SKAT

Swiss Centre for Development Cooperation
in Technology and Management

Less Water For More People

Report on the 13th AGUASAN Workshop
23-27 June, 1997

Bruno Strebel

Less Water for More People

The most pressing global challenge

Proceedings of 13th Aguasan Workshop in Gersau, Switzerland 23-27 June 1997

Paper 1: Proceedings

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1. Personal Foreword by the Rapporteur

1.1 The Workshop as an Open and Innovative Learning Laboratory

The **AGUASAN Workshops are well-known events** among the Swiss institutions and experts involved in international development cooperation and their partners. They are known for their constant and valuable contributions towards the **shaping of strategies and concepts** regarding Water and Sanitation. The AGAUASAN Workshops have become an institution and play an important role in learning and gaining new insights as well as in creating strategy consensus among the experts who have to define Water and Sanitation policies within Swiss development cooperation.

Being a geographer with broad experience in development cooperation, but not an engineer, and participating for the first time in an AGUASAN Workshop, I noticed some characteristics (on the basis of my personal perception), which are worth to be mentioned:

a) I was greatly surprised about the open, **integral and transdisciplinary views of the engineers** during the event. This openness to social, psychological, administrative, economical and environmental aspects of sustained development cooperation went so far that any discussion on technical aspects was apparently avoided on purpose. This is very unusual for engineers and needs to be acknowledged with respect.

b) The participants mostly knew each other personally and had already participated several times in AGUASAN Workshops. This fact created a **constructive working atmosphere** and facilitated a common understanding on what can be expected from the event.

c) I consider the workshop as an intensive and learner-friendly exercise. Participants will surely not forget the insights gained and remember the different opinions and arguments they heard. The theme «*Less Water for More People*» gave the opportunity to gain intensive **experience with complexity**. This global issue (global in the meaning of general as well as world-wide) did not allow, by the nature of the topic, either to tackle practical aspects, to develop conceptual tools or to provide practical guidelines. However, we gained three major insights: Firstly, the limits of the planning and conducting exercises became clearly visible. Secondly, we realised that development cooperation alone cannot solve the global water crisis. Thirdly, the team's insight into the need for pressure (i.e. the need for good legislation and law enforcement) relativizes the obvious need for broad participation (people's participation as widely demanded by the Agenda 21 of the Rio Summit).

1.2 How to Use this Report

With the aim to write both **brief and useful references** of the workshop, and not to produce a bulky report, just good enough to collect dust on the bookshelf, I faced the difficulty of selecting the most important issues for the participants to digest the workshop. I tried to apply an **optimal ignorance**. The report is divided into three different papers of rather independent nature:

1) Paper 1 *Workshop Proceedings* is a brief **description of what happened** during the workshop. This shall give the participants a simple review frame. In addition, under chapter 4 *(Water Management on Village Level)* more detailed information on the message of the Indian case study is provided. In chapter 5 *(Special Insights and Lessons Learnt)* we tried to summarise and interpret some aspects perceived as specially important and useful in practical development work. This chapter focusses on the Kenyan case study.

2) Paper 2 consists of 8 annexes and provides a **bulk of more detailed information** which can be read selectively. Annex 1 *Workshop Programme* serves as a kind of guideline through this report (see references) and facilitates its utilisation. The two presented principal case studies are presented in annex 4, respectively in annex 5.

3) Paper 3, the **Information Bonanza**, provides additional information to the reader with special interests. It is a collection of papers either elaborated by participants for or during the workshop, or a complement to a given theme.

I hope very much that you will find these proceedings useful. I thank you for your interest and hope to see you again.

Bruno Strebel
Bio-Geographer

P.S. In addition to the above, the participants of the AGUASAN Workshop 97 will also receive a paper with photo impressions.

2. Workshop Proceedings at a Glance

2.1 Objectives and Course of the Workshop

The **13th Aguasan Workshop** took place in Gersau, on the shore of the lake Lucerne, and was held from 23 tol 27 June 1997. The 29 men and 3 women participating (list of participants see annex 2) shared experiences on how to deal with the complexity of the issue and how to tackle and avoid conflicts around global water scarcity in the field of international development cooperation.

AGUASAN is an interdisciplinary work group for water and sanitation development. Individual members belong to several Swiss development and development research organisations, including the Swiss Agency for Development and Cooperation (SDC), Water and Sanitation in Developing Countries (SANDEC), HELVETAS and Swiss Centre for Development Co-operation in Technology and Management (SKAT). Since its formation in 1984, AGUASAN has held annual summer workshops in Gersau, bringing together project field staff, desk officers, researchers, experts and consultants for a week of exchange and reflection on selected development issues. As per tradition of the AGUASAN Workshops, the fostering of a mutual learning experience was clearly the main intention, sensitising technicians on non-technical aspects of water and sanitation development. Besides this major goal, the workshops also aim at utilising the broad and multi-faceted knowledge and experience available within the team, by mutually elaborating strategies and conceptual tools which will be of practical use in development cooperation. A list of the previous workshops is provided in annex 6.

The central theme of the 13th workshop was the global water crisis (with the title: Less Water for More People) and covered a very **broad, complex and global topic**. The objectives of the event were:

a) the exchange of experiences during group sessions and informal talks;

b) a better understanding of the system of water use and water management; and

c) the learning about appropriate approaches and measures which contribute towards a sustainable use of water.

The workshop consisted of a sequence of individual **presentations**, lectures by the resource persons, role play **performances** and of **group work** and presentation of their findings. A detailed programme is given in annex 1. Even though Baumgartner Ruedi, Wiesmann Urs, Jagannath N.R., Kiteme B.P. and Wacker Corinne acted as major resource persons, all participants, beside being passive learners, also actively played the role of teachers and providers of information, whenever time and situation permitted. The event was designed (often with necessary ad hoc corrections) and implemented under the skilful moderation of Zellweger Tonino.

2.2 Elaborated and Presented Case Studies

As food for thought and to initiate discussions and relate them to practical issues, the following case studies were presented:

2.2.1 **Case study India: Water Management on Village Level - From Rio to CR Palli** (a village in South India). The contributions under this title addressed the challenge of translating salient recommendations of the Agenda 21 of the Rio Summit, concerning participative water management, into the ground realities of villages in the semi-arid tracts of South India. For that purpose field experiences from two projects dealing with implementation and research were introduced:

(a) Watershed Development in the context of the Indo-Swiss Development Collaboration: The focus was on the PIDOW (Participatory Integrated Development of Watershed Development) Project as a pilot undertaking for participative and integrated development of watersheds in semi-arid areas of India, with special emphasis on achievements and shortcomings and the question of scaling up (see Annex 4.2).

(b) Collaborative Research on "Rural Livelihood and Natural Resource Management", financed by the Swiss National Science Foundation: This contribution addressed the problem of conflicting perceptions of water management on village level and the consequences for planned external development interventions, illustrated by the case of CR Palli in Andra Pradesh. It also invited the participants to apply a reference frame for the understanding of inner and outer dimensions of livelihood systems and their interaction with natural resources (see Annex 4.1).

Both cases were presented by N.R. Jagannath and Ruedi Baumgartner.

2.2.2 **Laikipia Research Programme** in the Laikipia District in the highland-lowland system of Mount Kenya in **Kenya**, East-Africa. This research and training programme is associated with a variety of watershed development activities of the Kenyan Government and local NGOs, supported by SDC. Major emphasis was given to the importance and the limits of bottom-up participatory planning. It became evident that accompanied research, embedded in communicative action, can greatly contribute towards the improvement of a situation by achieving a high level of wide acceptance among the various stakeholders.

The programme and its framework were presented by Boniface Peter Kiteme and Urs Wiesmann. The programme is described in annex 5 (annex 5.1 describes the programme, annex 5.2 describes the problem context and 5.3 deals with conceptual considerations).

2.2.3 **Sustainable management of alpine pasture land** in the Canton of Uri, Switzerland: This case was introduced by Ruedi Baumgartner to illustrate the relationship between system boundaries and sustainable use of natural resources and to emphasise the role of institution building. No additional information is provided in this report.

2.2.4 **Additional contributions** were presented by resource persons and participants:

- Play for Groups of Four on development of water scarcity, by Corinne Wacker;
- Rainwater harvesting techniques in Kenya, video presented by Hans Hartung;
- Ecological conditions of highlands in Cameroon, by Humphrey Tah;
- Water in Bangladesh, by S.M.A. Rashid;
- Excursion to the municipality of Geuensee and contact with strategies to reduce costs for wastewater treatment, by Martin Fritsch and Pius Stadelmann.

Paper 3, the Information Bonanza, gives the outlines of these individual presentations.

2.3 Group Work and Final Evaluation

Besides the above rather informative and instructive presentations, the following **group work** was done:

- Elaboration of Conflict Solving Strategies (see figures 3, 4 + 5)
- Role Play of four interest groups (Pesi river conflict, photo-page fig. 8)
- Group work on water potentials, on priority setting and suitable approaches
- Group discussion on programming aspects of watershed projects (pace setting, monitoring and role of NGOs)
- Editors' work producing the front page of Watershed News (as a group work to reflect on highlights and insights of workshop 13/97; annex 8).

The review and **evaluation of the workshop** on the last day of the event revealed that the participants considered the happening as a very fruitful learning exercise. Especially the friendly working atmosphere, the quality of the lectures and the design (and moderation) of the event were appreciated. However, the participants also realised that the complexity of the issue did not allow to enter into the elaboration of conceptual tools of practical relevance. In this respect, the workshop 13/97 could not fulfil all expectations. In addition, some persons would have preferred less lectures and more group work.

Annex 8 (of paper 2) with the 10 produced title pages of the **Watershed News** (editorial group work on the last day) **provides additional information on what the participants perceived as insights** and lessons learnt during the workshop.

3. The Global Challenge of Water Scarcity

During the introduction speeches both Karl Wehrle and Armon Hartmann emphasised the fact that today water is the **most endangered and over-utilised natural resource** of the world and that during the coming decades a growing number of people and countries will face acute water shortages. This alarming issue is visualised in figure 1.

In numerical data, the water scarcity trend can be described as follows:

year	number of countries	million people facing water scarcity
1950	12	20
1990	26	300
2050	65	7'000

The **magnitude and universality of the problem** obviously require corrective action at all levels of potential intervention and call for innovative and goal oriented approaches. Some additional information on water scarcity is provided in Information Bonanza (Paper 3): C on existing water networks and D on Water - a Commodity in Short Supply, by J.B. Zehner. Annex 4 recommends some further readings regarding the topic.

4. Water Management on Village Level - From Rio to CR Palli!

This chapter summarizes the discussions held by the participants on the findings regarding the rural livelihood system research in the village of CR Palli in South India. It shows that the perception of reality varies from person to person, from culture to culture and from institution to institution. It draws the attention of the reader to the fact that individual perceptions have to be taken account of in development planning and that the human factor plays a key role in any development intervention. This chapter is a contribution written by Ruedi Baumgartner.

4.1 Purpose and Context of the Case

The sustainable management of natural resources requires an active and responsible involvement of the users/actors concerned. Chapter 18 of one of the key documents of the Rio conference, the Agenda 21, on the protection of the quality and supply of freshwater resources therefore states among other points:

"Design, implement and evaluate projects and programmes that are both economically efficient and socially appropriate within clearly defined strategies, based on an approach of full public participation, including that of women, youth, indigenous people, local communities, in water management policy-making and decision-making."

Collective action of the above type must therefore take into account a commonly shared perception of the concerned actors of what a sustainable use of water resources means and what it requires. However, conflicting perceptions in this regard among such actors are rather the rule than the exception. To ignore this fact in development collaboration can defeat the very goal of development collaboration towards a more sustainable use of natural resources.

The present contribution evolves around a case of conflicting perceptions on village-based water resources and invites the workshop participants to mobilise their experience and creative thinking for dealing with such a situation. The case is drawn from a research project focusing on "Rural livelihood systems and natural resources management in semi-arid India" (see annex 4).

4.2 Different Perceptions of the Deterioration of a Village Tank

The following paragraph tries to answer the question: How much shared reality is needed among the actors to promote a sustainable use of natural resources?

The village tank of CR Palli which has been the essential source of irrigation of the wetlands of the village for centuries, has gradually silted up and therefore cannot fulfil its purpose anymore. Any development interaction in such a case should start with the following key questions:

Why does an essential water resource deteriorate?

How does the concerned village population explain and interpret such a process?

On the basis of interviews with the village population followed by an organised research feedback to the same audience, four different answers were given on this development. They are summarised **in the form of four conflicting perceptions concerning the reasons for the decay:**

Version I: The tank has not been desilted because

- the silt nowadays consists of sand instead of organic matter
- nobody is organising the desilting
- of neglect by the government
- of lack of draft power
- of more attractive options to fertilise fields with subsidised chemical fertiliser

Version II: The tank is not getting enough water anymore, because

- there is less rain than before
- the forest department has neglected the catchment
- the drainage channels for the protection of encroached fields on the foothills divert the water from the tank

Version III: Tank management is not attractive anymore because

- borewells are a more reliable source for irrigation
- electricity for running pumps is free of costs

Version IV: The tank is just an example of the increasing neglect of natural resources due to

- loss of power of the traditional village leadership
- changing priorities of a changing leadership under multiparty rule

Figure 2 **(photo of the tank and the surroundings at CR Palli, after heavy rainfall)**

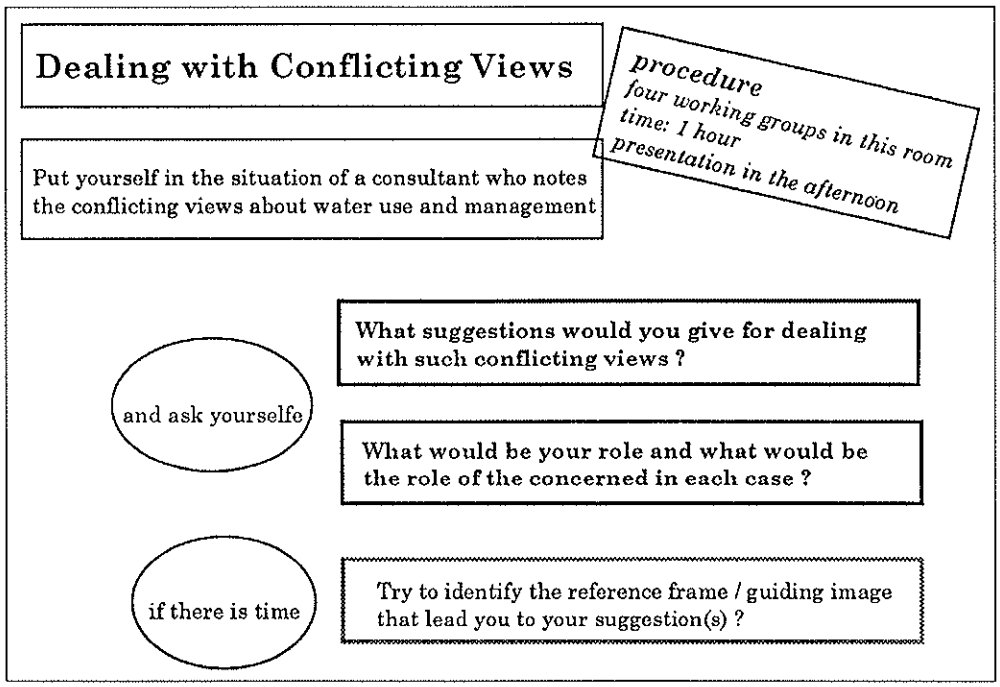
4.3 Group Work in Dealing with Conflicting Views

How to deal with conflicting perceptions regarding the state of a water resource?

And how to reconcile realities at village level with the request to follow clear-cut principles of participative water management as outlined in the Agenda 21 of the Rio Summit ?

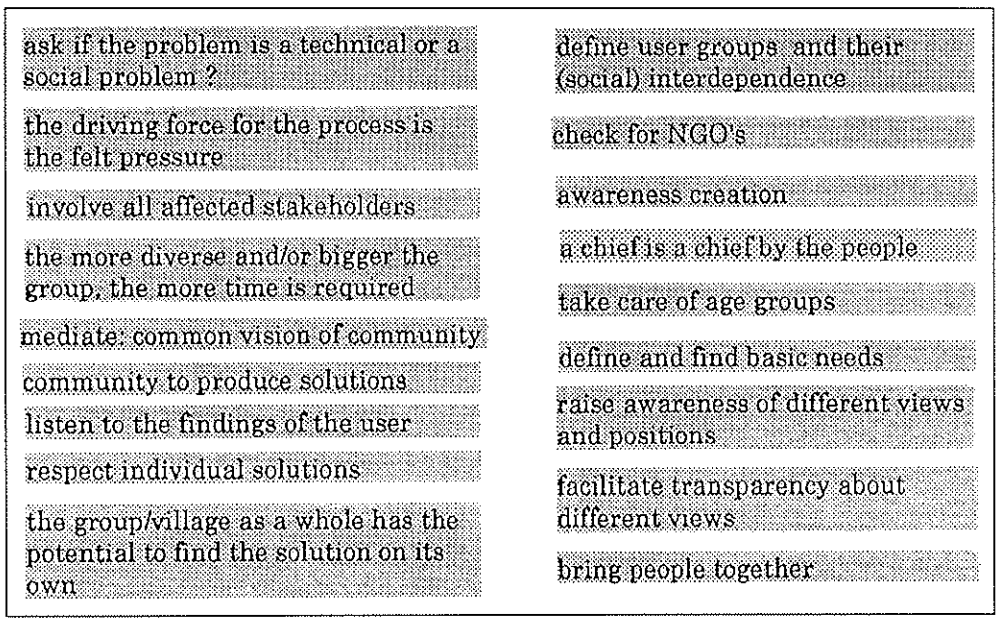
The following task was given to the groups (see figure 3):

Figure 3



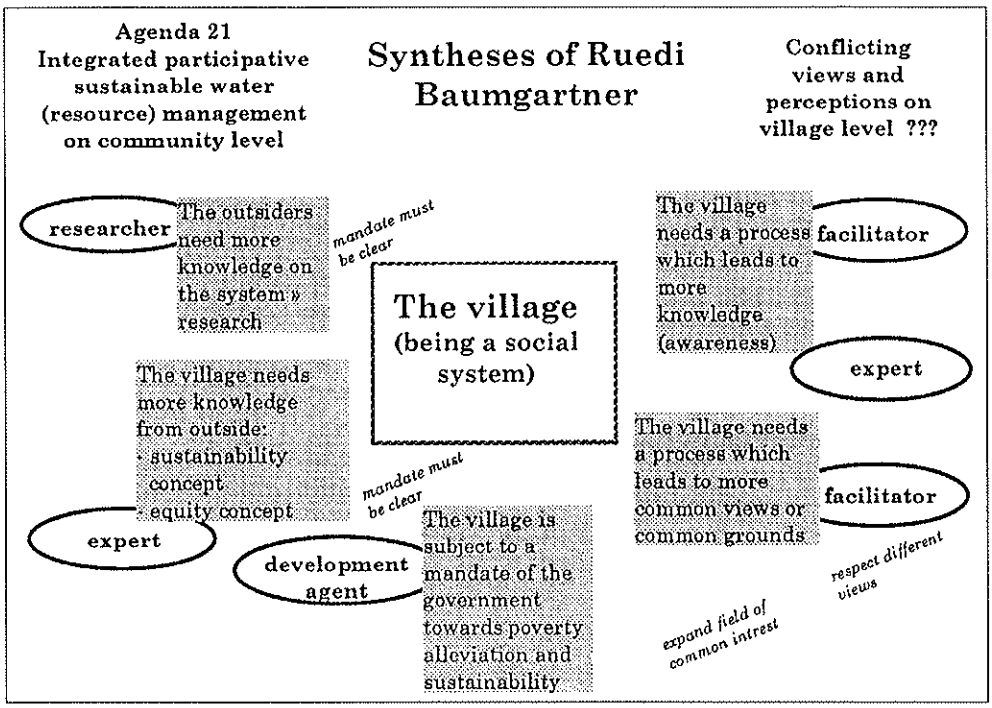
The groups of the workshop elaborated the following key statements (see figure 4):

