity of information and opportunities that can be shared (Lilja & Bellon, 2006). There is a growing interest in formation of multidisciplinary research teams for taking holistic approaches to studies as the effectiveness of the participatory approach and the quality of research from a scientific perspective is dependent on the capacity of the researchers and the team to conduct such studies. The capabilities of NGO's and CBO's to organize and supervise their own NRM research have also become more apparent, even though co-operation with existing research institutions, such as universities, may always be advisable and in some cases, necessary.

3. PARTICIPATORY RESEARCH APPROACHES

Participatory research (PR) is the process of producing new knowledge by “systematic inquiry, with the collaboration of those affected by the issue being studied, for the purposes of education and taking action or effecting social change” (Macaulay *et al.*, 1999). It is characterised by three key elements; people, power and praxis. In this approach to research, the problem being addressed concerns the intended participants and therefore fit into their mindset. It should be able to provoke a meaningful engagement, create interest and sustain active participation. It aims at increasing the benefits of research to end users. This helps to ensure that end users and other stakeholders do not get discouraged, so that they themselves discern the usefulness and direct applicability of what they are actually learning from the research.

3.1 Objectives and benefits of participatory research

Participatory research plays a functional role and also empowers the end users of the study. Functionally, Lilja and Bellon (2006) noted that participatory research improves the efficiency of research as the end users take part in the study. This helps to incorporate their views or needs and hence possibly adapt the study to fit into the operational reality in which they would take up the results thus in a way aiding adoption. Participatory research also empowers end users by bringing them together, helping them to understand how to learn, generate new ideas and form interest groups. This eventually provides participants the identity they require to collectively determine their needs, make decisions about them and subsequently take actions or demand services to fulfil them (Lilja & Bellon, 2006). The participants also learn from the experience created by taking part in the research itself, the end users and the researchers learning from each other.

Participatory research is also a good tool for effecting change in society. It helps to create and enhance trust between researchers and other stakeholders, notably the community who on various occasions are the research subjects (Macaulay *et al.*, 1999). Participatory research helps studies to fit within the socio-cultural and historical contexts and hence can improve the socio-economic conditions of people. Direct benefits of the research to the community should be an outcome of the research. The involvement of the community should also be an outcome of the research. This means that an equal emphasis is placed on both the process of the research and the products or services this process is meant to achieve. Participation in the process helps people to for instance build confidence and self-esteem not only by the virtue of taking part but also by learning from being part of it. In that way they can exercise more control over the results of the study and hence enhance their benefits from it.

3.2 The other side of participatory research

Participatory research also has its drawbacks. Macaulay *et al.* (1999) for example argued that it can increase the time period needed to conduct a study and this is likely to make it less

appealing to researchers. In case of a change in priority by one research partner, other partners may face challenges in continuing the study. There is also a risk that the expectations of research benefits may reach unrealistic levels.

3.3 Who are the stakeholders in participatory research?

Participatory research may attract, depending on its goals, a wide range of interest groups. Usually these are the researchers, community, government, funding agencies, NGOs, CSOs, private sector enterprises. Traditionally, the main players in natural resources research, especially agricultural research, are the researchers, farmers and extension agents (Ashby, 2003). This traditional trend has been changed in grassroots projects like those within the Landcare movement, where apart from the three, industry and markets are also involved. Despite the many interest groups, participatory initiatives have paid more attention to the community. A community is “a group of people sharing a common interest—for example, cultural, social, political, health, economic interests—but not necessarily a particular geographic association” (Macaulay *et al.*, 1999). The benefits accrued to the community are considered the main purpose of this research approach and it is envisaged that such benefits can materialise if the initiative comes from the community itself.

3.4 Types of participatory research

Many terms and concepts have evolved to refer to PR and related research approaches. Lilja and Bellon (2006) for instance distinguished between participatory research types according to the criteria used to select farmers to take part in a number of maize and wheat improvement research projects considered to at least have participatory components. They also considered the stage of the research at which stakeholders were involved (e.g. design, testing, diffusion) and the way their involvement was operationalised basically in terms of the activities in which they participated (e.g. technology evaluation, focus group interviews, and stakeholder meetings).

Reed (2008) discussed a number of typologies of stakeholder participation that have developed over time. These included typologies based on: (1) the degree of stakeholder engagement, presented as a continuum, ranging from passive dissemination of information (manipulation) to active engagement (citizen control); (2) nature of engagement, ranging from dissemination of information to passive recipients (communication), gathering information from participants (consultation) to participation where there is a two way communication in form of dialogue or negotiation; (3) existing theory, distinguishing normative participation (process focussed argument suggesting that participation in environmental decision making is a democratic right) from pragmatic participation (outcome focussed argument suggesting that participation is a means to an end and should therefore enhance the quality of decisions).

3.5 Levels of participation in knowledge gain

With the exception of the theoretical basis of participation typology where the normative and pragmatic arguments are presented, most of the types of participation exhibit a sort of continuum with both a lower and a generally preferred higher level of participation. Johnson, Lilja and Ashby (2003) reported five levels of participation in natural resources research. The main actors in their model of participation are scientists (outside agencies, extension systems and formal research agencies) and the farmers (intended users and other beneficiaries). These levels ranged from:

- conventional or no participation, where scientists make decisions alone without organised communication with farmers
- consultative or functional participation, where scientists make decisions alone but with organised communication with farmers
- collaborative or empowering participation, where scientists and farmers have organised communication with each other and share decision making authority
- collegial or empowering participation, where farmers decide as groups or individuals but with organised communication with scientists
- farmer experimentation or no researcher participation, where farmers decide as groups or individuals but without organised communication with scientists

3.6 Community-Based Participatory Research (CBPR)

Community-based participatory research is a “collaborative approach to research that equitably involves all partners in the research process and recognizes the unique strengths that each brings” (Vásquez *et al.*, 2007). One key concept in this definition of CBPR is collaboration. According to Macaulay *et al.* (1999), collaboration is “a partnership among equals with complementary knowledge or expertise”. CBPR is an approach or orientation to research but not a research method in itself (Horowitz, Robinson & Seifer, 2009; Minkler, 2005). Thus, it is applicable in interdisciplinary studies, such as is required by effective Natural Resources Management. It does not in itself limit the choice of research methods, but creates a window of opportunity for combining different research areas as required by the research objective in question and thus promoting and enabling real achievement and possibly tangible change.

