# the workshop sessions

## Session I: Working By Ecoregions: Focus and Aims of the Ecoregional Fund

*Chair: Dr. Mahesh Banskota, (IUCN Nepal)*

The single presentation in Session I, by Dr. Johan Bouma, provided an outline of the working principles and work of the Ecoregional Fund. It was followed by questions and discussion.

The session chair, **Dr. Mahesh Banskota** of IUCN Nepal, contributed greatly to the following presentation summary.

### The Ecoregional Initiative and Its Work – *Dr. Johan Bouma*

**Dr. Johan Bouma**, a native of the Netherlands, has been affiliated with the 'Fund for Methodological Support to Ecoregional Programs' or 'Ecoregional Fund' since its inception and he is currently chair of the International Scientific Advisory Committee (ISAC) which guides it. He gave a brief summary of its aims and modality (see Introduction).

Dr. Bouma pointed to the increasing awareness of the need for better communication between scientists, politicians, and policy makers in order to insure implementation of the new approaches. He emphasised that it was only through this type of interaction that the results from the ecoregional fund would reap maximum benefit. He went on to say that the linear thinking that had characterised earlier approaches to increasing agricultural production had to change. Competing demands for land use, role of multi-stakeholders, better understanding of the linkages, and available options all necessitate the need for joint learning. Dr. Bouma warned that all involved must be open to the fact that the process of interaction is always a compromise and so being would not always be satisfactory to all. Scientists working with stakeholders had to be open to the reality that often the direction of their research might have to change. There are no readily available blue print solutions that can be uncritically applied and available options have to be examined by all concerned stakeholders. The emerging message for scientists is the need for joint learning.

The five points below outline the different phases of an ecoregional project.

- Problem definition and delineation of ecoregion
- Characterisation of current conditions
- Model development of ecoregional processes
- Presentation, discussion, and amendment of options
- Implementation of land use options

Although all projects at some point go through the five points mentioned above, many specialise on one or two aspects depending on the availability of data and other resources. The ecoregional exercise was an important effort in joint learning and sharing between regions. Earlier this year at the Nairobi meeting all the participating Phase I ecoregional project groups from South America, Africa, and Asia had presented their findings. The first four reports have been finalised and are available on-line (www.isnar.cgiar.org/eco/). Funding has been mobilised for Phase II which will continue to build on Phase I but which will take things one step further to actually apply some of the findings in some areas. It is not clear which groups will be involved in Phase II but this would be discussed in the upcoming days.

During the discussions that followed Dr. Bouma's talk, the comments emphasised the urgency for better communication with policy makers. However, it was also pointed out that discussions with them must conclude at some point and result in some concrete action. Another comment urged that stakeholders commence putting the models to use, they should not delay until scientists thought that they had been perfected. Learning while doing was suggested for ecoregional exercises. Dr. Bouma closed by voicing the hope that ecoregional projects everywhere would help to enhance the 'lighthouse effect' in order to help us find niches of success.

In closing, Dr. Banskota, the chairperson, thanked the speaker and the participants for their valuable contributions. He pointed out that there was growing need for ecoregional modelling because of the complex linkages that exist between the environmental, economic, and social sectors of human activities. Modelling work is not always easy to justify and there is considerable scepticism on the part of the real world as to the usefulness of such exercises. He emphasised, therefore, that it was important to approach modelling carefully in order to ensure that useful results did emerge from such exercises. He suggested that there could be room for some future cooperation with IUCN (Nepal) especially in the area of environmental linkages. ICIMOD as a knowledge-focused organisation has a significant role to play in such exercises for the HKH mountain ecoregion.

## Session II: Mountain Perspective and Understanding

*Chair: Dr. Eklabya Sharma (ICIMOD)*

The two presentations in Session II looked at aspects of the idea of 'mountain perspectives', and were both followed by an opportunity for discussion. The session chair **Dr. Eklabya Sharma** of ICIMOD summarised the session.

### Mountain Perspectives: Concept and Findings – *Dr. Narpat S. Jodha*

**Dr. Narpat S. Jodha** is a Senior Advisor at ICIMOD and currently working on Policies. He has been at ICIMOD for 15 years with 3 years of assignment in between at the

World Bank. Dr. Jodha has pioneered the concept of 'mountain perspectives' which has received wide recognition. He defines the mountain perspective as an understanding of mountain specific conditions and explicit incorporation of their imperatives in the design and implementation of development interventions. His presentation focused on the mountain perspective framework. In the past, mountain development did not achieve its desired goals because of the lack of a mountain perspective in development programmes and policies. He outlined the mountain specificities such as limited accessibility, diversity, fragility, and marginality, and their imperatives. He went on to discuss the niche products and activities which arise from the mountain environment; these resources are characteristic of the biophysical conditions and the unique adaptation strategies developed by mountain peoples. He went on to discuss mountain specificities and, in a systematic analysis (by sector) of the conditions associated with high economic performance agriculture he showed that mountain environments are at a distinct disadvantage as compared with non-mountain environments.

Emphasis was laid on appropriate responses to inaccessibility, and adoption of different norms of investment for development in addressing the issues of fragility and marginality. The issue of globalisation and the potential threat it poses to the HKH region in particular was addressed. Dr. Jodha emphasised that mountain peoples can take on the challenge of globalisation by harnessing the benefits that can be obtained from niche products and resources. In summarising, he suggested that generalised development models should not be translated verbatim to mountain areas, but rather that special care should be taken to implement a mountain perspective in dealing with development issues in the mountains in order to achieve sustainability. He mentioned that there are now new ways of assessing both the biophysical and socioeconomic areas of spatial information by using GIS/RS tools and techniques. He concluded by pointing out the advantages of the new approaches, both GIS/RS and ecoregional, now being explored by ICIMOD for development planning.

**Some Ecoregional Thoughts on Mountain Perspectives – *Mr. Arjen Rotmans***

**Mr. Arjen Rotmans**, is a Professional Officer from FAO who has been working on the MASIF Ecoregional Project at ICIMOD for the past three years and is the project's technical coordinator. Mr. Rotmans first discussed the most basic question. What is a mountain? Is it characterised mainly by slope? by altitude? These are fundamental questions and lie at the very centre of common perceptions and generalisations on mountains. A survey of the scientific literature reveals that the concept of what constitutes a mountain is not strictly defined and definitions in terms of slope and altitude are not rigorous. One scientific attempt defines mountains in terms of the relevant dominance between physical and chemical weathering rates. Whereas mountains are characterised by a predominance of the former, plains are characterised by a predominance of the latter; however, even this classification is not universally accepted. So, one is compelled to conclude that 'mountain' constitutes a continuum of landforms, that any demarcations are arbitrary, and that generalisations are best avoided.

In light of the fact that mountains are not easily defined biophysically, and that even as recently as 15 years ago there was no focus on mountains per se, one can

appreciate that Dr. Jodha's 'mountain perspective' takes a very practical approach to the issues. Discussions in terms of the 'mountain perspective' have played a positive role in raising the awareness of national governments of the need to approach development in mountain areas differently. Now, at the end of the International Year of Mountains 2002, we stand at a turning point, poised between past successes on raising awareness on mountain issues and future actions and interventions. Mr. Rotmans explained that there is a need to go beyond a description of the mountains' inaccessibility, fragility, vulnerability, and marginality; many other ecoregions can be characterised similarly. It is important to realise that these characteristics are only hindrances for development where there is a lack of appropriate methods and technologies to exploit the diversity and the niche opportunities found within the region. Moreover, it is the lack of appropriate tools which is itself the main constraint for development.

In the ecoregional approach, the fact that mountains provide opportunities in terms of ecological niches forms the core focus of a new positive perspective in thinking on mountain development. Mountains are approached positively and their environments discussed not as fragile and vulnerable but rather as dynamic. The acceptance of shortcomings in a neutral manner and the identification of advantages is a step forward in the understanding, the management, and the control of resources which will ultimately lead to sustainable development and improved livelihoods for mountain people.

Identification of the variability in the resources that are characteristic of mountain areas reveals a large potential for diversification and specialisation, with niche opportunities and benefits not available elsewhere. Mr. Rotmans proposed that mountains are 'geographical storehouses of opportunity' but that in order to exploit these opportunities three things are needed. First, to explore and identify the ecoregional variability of the resource base. Second, to take advantage of experiences gained in mountainous areas to identify existing islands of success and transplant them to other suitable mountain areas. Last, to explore highland-lowland relations (at continental or global scales) in order to identify not only the dependency but also inter-exchangeability for the identification of new opportunities.

**Discussion**

The question and answer session helped to crystallise the differences in attitudes to mountains. Most of the questions and comments emphasised the overall agreement of participants that the traditional perspective that mountains only pose challenges must be revised. **Dr. Ann Stroud** added that it is necessary for mountain peoples to build on existing strengths and to adopt a positive strategy in order to encourage investment. **Mr. Alejandro Camino** gave examples from indigenous Andean mountain science where 'limitations' from the flatland perspective are actually opportunities for mountain people. He gave the specific example of night frosts that are traditionally used in the Andes to freeze dry the surplus tuber crops. Apparent constraints can actually be opportunities. Mr. Rotmans concluded the discussion session by reiterating that it is important to stop focusing on the symptoms and to start looking for the opportunities.

## Session III: Successes and Challenges in Mountain Agriculture

*Chair: Dr. Douglas Horton (ISNAR)*

The five presentations in Session III provided examples of successes and challenges in different mountain areas. The session Chair, **Dr. Douglas Horton** from ISNAR, summarised the contributions and discussion.

### Experiences and Successes in Agricultural Development in the Tibet Autonomous Region – *Dr. Nyima Tashi*

**Dr. Nyima Tashi**, a native of Tibet, China, is the coordinator of the MASIF Ecoregional Project at ICIMOD and works within the Centre's Mountain Farming Systems Division. His presentation focused on recent developments and changes occurring in Tibet. Tibet is characterised by a fragile ecosystem, low population density, limited market development, and little institutional capacity. Recent development policies have focused on poverty alleviation through development of infrastructure and markets. The government of the Tibet Autonomous Region has adopted time-bound programmes for poverty alleviation in which the primary emphasis has been on economic development (mainly road construction and communication infrastructure). The secondary emphases on social and environmental development and rehabilitation and conservation of environment remain long-term strategic goals. The government has a very active interest in agriculture and this interest was also shown in the presence here at the workshop of **Prof. Gu Maozhi**, Vice President of the Tibet Academy of Agricultural and Animal Sciences (TAAAS), and **Ms. Bai Choe**, Head of the Division of Agricultural Planning and Financing, Department of Finance and Policy, Lhasa.

Dr. Tashi gave examples of successes that include the introduction of new crops (winter wheat and improved varieties of barley), crop intensification (use of greenhouses and cultivation under plastic), and intensification of livestock production. Agriculture in Tibet is now a real success story, this area has achieved self-sufficiency in grain production and half of the requirements for vegetable production are met locally.

### Success and Experiences from Himachal Pradesh – *Dr. Tej Partap*

**Dr. Tej Partap**, a native of India, worked previously for 14 years with ICIMOD. He is currently Vice Chancellor of the CSK Himachal Pradesh Agricultural University, in Palampur (HP) India. Dr. Partap gave a broad-sweeping, lively, and well illustrated presentation on what he termed a "relative success case" of mountain development, in Himachal Pradesh. Half a century ago, and even as recently as 1970, this area, which has the highest percentage of rural population in India, was characterised by low-intensity land use, land degradation, and extremely low levels of income. Since then, a remarkable process of development had occurred through government intervention in the development of physical infrastructure (roads and transport, availability of piped water, electrification, investments in health care, and so on). Agriculture has prospered through diversification by harnessing production niches and the state now benefits from near universal education and empowerment of the poor (women in particular). There is a strong state commitment to social infrastructure development, agriculture has been diversified through R&D support and people participate in development through panchayati raj institutions (PRI)

institutions. Consequently, the relative impoverishment of rural people has undergone a remarkable reduction, regional inequalities have been diminished, and the level of living in remote rural mountainous areas has increased very substantially. Observers, including Nobel Laureate A. Sen, now consider Himachal Pradesh as an example of successful mountain development.

