PREPARING FOR THE NEXT GENERATION OF WATERSHED MANAGEMENT PROGRAMMES AND PROJECTS

AFRICA

Proceedings of the African Regional Workshop

Nairobi, Kenya
8-10 October 2003

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Food and Agriculture Organization of the United Nations
Rome, 2005

PREFACE

On the occasion of the International Year of Mountains, and in response to the clear consensus reached by the international community regarding the need to ensure harmonious and sustainable development of mountainous areas and watersheds, the Food and Agriculture Organization of the United Nations (FAO) and its partners undertook a large-scale assessment and global review of the current status and future trends regarding knowledge about and techniques for integrated watershed management.

The objectives were to promote the exchange and dissemination of experiences of integrated watershed management techniques, identify constraints to the implementation and development of those techniques during the decade from 1990 to 2000 and capture relevant new paradigms and approaches. The lessons learned from diverse experiences are being used to define a new generation of integrated watershed management projects.

Experts from four continents contributed to the assessment, which yielded four main outputs: 1) a review of experiences in watershed management, based on questionnaires that were sent to active partners in the field; 2) substantive reports from four regional workshops held in Nairobi (Kenya), Kathmandu (Nepal), Arequipa (Peru) and Megève (France); 3) four case studies from the Mediterranean basin, Nepal, Bolivia and Burundi; and 4) an international conference in Porto Cervo, Sassari Province, Sardinia, Italy.

Watershed management concepts and approaches were reviewed, and different experiences assessed. The results of this exercise are presented in several documents, including the proceedings of workshops and reports on the four case studies.

The conservation, use and sustainable management of watershed resources in order to meet the demands of growing populations have been a high priority for many countries over the past several decades. In this respect, integrated watershed management through people's participation has become widely accepted as the approach that ensures sound sustainable natural resources management and a better economy for upland inhabitants, as well as people living in downstream areas.

The African Regional Workshop on Preparing the Next Generation of Watershed Management Programmes was co-hosted by FAO and the World Agroforestry Centre (ICRAF) at the centre's offices in Nairobi from 8 to 10 October 2003. The workshop brought together 42 researchers, educators, development experts, river basin managers and government officials responsible for agriculture, environment, lands and water from 13 African countries, the United Kingdom, the East African Community Secretariat, FAO and ICRAF. The workshop was organized around technical presentations, a field trip, working groups and plenary discussions. Plenary proceedings were simultaneously translated into French and English.

Several issues emerged as priority, consensus issues. These issues were highlighted in the workshop summary and in the presentation that was made at the International Conference in

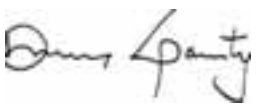
Sassari. The most important of them are poverty, governance, knowledge and information, and the need for enhanced capacity in integrated watershed management.

Levels of poverty are higher in Africa than in other regions of the world, and many African countries are experiencing increasing poverty. High absolute poverty has multiple impacts on watershed management – both resource users and governments have short time perspectives, there are fewer resources available for investment by resource users and governments, public investments are heavily dependent on donor priorities, and donors who put priority on poverty reduction are tending to underinvest in natural resource management.

Watershed governance in Africa needs to cope with the transactional nature of the region's water resources: most African countries share important river basins with other countries, and most important water sources are shared among two or more countries. On the positive side, many African countries have recently enacted new policies for water and environmental management and there are new commitments to regional harmonization of watershed management in many parts of Africa. Many challenges remain. There is still a compelling need to harmonize policies across countries, and to harmonize within-country policies across those sectors that relate to water and environmental management. In addition, there is an urgent need to develop the institutional capacity, financing mechanisms and enforcement mechanisms to implement fully those policies at the regional, national and local levels.

Integrated watershed management is constrained by large knowledge gaps about cause and effect relations in watersheds. These knowledge gaps are particularly large regarding the relations among trees, forests and key hydrologic phenomena, particularly large-scale phenomena such as floods and landslides. Even among those with good general knowledge of these relationships, there are very few data and very little information available to aid the work of management authorities.

Improvements in integrated watershed management in Africa will require substantial investments in capacity building and networking. There is a need to build the capacity of key institutions in Africa, with emphasis on developing tools in Africa that are appropriate for Africa. Systems for routine data collection and monitoring are in various states of repair across Africa. Improved networking among those involved in watershed management across the continent could help to exploit the considerable opportunities that exist for sharing concepts and lessons learned across Africa. Improved networking is needed among scientists of different disciplines, policy-makers and resource users, and among countries at different stages of institutional development.