CBPR is designed to ensure and establish structures for participation by communities affected by the issue being studied, representatives of organizations, and researchers in all aspects of the research process with the goal of improving the well-being of the people through action and social change (AHRQ, 2004). The study begins with a research topic of importance to the community and to the local natural environment, has the aim of combining knowledge with

action and achieving social change to improve NRM, ecosystem-status, local farming practices and ultimately the quality of life of the local population.

In CBPR, researchers are equitably partnered with those directly affected by and knowledgeable of the local circumstances that impact them (Horowitz *et al.*, 2009). They argue that, in order to maximize the chance that CBPR will lead to tangible, lasting natural resource management and in the long term improvement in the quality of life for communities, researchers will need to balance rigorous research with routine adoption of its conduct in ways that respectfully, productively and equally involve local partners. The principles that guide CBPR include: collaboration and participation at every stage of research, co-learning, community-driven projects, dissemination of results in useful terms, cultural appropriateness and definition of community as a unit of identity.

3.7 The importance of a high level of participation

In this present study, collaboration is viewed as a level of participation that has the potential to blend well with many of the current natural resources management regimes. This view is supported by the belief that current problems that concern human well-being and the environment are real, serious and interrelated. This is to an extent so complex that neither the researchers (scientists) nor the end users (land owners, stewards, farmers, etc.) can manage by themselves alone to generate appropriate solutions and solve or prevent the problems without the input of the others (Reed, 2008). Even the other stakeholders such as governments, donors and private sectors can have major stakes to the extent that their involvement is paramount. The basis of this assumption is that despite all the previous and rigorous measures of redress, critical problems like poverty, hunger and environmental degradation persist.

This study supports the preference of the higher levels of participation where end users have high control over the process and use of the outcomes. It also supports processes that lead to movement from the lower levels of participation to the higher levels. However, for the purposes of promoting collective action by participants and as a matter of obligation to allow them to exercise their democratic right to participate in environmental issues, this study looks at the collaborative level of participation as a good point of reference. This is because collaborative participation provides two-way communication and allows joint decision making (Johnson *et al.*, 2003).

The present study considered collaboration as one of the cornerstones of the Community Based Participatory Research (CBPR) that is currently widely used in the health discipline, for example, but less commonly in the natural resources arena. It considered collaboration between stakeholders in the research process as a signal of the possibility to reach the “ideal situation” where the goals of efficiency and sustainability can be realised. At the collaborative point, the “ideal situation” otherwise considered in this study to be “self-mobilisation” became

visible and apparently attainable. Mikkelsen (2005) defined self-mobilisation as a level of participation in which people participate by taking initiatives to change systems independently of external institutions, although the latter can help with an enabling framework. The interest in this study was therefore to see how natural resources research can be carried out with a level of participation close to or exactly at this point.

The subsequent sections of this study are devoted to devising a practicable means to realise self-mobilisation as a preferred higher level of participation in natural resources research. For reasons of practicability and based on the evidence of theory, some of which were given earlier and more yet to be suggested, it was not only assumed but actually believed here that PR in which the “self-mobilisation” level of participation is attained equates to CBPR. From this point, the study then concentrated on devising ways of carrying out CBPR (mainly the how and why aspects) in the field of natural resources. Not much particular attention was paid to the “what” aspects because it was believed that in principle these aspects of the participatory research process cross-cut disciplines and are somewhat adequately presented in the existing literature in forms adaptable to specific situations.

4. CREATING AN ENABLING ENVIRONMENT

Participatory research is generally carried out in a real life setting. There is no clear-cut definition of where it starts, reaches the middle and/or ends (Kelly, 1995). This section proposes the conditions that could facilitate the process of participatory research and increase local initiative and involvement.

4.1 Awareness about natural resources management

Communities require knowledge to better understand and then participate in NRM initiatives in their area. According to Forgie, Horsley and Palermo (2001), environmental education is critical in facilitating public involvement in related activities. This implies that by creating awareness, communities can appreciate being a part of studies to improve management of their natural resources. Awareness also gives the community confidence to initiate studies and present their case to other stakeholders. It can influence people’s attitudes and motivate them to seek change. As reported by Sullivan (2009), public awareness on environmental issues helped to bring together scientists, government agencies, academics, concerned residents and land holders in active groups across Australia. This is especially so in areas related to landcare, conservation and catchment management. The observations made by the communities help them to contribute to a body of environmental science, their own education and eventually enhancement of their scientific literacy (Sullivan, 2009).

4.2 Support for local initiatives

It should be possible to discern and support the activities the communities are already involved in. The level of community involvement depends on the need for specialised skills (Forgie *et al.*, 2001). In case such skills are not required, community initiatives should be supported within a framework of grant, advice and other necessary forms of support.