Dr. Partap emphasised that in spite of the fact that there is no doubt that Himachal Pradesh is already an agricultural success story, development in mountain areas must be seen as a never-ending process. In this process, continuing research and development are needed in order to convert the threats and adversities particular to mountains into sources of opportunity. This means innovative research with an area specific focus for developing diverse agricultural/farming systems that can capture ecological and bioresource niches. Dr. Partap felt that the type of work which is now being done in collaboration with the **MASIF Ecoregional Project** at **ICIMOD** on the delineation of production systems is essential.

Success stories in mountains largely confirm that the quality of the environment initially deteriorates as the GDP per capita increases and then improves after a threshold level of per capita GDP is achieved. Dr. Partap predicted a still better future for Himachal Pradesh over the next 15 years when mere subsistence farming will largely be replaced by a new generation of cash crops that exploit ecological and bioresource niches. There will be fewer farmers but more opportunities for the farmers there are. This vision of the future will need to be supported by farmer-oriented R&D in order to support farmers in their search for 'third-generation crops' and other means of producing high-value, marketable products in what are now considered unproductive environments.

What was amply evident throughout Dr. Partap's talk was that there exists an easy line of communication between the research community, farmers, and policy-makers in HP state. This point was further reinforced by the fact that **Dr. Jagroop Chand Rana** (Director of Agriculture, Himachal Pradesh) and **Mr. Surjit Singh Parmar** (State Secretary for Agriculture, Himachal Pradesh) were attending the four-day workshop and had actively participated in the discussions. In discussions throughout the workshop both Dr. Partap and Dr. Rana continued to emphasise that good communication between the research community and policy makers is key to the successful and rapid implementation of new agricultural norms and policies.

**Pathways Toward an Integrated Approach to Integrated Natural Resources Management: the Case of the African Highland Initiative – *Dr. Tilahun Ameda***

**Dr. Tilahun Amede**, a native of Ethiopia, is a physiologist by training and is currently working with the African Highland Initiative, based in Addis Ababa, Ethiopia. The goal of the AHI is effective integrated natural resources management in highland areas of Africa. The approach outlined includes capacity building, interdisciplinary R&D, analysis of market chains, farmer's research groups, scaling up, and other techniques. A step-wise approach is developed in localities in which relatively simple problems of individual farmers are attacked first, leading gradually up to more complex ones requiring collective action. The AHI is challenged to integrate results within system components (for example within the cropping system), across system components (for example across the livestock and cropping systems), and across

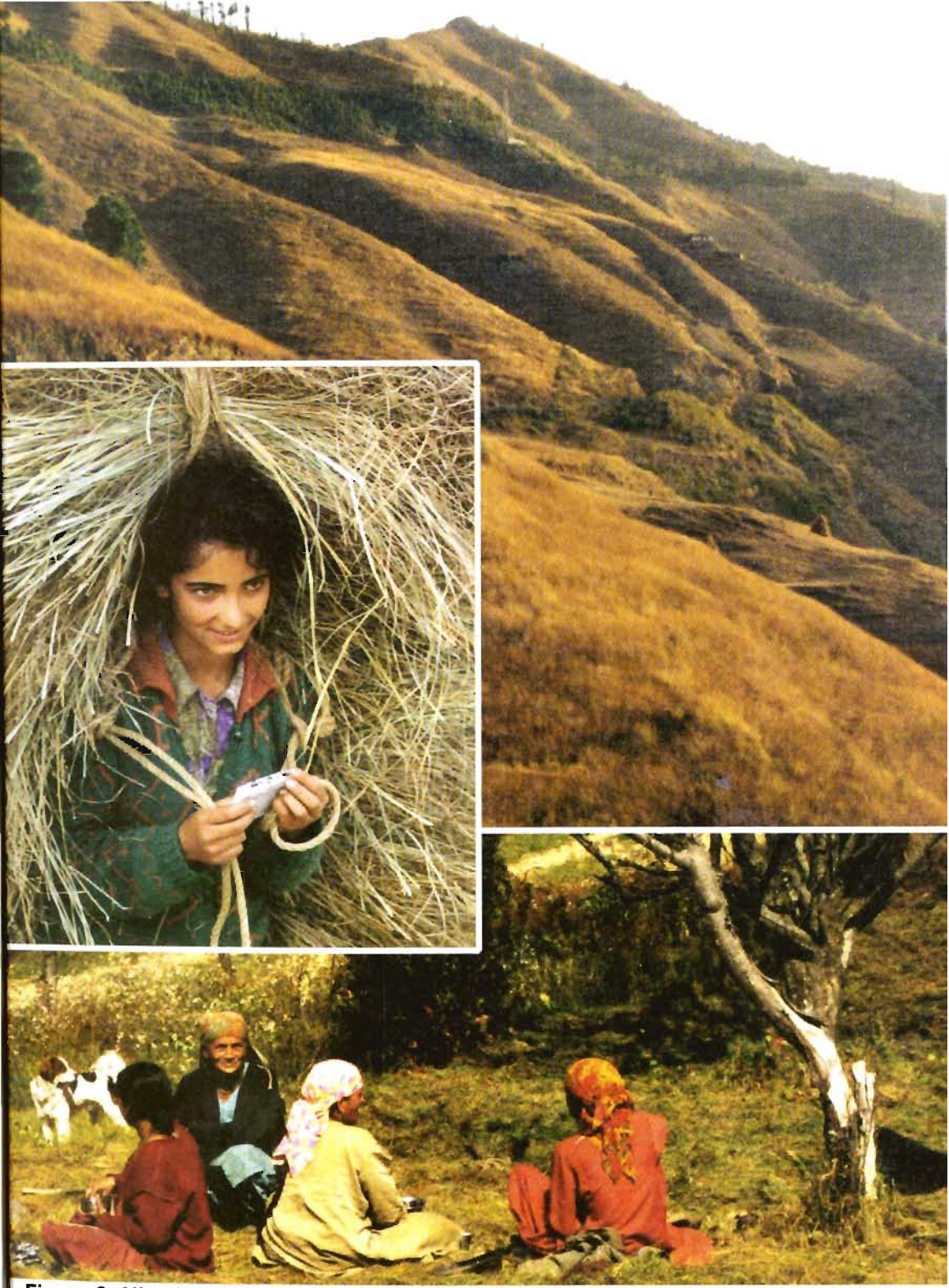


**Figure 2: Himalayan Region. Agriculture in Himachal Pradesh, India has prospered through diversification and harnessing production niches. The photo shows grass collection along with apple orchards on eastern facing slopes.** *(Photos: N. Tashi, A. Rotmans)*

scales (for example, from field, to watershed, and beyond). Some of the key challenges the AHI is dealing with at present concern the development of viable partnerships, dealing with complexity and diversity, and empowering farming communities. Dr. Amede emphasised that solutions to problems must come from the grass roots or at least be developed in collaboration with grass roots farmers, and that top-down approaches are often doomed to failure. He gave the very telling example of a recent World Bank scheme to encourage terrace building in hill areas in a 'food for work' project. Farmers did build terraces, but destroyed them when the project ended.

**Introduction to the Consortium for Sustainable Development of the Andes – *Mr. Alejandro Camino***

**Mr. Alejandro Camino**, a native of Peru, is currently Executive Secretary of the Mountain Forum, whose secretariat is hosted by ICIMOD. Mr. Camino delivered a presentation on the Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN), which has its headquarters at the International Potato Centre (CIP) in Lima, Peru. CONDESAN was established in 1992 as a mechanism for regional cooperation, and at present has about 70 members. Its members include national and international research and development organisations, universities, non-government organisations, local government agencies, donors, and the private sector. It works on a number of research and development themes, namely: protection of natural resources, making diversity work, boosting production and developing markets, shaping policy, strengthening policy, strengthening local capacity, and enhancing communications throughout the Andes. It combines biophysical and socioeconomic research and development at seven representative 'benchmark sites' but also works more generally to achieve larger impact through dissemination of tools and methodologies. Mr. Camino emphasised that CONDESAN projects ideally are regional (involve several countries) and should work on topics that provide tools and instruments to transcend country boundaries. Over time, the range of issues the consortium deals with has broadened to include such things as democratisation, the pooling of scientific and local knowledge, and the exploitation of culture and ancient knowledge in confronting the problems of today. The concept of a consortium that joins institutions together has started to work and there are now several high-level professionals/partners at sites working together.

**The Global Mountain Programme – *Dr. Roberto Quiroz***

The last presentation of the session was delivered by **Dr. Roberto Quiroz**. A native of Panama, Dr. Quiroz has many years' of experience in research and development in highland areas, most notably in the Andes. He is currently Head of the Department of Production Systems and Natural Resources Management of CIP, in Peru. Dr. Quiroz spoke of two recent programmes that have explored inter-ecoregional mountain experiences. He provided background on the 'Global Mountain Programme' that operates in the Andes of South America, Eastern Africa and the Himalayas. Launched by CGIAR in 1997, the main activities of the programme include: 1) creating or improving existing strategic alliances to increase awareness of the vulnerability of mountain ecosystems and to facilitate future activities; 2) developing and/or adapting tools and methods to generate information on ecology, natural resource potential, and socioeconomic activities, and 3) empowering mountain inhabitants through the training of local professionals in the use of new tools and methods.

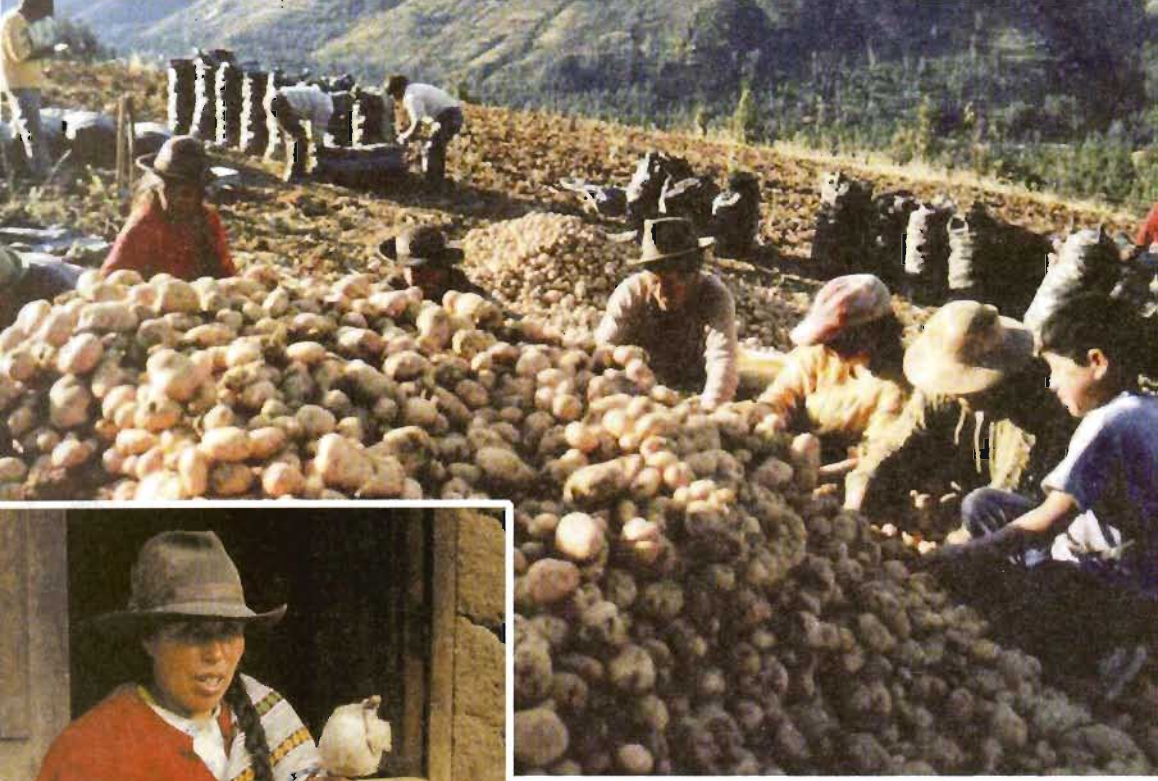


Figure 3: Andean region. Mountain agriculture is rediscovering the enormous potential of indigenous mountain crops. Another success story has been the upscale marketing of Alpaca wool. The photos show Andean farmers, Alpacas, spinning wool in the traditional way, and a basket of Andean tuber crops. *(Photos: J. Sumar K.; A. Cotahuasi; R. Uccelli; CIP)*

Dr. Quiroz then summarised some experiences gained in a project on 'Himalayan – Andean Watershed Comparisons'. This project aimed to develop common and comparative interdisciplinary methods to evaluate the state of the biophysical and human resources in eight mountain watersheds in the Himalayan and Andean regions and to illustrate successful conservation and rehabilitation approaches. One of the major products of this project was a set of 9 CD-ROMs which are intended to communicate science and development problems to decision-makers. Several slides from this set were shown.

