were probably empowered to negotiate, as local land tenure is clear (1). In Sumba, BirdLife had an intermediary role in negotiating National Park boundaries and resource use by the community with government agencies, while in Tanimbar, locals were incidentally helped to overcome their reticence to communicate their needs to government agencies (2, 3). Thus, while the effectiveness of the negotiated arrangements varies, it seems that many communities have insufficient capacities to negotiate, even if they have some part in the decision-making processes. In many of the cases explored, NGOs do seem to have a role as negotiators or intermediaries.

Sufficient capacity of NGOs: While aiming to raise capacity of local communities, in some cases, the NGOs themselves have insufficient resources for the tasks at hand. There is skepticism about the effectiveness of NGOs operating around Lore Lindu, where over 30 organizations are working with poor inter-coordination (5). While there has been widespread facilitation of agreements between the community and National Park, in some villages, many local people remain unaware of these agreements. NGOs have tended to be paternalistic and assume that local people needed help (5). It is not clear if their involvement is leading to empowerment when there is neither sufficient financial backing for projects nor encouragement of local initiatives. Some organizations present are not equipped with the skill sets required to integrate societal objectives into conservation schemes (5). Perhaps this shows symptoms of the growing requirement for NGOs to be 'all things to all people', when this is in fact beyond their scope. In a transdisciplinary research context, addressing this problem will need investments in capacity-building and adequate partnerships. NGOs and private negotiators should support the rural communities in implementing the agreements for years after initial negotiation (7).

15.4.2.3 Rules and Incentives

Adequate institutions: The institutional and legal context of resource use in landscape mosaics frequently involves both customary and state rules; sometimes they are complementary, but they are frequently in conflict. In many places, such as in Indonesia, national land legislation is derived and still strongly influenced by colonial laws that sought to appropriate land and exclude local users (3, 4). These rules are often related to land rights and extraction of resources from 'public lands'. Customary rules are common throughout Thailand, the Philippines, Indonesia and the Pacific. They work effectively while everyone is using the same set of rules (3). Many indigenous groups have arrangements to manage forest resources such as through regulations related to religious values (Wadley et al. 2004). As an example, sacred forests were used to conserve forest around vulnerable springs and rivers in dry areas in Tanimbar and Sumba (2, 4). The commitment of people to maintaining natural values may depend on sanctions based either on spiritual beliefs or strong community penalties to be paid in cash or labor (such as in Tanimbar, 4). In rural India, these 'assets' of traditional regulatory systems should be valued and used as local communities and are not ready for national state policies

(6). Multiple interviewees suggested that traditional regulations should be integrated more frequently in modern resource regulation (1, 4, 7). Yet, the integration of traditional and state regulations may not be simple. One problem is the complexity and possible incompatibility of the rule systems that have been developed by disparate kingdoms and the heterogeneity of their contexts (6). Participatory mechanisms are thus needed. The Tanimbar project has been re-negotiating land use designation to reduce further conflict between conservation and development interests (4). The careful involvement of all stakeholders in the process and the lack of current conflict have enabled successful negotiations. By focusing on participatory planning, the Podocarpus program in Ecuador has helped to open dialogue between local and national governments as well as indigenous farmer groups, commercial forest users and NGOs (9). There, co-management committees were successful in negotiating national reserve status for a lowland forest area threatened by gold mining and logging.