4.3 Develop local capacity to plan and organise

The availability of skills and resources within the community is important in order for them to take part in participatory research (Kelly, 1995). The resources that are underutilised in the community can be put to best use to the liking of the community through the development of participatory research processes.

Participation of landholders in planning the management of personal, physical and financial aspects of farms at both local and landscape levels can serve as an efficient tool in bringing various issues into a holistic perspective and encouraging local knowledge and action. Such planning normally is done by external experts. Various resources are available for guiding local people through such processes and linking with outside experts (Brouwer, Clowes & Thompson, 1999).

4.4 Scale of projects

Participatory activities have to be properly organised at manageable levels. When there are many interest groups in a wide geographical area, it may be difficult to manage activities. In Australia for instance, many NRM initiatives are delivered at regional levels. According to the Australian Government (2009) Natural Resources Management NRM Monitoring, Evaluation, Reporting and Improvement (MERI) framework, regional delivery provides an enabling environment for improving community participation. It also increases their level of awareness and knowledge and hence better management practices. Such regional arrangements can be based on landscapes, watersheds, water basins, aquifers, mountain reserves, forest reserves and not only on political units such as politically defined regions or municipalities.

4.5 Time

For communities to take part in research, it should be possible for people to spare some time to get involved. Kelly (1995) noted that time is a valuable resource for local involvement because participatory research takes time and because there are often arguments and differing opinions about whether it should go slow or move fast.

4.6 Landcare – a new tool for the getting of knowledge

Landcare in Australia began in 1986 in the mainland state of Victoria (Johnson, Poussard & Youl, 2009; Moore, 2005). It started when land users organised themselves to address land degradation problems in the neighbouring farms and then evolved to include land management at watershed or catchment levels (Johnson *et al.*, 2009; Moore, 2005).

The meaning of landcare remains elusive and differs from person to person. It may be used to depict: a broader community-based programme through which government funds the activities of voluntary land conservation groups (Campbell, 1995); a means to fulfil goals of land management such as soil, water and nature conservation (Wallace, 2003); and a system of volunteer groups loosely co-ordinated at state and regional levels that respond to land management problems based on the values of their community (Curtis, 2000). The Landcare movement as a model for community-based natural resource management is now rapidly growing on a global scale (Catacutan, Neely, Johnson, Poussard & Youl, 2009) and has a high potential as a tool for increasing participatory based research and knowledge adoption.

The key attributes that help to define landcare from other initiatives include: voluntary nature of groups (Wallace, 2003; Campbell, 1995); partnership with government and industry (Lockie & Vanclay, 2000; Wallace, 2003); diversity of goals related to land management (Campbell, 1995); regional, catchment or watershed level management; and the community driven nature of activities (Campbell, 1995). Although partnership with government and industry is a key attribute, landcare remains more of a social movement (landcare movement) than a state initiated programme (Lockie & Vanclay, 2000). The volunteer groups therefore are a part of an all-inclusive and broad-based movement concerned with the diversity of land resources and the various forms of their degradation.

The landcare groups play an important role in generating and sharing knowledge within and between groups. The knowledge results from the experiences and practices of the individual group members. They also gain through learning from the actions taken as a group, thus creating the experience of working institutional processes. As noted by Johnson *et al.* (2009), landcare improves access to technology.

Landcare groups facilitate generation of knowledge through initiation of research partnerships. As stated by Johnson *et al.* (2009), farmer groups directly initiate numerous research projects and this may form the basis of research partnerships. They may make observations and take readings that are entered into official government data bases and used for scientific purposes (Sullivan, 2009). This minimises the cost of generating knowledge, increases coverage, and integrates local perceptions. By being a part of this process, the people become aware and literate about their resources (Johnson *et al.*, 2009). This is therefore evidence that communities can play a crucial role in monitoring projects under a landcare type of arrangement.

4.7 The importance of land literacy

Land literacy is the intended outcome of activities designed to help people read, listen, learn and appreciate the signs of health (and ill-health) in a landscape, to understand the condition of and trends in the environment around them, and to make the invisible, visible (Campbell, 1995). Land literacy enables people to understand nature and develop the ethic required to improve management of natural resources (Campbell, 1995). Through the ethic, it becomes cheaper to invest in Landcare as a process of awareness raising and education than in funding large scale on-ground work (Curtis & Lockwood, 2000). Communities can collect data more cheaply than scientists could do alone (Campbell, 1995).

5. BUILDING PARTNERSHIP BETWEEN STAKEHOLDERS

Partnership and community involvement is becoming a pre-requisite to realise the change that can reverse environmental degradation (Forgie *et al.*, 2001). The participation in research activities makes the communities and other partners understand the process and results which may be accepted by all of them. Partnerships in CBPR can be formed for many reasons, among which are the need to address a particular problem and meet funding requirements (Seifer, 2006). As Minkler (2005) reported, the synergy that partners seek through collaboration is more than the exchange of resources and that by combining the individual perspectives, resources, and skills of the partners, the group creates value which is greater than the sum of its parts.

5.1 Funding

Inadequacies of funds for research in general constraints the use of participatory approaches. According to Johnson *et al.* (2003), such approaches are claimed to require more funds for mobilising, consulting and developing structures/strategies for the process of participation alone before even considering the actual study. Yet Seifer (2006) reported that participation in research can be a requirement to secure research funding. This therefore facilitates participatory research, especially in poor areas where local financial input may be inadequate. The challenge is that funds for some participatory research projects are not managed in a participatory manner. This could be because their contribution in mobilising the funds is not substantial or due to a perceived lack of skills for managing the funds. Kaudia (2003) also claimed that by employing participatory approaches in planning and designing programmes, research can still be relevant to local needs even with minimum funding.