**Discussion**
Each of the presentations was followed by a lively period of questions and discussion.

Dr. Tashi was asked what niche markets could be developed in Tibet. He responded that they were exploring 'culture-based' and 'NRM-based' activities, such as production of medicinal plants.

Dr. Partap was asked how Himachal Pradesh could cope with globalisation and the opening of markets. He replied that production patterns would need to change in future as market conditions changed. Farmers were showing great flexibility in shifting between crops and livestock in response to market changes. Farmers were looking to researchers to help them cope with the changes and introduce new crops and techniques in order to develop new niche markets.

After Dr. Amede's presentation, discussion focused on comparing development patterns and trends in the contrasting cases of Himachal Pradesh and Eastern Africa. Three unique characteristics of HP as compared with AH were identified as 1) proximity to a large market (in the Indian plains), 2) high educational level of the population, and 3) heavy investment in electrification, roads, health, and other public services. The question is: to what extent can these conditions be replicated elsewhere?

After Mr. Camino's presentation, questions focused on the institutional and organisational setup of CONDESAN. It was noted that this consortium is an informal group of organisations; it is not a programme of CIP.

Dr. Quiroz's presentation stimulated several questions on the process of formulating variables and parameters and on data collection. It was noted that these processes had been highly participatory, as the purpose of the exercise was to systematise and share information among people, across regions.

## Session IV: Strategies to Effectively Meet the Challenges

*Chair: Mr. Alejandro Camino (Mountain Forum)*

In Session IV the participants formed groups for two hours of in-depth discussions to identify the challenges and to suggest strategies to effectively meet the special needs found in mountain ecoregions. The three groups consisted of: the Himalayan Group, the African Highlands Group, and the High Plateau Group (which consisted of the Andean Mountain Group and Tibetan Plateau Group).

Eleven questions had been circulated to the participants before the meeting for consideration and were used to focus the discussions.

At the end of the group discussions the chair for each group summed up its findings and presented them at a plenary session for deliberation and comment by all. At the end of the day the three group chairs collated and summarised the findings from all of the groups taking care to compare and contrast the different ecoregions and to include the comments that had been voiced after each presentation. The summary of ideas, comments, and suggestions compiled from all the groups was submitted as a guide to be used by the committee that drafted the final recommendations for the conference. The full summary is presented below, arranged under the questions as headings.

**1. What is the current role and importance of agriculture in your mountain ecoregion?**

Agriculture is the most important sector of the economy in all the mountain areas represented (African, Tibetan, Himalayan, and Andes regions). Approximately 80-90% of the people in these highlands are engaged in agriculture. The highlands in East and Central Africa comprise approximately 23% of the area, house 50% of the people, and produce over 50% of the staple foods while contributing significantly to the GDP through cash crop exports. In Tibet, where most of the area is mountainous, only 40% of the GDP is from agriculture. In the Andes, a lower proportion of the population lives in mountainous, rural areas (35%), and although agriculture is the mainstay, mining largely generates income.

**2. What may be the future role of agriculture and importance as expected?**

Agriculture will continue to play a dominant role in the African, Tibetan, Himalayan, and Andean mountain areas.

**3. Which are presently the most challenging issues around agriculture in your region and which are the constraints?**

All of the mountain areas have **challenging physical limitations** of harsh climatic conditions, particularly in very high altitude areas such as in Tibet and Ethiopia. **Land degradation** is still a major challenge everywhere comprising soil fertility decline, soil erosion, grazing land degradation, declining biodiversity, and forest resources. Water is not always limiting, but due to increased water management, higher demands for water, and land degradation factors, water is becoming scarcer and more conflicts are arising.

**Political stability is an issue** in parts of Africa and the Himalayas. Here disturbances divert development investments and locally destabilise the population. Another issue is the size of the landholdings. Although there are few people who do not have access to land, the **landholding size** is either very small, as is the case in Africa, or shrinking due to population pressure.

**Technical support** to farmers exists in many areas, but, in spite of this, there are still challenges and issues. Availability of technologies and accompanying information is limited, technologies developed are not necessarily useful and appropriate, required

inputs are often inaccessible or unaffordable. In areas where the education level is low, the farmers' ability to absorb information and to make demands on services is often limited. **Access to markets** continues to be a challenge due to poor infrastructure (e.g. roads and transport) and is inadequate in most areas. In addition, market intelligence is not sufficient to enable people to analyse and dynamically take advantage of markets. There are **health-related challenges** – nutritional deficiencies (vitamins, protein, calories) and other diseases adversely affect local populations and the labour they can invest in agricultural production. HIV-AIDS is an issue everywhere in the world but in Africa it is predicted to affect 20-30% of the population in some areas and poses a formidable challenge.

**4. How are these challenges addressed?**

In parts of the Himalayan and Tibetan mountain areas more emphasis is being put on **developing infrastructure** which is having a positive impact on linking distant people to market centres and other opportunities. However, this is neither common nor uniformly implemented in all mountain areas; for example in Africa, infrastructure (roads, electricity) is still limited in most areas. **Responsiveness of governments to local needs** appears to be increasing in general. This is positively affecting mountain areas where they can take advantage of these new governance directions. Decentralisation and more democratic political systems coming into many of the African and Andean countries is positively influencing development investments through better targeting of local interests. **Enhanced peoples' participation in sustainable development** is increasing local ownership and contributing to the development processes in most highland areas. This is having a positive impact on natural resource management and marketing issues. Capacity building of farmers, community groups, and staff providing research and other services is a common feature, particularly in Africa and parts of the Himalayas.

**New crops and technologies** as well as a heightened interest in **traditional crops** are being actively sought to broaden the diversity, productivity, and increased income in mountain areas. This is the case for the Tibetan plateau where winter wheat and use of greenhouses have been introduced and are having a major local impact. In the Andes, traditional tuber and other crops are being promoted. In Africa, many new varieties have been added to the local germplasm options where they have helped to solve pest and disease problems as well as increase yields. In the Himalayan region, new cash crops are being introduced with success in some areas.

**Exploitation of culture and local knowledge** is featuring more highly on R&D agendas. Since mountain areas have a rich cultural diversity that is linked to the land and its resources, this trend should enrich appreciation and enhance use of local knowledge and traditions in confronting the challenges of the future. **Providing good conditions so that mountain people** can attain an adequate livelihood is a continuing challenge. There is true value in keeping people residing in mountain areas in order that they can continue to manage services and preserve the culture that will in the end benefit people everywhere. **Political instability and corruption** must be minimised to enable sustainable development.

**An increase in market-orientation** is being demonstrated in pockets or islands of success. The growing trend towards cash crop production and adding value is

**Figure 4: African Highlands Initiative, the Kabale District Farmers' Group is mapping their village and resources as part of a planning and visioning exercise that will lead to NRM and enterprise action plans.** *(Photo: R. Kirkby, CIAT)*

specifically pertinent for highland areas globally. Nevertheless, to get this to work requires a policy environment that is conducive to market intelligence, production information, and entrepreneurial skills and an ability to be flexible in order to meet the dynamics of the market. An interesting example was provided from Himachal Pradesh regarding farmer's ability to change from hop production to potatoes to peas. New crops coming in are, for example, lavender and olives, among many others.

**5. Which new challenges are to be foreseen if any?**

The recent challenge or increasing **globalisation** and its potential negative impact on mountain markets is a major concern in all areas. Policy interventions will be required to make local products competitive locally and abroad. In addition, the joint challenges of **global warming and climate change** and **decreased water availability** will potentially disrupt current production practices and have a major impact. This was listed as a major concern in the Himalayan region, Africa, and the Andes. In the future, **genetic erosion of traditional crops** could become a constraint in Tibet and the Andes unless conditions to preserve these are made favourable (markets, processing, policy support, research information).

As agriculture becomes more successful, continued intensification may have negative consequences. It is expected that unless policy and local action can be mobilised, degraded grazing, nutrient mining, and continued erosion will become serious limitations. **Relevant environmental policies and management practices for land use** must be implemented in order to safeguard against this.

**6. Is agriculture in your mountain ecoregion changing, and if so how?**

There appears to be a global trend in highland areas where people are either changing from or thinking about changing from subsistence to commercial farming. Enterprises that increase returns to land and labour in smallholdings include: horticultural and high value trees, medicinal plants, herbs, spices, nuts, and organically grown produce. Changing into more commercialised agriculture may have implications for NRM, gender balance, and the availability of labour. However, adapting these new systems will require market intelligence, market access and private sector investment in processing – which will have to go hand in hand with improved information access and infrastructure. These are being more rapidly deployed in parts of the Himalayas and the Andes than in Africa.

Without new and competitive opportunities, there is fear that **emigration from mountain areas might increase**. This is already happening in the Andes and in parts of the East African Highlands. On the one hand, emigration might relieve some of the pressures caused by population increase and unsustainable intensification (African Highlands) but on the other hand, it might result in new pressures on urban or adjacent lowland areas.

**The livestock sub-sector may further intensify** to improve options for income and nutrition supplementation. If this is to occur, it must go hand in hand with market development for animal products (added value), an improved feed resource base including better grazing land management, and good integration of livestock into the farming system. Livestock (cattle, yaks, llamas) is culturally and economically important in the services it provides in Africa, the Andes, and the Tibetan plateau.

If not tackled in the near future, the **sustainability of mountain ecosystems will be threatened by poor management.** There are severe challenges in managing soils (fertility and conservation), water, forests, and other unique sources of biodiversity including grazing lands. In addition, there was concern from some areas (Andes) of increased pollution and health hazards from indiscriminate use of biocides and from mining. This requires integrated technical solutions, supportive policies and incentives, and strong local, collective investment. Rewards provided to uplanders for the successful management of environmental services (water sources, sequestered carbon, landscape and biodiversity management) may increase the incentives and benefits to these people.