Rewards for biodiversity conservation: If conservation in developing countries is not properly resourced with sufficient incentives for locals, it will fail. The national park system may not be applicable in Indonesia and different approaches to conservation are needed (5). One form of incentive has emerged through new markets for cultural ecotourism, although these have often not met expectations. Nevertheless, other types of incentives may be created. Co-management efforts can lead to incentives such as in the Podocarpus program under which colonists are granted legal rights to land if forest cover is maintained and they allow hunting by indigenous groups (9). The translation of local park management plans into more clear and secure land access rights, access to safe drinking water, sustained yields of previously threatened tree products, more sustainable land use practices and ecotourism revenues make local people more aware of the benefits of conservation. In the selected case studies, rewarding local people directly for biodiversity conservation is either in an exploratory phase or seems difficult (3, 5, 7, 8). In Lore Lindu, there is some discussion about direct payments among local NGOs, inspired by reportedly successful schemes already established in Central America (5). Incentives for growing cocoa under shade, thus increasing its habitat value, are also being explored. However, in Zona da Mata, 'green coffee' marketing has been problematic due to a lack of market linkages, while in Jambi, marketing 'green rubber' from jungle rubber agroforests is difficult without official recognition of this land use (8). ATREE is exploring research results in the Western Ghats, with the hope of convincing policy-makers to use State taxes to pay for goods and services that compensate land managers for their environmental services (6). In the context of such rewards, measurable indicators for biodiversity service provision need further development. Currently, transaction costs, especially for monitoring, are frequently very high (3, 7). In Madagascar, the question of how incentives could work in the field of biodiversity conservation is quite new and thus related experiences are very few (7). The prospect of communities receiving payments for carbon sequestration by forests seems promising. However, it remains to be seen to what extent the rural poor will be able to take advantage of these schemes.

15.4.3 Realities of the Integration of Science in Conservation and Development Activities

Science has to adapt to reality: Project managers and project types are changing regularly – every five to ten years. This turnover can create a mismatch between scientific paradigm(s) and practice. As an example, the Integrated Conservation and Development Project (ICDP) was a dominant paradigm or approach before being replaced by the concept of payments for environmental services (Ferraro and Kiss 2002; van Noordwijk 2005). Nowadays, many specialists have become more critical about the potential of such markets (on this debate, see Karsenty 2004; McCauley 2006; Reid's response 2006; Wunder's response 2006). Despite such temporal variations, some common ideas, and sometimes myths, may last. For instance, the 'land use intensification hypothesis' that agricultural intensification will save land for conservation still remains an implicit paradigm in many cases without always being tested. Some theoretical ideas such as the concept of connectivity and corridors as part of mosaic landscapes can excite the imagination of people more easily than others. Ecological corridors are relatively easy to understand and they are already implemented in many parts of the world (for example, by the European ecological network and European Agrienvironmental program). There is no one overriding reason to discourage integrated and dynamic strategies encompassing the role of corridors, yet they are probably not always the most cost-effective way for conservation. Among other potential pitfalls, corridors can also promote edge effects, the filtering of communities, invasions and negative genetic impacts by reconnecting isolated fragments (Hilty et al. 2006). In addition, the concept is not as simple as is often advocated: corridor and matrix each mean a different thing for each organism and interpretations are scale-dependent. Thus, it is difficult to have a meaningful discussion on the overall value of corridors for biodiversity. Difficult decisions and trade-offs are involved in selecting and securing the best conservation investments. This arises from a general lack of knowledge on plant and animal movement within landscapes, concurrent uses of land, limited conservation funding and range of landowners and political entities with whom to negotiate (Morrison and Reynolds 2006). The discrepancy between science and practice, especially concerning biodiversity, was clear in Tanimbar (4). There, the concepts of rewards for environmental services, the principle of adaptive co-management and the influences of multiple scales were not addressed in existing land use plans. Even precautionary principles were difficult to advocate without local examples. This is a challenge for conservation in the developing world where it is critical to demonstrate the importance of biodiversity before attempting to incorporate science into projects involving local people (4).

The task of science is, on the one hand, to develop new concepts in order to tackle increasingly complex challenges and on the other hand, to meet societal needs. This second role is particularly important in tropical developing countries. Addressing social needs may not always need the development of new concepts and theories – it seems that a lack of ability to implement is one of the barriers we face. Instead, it requires sufficient accuracy in the interpretation of the causes and

catalysts of social issues. In some cases, research can be seen to have evolved not only technically but to also incorporate better knowledge of 'real-life' social issues. In Madagascar, for example, during the last 50 years, the knowledge about ecology, silviculture, management and exploitation of the dry forest system has increased substantially (Sorg 2006). This can be considered a result of the strong link between technology and applied research. More recently, a better understanding of the needs of the local population has grown, together with increasing international awareness of forest problems and political pressure to resolve these problems. Together with increasing pressure from the international conservation movements, this has led to the reconsideration of the research priorities for the dry forest landscape. Today, local research has three objectives:

- Review and promote the dissemination of the accumulated knowledge with respect to its general application in the forest but also outside the natural forest area (agroforestry, single trees outside the forest, secondary formations).
- Understand the people-forest interface at the level of the villages surrounding the forests, including use of non-wood forest products and potential for compensation for ecological services.
- Enhance multifunctional management of large forested landscapes and their surroundings to meet the different needs of the people.