5.2 Sharing of research benefits – an incentive for stakeholder participation

Participatory research processes are indeed demanding at least initially. It creates a need for compromises from both the communities and researchers. This is essential for building

and showing commitment by all stakeholders. For the communities, equitable treatment in research may be an incentive for them to work together with researchers.

5.3 Holistic approaches

CBPR can be appealing to researchers and institutions of different disciplinary backgrounds due to its interdisciplinary nature (Nyden, 2003). As community problems usually tend to be mired in complex socio-cultural, economic and political situations, the interdisciplinary nature of CBPR presents an opportunity for the community to partner with stakeholders who have various disciplinary backgrounds. This is because the nature of the problems deserves holistic approaches that researchers from a single discipline may be challenged to address. This contrasts with the conventional approach where research questions are based on the state of knowledge in a particular discipline (Moles, 2008)

5.4 The case of Australia: Funding for Landcare and related NRM activities

The first funding for Landcare was in 1986–1987 by the Victorian government (Johnson *et al.*, 2009). Funding for NRM in Australia is done in partnership by the national, state and territorial governments including the private sector (Australian Government, 2009). The government of Australia uses an integrated approach to invest in NRM. This starts from the design of programmes and leads to evaluation through adaptive management. The regional bodies bring together the governments and the communities to plan, finance, oversee and monitor management of natural resources using the catchment system. Though complex, the partnership helps in integrating the contributions towards NRM.

The three main sources of funding for NRM in Australia are: the Natural Heritage Trust (NHT), the National Action Plan for Salinity and Water Quality (NAP) and the National Landcare Programme (NLP). The latest of these is the Caring for our Country programme. The NHT was set up in 1997 and it helps to restore the environment and natural resources by funding community groups engaged in NRM. The work of the NAP is to contain the rising salinity and deteriorating water quality using funding from commonwealth and state governments. The NLP supports landholders to undertake landcare activities through collective action (Landcare movement) by the communities. From 2008, the Caring for our Country programme adopted a business approach to investment in which the existing NRM measures such as NHT, NLP and the Environmental Stewardship Programme (ESP) were consolidated. The regional NRM organisations are then funded by the Caring for our Country programme. The new arrangement is to remove bureaucracy associated with funding at national, regional and local levels (<http://www.nrm.gov.au/funding/future.html#priorities>). It also provides opportunities for NGOs, regional bodies, local governments and State, Territory and Australian Government agencies to access much of the funding.

6. FACTORS AFFECTING UTILIZATION OF KNOWLEDGE

Various factors affect adoption of knowledge generated by research, which in turn determines to a large extent the financial as well as other returns generated by the research activity. It is important to identify potential factors that facilitate knowledge utilization, of which only a few samples are discussed below.

6.1 Integrating adoption into the research process

Separation of research and adoption in the design of applied research programs is one of the reasons why the potential benefits of natural resources research is not fully utilised (Inall, 2005). Traditionally, researchers mainly generated the new knowledge and technologies and it was the task of the extension workers to transfer their findings to end users. This way of disseminating research findings reduces the chance for researchers and the end users of their work to interact directly, which is not the case in participatory research.

6.2 Property rights

People can use many new technologies for managing natural resources if the property rights are secure (Knox & Meinzen-Dick, 2005). Some technologies such as Integrated Pest Management (IPM) can best be adopted in a wide area. It therefore requires that farmers and land-owners collaborate if they own small sizes of land. Other technologies such as terraces take a long time and require a lot of investment which can be done only if the concerned people have secure rights to the property (Knox & Mainzen-Dick, 2005).

6.3 Knowledge and information exchange

Farmers can adopt technologies if they understand it or are informed about it. Knox and Mainzen-Dick (2005) found out that by working collectively as a group, the chances of information reaching everybody is increased. Grass roots approaches like Landcare provide opportunities for all members to be informed. People who would not learn and access knowledge and information have a chance even to take custody of the process by working in groups.

6.4 Physical infrastructure and extension services

In the developing countries, the poor state of infrastructure and extension services themselves means that even research that has a high potential for benefits does not necessarily have a practical impact on the ground (Templeton, 2005). This is because there is a need for farmers and extension agents to learn to generate and share knowledge and information. This requires good facilities for education, transport and communication.

7. GUIDELINES FOR INCREASING KNOWLEDGE GAIN AND ADOPTION

The complex task of improving livelihoods of local people as well as nations, and reaching sustainability in NRM requires more sound knowledge than the current research systems can provide. This section provides some insights and guidelines on means to increase the rate of knowledge gain and utilization with a focus on community participation.

7.1 Activating the community as a unit

Community members can as individuals or groups notice an issue of concern in their community and decide to get the attention of colleagues or authorities on the matter. Researchers may also become aware of a problem in the community and may get interested in it. There eventually develops an informal exchange of information mostly among interest groups. The community may take the lead to inform authorities about it who in turn can inform researchers. The community members may through their individual relations inform researchers directly. The researchers may also pick interest and seek to know whether they can help. No matter how it happens, it is important that people get informed. The community members should also communicate among themselves to know what is happening in their community and be willing to offer support to solve problems.

7.2 Analysis and definition of the problem

For the community to actively take part in research, given the investments required, the study has to be important to them. Research problems may be investigated to provide solutions to daily problems faced by communities. In this situation, it is easier to solicit and justify involvement of the community. However, the goals of some studies, though important, are usually not clear to the community involved. When the community has to be involved, it has to be clear from the beginning what role it plays.