**7. To what extent are opportunities used and which are felt to be insufficiently used, if any?**

**Intensification of niches** is beginning to take place in terms of commercialisation in both the livestock and crop sectors. In spite of the fact that this is happening in some locations it is not yet happening as widely as desired due to lack of links to markets and unexplored opportunities. **Diversification** and **adding value through processing** is happening and there are some success stories (Tibet, HP, and Andes). However almost all areas indicated that these processes are still limited due to unavailability of varieties, poor enterprise management and market information (especially in Africa). The lack of capital and modern expertise are real obstacles. On the other hand, **collective action and indigenous knowledge** can be and is being enhanced in Africa, the Andes and other places. There needs to be enhanced awareness of the value of this diverse local technical knowledge and of how to use it. **Improved policies with donor and government support couple with better governance** to continue to provide momentum for development; however, absorptive capacity and donor dependency remain challenges to achieving self-sufficiency.

**8. What is your perception of sustainable mountain agriculture in your ecoregion?**

All the governments having mountain areas promote sustainable development. Integrated support is required to promote economically productive and ecologically stable growth to encourage a good balance between production and conservation of resources. It is important to continue to raise government attention to the special requirements and opportunities in mountain areas.

**9. Do you have examples where this sustainable vision has been implemented effectively from your perspective?**

**East and Central African Highlands** – One example is the Central Kenyan highlands where, although there is a high population density and small landholdings, farmers have evolved their systems into largely cash crops such as tea, coffee, dairy, and horticulture. They have access to the Nairobi market on good roads. The tea industry has invested in rural feeder roads and has consistently paid farmers promptly for their tea. These options, a good resource base that is relatively well managed, and access to markets are key ingredients. Increases in education standards have provided a venue for off-farm income so that the educated proportion of the population has been able to move into other areas (downhill) and into other professions. This said the ties are still to the land and the home area, and investments are made in this regard. Farmer cooperatives and self-help groups are another feature of the area that are leading towards self-sufficiency.

**The Himalayan region** reported a number of examples where the successful exploitation of various niches has led to the production of cash crops. These include fruit, medicinal and aromatic plants, and commercial farming. A particular example was given of the Lahaul valley (HP) which, in spite of being snowbound for five months of the year, is nevertheless a real agricultural success story. Himalayan areas have also successfully exploited cardamom, tea, and broom grass cultivation in agroforestry systems in Nepal. These success stories are unfortunately by no means the norm and much of the Himalayan region is still dependent on traditional subsistence farming.

**The Tibetan Plateau** has very successfully introduced winter wheat that has doubled the yield of tradition varieties. This has lead not only to self-sufficiency but also to surplus grain production. They have also introduced greenhouses and plastic film technologies so that now 50% of the requirements for vegetables are being met locally. They have also successfully introduced improved varieties of grasses and new livestock species (like cattle, sheep, and poultry).

**In the Andean region** there is an increased awareness in mountain agriculture of the enormous potential of indigenous mountain crops (e.g. quinoa, oka, and tubers); this has led to increased investment in this sector. Another success story has been the upscale marketing of alpaca wool, this now ranks sixth as a source of foreign income. There is a recognition that the importance of agriculture is strongly linked to the preservation of traditional Andean mountain culture, but the challenge now is to make it more productive. Saving agrobiodiversity and at the same time creating markets and processing opportunities has led to increased incomes. There are new developments in niche markets such as artichokes and flowers for export and barley for the beer industry.

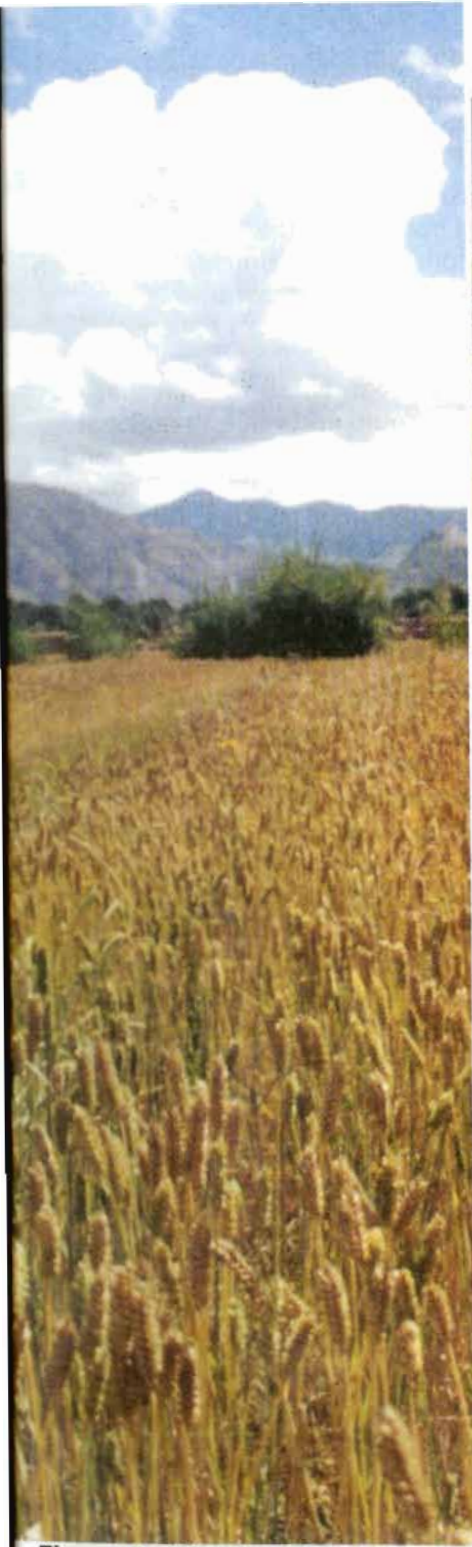
**10. Should agriculture have a key focus for development and how does it relate to other alternatives?**

Agriculture will remain a key focus for all of these mountain regions but there is an increased awareness that it should go hand in hand with sector support for environment, health, education and similar, i.e. integrated sustainable development (ISD).

**11. How do regional and inter ecoregional relations play a role in your case?**

The Africans noted some specific structures/organisations that are playing a positive role in solving regional issues through developing new policies (cross-border trade of seed) and sharing research results and information. These are the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and the Common Market for Eastern and Southern Africa (COMESA), which is helping to develop economic links as well as managing the sharing of major cross-border natural resources (Lake Victoria, Nile River). CONDESAN was an example of a consortium arrangement that is enhancing R&D in the Andes.

It was recognised that the strengths of such regional initiatives is that they can play a major role in marketing and input supply, and knowledge and technology transfer (including exchange of germplasm). They can also help in providing information and methodologies that assist in decision making at various levels (local, district,



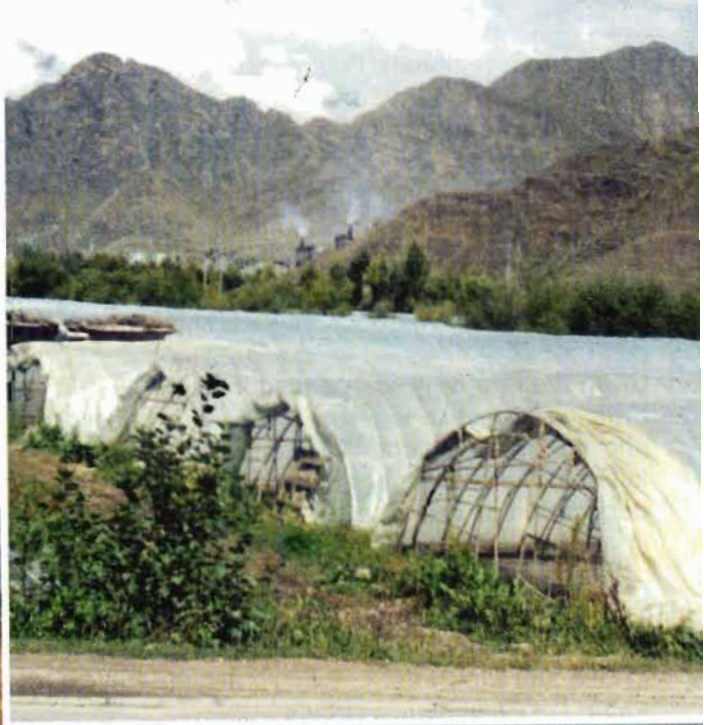


**Figure 5: Himalayan Region. Successful introductions on the Tibetan Plateau, China include high yielding winter wheat, improved varieties of grasses, new livestock species, and plastic film technology for growing vegetables. Yaks are still an important part of the traditional Tibetan way of life.** *(Photos: N. Tashi, A. Rotmans)*

national, or regional). Policy setting, local conservation and production efforts, and district planning are among other aspects that are important for sustainable development and that can be assisted by regional initiatives.

Two inter-ecoregional programmes had been discussed in Dr. Quiroz's presentation. The first was the 'Global Mountain Programme' that operates in the Andes of South America, Eastern Africa, and the Himalayas; the second was the 'Himalayan – Andean Watershed Comparisons' that aimed to develop common and comparative interdisciplinary methods in watersheds in the Himalayan and Andean regions.

Given the relatively scarce resources for sustainable development, it was felt that bringing expertise together to solve complex problems could add value to regional efforts. All groups could benefit from the heightened sharing of R&D successes and failures, the better targeting of interventions (particularly technologies), the reduced duplication of research, and the harmonised implementation of policies. This said, efforts would be most useful focusing on regional problems and opportunities in order to promote buy-in and cooperation from national governments.

## Session V: Methodologies and Tools as Support to Decision-Making

### a) Use and Limitations: Experiences in the Andes and Africa

*Chair: Dr. Johan Bouma (ISAC)*

The first part of Session V comprised three presentations on the use and limitation of tools in decision-making and in particular in the ecoregional projects from the Andes and Africa highlands. The session chair **Dr. Johan Bouma** (ISAC) summarised the presentations.

#### Use of Tools in the Decision-Making Process: Examples from the DME-SUR Ecoregional Project – *Dr. Roberto A. Quiroz*

**Dr. Roberto Quiroz** spoke about the importance of models to help bridge the gap between farmers, researchers, and policy makers. Problems have to be defined at the appropriate scale, because questions are asked by stakeholders and policy makers at different spatial scales. Multi-scale perspectives play a central role in ecoregional research since agricultural researchers are encouraged to do analysis across different spatial scales and agroecologies. The scale dependence implies that the results of analysis of the same phenomenon may differ considerably when different units of spatial analysis are used, and that the scale at which certain processes operate for each phenomenon under study might differ. Policy makers are interested in statements about regional-scale problems and solutions; however, these always have to be connected to what happens or to what is feasible at farm or local level.

Dr. Quiroz discussed how GIS and RS data are indispensable yet expensive tools that can be used to groundtruth land use and vegetation. In data scarce environments such as the Altiplano, some creativity is needed in order to collect and systematise the limited existing information. In this case the usefulness of the existing GIS or RS data can be extended by integrating it with process-based (both crop and livestock) models. Models built to simulate the plot level can fill in the gap between actual RS observations on crop conditions and the existing data can be used effectively to fine-tune simulation models for crop growth. Such models are strongly schematised

representations of reality that can be used to provide predictions for conditions that may occur rarely naturally or for changing conditions arising from proposed human actions. Dr. Quiroz went on to discuss how caution must be exercised when defining the scaling range, the optimum resolution, and the law function of spatial resolution since all of these may vary from one phenomenon to another. However, models, when properly used, extend the horizon of what appears to be feasible in the future; they can give a higher degree of confidence that a given approach will work in the field. Dr. Quiroz went on to give an example of down water from Lake Titicaca which became available because of damming by a hydro project. A computer model helped to confirm that since more water was available, cropping could begin earlier in the year and yield would increase.