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EDITOR'S NOTE

Materials prepared for (and during) the workshop are presented in this volume. This includes the 15 full text papers made available by the authors (Chapters 1 to 15), as well as the abstracts of all the communications that were presented at the workshop (Annex A). Given the variety of topics dealth with during the workshop, papers and abstracts were grouped in five parts as follows: FAO watershed management review (Part 1), links among land use, tree cover and water in Watersheds (Part 2), farming and watershed management in sub-Saharan Africa (Part 3), social factors in watershed management (Part 4), and African experiences in watershed management (Part 5). Group work findings and workshop conclusions are presented in Part 6. Additional information is presented in (Annexes B, C and D).

The African Regional Workshop on Preparing for the Next Generation of Watershed Management Programmes and Projects was largely an English-French bilingual event. Hence this publication includes a French section, in which this introduction, the abstracts and the workshop conclusions are presented.

ACKNOWLEDGEMENTS

The editors of this proceedings volume wish to acknowledge the many individuals and institutions that contributed to the workshop and this volume. The Government of the Netherlands provided financial support to FAO for this workshop and other activities undertaken during 2002/03 towards "preparing the next generation of watershed management programmes". Some of these funds were passed through to ICRAF, which handled administrative and logistical arrangements for the workshop. The European Union (EU) and the Danish International Development Agency (DANIDA) provided financial support to ICRAF through funds targeted for policy research in Africa. We also acknowledge the unstinting support and generous contributions of the senior managers of FAO and ICRAF to this collaborative effort. The Director-General of ICRAF, Dr Dennis Garrity, and the Director of the Forestry Resources Division of FAO, Dr El-Hadji Sène, welcomed the participants and made opening addresses to the workshop. The FAO representative to Kenya, Mr Bruce Isaacson, kindly participated in the opening session.

The workshop was a success because of the inputs of the 48 individuals who attended, including those who supported logistics, translation and travel. Those who gave presentations and submitted papers contributed valuable time before, during and after the workshop. Three individuals at ICRAF deserve special mention: Mahmouda Hamoud who facilitated the complicated travel arrangements, and Alex Awiti and David Mungai who organized an excellent field trip. Excellent translation services were provided by Clement Sopkor-Dufe, Jean Ngoma and Agbo Lawson.

The Government of Kenya supported this workshop in several ways. Government staff from several ministries, including the ministries and agencies responsible for agriculture, water, planning, lands and environmental management, attended the workshop and field trip. The Director-General of Kenya's National Environment Management Authority (NEMA), Prof. R.W. Michieka, made an introductory address. The Minister of Water Resources Management and Development, the Honourable Martha Karua, provided the opening speech, which was presented on her behalf by the Assistant Minister, the Honourable John Munyes. The Ministry of Agriculture and the Nairobi City Council helped to organize the field trip.

Beyond the workshop itself, several individuals contributed to this proceedings volume. We wish to acknowledge the facilitators, chairs and rapporteurs of the working groups, the authors of the papers (including those who were unable to attend the workshop), the individuals who reviewed technical papers, the copy editor (Ms Kris Vanhoutte) and those at FAO who helped to guide the production of the proceedings volume, particularly Dr Thomas Hofer.

ACRONYMS

AREX	agricultural research and extension services
Cap-Net	capacity building for integrated water resource management
CAPRI	Collective Action and Property Rights Programme
CASS	Centre for Applied Social Sciences
CEH	Centre for Ecology and Hydrology
CF	conservation farming
CFA	Communauté Financière Africaine
CGIAR	Consultative Group on International Agricultural Research
CIFOR	Center for International Forestry Research
CLUWRR	Centre for Land Use and Water Resources Research
CPR	common pool resources
CPRM	common property resource management
CWSA	Community Water and Sanitation Agency
DANIDA	Danish International Development Agency
DDF	District Development Fund
DFID	Department for International Development (United Kingdom)
EAC	East African Community
EAPI	Environment and Policy Institute
ECOWAS	Economic Community of West African States
EIA	environmental impact assessment
EPA	Environmental Protection Agency
EWR	ecological water requirements
FAO	Food and Agriculture Organization of the United Nations
FAWPIO	Forest and Water Policy – Improving Outcomes
FEM	Fonds pour l'Environnement Mondial (Global Environment Facility – GEF)
GIS	Geographic Information System
GPS	global positioning system
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
HOF	Hortonian overland flow
ICIMOD	International Centre for Integrated Mountain Development
ICRAF	World Agroforestry Centre (formerly the International Centre for Research in Agroforestry)
IES	Institute of Environmental Studies
IH	Institute of Hydrology
IIT	Indian Institute of Technology, Delhi
IRC	International Water and Sanitation Centre
IWMI	International Water Management Institute
IWRM	integrated water resource management
LWF	Lutheran World Federation
MDGs	Millennium Development Goals of the United Nations
NEMA	National Environment Management Authority
NEPAD	New Partnership for Africa's Development