7.3 Analysis, definition and mobilisation of the stakeholders

Involvement of stakeholders is important and equal treatment in participation of all interest groups matters. Environmental benefits of natural resources are essential for human well-being. These benefits go beyond the boundaries of landscape, geography, administration and land ownership. Defining the end user in this case for purposes of involvement in research and management of natural resources may be difficult. The people who have the passion to do the work and who are directly affected should be given priority. Otherwise, those whose interests are not deeply rooted in understanding and sustaining the benefits may be involved but may not take action. Since the activities are community driven, those involved have to take steps by way of acknowledging that the problem exists and showing interest in the activ-

ties to solve them. Stakeholder definition and analysis should help to create an identity for the research for resource mobilisation and good public relations.

7.4 Development of partnerships

According to Schensul (1994), to initiate partnership for action research, there should be a problem of critical interest to the proposed partners, an influential and committed researcher, and skilled knowledge-oriented activists. The community, researchers and the funders should be members of the partnership. There are usually many stakeholders but not all of them may be willing and able to actively participate. The partnership should therefore be developed to build a team based on commitment, capacity and need.

7.5 Setting a vision

The Primary Industries and Resources South Australia (PIRSA, 2000) noted that a vision provides a focus for everyone to work together for a common cause. If a problem exists in a situation where people have been working without a clear vision, then it is important to first create a vision. A problem may alert and bring people together, but there should be a vision to lead them. A vision increases the chance of achieving the long-term goals (PIRSA, 2000). The problem is not ignored but perceived as an obstacle to reach an end. While removing such obstacles is good, if the participants cannot see where to go afterwards, then it is possible that the goals will not be achieved. When the vision is clear, then a problem analysis can be carried out and goals set to address them.

7.6 Setting goals

A vision should present a broad ideal situation that the partners would like to be in on at a specified point in time. To achieve this situation, there is a need to set both general and specific goals and objectives. The goals set at this point should reflect the changes the CBPR is set to bring. With the help of suitable indicators and goals, success can be determined. In a participatory research process, a holistic approach is used but still the interests of partners should be reflected in the goals and objectives.

7.7 Developing a plan for research projects

A research team should be formed by the partners and the members of the partnership should be represented in the team. The research team should ask research questions and set research objectives to generate the new knowledge required. According to Moles (2008), the questions answered by natural resources research should be posed on the basis of a consensus by stakeholders who deem it necessary to co-operate in order to protect and sustain the productive and environmental services of the natural resources. This should constitute a key input of the

community in development of the research proposal. Even if the community cannot directly participate in writing the research proposal, their ideas should be fully considered.

Make use of the connections each partner may have for funding (Senturia, Seifer & Wong, 2006). Depending on the nature of the research and the length of time it may require, it is better to source funding to cover a long period of time if possible. This is because it may be necessary to increase the time allotted for the project depending on the performance of the planned project. Senturia *et al.* (2006) advised that it is important to be proactive and even creative while looking for funding for CBPR. One advantage that can be taken in CBPR is that in some cases it is a requirement for a research project to get funding (Seifer, 2006). This implies that by taking this approach, the researcher would have a higher chance of getting the initial funding to start the research project.

7.8 Implement project activities

Before data collection begins, the implementation of a CBPR project would have started. The activities that lead up to this stage of a CBPR form an important process component of the project. In the traditional or conventional research, research and implementation of activities using its results are handled separately (McDougall & Braun, 2003).

7.9 Dissemination

The findings of CBPR should be disseminated in ways that are understandable and useful to the community (Palermo, McGranaghan & Travers, 2006). All the partners should be involved in the dissemination of research findings and multiple methods should be used. These may include radio, newspapers, presentation at professional meetings, handbooks, policy position papers, internet home pages, and scientific journal articles (McGranaghan & Kauper-Brown, 2006). It is important to report results to both communities in understandable forms and also to write articles for scientific journals for the benefit of researchers and academia. There should be prior agreements on how the results will be disseminated and those who contributed to the study should be equitably rewarded. Issues of authorship and intellectual property rights should be addressed at the initial stage of the planning process so it does not undermine the partnership. Since CBPR is supposed to involve action and social change, it is important to use the results for influencing policy change (McGranaghan & Kauper-Brown, 2006). This can be done by preparing policy briefs that partners agree upon.

7.10 Evaluation of the research project

In the evaluation of CBPR, both the process and the outcome should be considered. In relation to the principles of CBPR, the process evaluation will help to discern whether issues related to the partnership such as the principles and operating procedures have worked (Flicker,

McGranaghan & Palermo, 2006). For example, the evaluation can be designed to investigate whether the process fostered co-learning, promoted active collaboration and participation and whether it was community driven. Ultimately, it should be known whether the process helped to build the individual and institutional capacity of the participants to generate solutions for addressing their problems in the long run. CBPR are also designed to solve existing problems. Evaluating the process alone will not be informative enough to know whether the problem for which the partnership was formed and research carried out has actually been solved. This means that the objectives of the research have to be achieved and the actions taken should diminish the magnitude and effect of the problem.

The evaluation process should be designed by the partnership and carried out using indicators agreed upon prior to the study. Lessons learned can be shared among partners. Success can be promoted and failures reflected upon for making improvements. According to (Flicker *et al.*, 2006), the evaluation should be on-going, involve all partners in designing, conducting and interpreting the results of the study.