Figure 4



The following chart (figure 5) represents an effort to synthesise the presentations of the results of the group work under the aspect of roles and options open to an outside intervention at the initial stage of an envisaged resource rehabilitation:

Figure 5



4.4 Livelihood Systems and Eco-Histories of Natural Resources

A short description of two approaches illustrating how the research project on Rural Livelihood Systems and Natural Resources Management attempts to analyse the development situations of the above type:

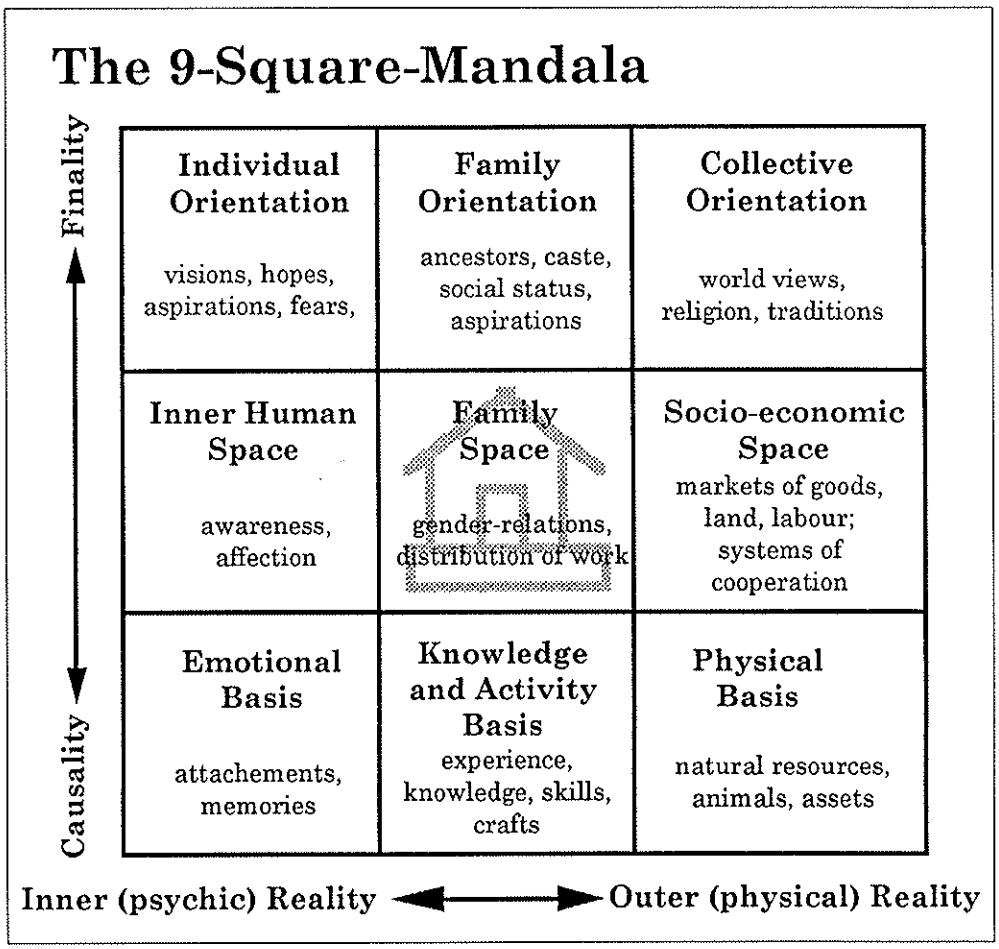
4.4.1 Livelihood Systems and Sustainable Management of Natural Resources

In rural development we are used to define sustainability with the focus on a given resource, i.e. we try to identify the conditions necessary for a sustained use of a specific resource in a given ecosystem. Yet development interaction with farm households and communities are confronted with a wider concept of sustainability. We have to realise that farm households are primarily interested in sustainable livelihood - in "keeping the household going". The local expression "Ghar Chalava" in one of the villages of our field research expresses in words the concept of sustainable livelihood. For "keeping the household going" they have developed context-specific livelihood strategies to meet physical, social and spiritual needs and they adapt their strategies with more or less success to changing socioeconomic, political and ecological circumstances. The result is that people use natural resources according to their perception of the role of these resources in their livelihood and their contribution to its sustainability. We can assume that development assistance is assessed along these lines.

Development interventions aiming at a more sustainable use of natural resources are thus interfering with an inner and outer rationality of a livelihood system, governed by a strategy aiming at sustained life of a given social unit, a community, a clan or a family. In such a case we may consider resources as an element of a family universe. How to capture such a holistic perspective of family-centred livelihood systems? How to develop a reference frame for a livelihood system which is accepted as a means of communication by the concerned people?

One of our research colleagues, Ruedi Högger, suggested to work with the nine squared mandala as an ancient and archetypal symbol of a holistic world view[1]. The adaptation as a reference frame for conceptualising livelihood systems has meanwhile taken the following shape:

Figure 6



[1] Högger R., The Family Universe, Towards a Practical Concept of Rural Livelihood Systems, A Working paper, Nov. 94

How to work with the Mandala?

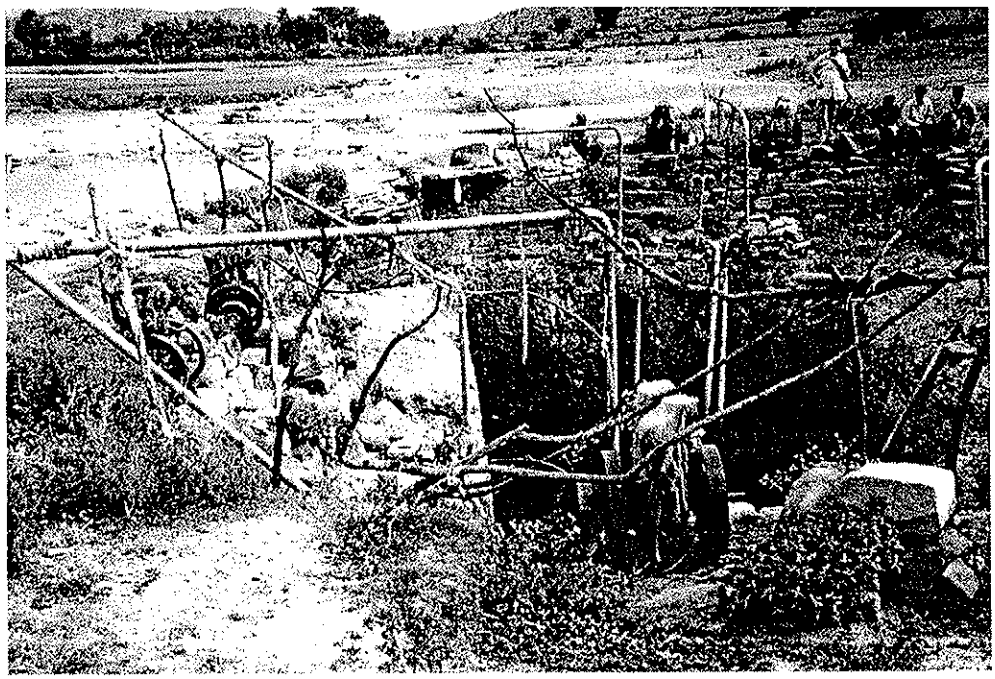
It invites us to perceive the management of natural resources - as e.g. the tank in CR Palli - in the context of a livelihood system and to see in such a resource more than just an element of the physical basis of the village economy. Impacts on tank management may result from changes in the "socioeconomic space", e.g. the role of administrative integration of this resource into the public works department, or we may find important clues in the square of the "collective orientation". It can contribute to the understanding of changing village leadership by comparing the livelihood systems of traditional leaders, belonging to the dominant caste, with emerging leaders from democratic election procedures. And finally it makes us aware of inner psychic realities of livelihood and brings us closer to the meaning of "keeping the household going".

4.4.2 Eco-Histories of Natural Resources

While the mandala provides an orientation in space, the "eco-history" adds the dimension of time. Again seen from the specific perspective of the concerned actors, it focuses on the actors' perceptions of change in the state and the use of the resource. The example used in the presentation showed the shift from irrigation with surface water, compounded in a tank, to the tapping of ground water.

For the outside observer such a change emerges as an illustrative example of a shift from managing water as a common property to treating it as an open access resource. The following photo showing a well in the middle of the tank, tapped by a dozen diesel pumpsets, illustrates such a change.

Figure 7 (tank and diesel pumps, CR-Palli)



5. Special Insights and Lessons Learnt

The following three sub-chapters summarise and interpret some selected insights gained during of the workshop. The contents of the three sub-chapters group human behaviour and public participation in action to overcome water scarcity.

5.1 Dealing with Complexity and Conflicting Views

It soon became clear to all participants that watershed management and sustainable use of water resources are dealing with complexity and conflicting views. It will therefore be important to realise

a) that the existence of a problem does not necessarily imply the existence of an (immediate) solution; and

b) that processes of behavioural transformation (involving also changes in values and believes) require sufficient time.

In addition to these insights (and emotional experiences, e.g. during the role play Pesi river conflicts), the workshop also enabled us to reflect on the importance to fully (or at least better) understand complexity. The question of how much research and rational analyses is required to optimise development intervention could not be dealt with during the workshop, even though the two case studies presented focussed more on research than on implementation. In this context, it is also interesting to note that during the group work "Elaboration of Conflict-Solving Strategies" two groups proposed a more thorough analysis of the situation, while two other groups, representing a different school of thinking, proposed more pragmatic approaches (with in-built regulation by the system itself). The statement "watershed management is political work" was also heard.

Obviously there are many ways to approach a goal. It seems however less important which approach is chosen than how a chosen approach is followed with sufficient sensitivity, transparency and consistency. The optimal ignorance regarding special features varies from person to person and from situation to situation. Successful dealing with complexity, however, requires sufficient distance from details and the consideration of spatial and time-dynamic interdependencies. The principles of how the system works, need to be understood and the human factor in the play requires due consideration.

5.2 The Pesi River Water Conflict

The example of the Pesi river water conflict from the Laikipia case study had an important function during the entire workshop, and made all participants aware that conflicts on scarce resources, such as water, can easily turn into a fight of mere survival.

5.2.1 Set-Up and Conflicting Parties

The Pesi river with a perennial flow in the upper catchment drains into the dry savannah lowlands, where its discharge feeds swamps, and finally evaporates during the dry season. Four numerous and constantly growing groups of human population and a great variety of wildlife depend on Pesi river water. In the upper catchment, horticulturists (PTY-Ltd. cash crop producers in our case) use water for irrigation. Some miles downstream, a large-scale settlement scheme (with the Marua, a low level community organisation, the legal settlers) uses river water for the irrigation of newly reclaimed land. The Samuru, the traditional pastoral people, live further downstream and face water shortages due to the heavy offtake in the upstream areas. Their grazing ground is being constantly reduced due to the expansion of the Marua settlements. The wildlife, especially herds of elephants, face similar shortages and migrate to the water source, destroying at the same time the crop fields of the Marua settlers. The pressure on the land close to the water source constantly increases. Every stakeholders action contributes (directly or indirectly) to a further overutilisation of Pesi river water. Thus a vicious circle develops. Subsequently, a variety of conflicts among the different groups arise. The Government tries to solve the tense situation. The Water Resource Assessment Group (WRAG) proposes some solutions. The District Commissioner calls for a meeting. On this background, the workshop participants performed in four groups a role play of the conflict solving meeting.

5.2.2 Insights from the Role Play

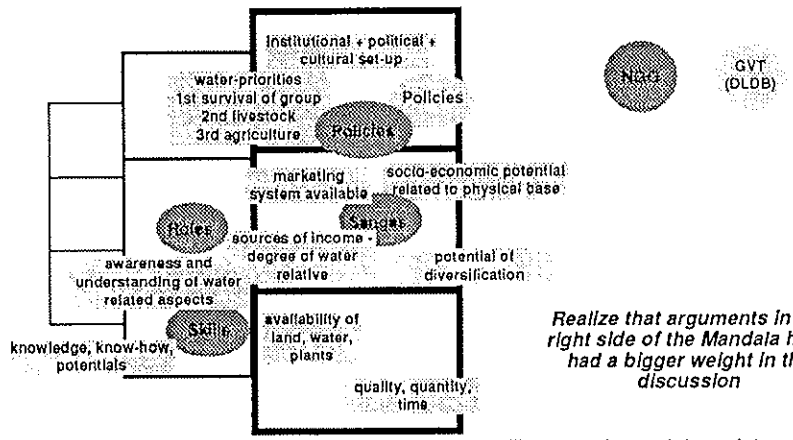
The photo page (figure 8) shows the four parties involved in the conflict and describes briefly the different positions. The role play performed by all participants allowed them to gain both rational – and what is more important - emotional experiences of being a party in a conflict of survival, which is hard or even impossible to solve. It also allowed to experience the uneven power of different arguments used in discussions.

5.2.3 Testing of the 9 Square Mandala

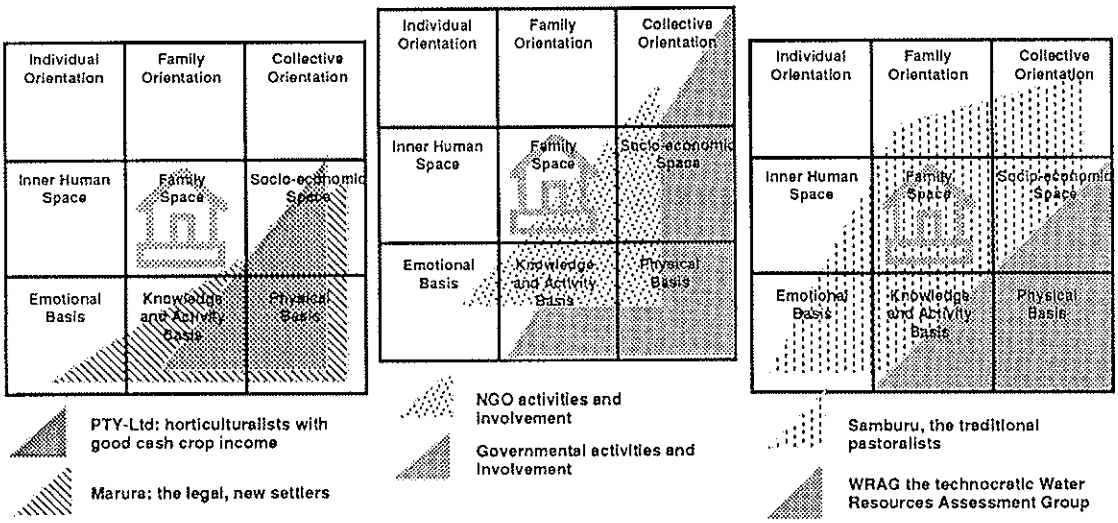
After the role play, the 9 Square Mandala (see figure 6) was tested again as a reference frame, to reflect on the weight of the various arguments which had been put forward. The following figure 8 shows an interpretation of the outcome of that discussion. It allows a better understanding or rather a better feeling of the complexity of people's behaviour. It hints that in modern (or Western) society the physical reality and causality, i.e. the right side of the Mandala, catches much more attention than the psychic reality. This stands in a certain contrast to the argumentation of more traditional societies such as the Samburu, who say (more honestly?) that they have a greater balance between the individual or family orientation and the physical or knowledge basis.

Figure 9

Example of Mandala application during the Role Play on Pesi River Conflict



Above figure is a visual conversion of the 9-Square-Mandala to illustrate the weights of the arguments forwarded in the discussion at DC's office. Note that the centric Mandala vision is often distorted by putting emphasis on physical reality and by superseding the inner reality of human behavior.



Above figure with three different mandalas visualises the different positions of the arguments forwarded during the role play and the subsequent discussions. It purposely avoids the listing of the contents of the arguments and depicts only the fields of the mandala touched within the different argumentations. The outcome of the role play has shown: it's efficient to argue with the right arguments! However, is the right side of the mandala realy the right side?

The exposition and discussion of the Pesi river conflict also clearly revealed the need of proper legislation. This topic leads us to the content of chapter 5.3.

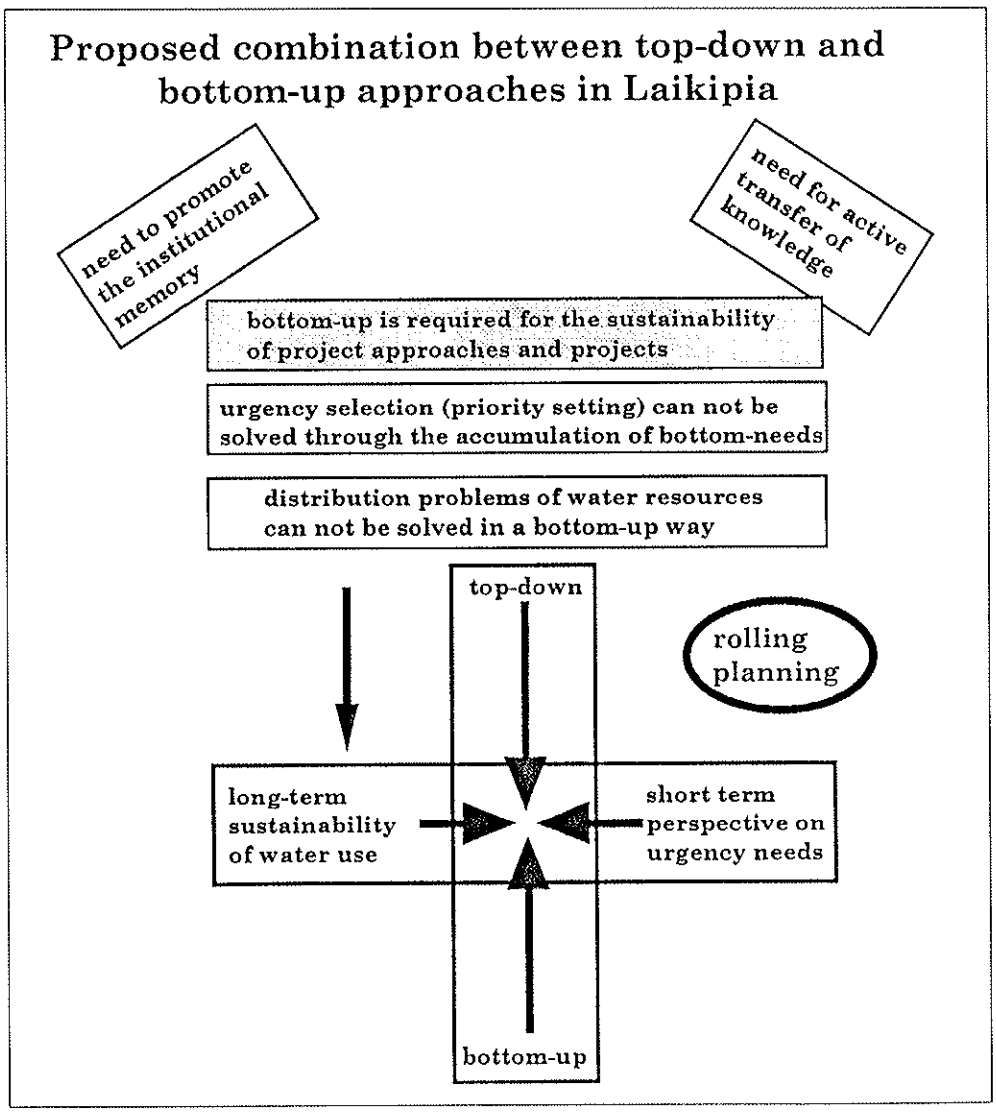
5.3 Nothing Works Without Pressure versus Full Public Participation

The disillusioning results of international development cooperation during the '70s and the '80s forced development organisations and governments to identify full public participation as a new strategy to increase the effectivity of development interventions. Within many organisations (e.g. World Bank, UN net-

work) and countries a real policy shift took place. People's' participation in decision-making, implementation and evaluation of programmes has become, at least verbally, a common feature of any project design. This positive trend, however, should not lead to an underestimation of the importance of a proper legislation. The aiming at the sustainable use of limited resources such as e.g. land, biomass or water, requires that the different stakeholders obey a minimum of binding rules, which in today's world need to be a part of the formal legislation. Scarce resources such as water cannot remain freely accessible. Hence, during the workshop the slogan "nothing works without pressure" was created, and land degradation problems in Kenya or India were often compared with the overutilisation of forests and pastures in Switzerland during the last century; where only a strict enforcement of rigid laws helped to halt degradation and to revert the process. People's participation and public legislation have not to be considered as competitive, but rather as complementary elements.