Thus, the drier technical and theoretical questions that once drove forest science are in this case giving way to an approach more in tune with the local environment, including human populations (8). Donors are another major influence on the way that science is practiced. These have their own motives and driving forces and may strongly affect research approaches, especially in development and conservation projects. Most of the interviewed experts commented on the general disinterest or even discouragement by donors to integrate scientific theories and project activities. Real choices for the design and management of reserves are limited and often, many of the critical decisions have already been taken. Thus, 'ideal' approaches generated from new theoretical models are unlikely to be very relevant (2). Donors do not always demand a sound scientific basis and integration between theories and planned activities, but want to be assured that outputs will be concrete and create immediate recommendations for development (2, 4).

Institutionalizing science: Conservation circles have drifted far from research and sometimes fall to surprising levels of simplification while trying to influence political will (4). On Sumba Island, government and communities did not know about and were not influenced by the cutting-edge theories (2). Since these communities are the ultimate decision-makers in management there, BirdLife acting as a facilitator concentrates on the most influential factors for these managers. At an even more basic level, valuable research data and results are often not used because of a lack of time to interpret or scan the latest literature. Data is even lost because of poor governance and short rotation periods of the staff. There is a need for some NGOs to act as intermediaries between scientists and practitioners to aid in the transfer of science to policy and action. These so-called boundary organizations (Cash et al. 2003) could try to facilitate in a way that might be uncomfortable for

traditionally trained scientists. The need for change concerning research and development relationships is also related to scales. Central government officers closely collaborate with scientists in Indonesia, while in the districts, officers lack trust in science (4). This might have been caused partly by bad past experiences with incompetent, short-term advisors. In the case of Tanimbar, a remote area, consultants have allegedly been opportunistic in earning quick money without delivering reports with sound data (4).

Improved monitoring: The Kerinci Seblat National Park in Sumatra was meant to have a solid scientific basis and considered as a showcase ICDP before being widely described as a failure (Sanjayan et al. 1997; Wells et al. 1999). It seems that one of the biggest sources of error was insufficient consideration of external driving forces (for example. international coffee markets and their influence on land use decisions). Unfortunately, only a few analyses have investigated this (4). Of course, time and funding set the limits. Issues such as the success of corridors need to be explored by long-term monitoring. This has rarely taken place. In the Podocarpus project, research still has to establish the importance of particular forest zones for the Páramo bear population (9). An adaptive management approach might be an acceptable option; however, this still requires some baseline information and project monitoring. In reality, this often starts too late or finishes too early to correctly evaluate the efficiency of the initiatives. Even the European Agrienvironmental program has had corridor schemes operating for several years without having corresponding baseline studies and monitoring systems (Kleijn and Sutherland 2003). While optimal solutions may indeed involve combinations of approaches, the contribution of each component may be difficult to isolate and monitor (for example, where there is simultaneous use of large protected areas and contiguous community forestry agreements at the local level). Considering the ongoing experience of Madagascar in forest management, monitoring is a crucial issue that is still not adequately resolved, especially at the landscape level (7, see also Muttenzer 2006).

15.5 Research for Informed Governance and Management of Tropical Forest Landscapes

15.5.1 Integrative or Transdisciplinary Research on Landscape Management in Developing Countries

The concept of transdisciplinarity was developed in the 1970s (Jantsch 1970; Piaget 1972) before the principle of sustainable development (Brundtland 1987) further encouraged integrative approaches. However, it is still being studied at a theoretical level (Naveh 2001; Klein 2004; Nicolescu 2005). The approach combines academic disciplines, takes into account ethical values, implies the participation of various stakeholders, academic or not, and is recognized as useful for landscape-level approaches (Tress et al. 2001). This 'action research' concept has been suggested to address complex societal problems (Horlick-Jones and Sime 2004) as they