7.11 The case of Australia: Regional approach to delivery of NRM

The regional delivery of NRM in Australia gained focus in the 1990s as a result of the landcare activities in the past two decades (Moore, 2005). The origin of the landcare groups is closely linked with the integrated catchment management strategy. The regional approach where landcare activities are funded through the regional action plans was developed to reduce the cost of administration and enhance the impact of interventions in areas like biodiversity conservation (Moore, 2005). This was because provision of services to the numerous landcare groups was costly and the activities of these groups at property level had little impact at the landscape scale. Currently, the preferred approach for NRM in Australia is the integrated NRM which at the regional scale is considered to foster ecologically sustainable development (Moore, 2005).

The regional NRM delivery comes in the form of regionalisation and regionalism (Moore, 2005). Regionalisation is a mechanism for developing decision-making and resource allocation to a scale that will combine the best aspects of local decision-making with sophisticated knowledge and management systems, including accountability (Wallace, 2003). In regionalisation, administrative units are formed with the guidance of the government or industry to improve the effectiveness and efficiency of NRM. Regionalism is initiated and developed by the community in partnership with government and industry (Moore, 2005). The regional approach in Australia developed from a combination of the two.

The effectiveness of the regional approach depends on the nature of the goals of NRM (Wallace, 2003). Wallace noted that the approach can be effective if the management goals permit operations at a level that can influence decision-making while remaining connected to local

groups and land management. The success of this approach is therefore partly dependent on the clarity of and focus on the management goals and their congruence with the process tools.

In order to achieve desired NRM outcomes, investments should be made for both means (social, institutional and economic outcomes) and ends (biophysical outcomes) (Australian Government, 2009). The biophysical characteristics of Australian natural resources are more similar regionally than on larger scales. A regional approach therefore enhances the chance of achieving good landscape outcomes. It is better to promote changes required for strategic NRM at a landscape level because of the uniqueness that can be exhibited by these areas. These landscapes are more apt to be found at the regional than at national levels (Keogh Chant & Frazer, 2006).

Management at regional level means that the communities can be more involved in NRM and this gives them a sense of ownership which is required for successful landscape scale management (Australian Government, 2009). A single NRM plan is prepared by the communities at the regional level and this is used by all the stakeholders involved in NRM in the region. It helps to reach and engage local communities. Sub-regions and/or sub-catchments can be formed if the regions are too big. There are now 56 NRM regional bodies in Australia (Johnson *et al.*, 2009; Moore, 2005). The regional bodies were formed on the basis of landscape and previous administrative boundaries.

7.12 Examples of community participation in research and monitoring

Community environmental monitoring has a long history in Australia. In recent years growing public awareness of environmental issues relating to landcare, conservation and catchment management has brought together scientists, government agencies, academics, concerned residents and landholders in active groups across the country (Sullivan, 2009). Such “citizen science” has the potential to accumulate ecological data across unprecedented scales and at a lower cost than through conventional approaches for monitoring and research. Such approaches are gaining a global momentum.

Among the many successful examples of community-based volunteer monitoring groups for enriching environmental data are:

- **Earthwatch – global.** An international environmental charity which is committed to conserving the diversity and integrity of life on earth to meet the needs of current and future generations. Earthwatch now has 140 projects in over 50 countries around the world and the mission is to engage people worldwide in scientific field research and education to promote the understanding and action necessary for a sustainable environment (Earthwatch Institute, n.d.).

- **Waterwatch –Australia.** A highly efficient national community water monitoring program that encourages all Australians to become involved and be active in the protection and management of their waterways and catchments (Waterwatch Australia National Office, n.d.).
- **Saltwatch – Australia.** This is the longest running community environmental programme in Australia. It helps the communities to better understand the salinity problems along water ways. During the salt week, schools and community groups can study the effect of salinity on water quality by testing water from the catchment with salinity meter to determine its salt content.
- **Junior Landcare – Australia.** Launched in May 1988, Junior Landcare recognizes that the contribution of young people is vital if the land they are to inherit is to be in the best possible condition. The program encourages young people to develop a sense of responsibility for the land and other natural resources, and there are close links with community and research and monitoring programs, such as the above (Jounior Landcare, n.d.).

8. CASE STUDY: ICELANDIC STAKEHOLDERS

As part of this study on means to increase the efficiency of research and knowledge utilisation, a case study on research and participatory-related views was conducted among Icelandic stakeholders involved in the management, conservation and restoration of natural resources. The aim of this was to:

1. Obtain direct views of stakeholders on participatory research as a means of improving knowledge gain and adoption.
2. Explore the opportunities for communities to form a partnership with researchers and other stakeholders.
3. Identify the factors that facilitate the utilisation of knowledge.

Iceland has suffered extensive land degradation and desertification in its 1100 years of human settlement and land condition in many parts of the island is poor (Arnalds *et al.*, 2001). Since 1990, strategies for revegetation and combating soil erosion are increasingly based on participatory approaches (Arnalds & Runolfsson, 2009).

The case study was conducted in Eastern Iceland, the headquarters of the Soil Conservation Service at Gunnarsholt, on a landcare day in South Iceland, and the Agricultural University of Iceland. The stakeholders interviewed in the study were farmers/landowners, consultants of the SCS, Agricultural Advisors and scientists at the Agricultural University of Iceland. The respondents were purposively selected on the basis of their experiences in farming, provision

of advisory services, participation in landcare activities and research experience. The responses from the interviews are summarized below.

8.1 The need to participate

The farmers generally agreed that it was possible to work with scientists in research activities. Participation of farmers should however be based on need and the potential benefits to themselves. The farmers said that they would participate if the researchers ask them to do so. Some farmers work with researchers mainly through arrangements between individual farmers and researchers but not with institutions.