The following chart (figure 10) shows the poster presented by Urs Wiesmann during the discussion of the Pesi river conflict. It clearly hints that top-down intervention, coupled with bottom-up action, is required to solve the case in a peaceful (and sustained) manner.

Figure 10



Annex 1
Workshop Programme

Date	Actual Activities	Reference to Proceedings
Monday June 23	Welcome + Introduction	
	History of previous workshops; how did it come to 1997 theme	annex 6
	Content and Objectives of AGUASAN Workshop 13/97	paper 1
	Global water crisis	paper 1 bonanza C figure 1
	Brief introduction into India case study	annex 4
	Brief introduction into Kenya case study	annex 5
	Evening: Play on water scarcity	bonanza E
Tuesday June 24	*Review on Monday*	photo-page 6
	India case study: Agenda 21 and CR-Palli village; conflicting views/perception on water in CR-Palli	figures 3 + 4 chapter 4.
	Group work on conflicting views	chapter 4.3 figure 3
	Feedback and exchange on group work	
	Interaction and discussion on livelihood systems and natural resources; introduction of the 9-Square-Mandala	figure 6
	Introduction into Laikipia area and case study; Pesi river conflict	annex 5
	Evening: Presentation of - Water and Bangladesh - Ecological conditions of Cameroon highlands - Rain Water Harvesting in Kenya (video)	bonanza D bonanza E
Wednesday June 25	*Review on Tuesday*	photo-page 6
	Pesi river conflicts	
	Role play of four interest groups Reflections on role play and interest groups in Laikipia	figure 8
	Introduction to afternoon excursion	
	Excursion to Municipality of Geuensee; dinner at farm house of Ruth Arnold in Krumbach	photo-page 5 bonanza A

Thursday June 26	*Review on Wednesday*	photo-page 6
	Reflections on role play about Pesi river conflicts	figure 9
	Laikipia: introduction into group work	
	Group work on water potentials / priority setting / approaches	*(limited results!!)*
	Group work presentation	
	Laikipia: multi-stage approach to water development planning	annex 5
	Moving back to India: PIDOW and Swiss involvement on the cross-roads of poverty line and area development programmes	*(limited results!!)*
	Group discussions (two groups answering four questions) on programmatic aspects of watershed projects (pace setting, monitoring, role of NGO)	*(limited results!!)*
	Using the 9-Square-Mandala reference frame to reflect on role play about Pesi river conflicts, role of NGO	figure 9
Friday June 27	*Review on Thursday*	photo-page 6
	Insight: no definition for sustainability possible	figure 10
	Laikipia: iterative planning process and the time consuming process of broad acceptance of water development plan	annex 5
	Back to Swiss roots: traditional pastures management in the Alps of canton Uri	no information
	Editors work on Watershed News: highlights and insights	annex 8
	Outlook on AGUASAN 1998	annex 7
	Evaluation	annex 8 chapter 2.3
	Closing and Departure	

Annex 2

LIST OF PARTICIPANTS

NAME	ADDRESS	TELEPHONE	TELEFAX E-MAIL
BECKMANN Herbert	Dipl.-Ing. / Private Consultant Odenwaldstrasse 19 D-63924 Kleinheubach /Main Germany	+49 9371 65 207	+49 9371 80 285
DESFORGES Dugu	HELVETAS Haiti B.P. 15030 Petion-Ville, Haiti, W.I.	+509 45 63 16 +509 45 97 29	+509 45 63 16
EXANTUS Pierre Georges	SNEP Service National d'Eau Potable Delmas 45, No. 1 Delmas, Haiti, W.I.	+509 46 29 27 +509 46 03 18	+509 46 08 81
FEIBEL Hedi	Haydnweg 13 D-64287 Darmstadt, Germany	+49 6151 71 82 86	
FRÖHLICH Urs	Private Consultant MISEREOR/HELVETAS Finkenweg 9 CH-8500 Frauenfeld, Switzerl.	+41 52 721 31 00	+41 52 721 31 00
GELZER Samuel	Institut für Kulturtechnik ETHZ FB Wasser und Boden HIL H ETH Hönggerberg CH-8093 Zürich, Switzerland	+41 1 633 30 11	+41 1 633 10 84
GSELL Rudolf	HELVETAS Moçambique C.P. 79 Pemba, Moçambique	+258 72 34 25	+258 72 36 24
HARTMANN Peter	SKAT Vadianstrasse 42 CH-9000 St. Gallen, Switzerland	+41 71 228 54 54	+41 71 228 54 55 peter.hartmann@skat.ch
HARTUNG Hans	FAKT Kanalstrasse 23 D-97990 Weikersheim, Germany	+49 7934 99 00 30	+49 7934 99 00 31 100413.2615@compuserve.com
HAUPT Frank	Infraconsult AG Bitziusstrasse 40 3006 Berne, Switzerland	+41 31 351 25 25	+41 31 351 25 87 frank.haupt.ic@ asit.ch
HEIJNEN Han	CWSPU-Ministry of Housing, Constr. and Urban Development "Sethsiripaya" P.O. Box 30 Bataramulla, Sri Lanka	+94 1 87 21 45	+94 1 87 21 43 INTERNET: heijnen@sri.lanka.net cwssp@sri.lanka.net
HUNGERBÜHLER Claudia	Ottilienstrasse 19 8003 Zürich, Switzerland	+41 1 451 32 79	+41 1 451 32 79

JAYAWEERA Palitha	COSI Foundation for Technical Cooperation, "Field View" Palletalawinna, Katugastota, Sri Lanka	+94 72 220 104	+94 8 499 675 (area code different from phone)
MAHURUF Mohammed	HELVETAS Sri Lanka 21, Raymond Road Nugegoda, Sri Lanka	+941 82 73 24	+941 82 73 25 helvetas@lanka.gn.apc.org
MÜLLER Josef	SDC, Humanitarian Aid and Swiss Disaster Relief, Eritrea c/o Jürg Zumstein, Eigerstr. 71 CH-3003 Berne, Switzerland P.O. Box 3099, Asmara, Eritrea	+41 31 322 35 64 +291 1 18 17 01	+291 1 12 46 25
NIEDERER Stephan	Niederer + Pozzi AG Zürcherstrasse 25 CH-8730 Uznach, Switzerland	+41 55 285 91 80	+41 55 285 91 81 active.ch@nipo
RASHID S.M.A.	NGO Forum for Drinking Water Supply and Sanitation 4/6 Block-E, Lalmatia Dhaka, Bangladesh	+8802 81 95 97 +8802 81 95 99	+8802 81 79 24 ngof@bangla.net
TAH Humphrey	HELVETAS Cameroon P.O. Box 114 Bamenda, Cameroon	+237 36 17 30	+237 36 22 30
WIEDERKEHR Andres	HELVETAS Switzerland Postfach 181 8042 Zürich, Switzerland	+41 1 368 65 00	+41 1 368 65 80
WIJNSMA Peter	WDANS Water Development Advisory & Networking Services P.O. Box 15333 Nakuru, Kenya	+254 37 210 931 +254 37 40 451	+254 37 215 269
Resource Persons			
JAGANNATH N.R.	SDC India, Bangalore Field Off. D-3 Casa Lavelle 4, 12/5 Lavelle Road Bangalore 560 001, India	+91 80 224 37 62 +91 80 224 38 66	+91 80 224 37 63
KITEME Boniface Peter	Laikipia Research Project, P.O. Box 144 Nanyuki, Kenya	+254 176 22 574 +254 176 32 527	+254 176 22 201 lrp@users.africaonline.co.ke
WACKER Corinne	Universität Zürich, Ethnologisches Seminar Forschungsabteilung Mühlegasse 21 CH-8001 Zürich, Switzerland	+41 1 257 68 32	+41 1 257 69 97 wacker@ethno.unizh.ch

Members of the AGUASAN Wokshop Preparation Group			
BAUMGARTNER Ruedi	NADEL ETH Zürich Voltastrasse 24 CH-8092 Zürich, Switzerland	+1 1 632 42 40	+41 1 632 12 07
BÜRGI Albert	HELVETAS, Head Office Postfach 181 CH-8042 Zürich, Switzerland	+41 1 368 65 31	+41 1 368 65 80
GÄHWILER Franz	SKAT Vadianstrasse 42 9000 St. Gallen, Switzerland	+41 71 228 54 54	+41 71 228 54 55 franz.gaehwiler@skat.ch
HARTMANN Armon	SDC, Head Section Water and Infrastructure Schwarztorstrasse 59 3003 Bern, Switzerland	+41 31 325 92 52	+41 31 325 93 63 armon.hartmann@sdc.admin.ch
WEHRLE Karl	SKAT Vadianstrasse 42 9000 St. Gallen, Switzerland	+41 71 228 54 54	+41 71 228 54 55 karl.wehrle@skat.ch
WIESMANN Urs	Universität Bern, Centre for Dev. and Environment (CDE) Geographisches Institut Hallerstrasse 12 3012 Bern, Switzerland	+41 31 631 88 69	+41 31 631 85 44 wiesmann@giub.unibe.ch
Moderator			
ZELLWEGER Tonino	LBL Landwirtschaftliche Beratungszentrale Lindau 8315 Lindau, Switzerland	+41 52 354 97 00	+41 52 354 97 97 eza@lbl.agri.ch tzellweger@access.ch
Excursion			
FRITSCH Martin	Institut für Kulturtechnik ETHZ FB Wasser und Boden HIL H ETH Hönggerberg 8093 Zürich, Switzerland	+41 1 633 29 99	+41 1 633 10 84
STADELMANN Pius	Amt für Umweltschutz Klosterstrasse 31 6002 Luzern	+41 41 228 60 64	+41 41 240 11 41
Rapporteur			
STREBEL Bruno	Private Consultant Sonnenhof 10 6232 Geuensee, Switzerland	+41 41 921 38 24	+41 41 921 99 34

Other support services

Accommodation: Hotel Rotschuo, CH-6442 Gersau
Waste water Treatment Plant: Mr. Franz Illi, ARA-Surental, CH-6234 Triengen
Water Supply Geuensee: Mr. Anton Bucher, Unterdorfstrasse, CH-6232 Geuensee
Dinner at Farm House: Mrs. Ruth Arnold, Krumbach, CH-6232 Geuensee

Annex 3

References and Recommended Readings

AGARWAL A, NARAIN S
DYING WISDOM: RISE, FALL AND POTENTIAL OF INDIA'S TRADITIONAL WATER HARVESTING SYSTEMS
Ed. Inst: CSE Series: Report 4 1997 404pp
ISBN: SKAT: B97132/310
Publisher: Centre for Science and Environment, 41, Tughlakabad Institutional Area, New Delhi 110 062, India
Keywords: Water, water harvesting, irrigation, india
Abstract: This publication looks at India's traditional water harvesting systems, it studies a millennial tradition that met people's drinking water and irrigation needs, and argues for a revival of local water harvesting systems

ROGERS PCOMPREHENSIVE WATER RESOURCES MANAGE MENT: A CONCEPT PAPER
Ed.Inst: WB Series: WPS 879 1992 18pp
ISBN: SKAT: B92170/300
Publisher: WORLD BANK, 1818 H STREET NW, WASHINGTON, DC 20433 / USA
Keywords: Water, water supply, watershed management, water resource planning
Abstract: This paper informs on fundamental concepts for water management, planning for water resources and gives generic issues of concern for the World Bank.

VISSCHER J T, S™RENSSON M
TOWARDS BETTER WATER RESOURCES MANAGEMENT: A CATALOGUE OF POLICIES AND STRATEGIES OF EXTERNAL SUPPORT AGENCIES
Ed.Inst: IRC Series: REFERENCE SERIES 10, 1994 196pp
ISBN: SKAT: B95057/300
Publisher: IRC, P.O. BOX 93190, 2509 AD THE HAGUE / THE NETHERLANDS
Keywords: Water resource planning, strategies, donor organizations
Abstract: This document describes the policies and strategies of 26 bilateral and multilateral external support agencies (ESAs). It provides information on the status of each ESA's water resources management policy and strategy, as well as some general information about the organization.

BOCHET J-J
MANAGEMENT OF UPLAND WATERSHEDS: PARTICIPATION OF MOUNTAIN COMMUNITIES.
Ed.Inst: FAO Series: FAO CONSERVATION GUI, 1983 199pp
ISBN: 92-5-101337-0 SKAT: B1287/310
Publisher: FAO, ROME / ITALY
Keywords: Surface water, watershed management, mountain communities
Abstract: Examines the identification with and physical and material participation of mountain communities in the design and implementation of watership management programms.

GIL NWATERSHED DEVELOPMENT: WITH SPECIAL REFERENCE TO SOIL AND WATER CONSERVATIONEd.Inst: FAO
Series: FAO SOILS BULLETIN 4 1985 257pp
ISBN: 92 5 100859 0 SKAT: B2707/310 BS.:
Publisher: FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO), VIA DELLE TERME DI CARACALLA, 00100 ROME / ITALY
Keywords: Surface water, watershed management, soil conservation

Abstract: Multidisciplinary area development considering the various potential of lands (for food, fuel, timber production) their reclamation, hydrology, irrigation water supply, susceptibility to hazards, requirements for transport for planners and specialists.

NILSSON AKE, SIVANAPPAN R K
HYDROLOGICAL AND WATER ENGINEERING ASPECTS OF THE AYYALUR INTERFACE FORESTRY PROJECT TAMIL NADU
Ed.Inst: Series: 1986 30pp
ISBN: SKAT: B94414/310 BS.:
Publisher:
Keywords: Surface water, watershed management, forestry works, india
Abstract: This report gives the details about the hydrology and hydrogeology of the project area, the agricultural and forest practices, soil and water conservation and management proposed in order to increase water availability and agricultural production, training programmes needed for the officers and farmers, and research and monitoring required for the evaluation.

SCHREIER H, SHAH P B, BROWN S (ed.)CHALLENGES IN MOUNTAIN RESOURCE MANAGEMENT IN NEPAL: PROCESSES, TRENDS, AND DYNAMICS IN MIDDLE MOUNTAIN WATERSHEDS
Ed.Inst: ICIMOD Series: 1995 261pp
ISBN: 92 9115 449 SKAT: B95313/310, BS.:
Publisher: ICIMOD, P.O. BOX 3226, KATHMANDU, NEPAL
Keywords:Watershed management, nepal
Abstract: Proceedings of a workshop held in Kathmandu, Nepal, on reports on research that ICIMOD together with the University of British Columbia in Canada has been conducting in the Jhikhu Khola water shed since 1989.

NEWSON MLAND, WATER AND DEVELOPMENT: RIVER BASIN SYSTEMS AND THEIR SUSTAINABLE MANAGEMENT
Ed.Inst: Series: 1992 351pp
ISBN: 0 415 08031 2 SKAT: B94039/420 BS.:
Publisher: ROUTLEDGE, 11 NEW FETTER LANE, LONDON EC4P 4EE / UNITED KINGDOM
Keywords: Watershed management, river basins, water resource planning, soil management, hydrology,
Abstract: This book reviews the evolution of river management and the history of applied hydrology to contextualise a global study of river basin systems and their contemporary management, setting this within both physical and social frameworks.

KUMAR P P D
FARMERS ARE ENGINEERS: INDIGENOUS SOIL AND WATER CONSERVATION PRACTICES IN A PARTICIPATORY WATHERSHED DEVELOPMENT PROGRAMME
Ed.Inst: SDC Series: 1994 40pp
ISBN: SKAT: B95172/420, BS.:
Publisher: PIDOW/SDC, SDC FIELD OFFICE, AISHWARYA APPT., 38 REST HOUSE ROAD, BANGALORE-560 001, INDIA
Keywords: Soil management, soil conservation, watershed management, irrigation, india
Abstract: This report on the participative and integrated development of watershed project Pidow-Myrada informs in its first part on the various aspects of indigenous knowledge, and in its second part on farmers' practices.

CONSERVATION ET GESTION DES EAUX ET DES SOLS AU NIGER: MESURES SIMPLES DE PROTECTION ANTI-EROSIVE DES ECOSYSTEMES AU NIGER
Ed.Inst: Series: 1995 55pp
ISBN: SKAT: B95303/422, BS.:

Publisher: INST. DE GENIE RURALE ET DE L'ENVIRONNEMENT, ETH HOENGGERBERG, 8093 ZUERICH, SWITZERLAND
Keywords: Erosion control, watershed management, ecosystems, niger
Abstract: This study first analyses important elements of a sustainable management of the water resources and appropriate measures and then gives technical recommendations on how to realise them.

STEIGER B V
PENURIE D'EAU: UNE ETUDE DE CAS AUX ILES DE CAP VERT.
Ed.Inst: EPFL Series: 1985 var.pp
ISBN: SKAT: B3741/423, BS.:
Publisher: ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE, INSTITUTE DE GENIE RURAL, LAUSANNE / SWITZERLAND
Keywords: Irrigation, watershed management, groundwater management, soil conservation, drinking water supply
Abstract: Project report, describing methods of catching, storing or re charging the groundwater with surface water for irrigation and drinking purposes. incl. appropriate soil conservation measures.