Modern communication techniques are essential to communicate our message to policy makers, farmers and other land users. 3-D dynamic geographic visualisations were demonstrated by Dr. Quiroz who claimed that they are more effective than classical reports and maps. Even illiterate farmers recognise 'their' landscapes on satellite images and can associate better with proposed changes thus visualised. 3-D visualisations of land use options may also turn out to be more effective when communicating with policy makers who are now difficult to reach.

**Digital Soil and Terrain Databases and Applications – *Mr. Vincent van Engelen***

**Mr. Vincent van Engelen** is a Senior Land Resources Scientist at the International Soil Reference and Information Centres (ISRIC). Mr. Engelen first gave a short history of the SOTER (soil and terrain) database. SOTER is a methodology that provides an orderly arrangement of natural resource data through mapping of areas with a distinctive, repetitive patterns of landform, morphology, slope, parent material, and soils. The SOTER database of ISRIC combines landscape characteristics with soil data in a database format that can be used to feed soil and landscape data into models describing landscape dynamics. Exploratory modelling, based on SOTER data, allows statements as to risk associated with current or potential management practices in specified areas of the landscape. Mr. Engelen gave several examples of the impact of soil erosion on food productivity and showed how it was possible to differentiate between nutrient-limited and water-limited yield decline. The procedure applies at the regional and higher levels and can also be used to define 'hot-spots' in landscapes where local research can be focused most effectively. However, Mr. van Engelen cautioned that every model is only a gross simplification of reality and that one needs be aware of its limitations in order to use it to give an outlook of what is possible or not.

**The African Highland Initiative: Enhancing Communities to Regenerate Mountain Landscapes – *Dr. Ann Stroud***

**Dr. Ann Stroud** is the Regional Coordinator for the African Highlands Initiative, ICRAF. Dr. Stroud's work begins where more sophisticated models have failed. This work goes back to basics and uses as its methodological premise the fact that local knowledge is central to management strategies and that without local participation there can be no sustainable benefit. Participation generates better research and participation leads to empowerment. Interactive work with different communities in the African Highlands resulted in tailor-made innovative farming systems in which expertise from researchers was combined with local knowledge by farmers and

resulted in intensive 'joint learning'. Such farming systems could be improved mainly on existing knowledge. Effective communication and building of trust among the many stakeholders involved is crucial here and it takes time to achieve this. The main focus is on the farm and watershed level; eventually input is provided to policy makers at regional level.

Dr. Stroud gave examples where they had worked with local farmers to improve soil fertility, food production, and income by exploiting a cropping system niche. This integrated technology created a triple win situation where seed and fertiliser remained where placed, the first crop provided a dry season feed source, and a legume cover crop improved the soil nutrient content. Dr. Stroud concluded with a few words of 'wisdom' about tools stating that they need to be well understood or they may be misused/misinterpreted, that short-term research/data collection needs to be supplemented by longer term observations, and finally that research results need to be returned to the stakeholders in a useful form and that rigour/quality does not equal lots of survey data and quantitative methods, it means striving for depth of knowledge.

**Discussion**

After Dr. Quiroz' talk there were several technical questions on the modelling itself. Is a cell-based approach logical? useable? what about polygon base vs. cell base? Dr. Quiroz replied that one has to be flexible in letting the problem at hand define the methods to be used. There was a question on data compatibility between models. The consensus was that it would eventually be necessary to establish standards so that models, tools, and data can be shared. It was suggested that possibly ICASA (International Consortium for Agricultural Systems Applications) is already working on this. One final question asked, 'what if in the process of collecting data to fine-tune the model, in the end the model tells you something that you already know from the data alone?' Dr. Quiroz answered that models are always only second best. The best is having plenty of data to analyse, but when data is scarce then one needs to rely on models; when data is plentiful then it can also be used to calibrate the model.

After Mr. van Engelen's talk there were comments to the effect that a regional level model and maps of soil erosion would be useful to get the message across to policy makers. Another comment suggested that in dealing with policy makers it is always better to formulate the argument in terms of 'risks' rather than 'suitability' since policy makers often have their own ideas of what is suitable.

Dr. Stroud was asked how she saw interacting at the political level. She said that at the moment they are working at the institutional level and that they have made a decision to stop at the district level and eventually link with others at the regional or national level. At the moment they are communicating the community needs to the district level. They are bringing research to the table where discussions take place and in the process they are building a rapport with decision makers, i.e. 'getting engaged'.

Dr. Bouma summed up the conclusions of this session in the following way.
The African work relates to environments where stakeholders have a relatively low education level. The interaction processes leads to empowerment, and can also imply

that wishes of stakeholders are better listened to at the regional level. The case study of Himachal Pradesh presented by Dr. Partap showed that innovations arise much more rapidly and spontaneously in areas where education levels are higher.

How can the technical and sociological approaches best support each other? Land use scenarios at the regional level that are mainly intended for policy makers require modelling and application of GIS, RS, and communication technology. Nevertheless such scenarios should reflect what is feasible and realistic at the farm or community level. Results of participatory research at the local level leading to tailor-made farming systems should therefore be fed into the regional scenarios. But models can provide additional information for the local level by exploring land-use possibilities beyond what is known at this time by researchers and stakeholders. This can contribute to true innovation. At the same time, political and economic realities from the regional level should be fed into the local interaction process to be sure that the 'designs' at the local level are realistic. Two-way traffic is therefore essential, and a mix of both 'hard' and 'soft' sciences is necessary in both directions.

Mountain farming is associated with many problems. However, judging its results by lowland standards is not very meaningful. Considering the many local successes of mountain farming, it is much better to consider mountains as 'geographic storehouses of opportunity' and to document these successes and explore possibilities to extrapolate them to locations where environmental and social conditions are comparable.

## Session V: Methodologies and Tools as Support to Decision-Making

### b) Experiences in the Himalayas

*Chair: Dr. Tej Partap (CSK Himachal Pradesh Agricultural University)*

The MASIF Ecoregional project was discussed at length in this session. The first three presentations were made by the two principal investigators of the project, Dr. Tashi and Mr. Rotmans. These laid out the framework for the project and then discussed in depth the tools developed. The two presentations that followed discussed in-depth examples that were worked out in collaboration with the project partners in HP and Tibet and were presented by the partners themselves. The final talk of the session was presented by Dr. Sharma who discussed an example in which a local mountain niche was successfully exploited sustainably. During the session the participants were invited for a tour of the ICIMOD Demonstration and Test Site at Godavari.

#### Methodologies for Assessing Mountain Agricultural Systems in the Hindu Kush-Himalayan Region: An Ecoregional Framework – *Dr. Nyima Tashi*

**Dr. Nyima Tashi** began by putting the great diversity that exists in the HKH ecoregion into perspective explaining that it consists of many socioeconomic systems. Usually outsiders' understanding of the region is based on a perceptional delineation that, because of a lack of appropriate methodologies, can be misleading. What is needed is an appropriate ecoregional approach and tools in order to achieve a better understanding of the HKH's agricultural systems. A simple analytical delineation would categorise the HKG into four production system zones: pastoral, agro-pastoral, agro-forestry-pastoral mixed, and crop dominated. However this may not be the most relevant classification, the classification that is chosen depends on the needs – and

who the stakeholders are for a particular question. An ecoregional approach attempts to sidestep errors in the relevance of the data being displayed by being able to consider each region simultaneously with its own administrative boundaries, and biophysical and socioeconomic elements.

The data can then be displayed in the most appropriate manner by adopting an agro-ecological zoning approach in which the stakeholders themselves specify what parameters are most relevant for the problem at hand. The entire region is then considered as a system with well-defined boundaries within which all agricultural activities take place in order to tackle the problem with a systems approach using systems analysis. The real innovation of MASIF is that the agro-ecological zoning is dynamic: since it draws on a large multi-faceted database, it can always be queried to display the data that is most relevant to the particular stakeholders.

The MASIF Ecoregional project has three main objectives: 1) to systematically assemble a database and a set of tools that will characterise the HKH mountain agricultural system; 2) to develop a framework for methodological aspects of an ecoregional approach to mountain agricultural development and planning in the HKH in order to identify and extrapolate islands of success and niches of ecological opportunity; and 3) to work towards a collaborative ecoregional network of NCIs with a capacity to implement a national and ecoregional framework for mountain policy. The ultimate goal of the project is to address the problems of sustainability and poverty alleviation by making data available to planners and policy makers in order to help them make more informed decisions.

Dr. Tashi explained that the project's toolbox approach builds upon the MASIF (mountain agricultural system information files) relational database which integrates a geographical information system (GIS), remote sensing, and simple models of agro-meteorological and social-economic aspects of agricultural systems. The interactive toolkit land use analyst (LUA) makes it possible to facilitate the sharing, retrieval, and analysis of useful information within the Himalayan region. At a greater level of complexity, the planning support tools (PST) employ the LUA in order to provide different scenarios for niche evaluation, risk assessment, and food security. These tools can be used for concerted planning and policy-making by stakeholders to assure sustainable development of mountain ecosystems. They will make it possible to adopt a multiple-scale ecoregional approach for setting priorities, targeting policies and extrapolating for sustainable agricultural and natural resource management.

The MASIF Ecoregional project team has established partnerships with various institutes in the region and in collaboration has fine-tuned the methodologies in order to render them of most use to the respective researchers, planners, and decision-makers. These partners include: Himachal Pradesh in India where 12 districts are collaborating with the Department of Science and Technology, HP Horticultural University, and HP Agricultural University; Naqu and Lhasa in Tibet, China, with four counties, CAS, TAAAS, and the Rangeland Programme of ICIMOD; and lastly Kabhre and Sindhupalchowk districts in Nepal with ICIMOD's Rangeland programme and PARDYP project.

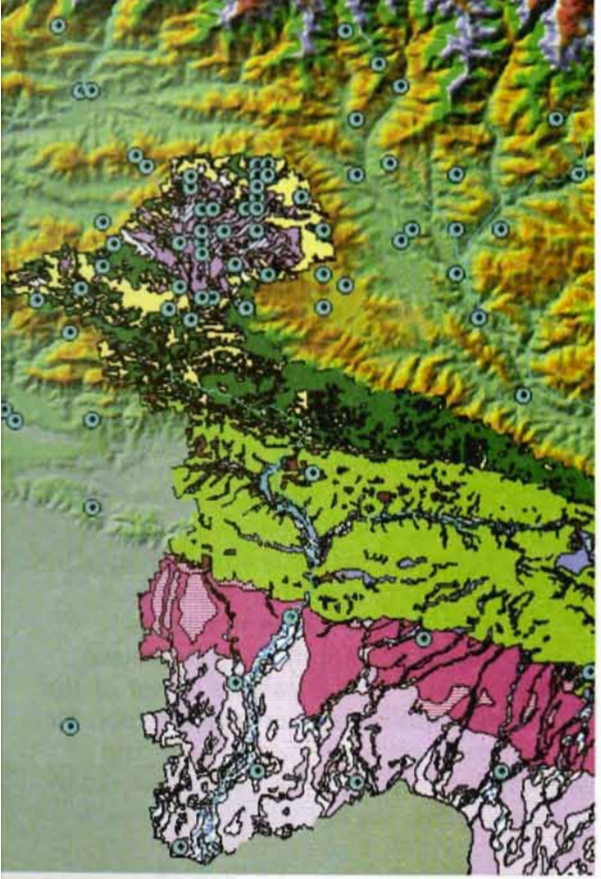
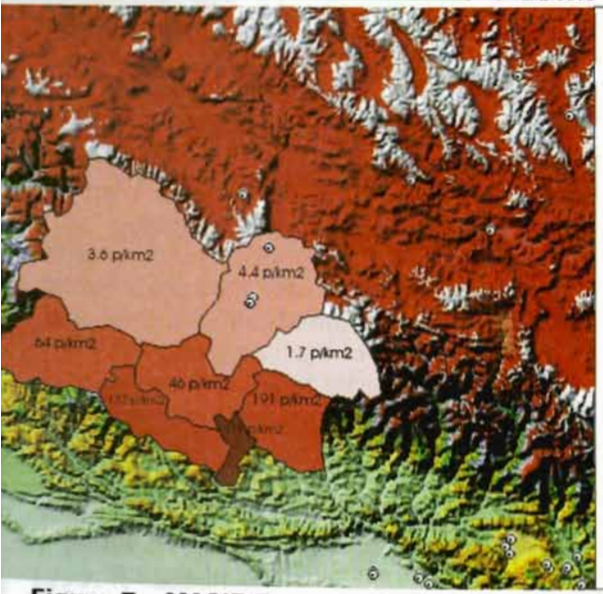


Figure 6: MASIF Example I. Query submitted by Ram Chandra Paudel, TU Institute of Civil Engineering, "I am doing a study on soil erosion for the Bagmati watershed. We have chosen to work with the latest version of the Morgan, Morgan & Finney model and need a number of parameters quantified, specifically soil textures. I have heard that you may have the required information in your MASIF database. Would it be possible to get a copy?" A composite map was extracted from MASIF using Nepal's digital soil and terrain database, soil reference profile data, coarse geographical delineation, daily meteorological data, and a digital elevation model. It took less than three hours.