In most cases, the researchers request permission to carry out experiments on a particular farmer's land, ask them to monitor the experiments or seek their views on the experiments for proper interpretation of the results. The respondents also had a positive view on whether farmers can organise themselves in groups and use the groups to link up with other stakeholders. They indicated, however, that existing volunteer groups face challenges in order not to disintegrate.

8.2 A culture of innovation

Farmers can work on their own in trying new ideas. However, they need the support of the researchers in order to refine and improve their ideas. According to the researchers, farmers are different; some of them are very curious about scientific innovations while others are not. The researchers often select the farmers from whom they can learn and leave out those from whom they cannot hope to benefit. Arnalds (2005) recognizes the role of farmers in knowledge generation and urges closer collaboration between farmers and scientists. Researchers on their part need to appreciate the innovative power of farmers and have an interest in developing their knowledge further. There is also a culture amongst the farmers of learning by doing instead of learning first and then doing after confirming that the method actually works. This saves time but can sometimes lead to inaccuracy in the results.

8.3 Leadership of individuals and local institutions

Farmers mainly communicate by sharing ideas among themselves informally and individually, not in organised groups. Some farmers, however, have already organised themselves in groups that are mostly informal. These groups include the Landcare groups and farmer associations initiated by individuals. Social events help to keep the groups together.

8.4 Communication networks among farmers at the grass roots

Farmers are generally not active in forming groups themselves and are not forced by any authorities to make groups. The agricultural advisors work with the farmers and have meetings

with them at the homes of farmers. They work for the farmers' association and can therefore link well with them and understand their needs. Farmers accept participating in research if they know about it, for instance through the agricultural advisors.

8.5 Funding for natural resources management initiatives

Increased funding from government for soil conservation and land restoration is one of the means of achieving sustainable land management, especially if linked to grassroots-oriented programs such as the Farmers Heal the Land Project and land improvement funds linked to Landcare and other community groups (Arnalds, 2005). Such funding could be linked to monitoring, research and evaluation of programme success, building bridges between policy, science and land users.

8.6 Farmer institutions and intermediary organisations

Farmers are already members of organisations that help to link them with other institutions. The professional farmers' associations that work at the various levels provide structures that can be used for the natural resources owners, users and stewards to partner with the researchers and other stakeholders for sustainable NRM. As one researcher said, "It is better that farmers build groups on their own, take trips together, visit experimental sites and then learn from each other." They can also learn from colleagues that they regard highly.

The extension offices run by the association present an opportunity to link farmers with the researchers. Farmers also form groups and associations, particularly to share ideas and generate knowledge for farming. For example, the Barley Farmers Association helps them to work closely with the researchers and colleague farmers to develop better ways of growing barley. Government agencies and farmer associations in some cases get research ideas from the community and forward it to the university researchers.

8.7 Community knowledge and knowledge generation initiatives

The researchers appreciate that the communities have knowledge and often carry out their own experiments without involving the researchers. They also agree that there is a potential for them to learn from the farmers if they work together. The researchers noted that farmers have a lot of experience in what they do on their farms. They recognise that this source of knowledge is important and farmers just need support to improve their practices.

8.8 Prospects for participatory research approaches in Iceland

This survey revealed that participatory approaches facilitate learning and should be promoted. The view of the scientists was that participatory research should be promoted but other basic

and applied studies should not be ignored. Farmers hailed this approach for helping in the education of the young people on environmental issues. They stressed that landcare facilitates environmental education and knowledge exchange and should be promoted alongside new technologies to ensure environmental literacy. Communication between stakeholders was regarded as critical for facilitating participatory research.

The main conclusion from this survey among Icelandic natural resources stakeholders is that participatory approaches can increase the efficiency of research and NRM. From the evidence of the Farmers Heal the Land and Landcare projects, it is clear that stakeholders can adopt participatory approaches if incentives are well targeted to support the process. The stakeholders proposed that environmental education go hand in hand with on-the-ground work.

9. THE ESSENCE OF PARTICIPATORY-DRIVEN RESEARCH APPROACHES

Unlike the conventional approach, the end users in participatory research share the research responsibility with the scientists and other partners and the application of results begins with knowledge gained in the process. The diversity created through partnership means that deeper knowledge is generated and the technologies are more appropriate (McDougall & Braun, 2003).

9.1 Using participatory research to maximise gain and adoption of knowledge

Although in principle the higher levels of participation are preferred (Lilja & Bellon, 2006), it is important generally to embrace the opportunity to develop the culture of participation from the lower levels to the higher levels. This is because the possibility for any community to successfully get engaged at a higher level of participation at the first instance is low because the skills required are also learned through action. However, members of the partnership ought not to take advantage of the lack of skills of a collaborating group and, possibly, marginalise them but rather help them to learn and take up their responsibilities.

Landcare groups have the potential to stimulate participatory research, particularly CBPR. This is because they are used as practical learning institutions by the farmers and membership is voluntary. According to Catacutan *et al.* (2009), communities have skills, knowledge, financial and technical resources that can through good partnership help to improve management of land resources.

9.2 Building a community base and strengthening local institutions for CBPR

Individual farmers who are active and determined to try new ideas and commit themselves to the sustainable management of natural resources have helped to organise people in groups.

They help to link their communities with external opportunities such as the chance to work with the researchers. According to Schensul (1994), it is important to have social activists participating in action research for it to succeed. Although the role of the activists is not clear, it is perceived that they popularise and promote ideas for community mobilisation.