occur in developing countries. While transdisciplinarity and its related systemic approaches are convincing in addressing sustainable development issues, they place very high demands on both research and development organizations (Tress and Tress 2001). Many authors argue that a first lesson is not to get lost in (or too attracted by) the diversity, complexity and variability of socio-ecological systems (Horlick-Jones and Sime 2004; Hadorn et al. 2006). Other known problems relate to the difficulty in overcoming disciplinary boundaries and related prejudices of different participants (Daily and Ehrlich 1999; Opdam et al. 2002). In practice, a clear definition of the role of each actor is a key element to avoid confusion in a team (Sillitoe 2004) as well as in a network of institutions. Another scientific difficulty lies in the numerous ways participation can be defined if one wants to generalize experiences, which are, by essence, very context-dependent (see the interesting debates on case study generalization, for example, in Flyvbjerg 2006).

The Consultative Group on International Agricultural Research's (CGIAR) research mission is to achieve sustainable food security and reduce poverty in developing countries through scientific research and research-related activities. The approach taken by the centers has evolved in parallel with the transdisciplinary movement as it focused on agricultural productivity in the 1960s and moved toward 'action research' or the Integrated Natural Resource Management framework for sustainability (Campbell and Sayer 2003; Frost et al. 2006). This framework highlights four sets of interrelated linkages between: (1) production and conservation, (2) spatial scales, (3) time scales and (4) research and adoption of results (Harwood and Kassam 2003). In developing countries, the integration of conservation into other priorities, especially economic development, should be a central preoccupation. According to Globescan (2004), the majority of people from developing countries feel that individuals can do little against species loss. These populations must often give more importance to economics and less to conservation. The implication for land use planning is that local people are to be included in natural resource management to avoid the failure or sabotage of measures due to their inability to meet local needs. Further, while poverty alleviation usually depends on local access to resources, state services generally do not have the means to monitor resources in remote areas. Thus, research for biodiversity conservation in tropical landscapes has to be designed to take into account local poverty concerns, local needs and rights to self-determination.

15.5.2 From Research Findings to Informed Governance and Collaborative Management

Within the transdisciplinary framework, scientific disciplines are not the only bodies facing difficulties in reconciling their differences. Conservation and development professional circles have faced similar difficulties. While conservationists are still struggling to understand the dynamics of the landscapes patterns and their driving forces (Rouget et al. 2006), people engaged in human development support

might argue that complex systems can be self-organizing and that the need to build adaptive capacity must be prioritized. This ability to adapt may be particularly emphasized given the present concerns regarding the impacts of climate change. At the same time, scientists might question the effectiveness of past efforts when the outcome monitoring of development projects has often been neglected. In terms of priority-setting and monitoring, it seems clear that closer collaborations would benefit both sides.

The link between a plan and its expected impact is crucial for researchers as well as for development practitioners. What is sometimes more complicated is how to transfer information from one 'world' to the other. In reality, policy-makers are unlikely to have a natural interest in research findings. If policy changes are a goal of a scientific team, suitable dissemination of research results must be planned from the beginning. A similar communication and efficiency gap appears between policy and site management. It is acknowledged by many governance specialists that some policies did not have the expected influences on the ground. In the context of landscape management, the key questions are:

- What type of (integrated or aggregated) information can influence policy-makers in making choices that integrate biodiversity conservation into land use planning, rather than opposing it with development?
- What type of policy changes or incentives will influence natural resource managers so that they would change their strategies in the short term, in the interests of biodiversity conservation in the long term?
- What kind of mechanisms will ensure that the new system will be able to correct false assumptions or react to new situations? (In other words, will it be adaptive?)

In this real-life context, domains such as ethics and psychology (Saunders et al. 2006) might have to be considered when planning research. As suggested by our case studies, regular links between 'knowledge' and 'action' are, to date, often poor. To fill this gap, boundary organizations that can form bridges for selected and relevant information are currently receiving attention (Cash et al. 2003). These 'boundary organizations' are those that are able to understand the values of both scientific and non-scientific knowledge to allow a beneficial exchange between the two. These may include quasi-government organizations, Non-Government Organizations or institutions that combine research and development aims and activities. In particular, institutions such as agricultural extension services, which mediate between the needs and interests of local farmers on one hand and the work of researchers on the other. Research that may inspire change could be directed to policy-makers or more directly to managers or to both.