NGO	non-governmental organization
NRI	Natural Resources Institute
NRM	natural resource management
ONG	organisation non gouvernementale
PRA	participatory rural appraisal
ROPPA	Le Réseau des Organisations Paysannes et de Producteurs de l'Afrique de l'Ouest (Network of Peasant Farmers' and Agricultural Producers' Organizations of West Africa)
SADC	Southern African Development Community
Sida	Swedish International Development Cooperation Agency
SIWI	Stockholm International Water Institute
SOF	saturated overland flow
SSA	sub-Saharan Africa
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme

INTRODUCTION

In 2002–2003, FAO led a global review of watershed management with the aim of reviewing the past generation of watershed management programmes and laying the foundations for the next generation. The review was initiated during the International Year of Mountains in 2002 and completed during the International Year of Freshwater in 2003. This process included several activities and involved a range of agencies and experts. The Forestry Department of FAO led the review, with inputs from other FAO divisions.

The objectives of the overall review were to:

1. review the state of watershed management programmes, policies and knowledge base;
2. identify key achievements and lessons learned during the last 15 years;
3. identify key gaps;
4. develop guidelines for the "next generation" of watershed management programmes.

Several research exercises and consultations were carried out in the framework of the review, including:

- a survey of key actors;
- case studies from four regions;
- a workshop with Consultative Group on International Agricultural Research (CGIAR) centres at the Integrated Natural Resource Management (INRM) Meeting in Aleppo, Syrian Arab Republic;
- a series of regional workshops in Europe, Asia, Latin America and Africa;
- a final global workshop in Sardinia, Italy.

The African regional watersheds workshop was co-hosted by FAO and the World Agroforestry Centre (ICRAF), with funding from the Government of the Netherlands. Workshop objectives focused on watershed management issues specific to the African continent.

THE AFRICAN WORKSHOP

The objectives of the African Regional Workshop on Preparing for the Next Generation of Watershed Management Programmes and Projects were to:

1. assess watershed management programmes and approaches in Africa by identifying and quantifying positive achievements, as well as perceived gaps;
2. review lessons learned and principal issues emerging from past experiences of watershed management in the African region, especially in the decade between 1990 and 2000;
3. identify guidelines for formulating and implementing the next generation of watershed management projects and programmes for Africa.

Participation in the workshop was by invitation. Individuals and institutions were identified by the conference organizers to represent: 1) all regions of the African continent; 2) French-speaking and English-speaking areas of Africa; 3) watershed management issues at multiple scales, from land use at the plot scale to transnational basins; 4) different categories of stakeholders such as international organizations, regional governments, national and local government agencies, elected politicians, water management authorities, non-governmental organizations (NGOs) and researchers; and 5) different disciplinary perspectives, from hydrology, sociology, economics, agriculture and engineering. A total of 48 participants, representing 13 countries and three international organizations attended the workshop. Several non-African experts also attended.[1]

The workshop was held from 8 to 10 October 2003 at the global headquarters of ICRAF. Participants were welcomed by the Director-General of ICRAF, Dr Dennis Garrity, the Director of the Forest Resources Division of FAO, Dr El-Hadji Sène, and the Director-General of the Kenya National Environment Management Authority (NEMA), Prof. R.W. Michieka. John Munyes, Assistant Minister for Water Resources Management and Development of the Republic of Kenya, opened officially the workshop, speaking on behalf of the Minister, the Honourable Martha Karua. Proceedings were held in both French and English, with simultaneous translation.[2]

The workshop was introduced by Moujahed Achouri who presented an overview of the global review. This was followed by a summary of initial findings by Larry Tennyson. Ian Calder discussed some common misconceptions in watershed management and advocated a more evidence-based approach. Jean-Marc Faurès spoke on the need to base watershed programmes on scientific evidence of land–water relationships.