ZAMAN M (Ed.)RIVER BASIN DEVELOPMENT
Ed.Inst: Series: WATER RESOURCES SERIES, 1983 239pp
ISBN: 0-907567-57-6 SKAT: B95169/120 BS.:
Publisher: TYCOOLY INTERNATIONAL PUBLISHING LTD., 6, CROFTON TERRACE, DUN LAOGHAIRE, CO. DUBLIN/IRELAND
Keywords: Water resource planning, river basins, rivers
Abstract: This book discusses: the efficient use of water, the employment implications of development; the development of international river basins; and the use of advanced techniques such as systems analysis and computer technology to improve water resources planning and management processes.

TOWARD SUSTAINABILITY: SOIL AND WATER RESEARCH PRIORITIES FOR DEVELOPING COUNTRIES
Ed.Inst: Series: 1991 65pp
ISBN: 0 309 04641 6 SKAT: B4326/121, BS.:
Publisher: NATIONAL RESEARCH COUNCIL, NATIONAL ACADEMY PRESS, WASHINGTON, DC / USA
Keywords: Natural resources, water resource planning, soil management
Abstract: This study reviews the constraints on productive and environmen tally sound soil and water management and outlines a research strategy for addressing these problems in the developint countries.

POSTEL S
WATER: RETHINKING MANAGEMENT IN AN AGE OF SCARCITY
Ed.Inst: WORLDWATCH Series: WORLDWATCH PAPER, 62 1984 65pp
ISBN: 0 916468 62 3 SKAT: B0069/300, BS.:
Publisher: WORLDWATCH INSTITUTE, WASHINGTON / USA
Keywords: Water, management, water resource planning
Abstract: The paper reflects on the water cycle and renewable supplies, consequences of mismanagment, augmenting dependable supplies, conserving water, and priorities for a new water economy.

POSTEL S
CONSERVING WATER: THE UNTAPPED ALTERNATIVE
Ed.Inst: WORLDWATCH Series: WORLDWATCH PAPER, 67 1985 66pp
ISBN: 0 916468 67 4 SKAT: B0070/300, BS.:
Publisher: WORLDWATCH INSTITUTE, WASHINGTON / USA

Keywords: Water, recycling, water resource planning
Abstract: The paper reflects on water consumption related to new cropping patterns, on water conservation in cities, water recycling, water conservation a.o.

BALEK J
HYDROLOGY AND WATER RESOURCES IN TROPICAL REGIONS
Ed.Inst: ELSEVIER Series: DEVELOPMENTS IN WATE 1983 271pp
ISBN: 0 444 41656 7 SKAT: B2488/300, BS.:
Publisher: ELSEVIER SCIENCE PUBLISHING, NEW YORK / USA
Keywords: Hydrology, water resource planning, tropical zones
Abstract: Description of the bahaviour of tropical waters and various eco logical, geographical and climatological conditions, and problems of water management in relation to agricult. & civil engineering.

WATER RESOURCE MANAGEMENT: INTEGRATED POLICIES
Ed.Inst: OECD Series: 1989 199pp
ISBN: 92 64 13285 6 SKAT: B2781/300, BS.:
Publisher: ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), PUBLICATIONS, 4 SIMROCKSTRASSE, 5300 BONN / F.R.GERMANY
Keywords: Water resource planning, policy
Abstract: A report dealing with policy integration and institutional char acteristics within the water sector so as to improve water quantity and quality, demand management, surface-/groundwater supply.

LECTURES IN WATERMANAGEMENTEd.Inst: WORLDBANK
Series: 70pp
ISBN: SKAT: B3524/300 BS.:
Publisher: WORLD BANK
Keywords: Water resource planning, water and sanitation, irrigation, water quality
Abstract: Lectures in water resource planing, groundwaterquality, trends in irrigationsystems, low cost sanitation, rural water supply, etc.

GUIDELINES FOR THE PREPARATION OF NATIONAL MASTER WATER PLANS
Ed.Inst: ESCAP Series: WATER RESOURCES SERIES 1989 163pp
ISBN: 92 1 119549 7 SKAT: B93297/300 BS.:
Publisher: UN PUBLICATION, NEW YORK
Keywords: Water resource planning, soil classification, management, water quality, water supply, case studies, china, malayia, philippines, korea republic of, sri lanka, ussr, irrigation schemes
Abstract: Guidelines for the preparation of national master water plans; these guidelines also include selectec country papers, as well as a manual for planning, design, operation and maintenance of irrigation systems

LE MOIGNE G (et al.)
COUNTRY EXPERIENCES WITH WATER RESOURCES MANAGEMENT: ECONOMIC, INSTITUTIONAL, TECHNOLOGICAL AND ENVIRONMENTAL ISSUES
Ed.Inst: WB Series: WB TECHNICAL PAPER N 1992 213pp
ISBN: 0 8213 2159 5 SKAT: B93353/300, BS.:
Publisher: WB, 1818 H STREET, N.W., WASHINGTON, D.C.20433, USA
Keywords: Water resource planning, pricing, institution building, technological change, environment, health, basins, case studies
Abstract: This publication provides country-based information organized around five broad themes: intersectoral water allocation and pricing, institution building, technological issues, environment and health, and international river basins.

CHATURVEDI M C
WATER RESOURCES SYSTEMS PLANNING AND MANAGEMENT
Ed.Inst: TATA Series: 1987 602pp
ISBN: SKAT: B94018/300, BS.:
Publisher: TATA MC-GRAW-HILL PUBLISHING CO. LTD., 4/12 ASAF ALI ROAD, NEW DELHI 110 002 / INDIA
Keywords: Water resource planning, groundwater management, water quality, india
Abstract: Starting with the basic concepts, issues and using a systems approach, the book systematically and comprehensively integrates the latest theory and research with real-life applications.

WISHART G
UGANDA'S WATER SECTOR DEVELOPMENT: TOWARDS SUSTAINABLE SYSTEMS
Ed.Inst: SKAT/HTN Series:HTN WORKING PAPER WP 1996 53pp
ISBN: SKAT: B96138/341 BS.: SKAT-3-013
Publisher: SKAT, VADIANSTRASSE 42, 9000 ST. GALLEN, SWITZERLAND
Keywords: Water supply systems, water resource planning, uganda
Abstract: This case study presents a review of the processes leading up to, and encompassing the establishment of, a revitalised system for management and development of water resources in Uganda.

BARROW C
WATER RESOURCES AND AGRICULTURAL DEVELOPMENT IN THE TROPICS
Ed.Inst: Series: 1993 356pp
ISBN: 0 582 30137 8 SKAT: B95013/423 BS.:
Publisher: LONGMAN SCIENTIFIC AND TECHNICAL, LONGMAN HOUSE, BURNT MILL, HARLOW, ESSEX CM20 2JE, UNITED KINGDOM
Keywords: Drainage, irrigation, agricultural development, water resource planning, tropics
Abstract: This book is intended to fill the gap that exists between the literature of water supply management, irrigation engineering and economics, and that of agricultural extension and environmental and socioeconomic appraisal.

Annex 4
Description of the Indian Case Study

In this annex additional information on the Indian case study is provided with:

a) background information on rural livelihood systems (by R. Baumgartner);

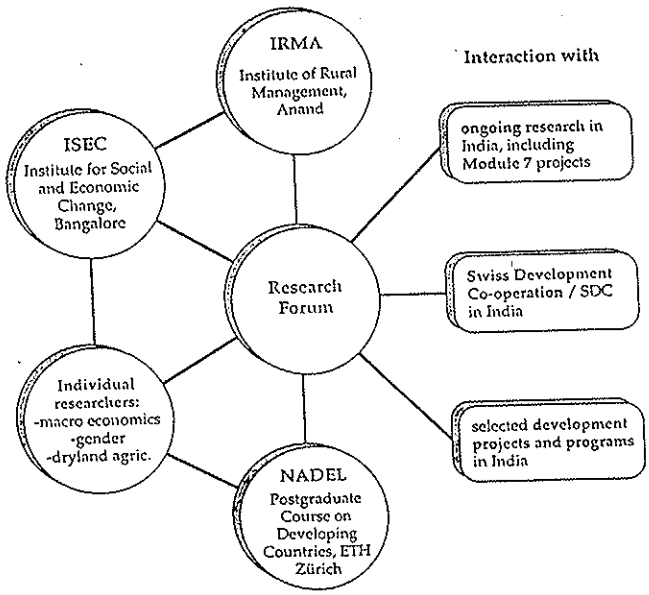
b) workshop paper on "Participatory Integrated Development of Watershed Development - A case Study (by N.R. Jagannath, SDC India), including copies of 6 transperancies of various SDC origin)

A) Rural livelihood systems and sustainable resource management:

An investigation into preconditions, strategies and policy implications for development support of rural livelihood in semi-arid regions of India

NADEL, ETH Zürich in co-operation with the Institute of Rural Management, IRMA, Anand, the Institute for Social and Economic Change, ISEC, Bangalore and the collaboration of SAMPARK, a Bangalore based NGO.

The project emerged from programme development for the bilateral collaboration of the Swiss Development Co-operation, SDC, in the sector "sustainable landuse in semi-arid areas" in India. It will contribute to the design and implementation of innovative development approaches for semi arid tropics, SAT, by investigating natural resource management as a process of strategy development guided by the farm communities' perceptions of their livelihood systems and its interactions with economical and political context. In the second phase, 1994-95, the partners will focus on a two track approach. On track I they will continue their interdisciplinary research in the field. On track II an intensive policy dialogue with implementing agencies and Indian policy makers will be taken up in order to formulate a complementary research programme. This procedure is expected to yield a set of sound policy recommendations for rural development in semi-arid areas of India.



B) Participatory Integrated Development of Watershed Development in India

Introduction

Perception relating to water among the common people are not uniform around the globe. The nomadic tribes in deserts, the inhabitants of arid zones, the residents of foothills with heavy precipitation, and the fisherman on the sea coast have each their own way of looking at and utilizing the resources. This is true of animals also. Animals define the rules for sharing water for their mere survival and continuity while the human being needed water not only for their purpose but also for nurturing his creativity called "Development". India mirrors this great variety. Historically, the initial feeling toward water was one of reverence, with rivers being named after goddesses. In the course of time however, a number of irrigation cum flood control systems have came to be established.

Growth of population, attainment of political independence and burgeoning economic ambitions have in recent times combined in India as in many other developing countries to provide a new thrust for efficient and optimal use of water. A major international effort is required to alert all concerned to the dangers of continued unscientific use of water, and for providing technical and financial assistance to bring about a more rational use for all round. Sensitive political questions need to be faced before the will to engage in cooperative action can be mobilized among the countries.

A participative approach that involves users, technologists and officials for evaluating current trends and for evolving programmes of actions in each country holds promise of sustained results. It is needless to mention that peoples involvement is crucial to success.

Watershed Development : The Concept

Green revolution in India has produced multiplier effects for accelerate growth of irrigated agriculture (Extensive literatures on this is also available). However, the irrigated agriculture has its own area thresholds. Where the irrigation potential exists, utilization levels have been low this is especially true of surface irrigation in the command areas served by major irrigation project. The statutory body like Command Area Development Authorities called CADAs have not been successful in bridging the gap between irrigation potential created and utilized.

The water release and use pattern has been at variance leading to low level of Water Use Efficiency. This variance has led to address many issues concerning the management of water in an optimal way. This scenario has made the planners to **shift the focus from irrigated agriculture to rainfed agriculture.**

The extended drought during the early nineties (1987) indicated further the depressing consequences of the dependency on timely and sufficient rainfall. Drought Prone Area programs of Government of India showed potentialities of such dry land for improving living conditions (to be out of poverty in the first place). Since problem of poverty is caused by many inter-related factors.

Since water is the crucial factor in land-use, its conservation and development assumes its importance. The approach followed towards this endeavor is "Watershed". Watershed is an area from which runoff, resulting from precipitation, flows past a single point into a large stream , river, lake or ocean. For convenience watersheds can be classified as regions, basins, catchments , subcatchments watersheds and subwatersheds interms of its size. The watershed approach provides an opportunity to realize the twin objectives of sustainable production of bio-mass and restoration of ecological balance through protection of catchment areas and practice of soil and water conservation measures. PIDOW in Karnataka is an attempt in that direction which also followed participatory approach.

The PIDOW project

In 1985, the state government of Karnataka and SDC initiated a collaborative project namely Participatory Integrated Development of Watershed (PIDOW) in Gulbarga District of Northern Karnataka. (**Transparencies -1, 2, 3 and 4)** for project identity card)

The Project Objectives

The overall objective of the Indo-Swiss collaboration in this project is to support farmers and village communities living in watersheds of semi-arid rural areas in improving their livelihood through their own efforts and find out a replicable strategy for participative, integrated and sustained development of watersheds in semi-arid areas with a due concern for the interest of the poor. The problem of poverty which is the overriding objective of SDC is being addressed with a difference in strategy the strategy which logically explains the interfacing elements in watershed approach. **(Transparency-5)**

PIDOW Results- from a case analysis.

Wadegera and Kalamandargi are the two villages located in Gulbarga district of northern Karnataka state of India are considered for the present workshop. The Main source of information are the periodic reports and my field visit to these areas and by design only those findings are presented which has relevance to the central element of the workshop ie **Water.**

Farmers perception to the concept and effect of watershed mainly related to the following viz

- Increase in production and productivity of crops
- Improved situation of fodder production
- Improved recharge of ground water
- Improved water level in the existing water bodies
- Increase in soil moisture regime
- prevention of excess run off
- Improved rainfall in the catchnment
- prevent fast drying of streams
- Improved irrigation facility

The two cases selected refers to issue related to the farmers perception on ground water recharge in the project area.

Case-1 : Improved water levels in the summer months
Kalamandargi watershed

Situation:

- Rainfall pattern in the project area is stable over the last 10 years. However, 40 years rainfall data indicated a high co-efficient of variation. However, increase in ground water after 1990 especially in open wells therefore cannot be attributed to sudden increase in rainfall. The unusual heavy rainfall in 1983 and average monsoon from 1984-1987 was adequate in the valley portion of Wadagera watershed to irrigate just 12 acres of land.

- Total number of drinking water open wells — 3 in the middle land
- Total number of bore wells — 2 one each in middle and low land
- Portable mini water supply — 1 With bore well in the low land.

Results

- Farmers felt the improvement in drinking water problem
- The situation improved significantly after taking up the watershed activities in terms of improved water levels in all the three open wells without problems during the summer months
- The bore wells after the implementation of watershed activities is providing water throughout the year
- In the project area, before the watershed activities were taken up, the portable mini water supply was to the duration of one hour a day during summer months. With the watershed activities in place the duration and frequency of water supply has improved to twice a day with I ½ hour supply a day.

The transparency gives the ground water recharges in the summer months in irrigation wells **(Transparency 6)**

Case study 2 **Effect of treatment measures on the water levels in the open wells Wadagera watershed**

Situation analysis

The treatment measures undertaken were in the from of construction of (a) Earthen bund (b) Boulder bunds © Gully checks (d) Check dams (e) Diversion drains (f) Block plantation and farm forestry

There are 7 open wells in the lower reaches. In 1987 these wells provided water only for 12 acres of sugar cane. The rainfall pattern and distribution has not been encouraging since 1987.

- However, farmers felt during the year 1991, situations improving. The improvement in sub-soil water resulted in the cultivation two agricultural crops in the valley as a consequent to the treatment measures taken up by the soil and water conservation department.
- The introduction of boulder bunds, nala bunds, trenches, small dams have increased ground water level and now the water is available after January untill the rainy season
- The situation improved with wells acquiring propensity to irrigate more area (12 acres to 30 acres)
- 7 Wells which used to dry up during the months March to June is no longer the situation
- Farmers however, are not able to articulate in more scientific terms the relationship between watershed measures and its effect on the water table and contribution of rain fall to the water levels in the wells
- However, farmers felt strongly that earthen structures are very useful to control the water velocity and increase the water holding capacity of the fertile soil consequently increasing the water table through percolation effects
- Farmers opined that treatment measures helped recharging of wells down stream of nala bunds
- Recharge of wells is an important indicator of success of the watershed project due to farmers orientation towards irrigated agriculture due to its assured income and production
- Farmers cultivating in the middle reach however, reported that with the implementation of watershed activities, crops are able to withstand the dry spells of upto 3 weeks as against 10 days prior to treatment measures

Conclusions

- Watershed Concept has gained acceptance by the farmers to insulate from drought and poverty
- The concept has helped for improvement of production environment and restoration of ecological balance through scientific management of land and water. In the process, in-situ moisture conservation, network of run-off management structures and devices for recharge of ground water to enhance availability of water for human and livestock drinking purposes, domestic consumption, life saving irrigation and raising of appropriate cash crops like sugarcane according to agro-climatic potentials.

Issues for future consideration

- Conjunctive Use of Water- Problems & Prospects
- The laws governing water rights in a civil society
- Water Delivery mechanisms

PIDOW - A PROJECT IDENTITY CARD

PIDOW

Participative and Integrated Development of Watersheds

Project Area

Mullamari River Basin, Kamalapur Revenue Circle, Gulbarga District, Karnataka

Ondulating tracts of Deccan Plateau with shallow to deep soils (laterite and black cotton) on mild to medium slopes; erratic rainfall (5-700 mm p. year with only 10-12 rainfall days); temperatures well above 45 degrees centigrade in summer; high degree of soil erosion/degradation; traditional rainfed agricultural techniques with low productivity and high marginal costs; predominantly small and marginal farmers, with high percentage of tribal population (lambani); growing population density (32'000 inhabitants on 26'000 has of land in 1984); only one agricultural season with frequent failures due to drought or irregular distribution of rains.