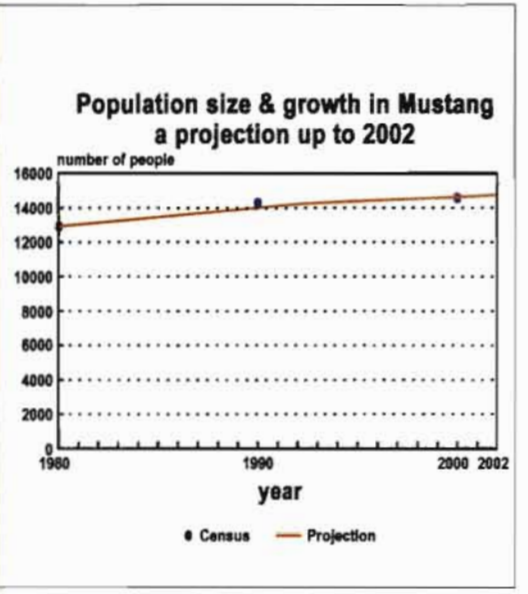




Figure 7: MASIF Example 2. Query submitted by Camille Richard, ICIMOD Rangeland Programme coordinator, by telephone, "Hey, guys good morning! I am leaving tomorrow for collaboration with my partners in Mustang. Would you happen to have an idea how many people are actually living in Mustang now?" Population size and growth in Mustang extrapolated to 2002 is 14,763 people; data extracted from MASIF database in 15 minutes.

More work needs to be done before the MASIF ecoregional project can be considered complete; however, it has already scored a number of successes. These include: 1) establishing the first ecoregional framework towards a complete understanding of the HKH region; 2) compiling MASIF, a large scale database for direct mobilisation and use; 3) developing in-house expertise for the relevant software programming and software development; 4) creating an awareness of the ecoregional approach through dissemination of information; and 5) developing a number of methodological products which are ready to be deployed.

**Theory, Tools and Functions of the MASIF System** and
**MASIF Functions and Examples of Their Use – *Mr. Arjen Rotmans***
**Mr. Arjen Rotmans** and his project colleagues (Mr. Sudip Pradhan, Mr. Rajesh Thapa, Ms. Smriti Shrestha, and Dr. Nyima Tashi) presented the HKH version of the MASIF software. Mr. Rotmans explained that it was with a vision of systematically mapping the complexity of the HKH ecosystem that they endeavoured to take an ecoregional approach to developing a set of methodologies that would facilitate the sharing of relevant data. The MASIF software, which is the major output of the project, was designed to contribute to the enhanced understanding of the different aspects involved in improved planning for mountain agricultural development. It will allow researchers, planners, and decision-makers in the region to harness the power of the data by using it as a natural resource management decision support system tool. Mr. Rotmans explained that this is the first time that decision-makers, planners, and development experts in the HKH region have been able to visualise huge amounts of resource data over vast areas simultaneously and easily. These tools give planners and developers a common ground where they can communicate, share information, and eventually benefit by sharing islands of success and exploring niches of opportunity.

Mr. Rotmans went on to discuss some of the approaches taken by the MASIF Ecoregional Project. The first issue tackled was that of data scarcity, which is often perceived as a major limiting factor, but in fact, is not. The perceived data scarcity is largely only a relative problem; actually, much data exists, but it is often in a form that is difficult to access, integrate, and make available. The MASIF Ecoregional Project strategy has been to collect what data is available from public sources and to obtain additional data through partnering with universities and national collaborating institutes. Once partners are convinced of the usefulness of the MASIF database and methodologies they combine their intensive understanding of existing traditions in their own countries for monitoring, survey, and census in order to retrieve valuable data. In this way much information from HKH mountain areas has been mobilised in a relatively short time.

Essentially the MASIF database forms an integrated georeferenced framework which works hand in hand with embedded analytical tools to explore what is known about specific mountain ecoregions. These analytical tools address a variety of issues including natural resources, biophysical parameters (solar position, radiation, mountain shadows, slope, energy, climate classification, rainfall probabilities, thermal and moisture regimes), and agriculture (reference and likely growing periods and agricultural systems). The decision support system tools within MASIF then use these date with more sophisticated models in order to help planners and decision-

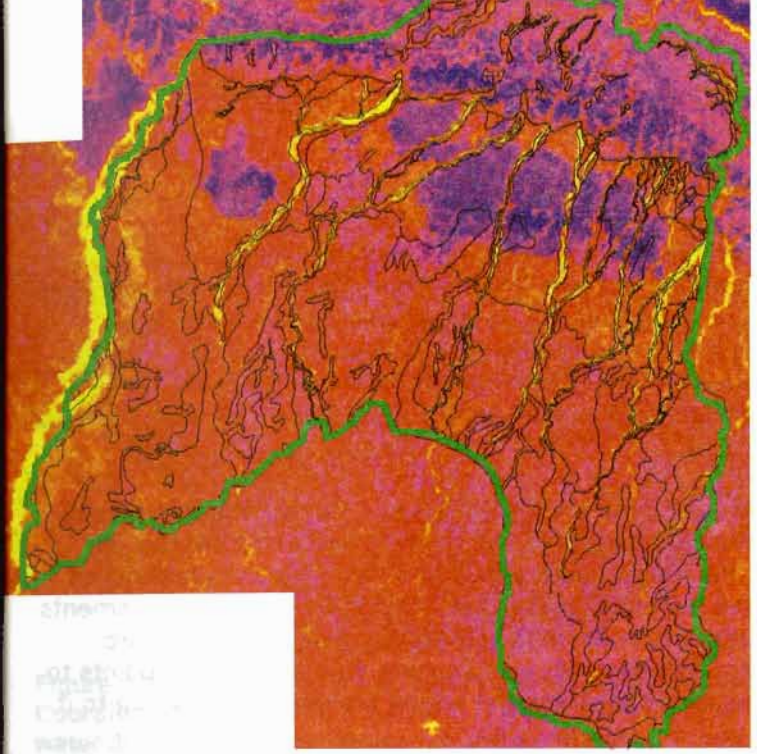


Figure 8: MASIF Example 3. Query submitted by Dr. Alex Hooijer, CARE Nepal: "I am working on a soil erosion impact study in the Siwalik and Terai Region. We will soon go for a field survey and assessment study and are in the process of compiling all available information about our two districts. We don't yet have any soil and land use information. Is it possible to come and have a look at what you have and use it for our study?" The figure shows soil and terrain with vegetation cover from MASIF.

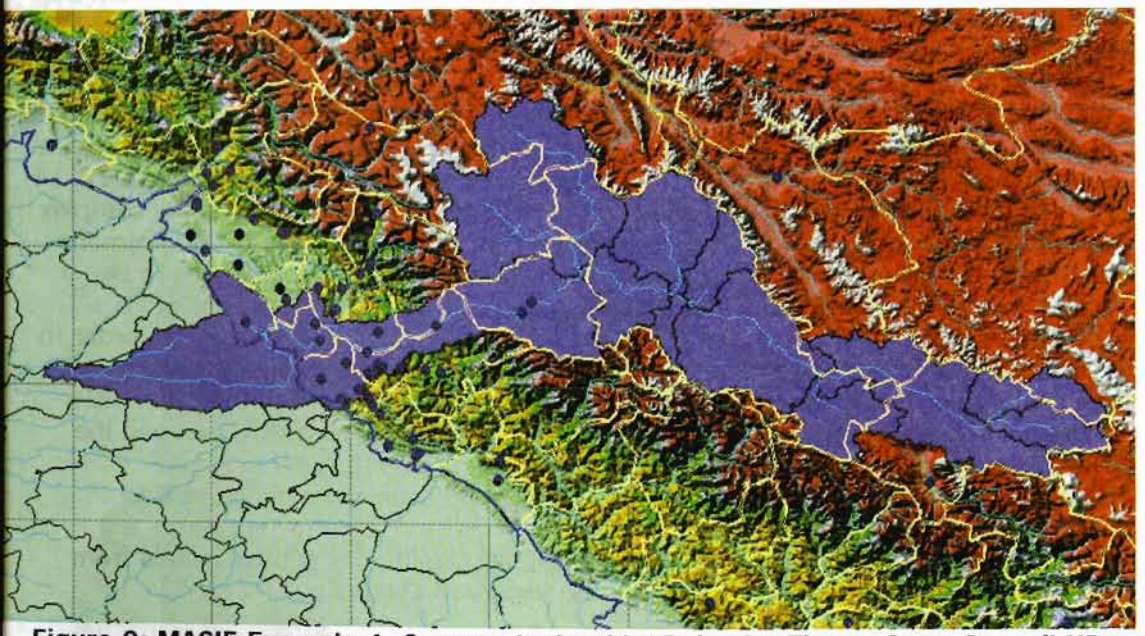


Figure 9: MASIF Example 4. Query submitted by Rajendra Thapa, State Council HP. "...another question that we still have is about an extreme flood in the Sutlej river in 1999. It caused severe damage in the State but we still don't know exactly what happened. We did not have any warning of such a flood, and on the Chinese side we simply don't know how big the catchment is. It could have been a glacial lake outburst or a landslide. Can we have a look at the total catchment in MASIF to find which glacial lakes might be in the upper basin part?" The figure shows the Satluj river basin and its upstream area coverage on the Chinese side; extraction time from MASIF 10 minutes.

makers explore issues of population dynamics, agricultural niches and opportunities, crop diversification, and food security.

The MASIF framework combines data and analysis to retrieve and analyse information on a wide range of topics of key importance for the enhanced understanding of mountain agricultural systems. It is especially because mountain are characterised by a large diversity of niche environments that they can most profit from the rich MASIF information base. Using it, it is possible to match the widest range of potential opportunities to the corresponding local conditions. The MASIF framework will provide the various multi-stakeholders in land use negotiations with basic information that they can use to plan sustainable development through the best use of mountain resources.

The MASIF database and tools are still in the early stages of development; however, even at this early stage it is already possible to use them in order to solve real life problems. Over the past year the MASIF team at ICIMOD has assisted a number of researchers and planners in the region by giving quick regional overview assessments on topics ranging from agriculture to conservation, hydrology and infrastructure planning. The demand for these assessments is increasing and this in itself points to the value that planners and decision-makers in the region are already assigning to it.