Participants' presentations followed this introductory session. Presentations varied in geographical scope, from plot-level studies (i.e. Alain Albrecht on on-farm effect of agroforestry), watershed-level studies (i.e. Seef Rademeyer on South African watershed management policies), and transboundary watershed studies (i.e. Amadou Aiga's description of a regional-level approach to watershed management in Fouta Djallon highlands). Different disciplines were represented, including rural sociology (i.e. Jean Bonnal on participation and decentralization in watershed management). Development aid policies were also addressed: for instance, Gete Zeleke's presentation stressed the need for larger and more sustained support for natural resource management in Ethiopia, shifting away from short-term support for food aid and relief operations.

During the second day, additional presentations were given including Robert Hope on the Limpopo basin of South Africa, David Mungai on the central highlands of Kenya, Pusmane Diallo on the Niger River basin, Abdellah Zitan on the Upper Atlas Mountains, and Kwame Odame Ababio on the river basins of Ghana.

A field visit followed to Thika district mountains, where participants were Ministry of Agriculture local officers. The group witnessed erosion on steep hillsides and landslide areas,

1. Full contact information for the participants is provided in Annex D.
2. See Annex B for more details of the opening statements and Annex C for the full workshop programme

and visited the Ndakaini dam, which significantly contributes to Nairobi domestic water supply. While the water in the dam appears to be very clear and the catchment area relatively pristine, discussions showed that this water resource is threatened by uncoordinated land use in the catchment area. Major concerns about the use of the dam and its water resources have been raised by both local community groups and downstream companies, but have not been systematically addressed. This experience provided a chance for participants to learn about the on- and off-site challenges and conflicts that impinge on watershed management.

The technical discussions and field trip laid the groundwork for group work during the final day of the workshop. Working groups were convened around three topics. Group 1 considered upland–lowland linkages in watershed management. Group 2 considered the policy and institutional context for integrated watershed management. Group 3 considered implementation issues in watershed management. All groups were asked to consider achievements, gaps and directions for the future. Working group discussions were held in both French and English. Reports were prepared and presented to plenary after lunch. The workshop concluded with the presentation and discussion of a draft summary of the workshop proceedings.[3]

While workshop participants travelled back to their home bases in the days following the workshop, a final workshop summary was circulated by e-mail to all participants. A final summary was approved by participants before being presented at the global workshop that FAO convened in Sassari, Italy, less than two weeks after the Nairobi workshop. Final versions of the technical papers were prepared, reviewed, revised and finalized during 2004. This edited proceedings document includes some papers from individuals who were invited to the workshop, but who for various reasons were unable to attend.

OVERVIEW OF TECHNICAL PRESENTATIONS

Introductory papers by Moujahed Achouri (Chapter 1) and Larry Tennyson (Chapter 2) presented the international process of review and dialogue on watershed management that FAO initiated in 2002.

Tennyson (Chapter 2) presents summary results of the key actor survey, the review of FAO watershed experiences and the previous regional workshops. His paper ends with a table that summarizes the past scenario and provides directions for future watershed management programmes. Key lessons learned from this can be summarized as follows:

- In the past, watershed management has focused on the biophysical symptoms of watershed management: in the future, it should focus on the identification and treatment of the underlying causes of those problems.
- In the past, watershed management has given priority to the downstream impacts of upstream land use: in the future, at least equal priority should be given to the on-site costs and benefits of watershed management.

3. Workshop findings are presented in Part 6 of this publication.

- In the past, watershed management programmes assumed significant government capacity and a conducive policy environment: in the future, programmes should build necessary capacity and ensure appropriate policy changes.
- In the past, watershed management programmes had a top-down approach to technology development and transfer: in the future, there will be greater emphasis on participatory learning by multiple stakeholders.
- In the past, there has been a focus on the production of particular agricultural commodities: in the future, there will be more emphasis on combinations of land use that enhance rural livelihoods.
- In the past, the integrated watershed management approach has been grafted on to existing rural development projects and line ministries: in the future, multiple use of natural resources will be the starting point, with responsibility for particular issues given to appropriate lead institutes.