Partners

- Village Community Organisations (Sanghas and Self Help Groups)
- Government of Karnataka, Dryland Development Board, Ministry of Agriculture
- MYRADA (NGO)
- Swiss Agency for Development and Co-operation

Objectives

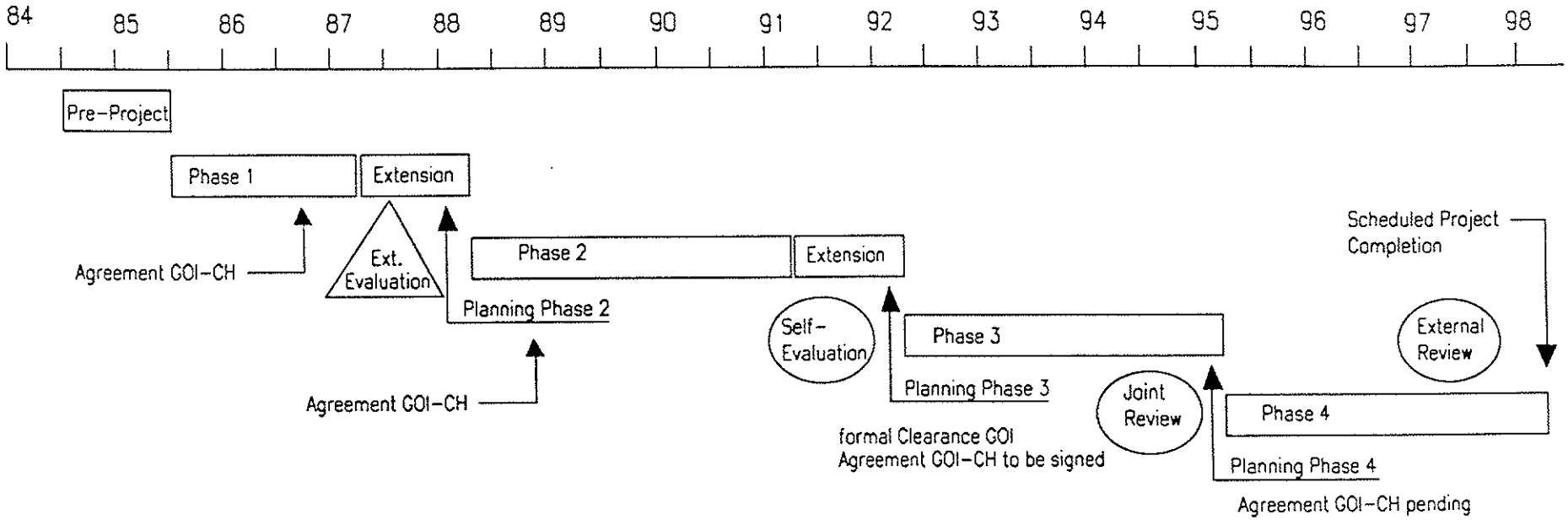
PIDOW aims at the **development of replicable approaches to sustainable land use in semi-arid rainfed farming systems** through:

- Rehabilitation of watersheds (areas of common darinage with a catchment of 3-500 has each) by means of:
  - physical treatments for soil and wter conservation (expl: field bunding; gully erosion plugging; contour bunding/planting; in-situ moisture harvesting; nullah drainage etc.)
  - vegetative treatment for soil and water conservation and biomas regeneration (expl: afforestation of upper catchment; agroforestry activities; hedging; grassland regeneration; bund planting, etc.)
  - promotion of appropriate/sustainable farming practices
  - horticulture promotion based on low water consumption technologies
- Community development through self-help credit groups and the formation of democratic and self-ruled community organisations (Sanghas)
- Design and testing of procedures for participative planning, implementation, monitoring and maintenance of structures and assets for effective beneficiary involvement (PRA)

Principles and Strategies

- develop institutional partnership where strengths of different specialised agencies are blended towards a set of common objectives
- focus on genuine and effective involvement of village communities through all steps of the project to increase people's 'ownership'
- insist on people's contributions in cash or kind (commitment)
- valorise local knowledge and traditional wisdom in natural resource use
- low-cost, environment-friendly and locally manageable interventions
- facilitate each partners' own responsible initiative towards the common goals

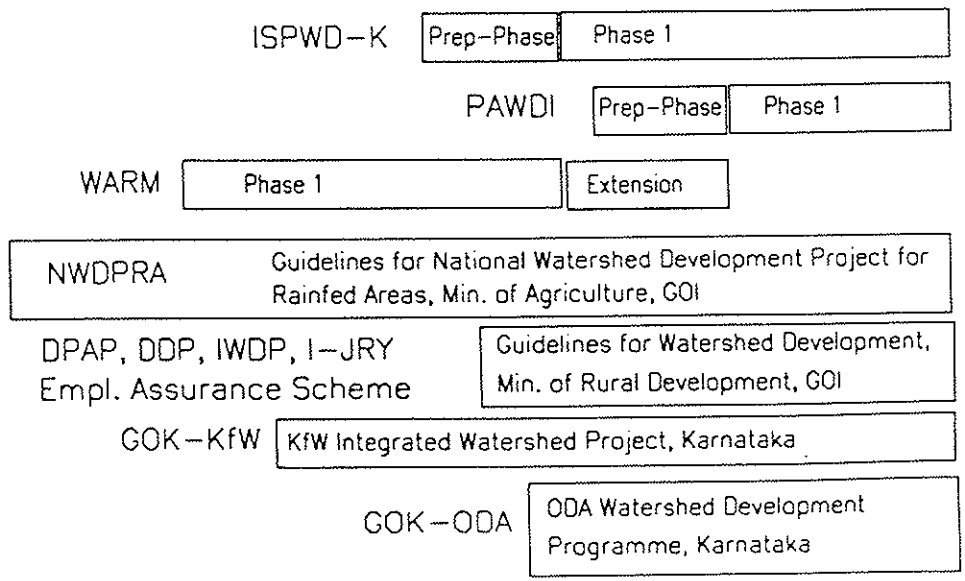
PIDOW Project Life Line and Spread Effects



Other Projects/Programmes with Reference to PIDOW Concept and/or Experiences:

ISPWD-K	Indo-Swiss Participatory Watershed Development Karnataka (SDC funded)
PAWDI	People's Action for Watershed Development Initiatives Rajasthan (SDC funded)
WARM	Watershed Resource Management and Training, all India (SDC funded)
KfW	German Bank for Reconstruction and Development
ODA	British Overseas Development Administration
DPAP	Drought Prone Area Programme GOI
DDP	Desert Development Programme GOI
IWDP	Integrated Wasteland Development Programme GOI
I-JRY	Intensified Jawahar Rozghar Yojna
NWDPRA	National Watershed Development Programme for Rainfed Areas GOI

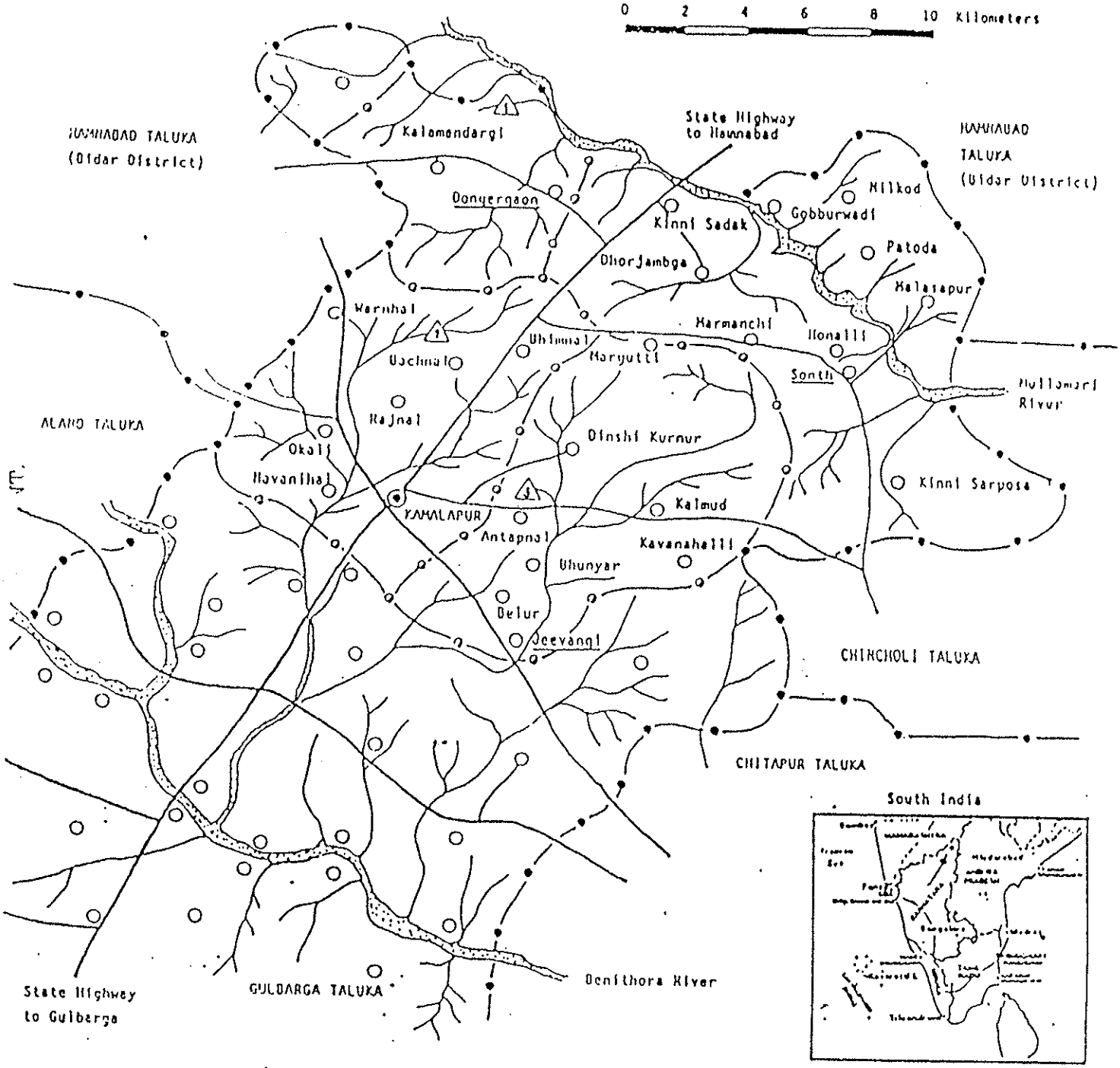
SDC Bangalore-SDM/3.96



PROJECT MAP

Map of Project Area

Annex 1



◉ .: KAMALAPUR	Revenue Circle (and Mandal P.)	—•——•—	Taluka Boundary (in North District Boundary)
○ Kalmud	Village in Project Area	—o——o—	Sub-Watershed Boundary (Dongergaon, Sonth, Jeevangi, Kamalapur)
○ Sonth	Mandal Panchayat Center	⚠1	Mini-Watershed : 1 = Bhandankeri 2 = Bhagwan Tanda 3 = Wadigera
———	Major Road		
———	Minor Road		

Source : reduced from Taluka Map Gulbarga Taluka (scale 1" = 2 miles)

TARNSPERANCY - 4 **BASIC DATA**

Basic Data on District, Taluk and Project Area

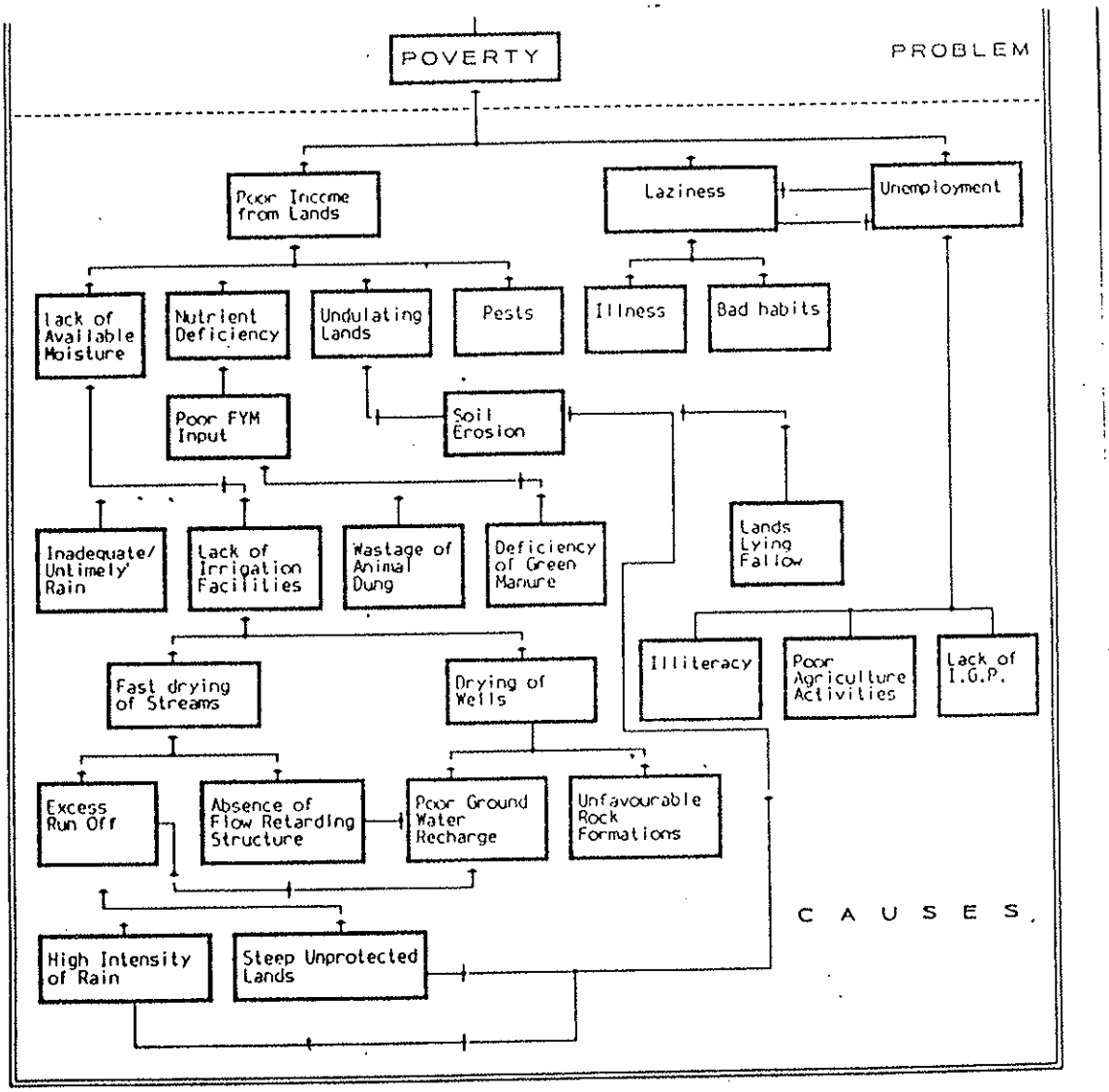
	(Unit)	Gulbarga District	Gulbarga Taluk	Project Area
1. Area and Population				
(a) Area	(hectares)	1'610'245	173'165	26'094
(b) Inhabited villages		1'305	137	27
(c) Population		n.a.	n.a.	32'742
(d) Literacy	(%)	18.7	31.0	21.0
2. Agriculture & Forestry				
(a) Net area sown	(hectares)	1'186'868	23'709	17'152
(b) Forest	(")	70'314	3'229	1'068
(c) Area not availble for cultivation	(")	122'354	9'154	670
(d) Barren and non-cultivable land	(")	74'341	5'474	1'476
(e) Land put to non-agric. activities	(")	48'013	3'380	420
(f) Permanent pasture	(")	51'917	6'336	1'057
(g) Cultivable wasteland	(")	17'283	2'104	780
(h) Fallow land (more than two years)	(")	70'370	8'440	920
(i) Current fallow	(")	173'177	26'036	2'554
(k) Net area irrigated	(")	26'699	3'271	128
3. Infrastructure				
(a) Roads (total)	(kms)	4'645	494	59
(b) Roads (metalled)	(kms)	2'901	382	34
(c) Roads (earth)	(kms)	1'744	112	25
(d) Village electricity		1'072	125	26
(e) Borewells for drinking water		4'365	598	165
(f) Mini Water Supply		142	24	7
4. Services				
(a) Health care centers		125	17	2
(b) Primary school		1'772	281	27
(c) Secondary school		109	23	9
(d) Colleges, all type		64	41	2
(e) Post offices		620	86	5
(f) Telegram offices		140	22	1
(g) Bank branches		151	35	3
(h) Cooperatives		230	29	5

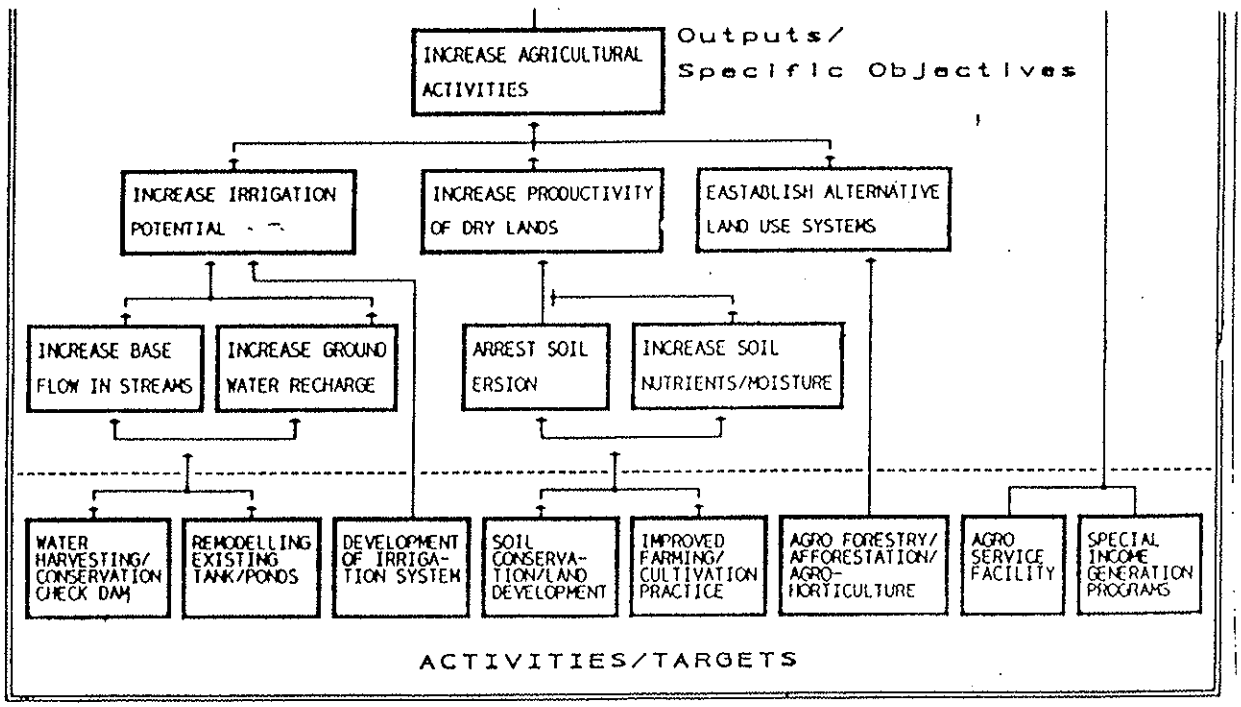
Source : IRDP, Annual Plan 1986-87 (District), Taluka-wise Plan Statistics 1984-85 Revenue Department, Census 1981 (Kamalapur Circle), PIDOW (Project Area)

P.S. The Project Area includes Kamalapur Revenue Circle and Jeevangi village.

WATERSHED CONCEPT TREE

WATERSHED DEVELOPMENT ELEMENTS





TRANSPARENCY- 6

GROUND WATER RECHARGE IN SUMMER MONTHS

Ground water Re-charge in Summer Months in Irrigation Wells Kalamandargi Village

Time Line	1990	1991	1993
• Farmer-1	Dried	Water was there	Silt accumulated
Farmer-2	Water level less in the valley	Water level less	Water level improved
Farmer-3	Small quantity available low recharge	Moderately recharged	Well is fully recharged

Source: PIDOW project.

In a Nutshell:

LRP - Laikipia Research Programme

LRP is a programme of associated projects for oriented research and training on the sub-national level aiming at supporting sustainable development in the highland-lowland system of Mt. Kenya

1. Programme

- LRP studies the semi-arid Laikipia District in the highland-lowland system of Mt Kenya since 1984
- LRP is a collaborative effort of the Government of Kenya and the Universities of Nairobi and Bern
- LRP addresses problems and conflicts between the needs of marginalised rural populations and the need for sustainable resource use
- LRP supports regional and project planning and promotes application oriented research and training

2. Problem Context

- Water is the main limiting natural resource to agro-pastoral development
- Population doubles within ten years due to immigration of small holders
- Fast land use transition causes degradation and pressure on perennial rivers.
- Down stream ecosystems and populations are heavily affected by the loss of water
- Policies and projects are hardly able to respond to needs and conflicts.