Seven examples of actual queries that came to the MASIF project were presented and discussed together with the answers that MASIF provided. Six of these are presented in Figures 6-12 because they provide the best evidence of the type of meaningful information that MASIF can provide even at these early stages. While these real queries are still of a relatively low degree of complexity and were answered quickly using MASIF, they nevertheless show what the system is capable of. Two more sophisticated examples related to the Godavari Test site are shown in Figures 13 & 14 With continued training and capacity building, planners will be able to probe complex planning issues on a more sophisticated level. The final point raised by Mr. Rotmans dealt with the issue of upscaling. The MASIF system is designed to be able to be scaled independently in order that it can be used with various resolutions of geographical detail and coverage. The framework was designed in this way in order to allow different versions of the software to be written at subnational, national, or regional scales. Banking on the experience gathered in working with the three HKH ecoregional project partners (Nepal, the state of Himachal Pradesh, India, and the Tibet Autonomous Region of China) he envisioned that in future other MASIF databases could be compiled for the major mountain ecoregions of the world.

**Redefining Agro-ecological Zones for Sustainable Livelihoods (Policy Issues from the State of Himachal Pradesh, India) – *Dr. Shashi K. Ghabru***

**Dr. Shashi Ghabru** is Scientist In-charge at the GIS and RSA Centre, CSK Himachal Pradesh Agricultural University, Palampur (HP) India and has been collaborating with the MASIF ecoregional team for the past two years. Dr. Ghabru began his presentation by discussing the existing agro-ecological zonation maps for Himachal Pradesh. These maps are based mostly on elevation but somewhat also on rainfall data. He went on to explain that in HP, which has a very vibrant agricultural sector where the land use patterns are changing, these maps are now largely inadequate. They are inadequate for many reasons, namely: they do not take socioeconomic

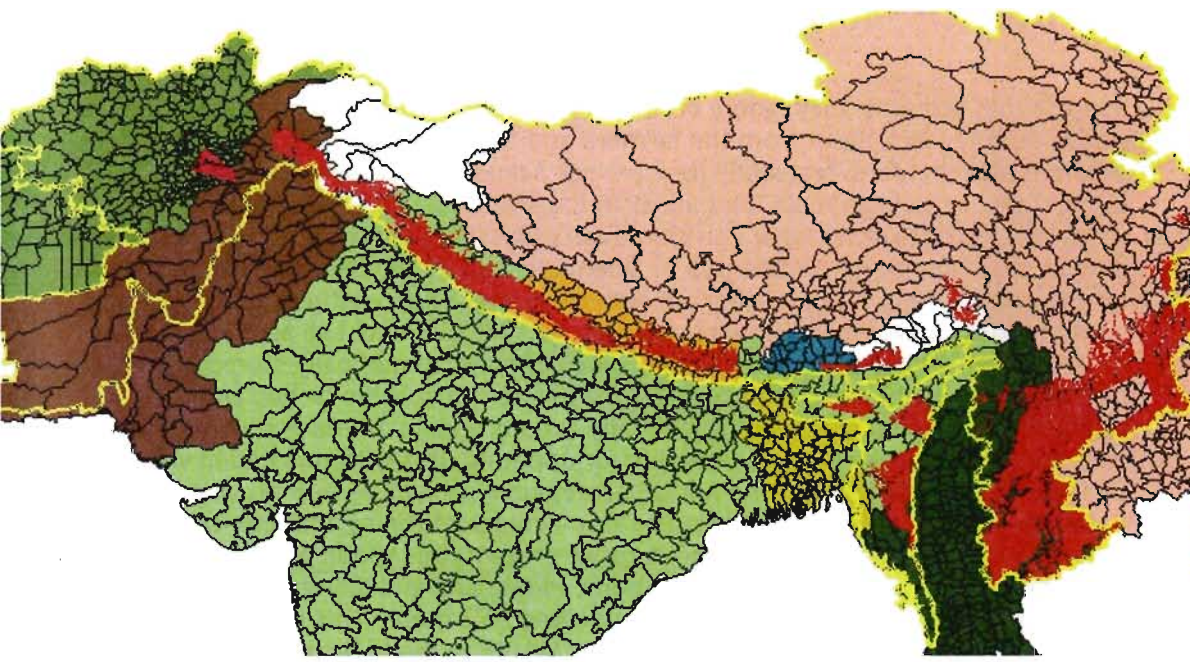


Figure 10: MASIF Example 5. Query submitted by Roger White, PARDYP Project Coordinator, " ...the other question is about the extent of 'middle mountain watersheds'. Could you please ask the Ecoregional Project for their best estimate of how much of the HKH fits in with our meso type watersheds, that is within the 800 to 2,500 mm rainfall belt and at 700 to 3,000m." The figure shows the estimated area to be about 11% of the HKH, extraction time from MASIF one hour.

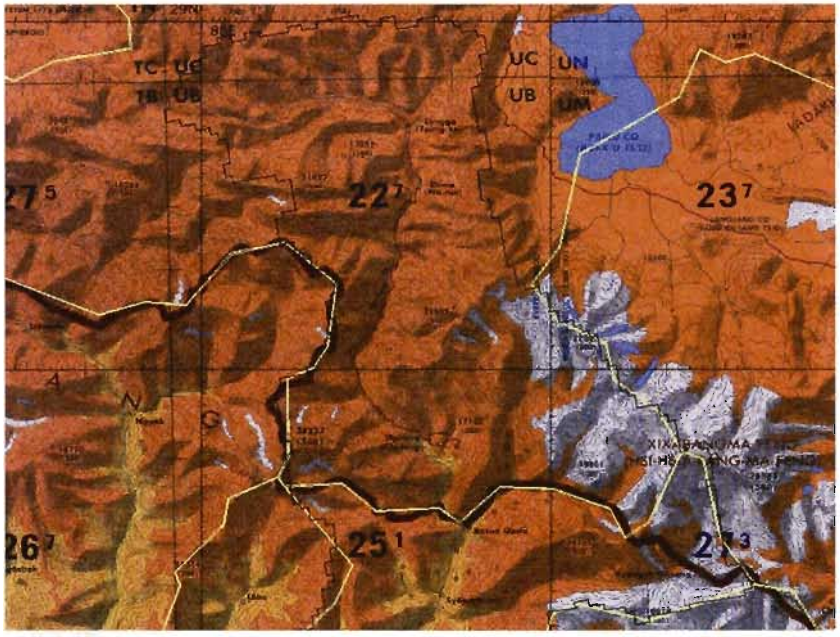



Figure 11: MASIF Example 6. Query submitted by Mandira Shrestha from MNR, "A colleague of mine is working on the design of a new hydropower plant on the upper Trishuli basin. They need good design criteria, but they don't know how large the catchment is, as a large portion is on the Chinese side. Do you have a map coverage in MASIF that would cover this area and can help us to calculate the area through a GIS?" MASIF equal area calculation reported a catchment above the proposed construction site of 3,942 sq.km, extraction time 30 minutes.

aspects into account; they ignore cross-cutting phenomena such as steep slopes, and irrigation; they lack input from the farmers and the perception/involvement of different stakeholders; and lastly they are not acknowledged by the Forestry Department which is a main landholder in the state. Dr. Ghabru went on to show many pictorial examples where an elementary classification by altitude was obviously inadequate. Due largely to this lack of adequate AEZ maps, the information systems for decision-making and planning are either missing, incomplete, or unreliable and consequently land resource management in HP is not as effective as it could otherwise be. A vision for new AEZ maps includes a systematically stored and managed information system which can be tailored to specific niches and opportunities, which is able to dynamically accommodate different stakeholders' perspectives, and which offers flexibility for updating. It is with this end in view that this team is partnering with the MASIF ecoregional project. MASIF provides a database platform that allows dynamic agro-ecological zoning that can be custom tailored to the needs of the stakeholders. At present, this group is in the process of defining different stakeholders' perceptions, identifying and filling data gaps, and adjusting the tools required to provide improved AEZ maps. This is a concrete example of one of the first intended uses of MASIF to really help to make a difference at the level of decision-making and policy setting.

**MASIF Preparation in China – *Dr. Lu Changhe***

**Dr. Lu Changhe** is a Senior Research Scientist with the Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS) in Beijing. Dr. Lu spoke of the preparations that are being made in China in order to be able to take advantage of the powerful computing capacity of the LUA and other tools. He presented the output of the pilot area case study of the Ecoregional Project at ICIMOD. These consist mainly of data collection (i.e. digital vector maps, soil profiles, time-series population data, land resources, land use, time series meteorological data and others) and compilation of these data into MASIF-China. Data is being collected for the HKH region of China and five counties that represent the major agricultural systems in the Tibet Autonomous Region, namely, Naqu, Dangxiong, Linzhou, Duilong, and Nimu. Dr. Lu went on to illustrate some of the examples of using data collected to generate maps for the HKH region of China and for the pilot area. Several maps such as the digital elevation model for the five counties, population distribution in the HKH region of China, soil map and land use of the pilot area, and some changing trends of agricultural development in Tibet were discussed.

Dr. Lu suggested that the Ecoregional Project at ICIMOD should continue and that one of its mandates should be to provide training for the partner institutes in order to build capacity. For example, with training the regional partner in Tibet could then incorporate data collected for the local scale into MASIF-HKH. He went on to say that the MASIF's LUA tools provide a very good way to combine biophysical and socioeconomic data in a very dynamic way since the database and software are so flexible. He foresaw that there is great scope in this approach and that it can and would be successfully applied as a support tool for the assessment of highland agricultural development and planning in Tibet in the future. He concluded by reaffirming his support of the Ecoregional Project at ICIMOD and urging that there be continued interaction between scientists in Tibet and scientists from the Ecoregional

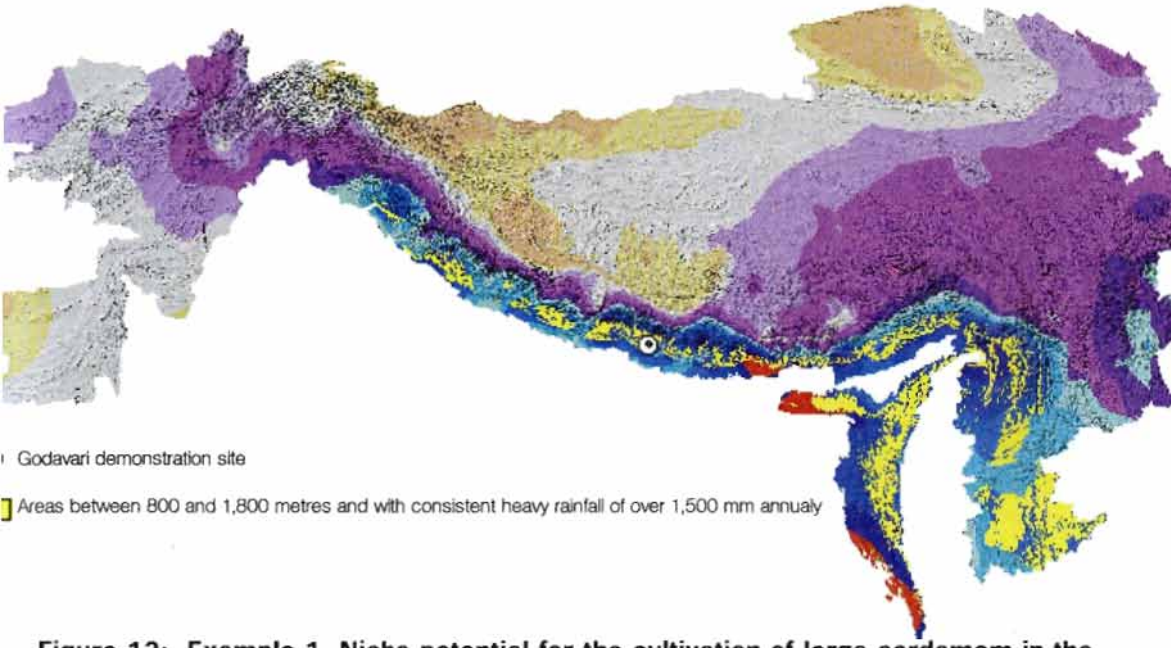



**Figure 12: Example 1. Niche potential for the cultivation of large cardamom in the Hindu Kush Himalayas. The gross estimate at the regional scale shows that 4.9% of the HKH may have conditions that are suitable. Local factors would be incorporated for a more comprehensive area estimate at a smaller scale.**