Presentations in Part 2 review evidence on the links among land use, tree cover and water in order to inform better watershed management. Faurès (Chapter 3) summarizes the results of a review undertaken by the Soil and Water Management Division of FAO of the biophysical links between land use and water. The review indicates that land use has a significant impact on water quality, particularly through pesticides, salinity and soluble nutrients. Land use can have measurable effects on the total availability and seasonal patterns of water in small watersheds, but in larger watersheds these effects are usually overwhelmed by spatial and temporal variation in intensity of rainfall, patterns of rainfall and runoff, soil type, and geography of parent material. Faurès further argued that environmental service mechanisms may be feasible for better linking upstream and downstream components of watersheds, but only when they are based on careful assessment and valuation of linkages and potential interventions.

Calder (Chapter 4) reviews evidence challenging some conventional wisdom, and laments the poor links between policy and science in integrated watershed management. Generalizations about tree–water relationships that are used to justify tree planting and water harvesting programmes are more often wrong than right, resulting in millions of dollars of wasted resources. What is needed is a site-specific understanding of these relationships, supported by empirical models that can easily be calibrated for new conditions.

The other presentations can be distinguished by their scale and scope of analysis, from analysis of institutions governing transnational river basins and watersheds (see Part 5), to the links between land use and water at the plot scale (see Part 2). At the broadest scale are the presentations by Amadou Maiga (abstracted in Annex A) and Ousmane Diallo (Chapter 15) on watershed management in the Fouta Djallon highlands and the Niger River basin. The importance and challenges of managing shared river basins were stressed throughout the conference. While there are some notable examples of effective transnational river basin agreements, for the most part, shared resources remain the least developed and most contentious water resources in the continent. Water resources such as Lake Chad and Lake Victoria have already suffered great damage. Maiga described a promising new approach to shared development of the transnational water resources of the Fouta Djallon highlands and Diallo described the challenges of shared management of the Niger River basin, one of the rivers that emanate from the Fouta Djallon. Governments need to commit themselves to doing much more and should commit to common institutions and laws.

Four papers deal with water resource management at the national level. Gete Zeleke (abstracted in Annex A) is concerned with Ethiopia, S. Rademeyer (Chapter 12) with South Africa, Kwame Odame-Ababio with Ghana (Chapter 13), and Hodson Makurira and Menard Mugumo with Zimbabwe (Chapter 14). These papers reflect the major differences that pertain across African countries. At one extreme, Rademeyer shows that South Africa has very limited water resources that it manages in a rigorous and sophisticated manner. Water storage capacity per capita is relatively high compared with other African countries; water management institutions are relatively sophisticated and all but one of the major river basins are interconnected. Water is considered to be a national resource, with each individual guaranteed a minimum amount for domestic and personal use. Significant amounts of human, financial and infrastructure resources are invested in water resource management and in the regulation of water use. Ghana has taken a similar approach, investing in large-scale water storage and a national system for water monitoring and management In 1998, Zimbabwe adopted a new water law that sought to reverse decades of discrimination in water allocation that had been built into previous water acts. The new law is designed to provide for more inclusive involvement of stakeholders in water management, greater efficiency in water use entitlements, water permits to replace water rights, catchment water use plans, and minimum allocations of water for the environment. Unfortunately, the new institutions require additional resources at the very time that both national and donor resources have become very restricted. Ethiopia appears to be an extreme case of undercapacity in water resource management (Zeleke, workshop communication). Although the country receives relatively plentiful rainfall, it has almost no water storage capacity and invests very little in water or watershed management. Ethiopia is very dependent on donor funds, which are directed much more to emergency relief than to long-term development and conservation of resources.