Figure 15.2 illustrates different combinations of 'science' and 'action'. The lower categories of the y axis would include articles done essentially for the sake of pure science or academic ambition as they would not aim to reach decision-makers, managers or implementers. Box A represents specific technical research used for development. For example, research typical of findings provided by scientists about a Non-Timber Forest Product processing technology to the company managers. From a multidisciplinary perspective, the reports that Millennium Ecosystem Assessment

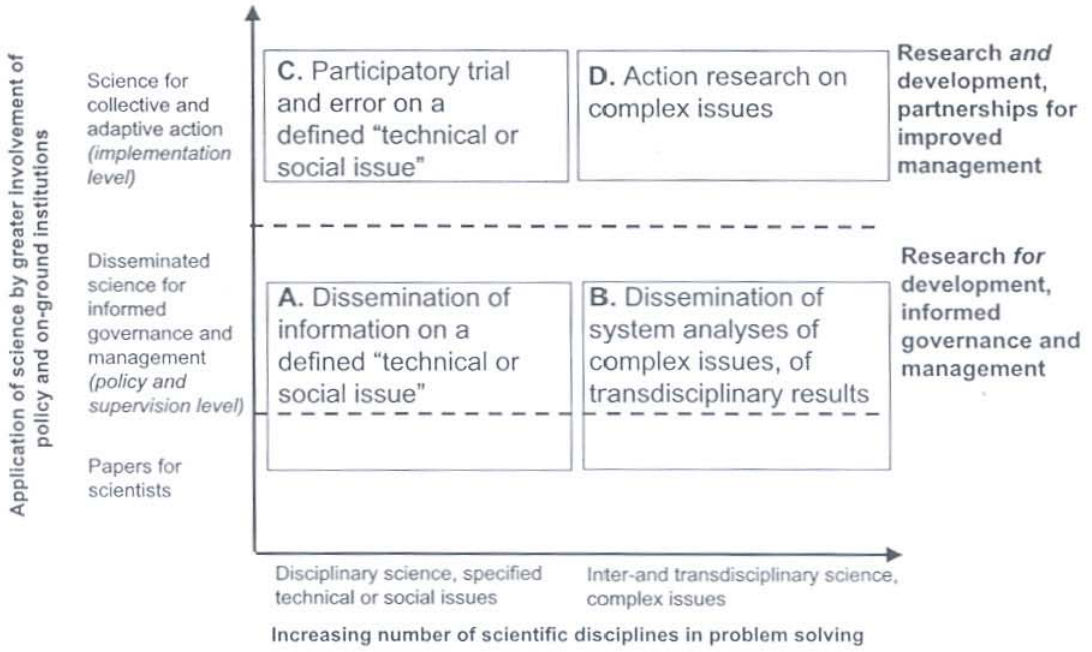

Fig. 15.2 (modified from van Noordwijk et al. 2006): Interface between knowledge and action along a qualitative scale. Increasing integration of scientific disciplines in problem solving is along the horizontal axis, while the involvement of institutions such as NGOs increases on the vertical axis

(WRI 2005) provided to high-level decision-makers would illustrate the type of research of Box B. If one goes further in the willingness to collaborate directly with operational partners, participatory research on mahogany planting might be an example of Box C, while an action research project focusing on negotiation support systems, aiming at rewarding upland managers for environmental services (RUPES, van Noordwijk 2005), could fall in Box D.

If we consider that biodiversity conservation at the landscape level is urgent, institutional changes in the context of research for conservation and development are needed in the short term. New ways of communicating and partnering are required – between disciplines in research as well as between science, policy and active, adaptive management. In reality, integration of multiple forms of knowledge and multiple partially independent decision-makers acting on the same landscape and on its drivers of changes will be challenging. Thus, the bridges between science, policy and implementation need to be built early, well-designed and empowered in adaptive and collaborative management systems (Cash et al. 2003; Tomich et al. 2006).

15.5.3 An Example of a New Research Approach

This section describes a recent example of research design that is being developed for enhanced tropical landscape management. In 2006, CIFOR and ICRAF launched