3. Main Focus

- On the regional or sub-national level
  - ⇒ Bridging micro- and macro-perspectives of sustainable development
  - ⇒ Combining local processes and needs with supra-regional forces, effects and requirements
  - ⇒ Balancing bottom up and top down approaches in development activities
- On problem and solution oriented research
  - ⇒ Bridging baseline and applied research
  - ⇒ Combining natural, technical and social sciences with participatory approaches
  - ⇒ Balancing inventorising and process oriented research

- On oriented post-graduate training
  ⇒ Bridging disciplinary approaches with interdisciplinary requirements
  ⇒ Balancing theoretical knowledge and practical exposure

4. Major Thrusts

LRP applies an iterative sequence of four major thrusts which are grouped in a Programme of associated projects:

1. Integrated regional baseline studies to assess key problems, conflicts and possible strategies (Core LRP)
2. Long-term monitoring of key natural resources and the effects of land use systems and technologies (NRM-Project: Natural resource monitoring, modelling and management)
3. Actor-oriented perspective of regional development to balance different policies, strategies and interests (ASP-Project: Actors' strategies and perceptions for sustainable resource management and planning)
4. Development of planning tools and application-oriented transfer for sustainable regional development (Core LRP)

5. Support to Planning and Implementation

Transfer Strategies:

1. Demand oriented transfer:
   Responding to requests by target groups (communities, planers, authorities) through participatory processes
2. Active transfer:
   Actively addressing key issues of sustainable development (examples see below) for which there is no direct demand or which tend to be neglected due to conflicts with other agendas

Key Tools of Transfer

- GIS on five interrelated scales
- Integrated data-base on ecology and socio-economy
- Specific studies on key processes
- Interdisciplinary team and expertise
- Broad institutional network (local to international)
- Participation in planning processes

Example: Water Resources

Active transfer on regional water policies, e.g. through:

- Water awareness campaigns (local to national)
- Expertise to Water Boards and development agencies
- Area specific water development plans (rolling planning)

Example: Land Subdivision

Active transfer on outer boundary of further subdivision, e.g. through:

- Area specific scenarios on agro-pastoral development potentials
- Awareness campaigns on resource gradients and their implications
- Elephant fencing as tool to mark boundary of small holder settlements

Example: Smallholders

Active transfer on promising strategies to support the adaptation of immigrating agro-pastoral smallholders to the new environment, e.g. through:

- Awareness creation on household strategies with planers and agencies
- Concepts for direct and indirect support of ecological adaptation

Example: Policy Dialogue

Active promotion of policy dialogue on procedures, concepts and objectives of regional planning for sustainable development, e.g. through:

- Active participation in planning processes (local to national)
- Support to regionally oriented development authorities and agencies

Examples: Transfer on Demand

Responding to demand for information and expertise by communities, planers, authorities and agencies, e.g. through:

- Compilations from the data-base (e.g. for planning of infrastructure)
- Specific studies (which are important entry points for active transfer)

6. Contact

Laikipia Research Programme (LRP), P.O. Box 144, Nanyuki, Kenya
EMail: lrp@users.africaonline.co.ke

Centre for Development and Environment, University of Bern, Hallerstr. 12, 3012 Bern, Switzerland
EMail: wiesmann@giub.unibe.ch

Problem Context:

Laikipia District, Kenya:

Natural resources, socio-economic transformation, and ecological degradation

Figure 1 gives an overview of natural resources on the Laikipia high plateau and the socio-economic dynamics of the Laikipia District. Using an overlay of the two maps, this figure illustrates the central development and environmental problems found in the District. These problems can be characterised as follows:

1. Limited natural resources

Laikipia District, which has a total area of 9,700 km^2, is located between 1,600 and 2,300 meters above sea level on a semi-arid high plateau north-west of Mt. Kenya. Three-quarters of this plateau consists of volcanic rock with a topography that shows little dissection and minimal relief energy. Greater relief energy is found on basic rock in the north-eastern part of the District. Aside from Vertisols, which are not well suited for use, deep soils - particularly Phaeozems - predominate. These are characterised by their high water-retention capacity but also by greater erodibility.

Precipitation comes chiefly during two rainy seasons. Both the spatial distribution and the temporal variability of rainfall are strongly influenced by the Mt. Kenya massif (5,199 m) and the Nyandarua Range (3,999 m), which lies to the south-west of the plateau. Mean annual rainfall declines along a steep gradient, from 800-900 mm at the foot of both massifs, to under 500 mm in the northern part of the District. Rainfall is characterised by great variability in terms of amounts and time and increase along the same gradient.

Agro-climatic zones vary according to precipitation gradients, from semi-humid (Zones III and IV) to semi-arid (Zones V and VI). Great variability in precipitation means, however, that there is great spatial and temporal fluctuation in the critical boundary for rainfed agriculture between Zones IV and V on the high plateau.

Together with the slopes of Mt. Kenya and the Nyandarua Range, Laikipia forms the upper catchment area of the Ewaso Ng'iro River, which is of crucial importance to the semi- arid and arid lowlands to the north-east. The tributaries of the Ewaso Ng'iro which flow through Laikipia District are perennial streams fed exclusively from Mt. Kenya and the Nyandarua Range during the dry seasons. The forest belts of both mountain systems are very important in this process. Surface waters that form on the high plateau conduct water only

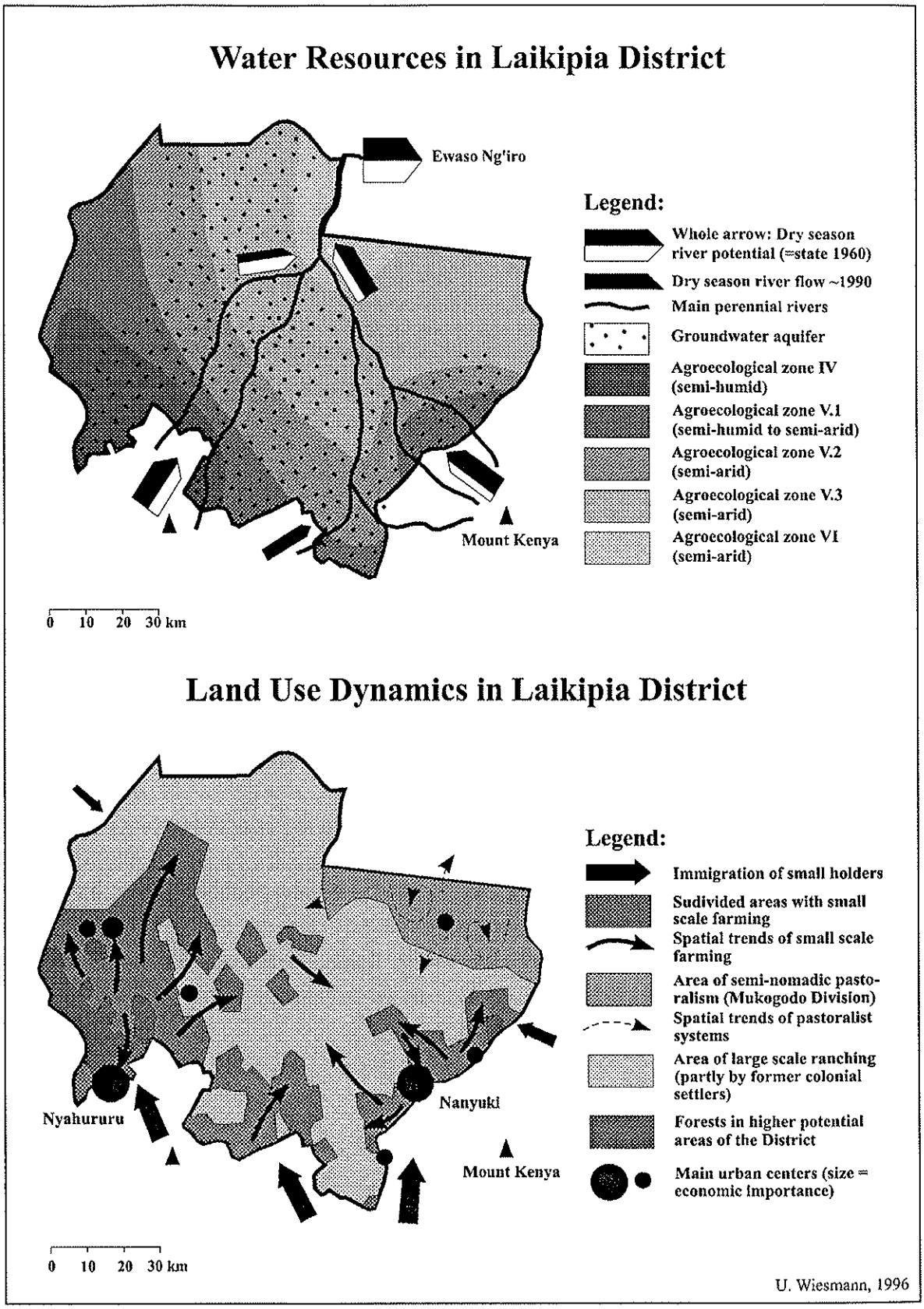


Figure 1: Water resources and land use dynamics in Laikipia District, Kenya.

seasonally or episodically. The volcanic portion of the Laikipia Plateau also has a large aquifer, but its recharge rate appears to be rather low, based on evidence from groundwater dating.

In conclusion, it can be stated that the combination of great variability in precipitation, low availability of water, and the erodibility of essentially fertile soils imposes decisive limits on the suitability of Laikipia's natural resources for human use.

2. Overall dynamics of land use and socio-economic transformation

Land use on the semi-arid Laikipia Plateau has undergone two major transformations in the 20th century, each of which was associated with a fundamental change in demographic structure.

Until the first decade of this century, the Laikipia Plateau was exclusively used by semi-nomadic pastoralists. In 1911 most of these pastoralists, who were Massai herdsmen, were displaced to southern Kenya by British colonists, and a 'native reserve' was established in Mukogodo in the north-eastern part of the District for those who remained. Most of the high plateau was incorporated into the so-called 'White Highlands', subdivided into large farms and ranches, and occupied by a low-density population composed primarily of white British settlers who mainly practised extensive, market-oriented livestock farming. This transformation of the land use system resulted in a reduction of the population from approximately 60,000 to 30,000.

A further, even more dramatic change in land use occurred when Kenya became independent in 1964. Many large farms and ranches were either taken over by the government or sold to private companies. They were subsequently subdivided into small and very small plots of 0.5 to 5 ha, and then sold to small-scale farmers from the heavily populated and fertile highlands of Kenya. This redistribution of land triggered a successive, heavy immigration of small-scale farmers which caused the population of Laikipia to swell from approximately 30,000 to almost 250,000 (1989) in less than three decades - an annual population increase of 7-8%. Along with this process of migration, a system of urban and rural centres that had already begun to form in the colonial period continued to develop. Subdivision of large-scale farms and immigration of small-scale farmers has continued undiminished, giving rise to forecasts that the population will approach 450,000 by the year 2002.

These processes of transformation are reflected in Laikipia's land-use system (see Figure 1): Massai pastoralists continue to use Mukogodo, in the north-eastern part of the District, where there are now serious signs of degradation owing to population pressure and areal constraints, as Mukogodo is not large enough to allow pastoralists and their animals to move freely and follow the rainfall. Much of the central and northern part of the plateau is still occupied by an extensive form of land use consisting of large ranches with savannah vegetation, where livestock are raised for the market. Some of these ranches are still owned by white settlers. The newer small-scale farming areas are arranged in the shape of a crescent, stretching from the south-east to the western part of the plateau, and they continue to

advance further northwards into more marginal areas. Immigrating small-scale farmers practice a subsistence form of mixed farming imported from the high-potential highlands, in which rainfed agriculture and livestock keeping are combined. Given the limitations of resources on the Laikipia Plateau, however, this farming system is not adequate to ensure subsistence. Consequently, it is supplemented with other activities such as off-farm employment.

3. Growing pressure on water resources: an environmental and developmental problem

Rapid population growth combined with the process of transformation in land use is producing a heavy increase in demand for water, primarily in small-scale farming areas and rapidly growing urban centres. This demand is being intensified by private companies that sell land as well as by local politicians, who imply that immigrating smallholders can expect benefits from irrigation. In addition, many existing water supply installations, such as boreholes and small dams, suffer degradation when large ranches are transformed into small-scale settlements, thereby widening the gap between supply and demand.

Since migrant farmers are not well organised socially and politically, and because capital to maintain existing water supply installations is usually lacking, the demand for water centres on perennial rivers, which represent the most accessible and most reliable source of water. Water intakes on Mt. Kenya and the Nyandarua Range are making increasing use of these rivers to supply rapidly growing urban centres.

The heavy increase in demand concentrated on perennial rivers has serious trans-regional ecological impacts. Heavy use of perennial streams has reduced the discharge of the Ewaso Ng'iro during the dry season by half since 1960. This has serious consequences not only for people living downstream but also for the Samburu National Park, which is of considerable economic importance, as there is a danger that the Ewaso Ng'iro will run dry during the dry season.

In conclusion, it can be stated that the dramatic transformations in land use in the semi-arid Laikipia District since the time of Kenya's independence have not only made it difficult for smallholder households to ensure their subsistence, but also threaten the existence of populations living downstream, owing to overuse of perennial rivers.

Further Reading:

Wiesmann, U., 1997: Sustainable Regional Development in Rural Africa: Conceptual Framework and Case Studies from Kenya. African Studies, Geographica Bernensia. Bern. (This publication contains an extended bibliography on Laikipia District)

Conceptual Considerations:

Water Development Planning in Laikipia:

Balancing sustainability and need in approaches to more sustainable development

1. Necessity for intervention through water supply planning in Laikipia

Against the background of the problem context (see Annex 5.2) it can be shown that one faces the following situation regarding the question of the degree of sustainability of water use in Laikipia:[1] **(1)** The reduction of dry season discharge of the Ewaso Ng'iro must be attributed to a great degree to the development of smallholder settlements in Laikipia, and has therefore to be considered as an ecological impact of resource use. **(2)** This ecological impact is valued unsustainable in terms of both the general natural potential[2] and the specific natural potential of the populations living downstream. **(3)** However, this impact is not unsustainable in terms of the specific natural potential of the smallholders in Laikipia, who at the same time are the main cause to the impact. This situation implies that the use of river water in Laikipia is **unsustainable** due to the condition that sustainability is only given if the impacts of resource use do not lead to depreciation in the values of both the general and the specific natural potential.

The conclusion on unsustainable river water use in Laikipia **calls for improvement** in the sense of increasing the degree of sustainability, or at least of hindering further devaluation. The above evaluation has shown that this improvement can not be based primarily on indigenous problem-solving potentials because the specific natural potential of smallholders in Laikipia does not assume unsustainability. Hence, the local feedback control systems between land use, ecological system and specific natural potential will barely be activated or not activated at all. This clearly implies that **external intervention is needed** if the amendment of the identified sustainability problem is declared a development goal. This external intervention has to aim at stabilising or even reducing the use of river water in the Upper Ewaso Ng'iro catchment and especially in the smallholder areas of Laikipia.

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[1] For a detailed analysis and justification see Wiesmann, 1997

[2] The 'general natural potential' refers to a valuation of the environment which is guided by norms and values of industrialised societies. The 'specific natural potential', however, refers to valuations of the environment which are guided by the norms and values of the local societies within concrete regional context. It can be argued that sustainability is only given if both, the general and the specific natural potential are not devaluated by the processes of resource use. This means that the normative concept of sustainability requires an view by 'insiders' as well as by 'outsiders'. For more detailed considerations on the concept of sustainability see e.g. Wiesmann, 1997.

This could principally be done by imposing strict regulations and controls on river water use. However, this type of approach would conflict sharply with other crucial development aims such as improving the situation of immigrant smallholder households who struggle for survival within the limiting conditions of Laikipia. This conflict is, for example, expressed by figures on main constraints to household development which rank water problems first. It can further be illustrated by the expressed need of households for the development of water supply for irrigation purposes, as **97.5%** of all households assign very high priority to this development need. This underscores that external intervention solely aimed at solving the problem of sustainable use of river water will **conflict strongly with fundamental needs of the concerned population**. In combination with the ongoing subdivision and immigration processes, this impressive figure on water development needs further implies that the **exploitation of river water will not only continue but will increase in future**. Grassroots-oriented development projects and decision makers will additionally support and promote this process in an attempt to respond to the expressed needs of the smallholders, within the planning procedure of the Kenyan District Focus available since the mid-1980s, which is based on bottom-up collection of project proposals.

Against the background of the increasing need for external intervention to solve the sustainability problem, and its inherent conflict with essential needs of the smallholders in Laikipia, it becomes clear that promising approaches to sustainability must primarily concentrate on the water supply problem in Laikipia. This necessary concentration on water supply implies that approaches must be found which **balance the need for reducing use of river water with the need to increase water supply to smallholders**. It is obvious that such approaches can not be primarily community based, but require a regional perspective which can address the distribution problem of water resources in light of the sustainability criterion of a minimum discharge of 1.5 m^3/sec at the outlet of the Ewaso Ng'iro from Laikipia. Hence, **regionally oriented water supply planning** is required.

2. Requirements for water supply planning aiming at sustainable use of water resources in Laikipia

Through the above considerations of the necessity of and potential conflicts faced by interventions aiming at addressing the identified sustainability problem of river water use, we have concluded that planning of water supply development on the regional level is urgently needed due to the ongoing dynamics of socio-economic transformation and the increasing pressure on water resources in Laikipia. Such water supply planning must take the following problems into account and find ways of fulfilling related **requirements**:

1. **The problem of sustainable use of water and other natural resources:** An expansion of water use in Laikipia, necessary to ensure the existence of a population that continues to grow rapidly, must not be allowed to threaten the long-term availability of water resources in the District and in areas downstream. Water supply planning has therefore especially to ensure the sustainable level of dry season discharge of the Ewaso

Ng'iro established above. In addition, water supply development must not lead to concentrations of land use and changes in use that endanger further natural resources such as vegetation cover and soils.

2. **The problem of water distribution based on need priorities:** Planning for water supply development must ensure that the supply situation can be improved first for those segments of the population suffering most from a shortage of water. The requirement for prioritisation according to needs becomes even more important in a development context where funds for the implementation of supply systems are very limited, and even tend to shrink on a per capita basis due to increasing population and stagnating support from the Government and development agencies. This implies that the planning approach has not only to establish the urgency of needs but must also make sure that special interests - which may be politically represented by local decision makers and administrators - do not override the need-criterion.

Although the balancing of sustainable water use and development of need-oriented supply are the key requirements of water development planning in Laikipia, further problems have to be considered and respective requirements taken into account:

3. **The problem of technical suitability of supply systems:** Water supply systems proposed by the planning process must be technically designed with the level of organisation and the financial resources of the local communities in mind if their long-term maintenance is to be ensured. As the level of community organisation of smallholders in Laikipia is rather low due to the situation of immigration, and as the financial resources of the households are generally very limited and preferably invested in the development of the newly settled plots, this requirement becomes very crucial if the proposed supply systems are to cover the needs reliably.