The presentations by Brent Swallow, Leah Onyango and Ruth Meinzen-Dick (Chapter 10), Robert Hope (abstracted in Annex A) and Nontokozo Nemarundwe (Chapter 11) focused on water resource and watershed management at the catchment and village scales; the scales at which social–hydrologic interactions are perhaps most evident. Swallow, Onyango and Meinzen-Dick develop a conceptual model of catchment property rights, and apply that model in an analysis of the effects of property rights on management and use of resources in the badly degraded Nyando basin in western Kenya. Four general implications can be drawn from their conceptual framework and analysis: 1) land tenure, settlement patterns, population density and land-use patterns are closely related by common historical processes; 2) land, water and tree rights are often closely intertwined in African cultures; 3) moderately sized catchments often contain a wide range of overlapping and possibly competing property rights; and 4) the parts of the landscape that have the greatest impact on overall catchment management – especially riverine areas, boundaries and roads – are often the most contested and have the most ambiguous property rights. Hope presented a model of blue–green water allocation and valuation, and applied that model to the Luvuvhu catchment in the Limpopo basin of southern Africa. His analysis relates people's livelihoods to the evaporation and transpiration of water (green water), noting that the relatively poor are particularly dependent on green water for generation of income and subsistence food production. Nemarundwe (abstracted in Annex A) described the flexible and overlapping institutions for water governance that pertain in a single village in Zimbabwe. This detailed village case study shows the diversity of both water resources and the institutional arrangements that exist within particular villages, which have rules that are well known to everyone in the village, but that are implicit, flexible and nuanced. Access to water resources is based on appropriate use, with the understanding of appropriate

use varying across water uses. This case study shows that many African villages have the capacity to develop sophisticated water management regimes, although the details of these regimes may not be transparent to outsiders who look for well-defined boundaries, codified rules and formal enforcement mechanisms.

Presentations by Jean Bonnal (Chapter 9) and Zitan Abdellah (abstracted in Annex A) focused on participation in watershed management. Adbellah describes the participatory approach that was taken to the development of sustainable agriculture in the Tassaout basin in the high Atlas Mountains of central Morocco. The pilot watershed management project put in place in Tassaout between 1996 and 2002 achieved a high level of success owing to the novel way in which it was implemented with the following features: 1) taking account of both hydrologic and ethnic considerations in defining the areas of implementation; 2) recruitment of a local team of organizers who were not overly constrained by existing administrative structures; 3) emphasis on novel approaches to agricultural practices that would conserve soil and water; and 4) a new spirit of cooperation between forestry administration and the local population. Bonnal analysed the socio-political context for participation in watershed management. Decentralization and devolution of authority are necessary for real increases in local participation: decentralization in turn requires attention to institutional and organizational issues within the context of the local political environment. For watershed management best to address local, regional and international concerns, three things are required: 1) sharing of information; 2) strengthened capacity in local organizations; and 3) stronger dialogue between local and national organizations.

Three papers deal with interactions between dryland agriculture and watershed resource management. F.T. Mugabe (Chapter 6) focuses on the effects of land use and land management on groundwater and reservoir recharge in the Romwe catchment in semi-arid southern Zimbabwe. Analysis of detailed data collected throughout the catchment over the last ten years shows that land management has large effects on both groundwater recharge and surface runoff. Groundwater recharge is highly variable across space and time, with most recharge associated with particular rainfall events in parts of the landscape where surface water accumulates, especially above contour ridges and along surface drains. The amount of runoff generated during storms is affected by cultivation, which increases infiltration and reduces runoff. Anja Boye and Alain Albrecht (Chapter 5) described the effects of agroforestry and conservation farming techniques on infiltration and runoff in the farming systems of western Kenya. Experimental results indicate that improved fallows can increase infiltration and reduce soil loss significantly, with the amounts and the statistical significance depending on the soil type. The no-tillage option had surprisingly little impact on infiltration and soil loss. Johan Rockström and Kurt Steiner (Chapter 7) focused on the technical innovation of conservation farming and its ability to increase the availability and productive use of water in agriculture. Trials in semi-arid parts of the United Republic of Tanzania, Madagascar and the Sudan show that conservation farming can generate large increases in agricultural production and water use efficiency. Production and efficiency effects are largest, however, when conservation farming is combined with soil fertility interventions. This supports the conclusion that soil fertility and water conservation are complementary techniques that have the potential to increase drastically both agricultural production and water use efficiency in semi-arid Africa. P. Mbile *et al.* (Chapter 8) explore the links between watershed function and the structure of cocoa agroforests in a humid part of Cameroon. Survey evidence from 30 cocoa agroforests suggests that the cocoa farms now contain large numbers of indigenous trees that provide little direct

economic value, but have significant value in terms of biodiversity conservation, rainfall interception and infiltration. The authors hypothesize that many of these trees will be removed as farmers seek to diversify away from cocoa. These changes are likely to have significant effects on water balances and watershed function.

THESE PROCEEDINGS

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