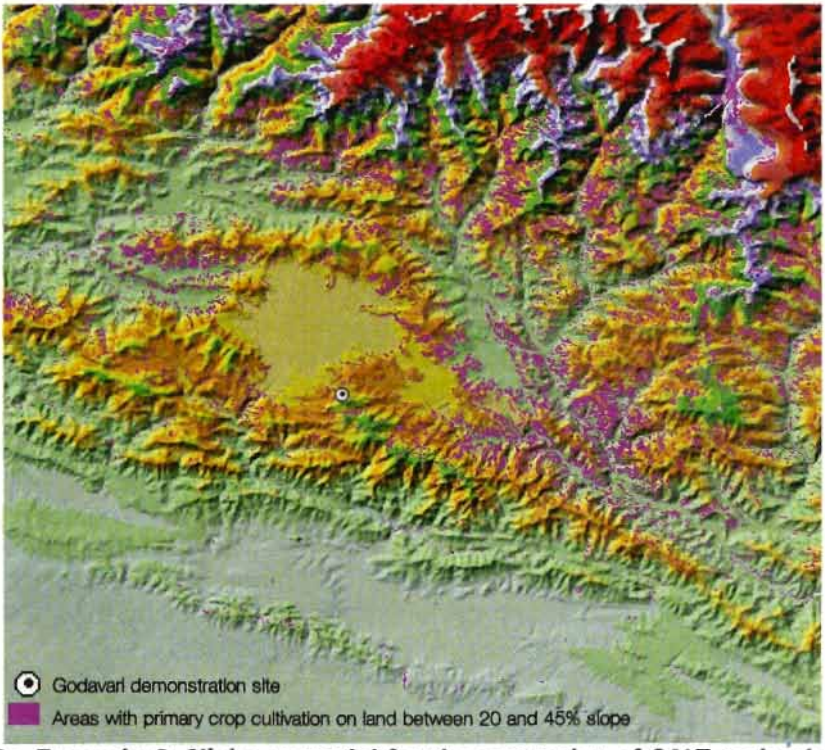



**Figure 13: Example 2. Niche potential for the promotion of SALT technology. Approximately 9.2% of the mid-hills area of Nepal could be suitable for promotion of SALT technology, as determined by slope and land use.**

Project at ICIMOD. Should such a collaboration continue, Dr. Lu foresaw that it should be possible to build an operational and locally based MASIF-China in the future.

**A Boon for Mountain Populations: Large Cardamom Farming in the Himalaya – *Dr. Eklabya Sharma***

**Dr. Eklabya Sharma** is a native of India, he is currently Division Head/Senior Agricultural Specialist Mountain Farming Systems at the International Centre for Integrated Mountain Development (ICIMOD). Dr. Sharma discussed an example where a local mountain niche was successfully exploited sustainably. Farming and tourism are the primary livelihood options for mountain people in the Hindu Kush-Himalayan region. In Sikkim more than 80% of the population is still dependent on agriculture and while efforts have been made to modernise the agriculture sector, these efforts have been only marginally successful. Economic forces have induced the farmers to switch to cash crops and the one crop which has been a real boon to the mountain people of this area has been the cultivation of large (black) cardamom. Large cardamom is a perennial cash crop grown beneath the forest cover on marginal land; it is a low volume crop that nevertheless has high economic value. Apart from its high-income value and the fact that it is not labour intensive, large cardamom is also a low-volume, non-perishable crop; this is an advantage in an area where accessibility and transport are restricted. By comparison with other cash crops, large cardamom is a low-input crop and nutrient loss from the system through agronomic yield is minimal, making it an excellent crop for this fragile ecosystem. Its cultivation is an example of how a local mountain niche can be exploited sustainably.

**Tour of ICIMOD's Godavari Trial and Demonstration Site – *Mr. Suraj Thapa***

The participants were invited to lunch and a tour of the site hosted by the site manager, **Mr. Suraj Thapa.** Mr. Thapa explained that the 30 hectare site was acquired by ICIMOD some 10 years ago. The main purpose of the site is to test and demonstrate various technologies for, and approaches to, sustainable mountain development which are appropriate in the Hindu Kush-Himalayan region. This site has many features that render it an excellent test site: the altitude ranges from 1,550m-1,800m, the slopes vary from 5 to 60 degrees, and the climate ranges from subtropical to warm temperate. The average rainfall is 2,000 mm and the mean annual temperature is 16.6 °C (-1.7°C min. and 33.9°C max.). The natural vegetation of this area was originally mixed deciduous and evergreen forest, but at the time it was acquired by ICIMOD the forest had been degraded by human intervention and consisted mainly of shrubs and severely lopped trees. Over the past ten years the site has been rehabilitated by ICIMOD to demonstrate viable options for the rehabilitation of degraded lands and sustainable mountain agriculture. The site also provides training facilities to improve the skills in and technical expertise on new and proven technologies and approaches to sustainable land use in the HKH. This site demonstrates some of the potential niche-based and mountain technological approaches that could be used at appropriate sites identified using the MASIF system.

**Discussion**

During the discussion session that followed, Dr. Sharma and Mr. Rotmans entertained questions on niche suitability for specific crops as suggested by the participants. The first example made use of the niche extrapolator function to determine potentially

**Figure 15: Large (black) cardamom based agroforestry system. Top right: *Alnus nepalensis* as a shade tree and large cardamom (*Amomum subulatum*) as an understorey crop. Top left: the large cardamom pseudo-stems (tillers) and inflorescence, clusters of flowers at the base that produce fruit capsules. Left: fruit capsules and seeds.**
*(Photos: E. Sharma; D. Maharjan)*

suitable areas for large cardamom cultivation in the HKH (Figure 13). The second example looked at potential locations for promotion of SALT technology in the mid-hills of Nepal (Figure 14).

## Session VI: Wrap-Up Session

### a) Managing Knowledge and Information for Mountains

*Chair: Dr. Roberto Quiroz (CIP)*

The wrap-up session started with two presentations on the use of specialised models in mountain decision-making. The session chair **Dr. Roberto Quiroz** (CIP) summarised the presentations.

#### The Role of Models and Tools in the Decision-Making Process – *Dr. Johan Bouma*

**Dr. Johan Bouma** set the tone for the talk to follow by discussing the role that models can have in helping to facilitate the dialogue between researchers and scientists. There often exists a large gap between what researchers find and what policy makers want to implement - models can help bridge the gap by putting relevant data into an understandable format, and thus help to facilitate dialogue. Dr. Bouma outlined the phases for problem resolution: 1) defining the problem, with the definition grounded in real problems as defined by stakeholders; 2) characterising the existing conditions to be used as a baseline for future evaluation; 3) modelling the problem, always gearing it to the real needs of the peoples concerned; 4) presenting, discussing, and amending of options possibly also to include tradeoffs and compromises; and 5) implementing. Dr. Bouma noted that in spite of the dialogue and the give and take one still finds in classic relations between scientists and policy-makers, there is still a huge gap between researchers' views and policy-makers' needs. How can the research community better communicate with policy makers? Scientists can no longer afford to ignore the needs of policy makers. Dr. Bouma was emphatic in saying that at some point the participants in the dialogue should also know their place and their limits. What is best done by scientists and researchers should be done by them and what is best done by policy makers should be done by them. An improved model of modern policy making would have the problems defined by the scientists (without help from policy-makers) and policy prepared jointly as learning between the two. The final decision-making should then be made mostly by policy-makers (with scientists at a distance) and finally during the evaluation phase scientists can again be useful as resource people and facilitators. The five essential steps would involve 1) data, 2) information (adding meaning to the data), 3) knowledge (what people do with the data once it is internalised, 4) wisdom (knowing when to use or not to use knowledge, and 5) inspiration – the wisdom at hand is so powerful as to elicit passion.

#### The Tradeoff Analysis Model: A Case Study – *Dr. Jetse J. Stoorvogel*

**Dr. Jetse J. Stoorvogel**, an Associate Professor at the Wageningen University Laboratory of Soil Science and Geology in The Netherlands discussed how Tradeoff Analysis (TOA) can help stakeholders to make informed decisions concerning the dual goals of agricultural production and safeguarding the environment. To what extent does agricultural production damage the environment? How do agricultural policies and new technologies affect relationships between agriculture and the environment?

Decision-makers often have to make choices between these goals based on limited information. TOA quantifies the relationship between key economic, social, health and environmental indicators. At the outset the decision is made not to summarise the performance of a system into a single indicator, e.g. cost-benefit analysis, but to look at all of them and evaluate the joint distribution process as tradeoffs. In this tradeoff process the steps can be seen as the following: 1) stakeholders define scenarios, 2) researchers do priority setting and identify sustainability criteria and formulate the hypothesis as tradeoffs, 3) project design and implementation, 4) trade off assessment, 5) feedback, and 6) communication of results.

Dr. Stoorvogel went on to discuss an actual case study where TOA was used to study the environmental impact of pesticide use in the potato-dairy pasture system in Carchi, Ecuador. In this area farmers already make heavy use of pesticides in potato production. Greater use of pesticides increases the economic value of potato production by reducing crop losses, but damages the environment. The two tradeoffs in this case are: pesticide groundwater contamination by leaching of several chemicals versus the value of potato and milk production, and neurobehavioral risk on human health versus the value of production. In studying this problem it was decided to set the scale at the centre of the scene; even though the problem is defined at the regional level, the action is at the plot level. Systems analysis tools were used to fill in data gaps and interdisciplinary research was used to quantify indicators. The scenarios and results of the tradeoff analysis were presented to the stakeholders as curves and maps and thresholds were used. In order to make the point more vividly to farmers, fluorescent materials were incorporated into the pesticide. The widespread contamination of even household items with pesticides was revealed by using a black lamp. One of the key findings of this research was that targeting the most toxic pesticides could create a win-win environmental-economic outcome: improvements in health resulting from decreased pesticide use can improve the labour and management capabilities of farmers which in turn can increase their incomes.

**Discussion**

During the discussions Dr. Rana asked that in the dialogue between scientists and policy makers the role of 'the man from the hills' and the farmer as stakeholder should not be forgotten. He also reminded the audience that ICIMOD is the only international institution that can speak for hill people and take their concerns to the international forum in the HKH region since most governments are staffed mainly by plains people. Dr. Stroud reminded the audience that in the dialogue between scientists and policy makers the process must of necessity be iterative. Impact usually comes from opportunities and researchers need to be atuned to look for windows of opportunity. Dr. Horton commented that it is most important to build local capacity in order to help in the interaction between policy makers, scientists, and development workers. Dr. Stoorvogel was asked whether the tradeoff assessment model was scale dependent. He replied that yes, it was and that in TOA it is necessary to look at spatial dependency as a function of scale. He went on to say that it is necessary to realise the need to obtain data in order to communicate with and to convince the local people.

## Session VI: Wrap-Up Session

### b) Discussion and Approval of the Recommendations

*Chair: Dr. Ann Stroud (AHI)*

The recommendations were developed and then discussed in a Plenary session. The final form agreed by all the participants, representing the three ecoregions – the Hindu Kush-Himalayas, the African Highlands and the Andes – is shown after the next section.