The availability of funds for research also plays an important role in implementing CBPR activities. However, unless the funds are properly managed, their use may become conflicting. In Eastern Iceland for instance, the funding provided for revegetation by a new hydro-power project is weakening the local landcare groups. A land improvement fund established to provide compensation for lost resources by the company provides direct payments to farmers and landowners for doing the same work they were doing as a group, although on a larger scale. Some of the members of the landcare group as a result have opted for the better incentives, hence weakening the group effort. The danger of this arrangement is that the land may be efficiently reclaimed but the opportunity to share knowledge which would be the case with a bigger involvement of the landcare groups is lost and the spirit of collective action may dissipate.

9.3 Maintaining partnership and sustaining the conditions required for it

Although CBPR is community-driven, researchers need to help the communities to start their own projects. When the community gets organised, develops interest and takes action, it gains experience and learns lessons that can increase its self-sufficiency in the future.

While the benefits of the research to communities in the CBPR are important, the benefits to other participants should be clear as well. This is because the manner in which CBPR is conducted deviates considerably from the way researchers are evaluated by their institutions. According to Delmer (2005), scientists in academia are overworked and yet evaluated based on success in teaching, service to institution and ability to win funding for research. These evaluation policies do not motivate and enable them to translate their research outputs into real benefits. Further still, Delmer (2005) noted that the scientists do not have the opportunity to interact with those involved in directing, for example, agricultural development at international levels and also have funding limitations to finance the supposed interactions. This means that if the benefits to other partners are not considered, they may perceive CBPR to be of little benefit to their career aspirations.

10. RECOMMENDATIONS

The evaluation of the literature and the outcomes of interviews with Icelandic stakeholders led to the following recommendations:

- Researchers should be encouraged to interact more with communities and use participatory approaches in their work.
- Apart from making contractual agreements to carry out experiments on farmers' land, the landowners should be informed about the logic and vision of the research projects.
- New windows of funding should be opened for natural resources management in terms of subsidies and grants for research to facilitate group activities by communities.
- Research institutions should find ways of rewarding staff engaged in grass roots research approaches.
- Collaboration among public institutions in different disciplines is important for studies that take the holistic approach to succeed.
- There is a need to investigate the role of NGOs in participatory research and NRM.

11. CONCLUSION

The evolution of research approaches from basic or applied non-participatory to participatory approaches is increasingly gaining momentum. This is of profound importance in the area of natural resources research because the utilisation of these resources can have complex implications in regards to the environment and human livelihoods. These approaches thus provide the opportunity to generate knowledge directly applicable for solving practical problems through sustainable solutions.

This study is a response to the quest for sustainable solutions to existing NRM problems. It shows that participatory approaches facilitate learning among stakeholders and can lead to increased environmental literacy besides achieving the NRM objectives. The study also indicates that through awareness raising and participation in environmental monitoring, the community becomes scientifically literate. This can strengthen the avenues for communication between professional scientists, the community and other stakeholders.

The use of participatory research approaches is challenging because it can involve collaboration between diverse groups of stakeholders. It therefore requires suitable conditions to facilitate local initiative and involvement of stakeholders. These conditions include: community awareness about environmental issues, the possibility of support for local initiatives, and local capacity to organise and plan participatory processes.

Partnerships form a powerful tool for organising stakeholders for participatory research. This is required because of the holistic nature of participatory research where scientists and institutions of different disciplinary backgrounds work together with stakeholders and other interested people to seek sustainable solutions to the existing complex problems. The opportunities for forming these partnerships include: availability of funding, the need for holistic approaches to natural resources management problems, existence of farmer institutions and community knowledge generation initiatives.

Knowledge generated in these studies has a role not only to bring new solutions to NRM issues but also to be used to improve the efficiency of further research. The adoption of the knowledge gained can be facilitated by integrating adoption into the research process so that all the stakeholders monitor its utilisation instead of leaving the task to extension agents. Sharing of knowledge and information and availability of infrastructure for extension facilitate adoption.

This study has provided guidelines that give an insight into how to use participatory approaches for improving the efficiency of natural resource research and how certain activities and actions can be taken to conduct participatory research. The ideas provided in the guidelines may not be complete for every situation but provide useful views on possible research directions. It is expected that the users of the guidelines will, as needed, adapt them to their situation.

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APPENDIX

Interview questions for the Icelandic case study

The following questions were used to guide interviews with farmers and other stakeholders for natural-resources-related research in the Icelandic case study:

I. Conditions necessary for local initiative and involvement

1. What is your view on the idea of farmers/landowners organising themselves in groups for managing land and using the groups to link with other stakeholders/partners?
2. What criteria would you suggest for forming a group to help farmers/landowners achieve both personal and community goals of sustainable management of land resources?
3. What factors would you consider to get farmers/landowners collectively involved in activities to improve the management of land resources?

II. Opportunities for forging partnership with researchers and other stakeholders

1. What is your view on the idea of farmers/landowners actively taking part in research activities in the community with researchers and other partners? (motivating factors)
2. What would be your preferred strategy for selecting the priority areas of research and the specific topics to increase your benefits from the study?
3. What factors would you consider to take part in research together with researchers and other partners to improve management of land resources?
4. Which organisations would you consider to be appropriate to work with and what services would you expect them to provide?

III. Access and use of appropriate knowledge and technology by end users

1. What are the sources of knowledge and information currently used by farmers/landowners for managing land resources?
2. What determines the choice of the source of knowledge farmers/landowners use for managing the resources on their land?
3. How do farmers/land owners normally get this information or knowledge (i.e. if from external sources)?
4. What constraints do farmers/landowners normally face in accessing and using the information they require (appropriateness) to manage the issues that concern land on their farm and in their community?
5. What would you suggest to help farmers/landowners to acquire the appropriate knowledge required for managing the resources on their land?