4. **The problem of acceptance by smallholders and decision makers:** If water supply planning which fulfils the above requirements is to be implemented in a binding way - i.e. by not being sidelined by water supply investments which are not compatible with the plan and its sustainability and need-orientated goals - it will require acceptance by all involved parties. This means that the planning process must not only respond to the needs of the local communities of smallholders but it must also gain the support of decision makers, institutions and agencies involved in water supply development. In the context of Laikipia, this requires strengthening of the links between the District Focus and the sectoral planning apparatus of the line Ministries, as well as co-ordination among the different donor agencies.

5. **The problem of dynamic modification of water supply planning:** Given the extraordinary dynamics of socio-economic and land use transformation in Laikipia District, a plan must be developed that will not just deal with the above problems for several years but will allow dynamic modification in the form of rolling planning. Thereby the principle has to be applied that adaptations to changing supply needs should be

made possible without endangering the requirement of long-term sustainable use over water resources.

The following chapters will demonstrate a practical path to planning of water supply development for Laikipia District which fulfils the above requirements. The 'Water Development Plan for Laikipia District' was realised during the early 1990s.[3]

3. Main features of the approach to water development planning for Laikipia District

In accordance with the requirements mentioned above, the **aim** of the water development plan was formulated as follows:

> *'The Water Development Plan for Laikipia District aims at the identification of areas where projects could be implemented within three to six years and which optimise the impact of water development in the District, taking into consideration a long-term rational utilisation of the natural and implementing resources for domestic, livestock and agricultural purposes in rural areas' (Leibundgut et al. 1991, 2).*

This aim implies **three main questions** about water development that must be addressed by the regionally oriented planning approach:

1. Where and for what purpose should the water supply be developed? This is a question of spatially differentiated priority of supply needs and the prioritisation of supply for domestic, livestock and agricultural purposes.
2. Which components of the hydrologic cycle should be used for supply in each case? This is a question of spatially differentiated long-term water potential available for various designated purposes, taking into consideration the sustainability criteria established above.
3. What technical approaches should be employed to make designated water potential usable for the purposes identified? This question raises the issues of implementation sustained by the population and prevention of undesirable ecological and socio-economic side effects.

These three main questions are addressed in a **multi-stage approach** which is illustrated in **Figure 1**:

1. In the first stage, relevant baseline information about ecological and socio-economic systems, and especially about water resources, water demand and existing water supply are transferred to planning units and structured into three data and information blocks: (1) general water potential of different components of the hydrological cycle, (2) pres-

[3] The plan was elaborated in collaboration between the Laikipia Research Programme, relevant Authorities and Ministries of the Government of Kenya, and a supporting group of hydrology experts. See Leibundgut, Kabuage, Mozer & Wiesmann (1991), Mozer & Wiesmann (1991), Wiesmann (1992 and 1997).

ent and projected supply deficiencies related to the different purposes of supply, and (3) further ecological and socio-economic considerations.

2. In the second stage, certain planning units are excluded from further consideration on the basis of ecological and socio-economic arguments. The remaining planning units are then ranked in order of priority for water development on the basis of supply deficiencies, and implementation of the plan should take place according to this ranking.
3. In the final stage, an individual water supply development strategy is designed for each priority area, describing what type of water potential is to be developed to what degree, for what purpose, and with which implementation approach and specific technical options. These specific strategies by priority area provide the basis for planning and implementing individual projects.

In principle, this briefly outlined approach fulfils the requirements for regionally oriented planning of water supply development mentioned above: It is based on an assessment of water potentials which takes sustainability criteria into account, it prioritises the needs for water supply deficiencies, and it outlines boundary conditions for area-specific strategies. It thus provides the basis to shift from a top-down approach necessary to solve the distribution problem in a sustainable way at the regional level, to bottom-up approaches involving local communities at the level of site-specific implementation of water projects. In order to illustrate this, we will discuss the procedures and results at the different stages of the approach, with **special emphasis on methodological problems and principles** to be addressed at the different stages.

4. Problems of spatial reference and information basis for the water development plan

One key conceptual and methodological problem is relevant to all stages and greatly influences the results and the quality of water development planning: The choice and delineation of **planning units** and the transfer of relevant information to these units. The choice of planning units is crucial because it determines the level of spatial and societal differentiation in the planning approach, and because it plays a decisive role in determining how financial and other resources employed for implementation will be optimised according to the urgency of the need for water supply development. Implementation will thereby be more effective and efficient if planning units are as homogeneous as possible in terms of the water potentials of the different components of the hydrological cycle, and even more important, in terms of the need for water development expressed by supply deficiencies for different populations and purposes.

Based on these considerations the primary **criterion for the delineation of planning units** as a spatial reference for the water development plan must be the homogeneity of socio-economic structures and land-use systems. Further divisions of reference units can then be made according to the additional criterion of homogeneity of ecological conditions. These

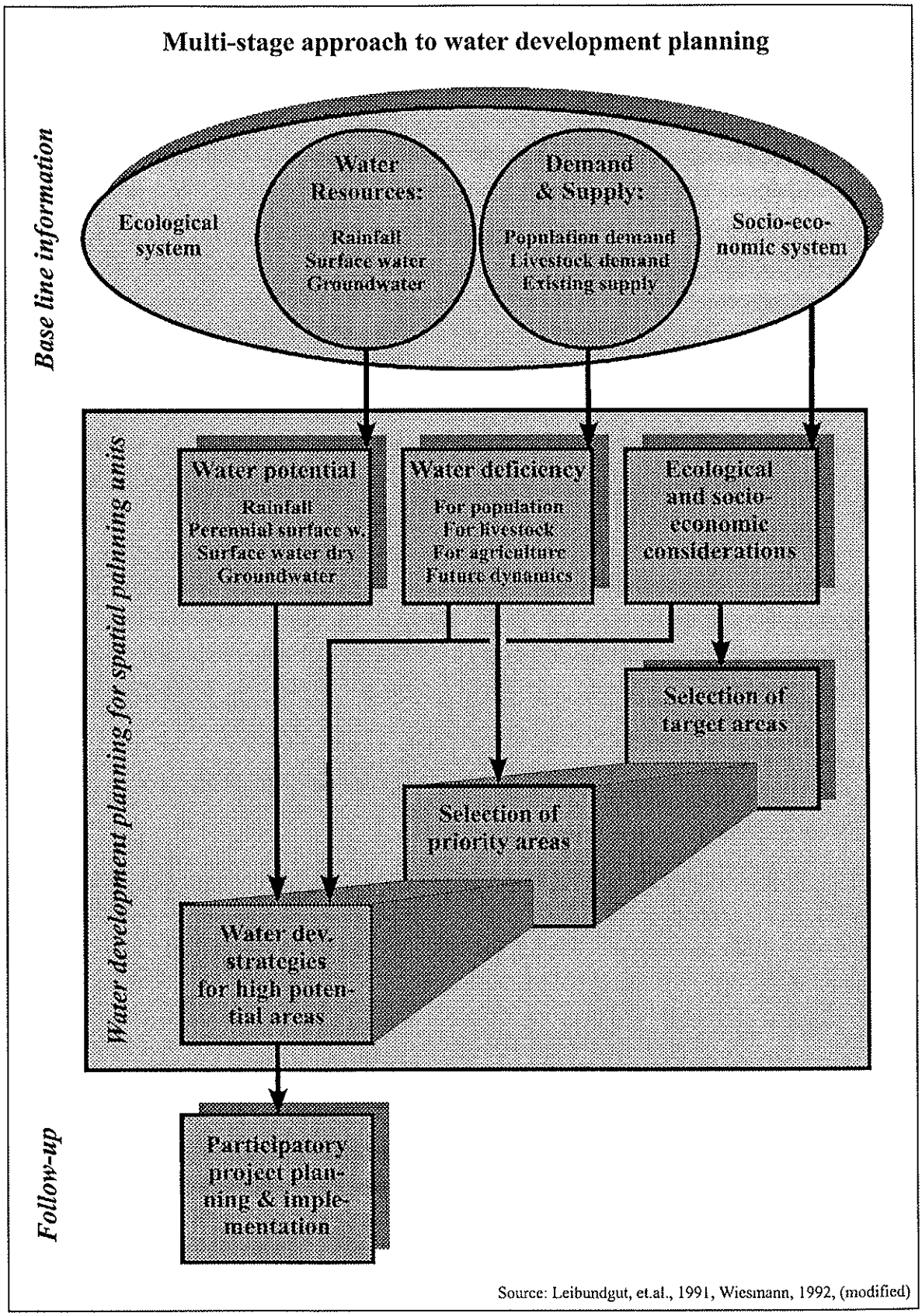


Figure 1: *Model of the multi-stage approach to water development planning in Laikipia District*

criteria make it clear that the spatial frames of reference which are often applied in planning approaches, such as large catchment areas or administrative units, are not adequate for the required optimisation of resource inputs for implementation on the basis of needs. They can actually have a counterproductive effect in that they may intensify shortcomings in the planning procedures mentioned above and encourage distribution based on special interests and political representation.

In the case of Laikipia, the above criteria for the delineation of a spatial frame of reference for the water development plan are applied by choosing estates - mainly former large-scale farms and ranches - as planning units. Since these estates were each subdivided into small plots at a specific time and subsequently settled, they fulfil the stated conditions of homogeneity to a great extent. In view of implementation, it is also important to note that the formation of self-help groups and local project groups is frequently done on the level of these estates, and that they can also be aggregated to administrative units such as locations and divisions, and are thus compatible with the District Focus. In cases of considerable inhomogeneity within single estates in terms of land use or natural conditions, further subdivisions are made.

The type of spatial reference for planning purposes is of crucial importance in **compiling relevant information at the selected level of planning units** (see Figure 1). Two fundamental problems are evident here:

1. **The problem of disaggregation:** In development contexts in rural Africa, often only imprecise and heavily aggregated data are available on topics relevant to planning, such as land use, natural resources, population and socio-economic structures. Hence, there is a problem in breaking down this aggregate information at the level used for the selected spatial reference of planning. Based on the above considerations, that only disaggregated spatial planning units and respective information will make it possible to free planning from the grip of special interests and keep it focused on the needs of the impoverished population, the quality of this information break-down will be decisive for the quality of planning. This implies that complementary inventorial surveys on different topics may constitute a key element in relevant and application-oriented research in development contexts. In the case of a water development plan for Laikipia, one can build on the data base which was established by the Laikipia Research Programme, in view of its application to regional development planning aiming at sustainable development.
2. **The problem of spatial overlapping:** For many areas of rural Africa relatively detailed information would be available on aspects such as geology, soils, climate, surface water, vegetation, etc. But regardless of their quality, these data are often revealed only in summary fashion or not at all in spatially differentiated planning processes. One reason for this is that these data are not converted into information relevant to problems addressed by planning, to a great degree because the methodological problem of spatial overlapping of different spatial frames of reference is not addressed. In the case of water development planning this would, for example, mean that the problem of individual

natural units such as catchment areas which overlap with planning units is not addressed, causing problems with regard to attributing water potentials and ecological conditions to the spatial frame of reference for planning which is necessarily justified mainly on a socio-economic basis (see above). In the water development plan for Laikipia District, this problem is solved by converting existing information about hydrological characteristics and processes into potentials of the different water components for hydrologically relevant spatial units. These potentials are then distributed to the planning units according to the quantitative relations of spatial overlapping between the two spatial frames of reference.

Against the background of the considerations on spatial references, which are decisive for the quality of the regionally oriented planning approach to water supply development, we may now turn to the questions of how to balance long-term perspectives on sustainable use of water resources with short-term perspectives on the need for and the urgency of water supply development.

5. Long-term perspectives on sustainable use of water resources

As we have pointed out, the long-term perspective on the water development plan for Laikipia District is to promote more sustainable use of natural resources, and especially of river water, where a serious sustainability problem was identified which has trans-regional consequences. According to the approach outlined above, this aim is attained by assessing sustainable levels of water use for the different components of the hydrological cycle. This means that the sustainably available water potentials for different supply purposes - such as supply for domestic, livestock and agricultural purposes - have to be assessed and distributed to the planning units, using the procedure described above. Several **methodological problems** are apparent in this required assessment of water potentials for different purposes per planning units in Laikipia:

1. **Distinguishing components of the hydrologic cycle:** The hydrologic cycle has to be divided into separate usable components such as collectable rainwater, perennial surface water, storable seasonal or episodic surface water, and groundwater. However, the dynamic link between these components must not be neglected when calculating their respective potentials. Thus, for example, not all flood flow from perennial and episodic surface water is available for use, since it is very likely that this flood flow contributes significantly to groundwater recharge. Hence, a portion of these flood flows has to be excluded from classification as available potentials.
2. **Maintaining a minimum discharge of the Ewaso Ng'iro River:** As we have discussed above, the requirement to maintain a minimum discharge of 1.5 m^3/sec of the Ewaso Ng'iro at the outlet of Laikipia is one of the key criteria for sustainable water use and a key argument for the urgency and justification for a regional planning approach to water supply development. This implies that the potential of perennial surface

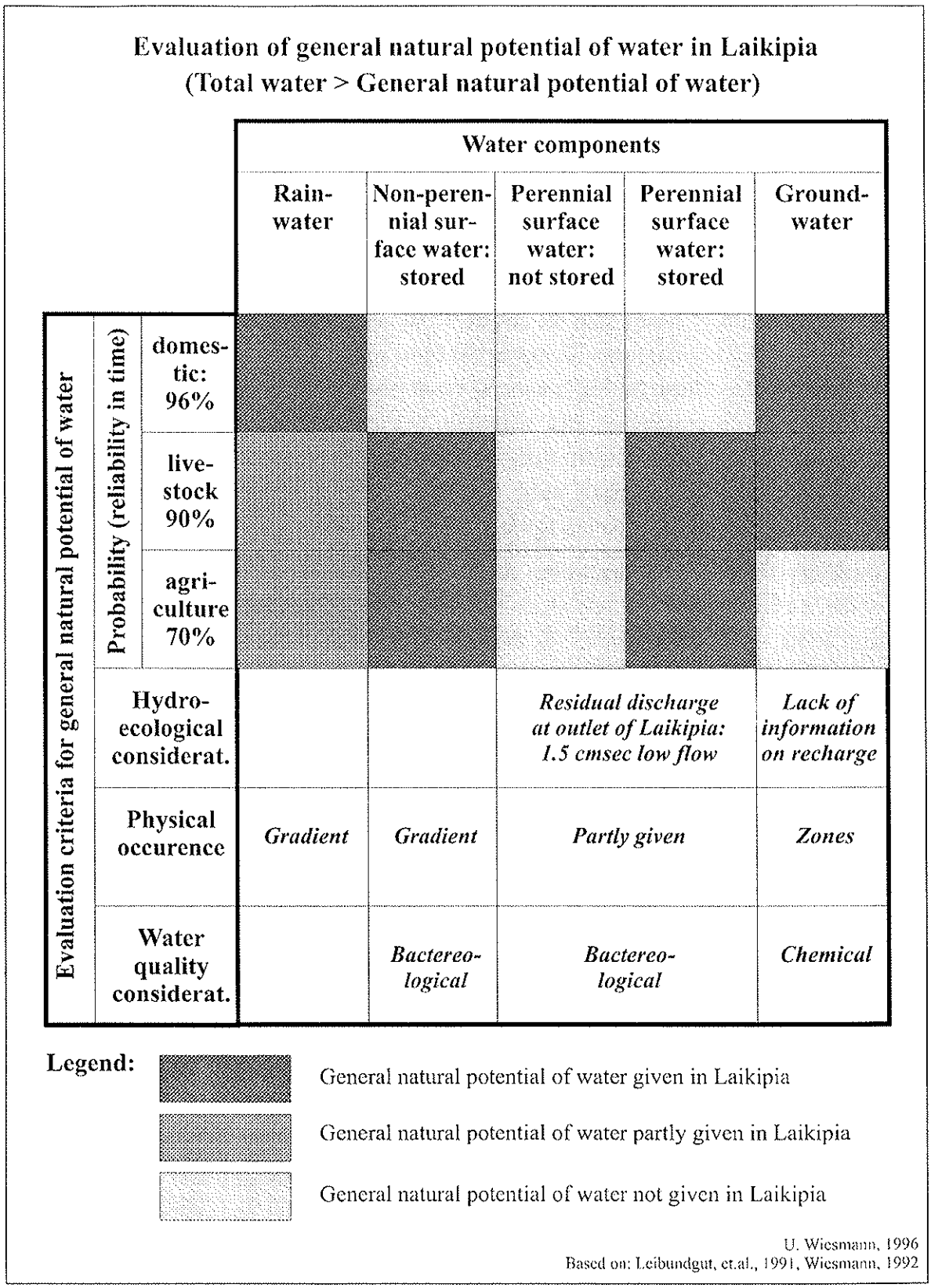


Figure 2: Criteria and results of the assessment of water potentials for different supply purposes in Laikipia District

water can only be distributed among planning units after allowing for this minimum discharge. As the required minimum discharge corresponds roughly to the summarised Q90% values of the daily duration curve, this is reached by only allowing low flow abstractions if the actual discharge exceeds this value.

3. **Considerations on reliability and quality of water components:** The temporal reliability and physical occurrence, as well as the chemical and bacteriological quality of water, are crucial factors in calculating the potentials of the different water components for the different purposes. Because the reliability level must be higher for domestic water (96%-reliability level) than for livestock purposes (90%) or irrigation (70%), and because quality requirements decline in the same order, potentials will increase sharply in reverse order. Given the high temporal variability in the hydrological cycle of the Upper Ewaso Ng'iro catchment, this means, for example, that water potentials for domestic purposes are much smaller than for irrigation purposes. From this consideration alone, it follows that domestic water supply will take priority over livestock and agricultural purposes when it comes to eliminating deficiencies.
4. **Dealing with lack of information:** As all information necessary will never be available within a planning process, allowance has to be made for the lack of adequate information about several components. In the case of Laikipia this is true particularly for the groundwater recharge rate. Determination of potentials is therefore based on conservative estimates in order to ensure preservation of resources. Estimates of water potential can be modified in the process of rolling planning if better information becomes available.

Figure 2 summarises the above methodological considerations and roughly indicates in which components of the hydrological cycle and for which purposes water potentials are available on a sustainable level in Laikipia.

The main results of the relatively complex process of calculation and assessment of water potentials for Laikipia can be summarised as follows: First we must note that the **direct use of perennial rivers** e.g. by means of pumps, furrows, pipelines, etc., **has reached its absolute limit**. This means that the water development strategy in use since subdivision of former large-scale ranches and subsequent immigration of smallholders must be discontinued immediately. On the other hand, perennial and episodic surface water represents a **considerable storable water potential** for livestock and agricultural purposes. However, this potential does not exist for domestic water owing to high reliability and quality requirements. For domestic purposes, strategies based on groundwater and rainwater harvesting come to mind and it can be noted that harvesting rainwater from roofs can considerably increase the supply of drinking water, but that as a rule an additional source of supply - e.g. groundwater-based - will be necessary.

In summary, this brief presentation of the water potential assessment in Laikipia demonstrates that there is **considerable potential for further supply development** for domestic, livestock and agricultural purposes in all planning units of the District. However, it also

clearly outlines that these potentials no longer exist in the water component which has been preferred by smallholders up to now. This implies that **further water supply development must necessarily be diverted to other water potentials** than direct abstraction from perennial rivers, if water is to be used sustainably in future.

6. Short-term perspectives on the supply needs of local communities

The aim of the evaluation of water supply needs is to show where, with what urgency and for what purpose water should be made available through supply systems which are based on the established water potentials. Contrary to the assessment of these water potentials, which show what water amounts could be used on a long-term basis without endangering sustainability criteria, the **evaluation of supply needs has to be short-term and modifiable**. This is to allow for reaction to the ongoing dynamics of socio-economic and land use transformation in Laikipia, as well as to future changes in water supply needs.

According to the multi-stage approach outlined in Figure 1, water supply needs are in principle evaluated by looking at the difference between water demand and supply in terms of supply deficiencies per planning unit. These deficiencies are then ranked in order to identify priority areas for water supply development. However, this evaluation process involves several **conceptual and methodological problems** which relate to more than just the problems of information gaps already mentioned. These problems and the solutions which are applied in the water development plan for Laikipia District are briefly presented and discussed below:

1. **Selecting target areas for water development planning:** Supply deficiencies as an expression of need cannot be the only criterion for selecting areas to be developed. It is also necessary to anticipate the potential undesirable side effects of expanding the water supply. Forests and swamps in Laikipia are excluded from the selection process for this reason, since water development in such areas could further intensify the already existing land use pressure, producing a threat to these ecologically significant sites. Furthermore, the large-scale ranches still in existence are also excluded since they have the economic power to ensure water supply for their mainly extensive land use systems within the limits of the established water potentials. This preliminary selection process limits the target areas for water development planning to small-scale farming areas and to Mukogodo, which together represent more than 75% of the rural population of Laikipia. Some of these selected planning units are designated as 'observation areas' and excluded for the time being from further consideration because land use in these units is presently undergoing major transformation. It is recommended that the further development of these areas be observed before a decision on possible water projects is made.
2. **Setting of priorities among supply needs for different purposes:** Before supply deficiencies can be ascertained, priorities have to be established among the different purposes of possible water uses: Based on the consideration that domestic water and especially drinking water are necessary conditions of existence, they are assigned the highest

priority. Setting priorities for water supply development for the two economic activities of animal husbandry and crop farming is more difficult. In the water development plan priority is given to water supply for livestock, based on the argument that animal husbandry provides an important economic buffer within the household strategies of smallholders and is the key activity of pastoralists. Furthermore, giving higher priority to water supply for domestic and livestock purposes makes it possible to avoid the problem of water demand for agricultural purposes being virtually unlimited: Through this priority ranking of the three purposes, the demand for irrigation water loses importance in selection of priority areas and it can be satisfied in part by potentials not used to supply domestic and livestock water needs. Thereby it is important to recall that there is more water available for agriculture than for the other purposes, due to the lower reliability requirements.

3. **Evaluation of supply deficiencies:** Based on the above considerations, evaluation of supply deficiencies in each planning unit can be limited to water supply for domestic and livestock purposes. Thereby current supply is calculated on the basis of an inventory of 405 supply systems such as dams, wells, boreholes, springs, furrows and piped systems etc., as well as on an assessment of direct use of river water by people and livestock. The quality of water is further taken into account by reducing actual supplies if the source of water poses quality problems. On the demand side with regard to supply deficiencies, demand for domestic water is determined by taking account of average use per household, and future projections are made for each planning unit using a population model. Another procedure has to be used to determine demand for animal husbandry: In order not to promote overstocking because of an over-expanded water supply, water demand is calculated based on numbers of livestock that do not exceed the potential of fodder on pastures.

4. **Selection of priority areas for water supply development:** Supply deficiencies for both domestic and livestock purposes in each planning unit result from the difference between supply and demand. In order to establish a comparable unit of measure for ranking, a 'basic need factor' is calculated that expresses the deficit per person and per head of livestock as a percentage. Although this is a good measure for establishing individual need, areas of low or very low population density show particularly heavy deficits. Thus a 'development factor' is additionally calculated to express the corresponding deficit per km^2. The two factors are combined to rank planning units according to supply deficiencies, both for domestic and livestock purposes, thereby telling where and for what purpose water supplies should be made available. By weighting the two rankings, it is further possible to establish implementation priorities chronologically: Planning units that have heavy deficiencies in both areas receive the highest priority, while those with largely domestic water deficits receive the next highest priority, etc. This combined priority ranking therefore indicates in which sequence development support for water supply should be given to the local communities in the respective planning units.

This brief description of the evaluation of priority areas for water supply development illustrates that its purpose is spatio-temporal channelling and optimisation of development support by all institutions and agencies employed in water supply development, according to supply needs which are evaluated in a comparable way for the whole District. This approach allows efficient response to the urgency of water supply needs in a way which is not dominated by special interests or the virtually unlimited demand for irrigation within the planning process.

7. Water development strategies for priority areas and perspectives on rolling planning

The evaluation process of priority areas for water supply development indicates where and for which purpose water projects should be implemented. Against this background, focus can shift to the single selected planning units, and from the top-down approach of the regional planning process to a more participatory, **bottom-up approach** on the level of the local communities in order to elaborate **specific water development strategies for every selected area**.

The process of water development planning on the regional level provides **guidelines and boundary conditions** for the participatory development of such specific strategies: The selection process of priority areas establishes which quantity of water should be provided for what purpose. At the same time the assessment of sustainably available water potentials for each planning unit indicates which water component could be used to provide the required supply.

Within this framework set by the water development plan, local communities in collaboration with implementing agencies can now **develop and implement concrete projects** which are adapted to the specific local conditions and the needs of the concerned population. Thereby it is important to note that this process is not limited to the domestic and livestock water supply needs which were used to select priority areas, due to the higher urgency attributed to deficiencies referring to these purposes. On the contrary, the development of concrete strategies in the selected priority areas **must also consider the local demand for agricultural purposes**, which is given very high priority by smallholders. After deduction of the water needed for projected domestic and livestock purposes, the assessment of available water potentials indicates which type and amount of water could be made available for irrigation purposes.

In summary, the outlined regionally oriented planning process for water supply development in Laikipia District fulfils the planning requirements outlined above: It allows participatory development and implementation of water supply projects which are adapted to the local needs, capacities and conditions within a framework of need-oriented prioritisation on the regional level, and based on water potentials which can be used without endangering the aim of sustainable use of water resources in Laikipia. The fact that some key agencies employed in water supply development in the District have adapted their programmes to

the outlined plan further underscores that the water development plan fulfils the above requirements not only on a conceptual but also on a practical level.

Moreover, the outlined planning procedure not only provides a plan for the implementation of water projects in the near future, but also a **tool for rolling planning**: The great advantage of this approach is that it clearly distinguishes between the long-term-oriented assessment of sustainably utilisable water potentials in all planning units and the short-term-oriented evaluation of supply needs based on supply deficiencies in target areas. This allows regular updating of the concrete plan with much less input than what was needed to establish its first version: The supply situation simply needs to be re-evaluated and recalculated every few years and new priority areas determined, whereas the complex assessment of water potentials can continue to serve as a base for water supply planning and only requires modification if there is new information about the hydrologic cycle - e.g., if additional investigations of groundwater reveal a greater recharge rate than assumed here.

8. Supplementing water development planning with a broader development strategy

The regionally oriented planning approach to water development in Laikipia District demonstrated an operational way for dealing with the serious sustainability problem which results from the socio-economic and land use dynamics in Laikipia and which will not be solved through indigenous self-regulation. The main thrust of this approach is to effectively and efficiently respond to needs within a framework delineated by sustainably available water potentials. It is therefore based on the principle that strategies to enhance ecological sustainability in rural development contexts can only be successful if they are closely related to the problems of existence of local actors and communities and respond to relevant needs. This is especially crucial in cases where the sustainability problem to be approached is either not reflected or hardly reflected in the specific natural potential but is identified within the general natural potential.

Due to its primary focus on needs, the approach developed here is likely to gain broad acceptance. However, it does not fully guarantee sustainable use of water resources on the long run, due to the extraordinary dynamics of socio-economic and land use transformation on the Laikipia plateau and due to the virtually unlimited water demand for agricultural purposes from the immigrant smallholders who face great difficulties in ensuring their survival. This implies that the approach to water development has to be bound into a broader development strategy which supplements its thrust and thus reduces the risk of being overridden by the dynamics taking place in Laikipia.

Such a broader strategy will have to be based mainly on **two principle thrusts**: On the one hand, it will have to include components and measures which support the acceptance and implementation of the outlined planning approach. On the other hand, it will have to shift from the supply focus of the water development approach to a focus on the demand side of

water use, thereby aiming at strengthening indigenous feedback control systems and at reducing or controlling the dynamics in Laikipia.

The aim of the **first thrust** is to enhance acceptance and implementation of the present approach to more sustainable water use. As we have outlined above, the principle of this approach is to respond to needs by diverting the water demand to those water components which do not pose sustainability problems. Both aspects of this principle will cause problems: The need orientation is based on setting priorities, thus leaving needs uncovered which were not yet attributed high priority. The diversion to alternative water sources is hardly anchored in smallholder strategies and in current planning approaches due to the fact that these alternatives are not immediately obvious and that the cause of this diversion - the sustainability problem of perennial rivers - is not reflected in the specific natural potential. These problems need to be addressed at the following levels, which thus indicate components of the broader strategy required to supplement the water development approach:

- **At the community level:** In order to prevent circumvention of the water development plan by communities and smallholders trying to cover their water demand by abstracting river water by their own means, provision has to be made to react to these local initiatives, but not merely by enforcing controls and the application of the legal framework. Rather, this reaction has to provide support to local initiatives in the sense of technical - and perhaps material - support aiming at diverting the local projects to alternative water sources. This means that not only the communities in the priority areas of water development should profit from external support but also all the others, given the development of local initiatives. This further implies that a general thrust - not only involving the water sector - has to be enforced, aimed at strengthening community organisation with special emphasis on the immigration areas of Laikipia. A likely side-effect is that better community organisation would also increase the technical options for water supply development.
- **At the level of District planning:** A key problem at this level is to guarantee continuity with reference to the application of the principles of the present approach to water development, as this réquirement sharply conflicts with the rapid turnover of administrators and technical personnel at this level and with often punctually appearing - and disappearing - donor agencies. This implies that provision has to be made to guarantee continuity, e.g. through regular awareness and training campaigns and through increasing donor co-ordination. The institutional memory at the District level could be further promoted if the principles of the present approach are used to guide personnel evaluation at the superior political level.
- **At the level of the whole Ewaso Ng'iro catchment:** The water development plan for Laikipia is based on a perspective on the whole Ewaso Ng'iro catchment but consequences are limited to Laikipia District. However, water use will only be sustainable in the long-term if the Districts upstream and downstream apply similar approaches. This requires a guiding overall strategy and co-ordination for the whole catchment.

These briefly outlined components of a supplementing development strategy will enhance the probability that the principles of the water development approach are applied and implemented in the long run. However, they do not yet guarantee that the approach to more sustainable use of water will not be overridden by the dynamics on the Laikipia plateau. We have therefore to turn to the **second thrust** which shifts from the supply focus to a focus on the demand side of water use, aiming at reducing or diverting this demand. Contributions to this aim can be identified at the following levels:

- **At the level of crop farming:** As we have already underscored several times, the main problem hindering sustainable use of water resources is the water demand for agricultural purposes coming from immigrant smallholders. Due to their problems of ensuring their survival in semi-arid Laikipia and continued immigration, this demand is likely to increase further and can hardly be directly controlled (see above). Therefore the only promising approaches to influencing this demand are, on the one hand, to divert it to other water sources in the way outlined above, or, on the other hand, to potentially reduce it by reducing the risks involved with crop farming when there is no access to irrigation water. This can be done by either promoting crop varieties which are more drought resistant (and in the Laikipia situation also resistant to cold), or by promoting land use techniques - such as mulching - which reduce soil water losses during dry spells. However, such approaches will only reduce water demand for irrigation if their effects are considerable, and especially if they fit into the multi-strategies of smallholders. As an example of this, it was shown that a conflict exists between crop farming and animal husbandry over mulch material. Hence, mulching will only be an option if this conflict can be resolved.

- **At the level of household strategies:** Even if crop varieties and land use techniques contributed principally to reducing risks of crop failure, two further problems occur: One is that only those smallholder households who can afford to take the risk of experimentation will adapt these alternatives. The other is that the demand for irrigation will still persist - although with less urgency - because these alternatives will not fulfil the expectations linked with irrigation. These problems can be approached by creating and promoting opportunities in other spheres of action of the multi-strategies of smallholders than crop farming. Such opportunities can mainly be identified in relation to animal husbandry and off-farm employment, and may contain a wide range of concrete measures, extending from promoting bee keeping or ostrich farming to offering better training or credit schemes in promising areas of off-farm employment. We will not discuss the advantages and disadvantages of these options here, but we would like to underscore that they have to be seen as a part of water strategy.

- **At the level of settlement and land use planning:** Even if the above attempts to reduce agricultural water demand succeed, their effects may be compensated by continued immigration of smallholders. Therefore, approaches have to be found to reduce immigration in the long run. One option is to prevent further subdivision of large-scale ranches by establishing an outer settlement boundary, even if this involves a complex

process which has to involve the national level due to its legal implications. Another option is to develop alternative settlement structures combined with changed legal status and management of pastures in smallholder areas, which would imply buying plots of owners who have not yet settled.

This brief discussion of components in a development strategy to supplement water development planning in order to increase the chances of solving the serious sustainability problem of water use in Laikipia, has illustrated the complexity of such an attempt: It must necessarily involve a broad spectrum of different sectoral components which relate to actors and institutions from the local to the national level. In other words: many ongoing sectoral planning and implementing activities taking place at the different levels of decision making also have to be understood and evaluated as contributions - or hindrances - to a broader development strategy aiming at increasing sustainability, even if this is not obvious at first glance.

Further Reading:

Wiesmann, U., 1997: Sustainable Regional Development in Rural Africa: Conceptual Framework and Case Studies from Kenya. African Studies, Geographica Bernensia. Bern. (This publication contains an extended bibliography)

Annex 6
Previous Aguasan Workshops

1	Water Decade	1985
2	Participation and Animation	1986
3	Sanitation And Health	1987
4	Operation and Maintenance	1988
5	Monitoring and Evaluation	1989
6	Sustainability of Drinking Water Supply and Sanitation Projects	1990
7	Monitoring and Evaluation	1991
8	Communication in Development Cooperation	1992
9	Water is no longer a free resource: Who pays?	1993
10	Sustainable Water and Sanitation Projects through Fair Negotiations	1994
11	Urban Sanitation: the Challenge to Communities, Private Sector Actors, Local Governments and External Support Agencies	1995
12	Transfer of Ownership in Water Supply and Sanitation Systems	1996
13	Less Water for More People	1997

Annex 7
Suggested Topics for the Aguasan Workshop 98

Legal Systems
- collective responsibility for water supply and sanitation
- water laws connected to water use
- traditional and modern water laws
- outside influence into systems, e.g. in watershed

Environmental and economic issues
- community self-financing in water supply and sanitation

Private versus public sector
- privatisation and globalisation in water supply and sanitation
- community management systems
- users and viability of the water sector
- Government responsibility in water supply and sanitation
- water as a common good

Technical and methodological issues
- human and technical dimensions of flood control
- urban or peri-urban problems in water supply and sanitation
- models and experiences in water supply and sanitation
- peri-urban agriculture and water supply / sanitation
- waterquality especially in urban sector
- drainage in rural set-ups
- solid and liquide waste disposal in rural areas

Institutional issues
- organisation and management
- organisational and institutional development
- institutional building at local level
- researchers, consultants; (we) and the institutional memory
- key players in watersector

Scarcity issues
- scarcity of quality, quantity, access, finances, technical knowhow in water supply and sanitation
- allocation of water for different purposes: new visions
- water supply under condition of scarcity (can we learn from history)

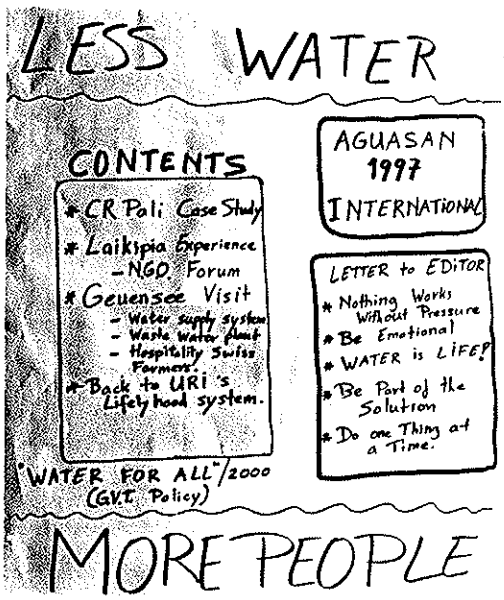
Education and human resource development
- how to maintain an adequate knowledge base in the sector (water supply and sanitation

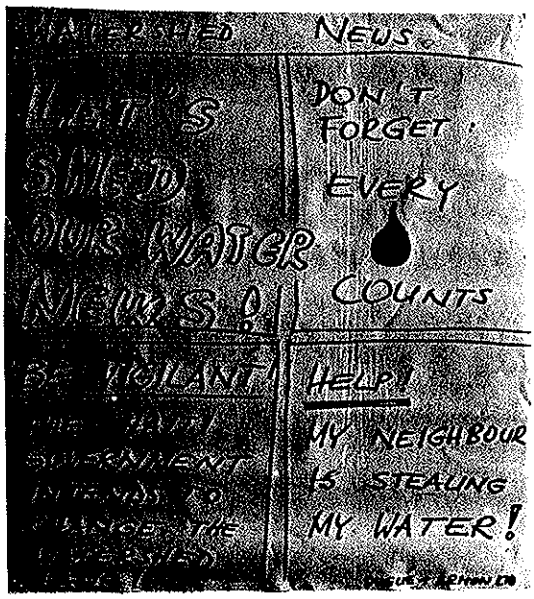
Local knowledge systems
- how is development aid perceived by the receiver
- ecosystems and local knowledge of water supply
- water and culture
- understanding myths around water

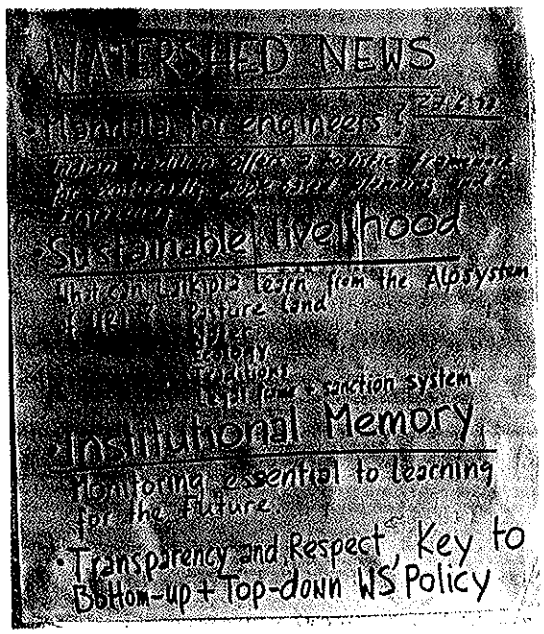
Annex 8

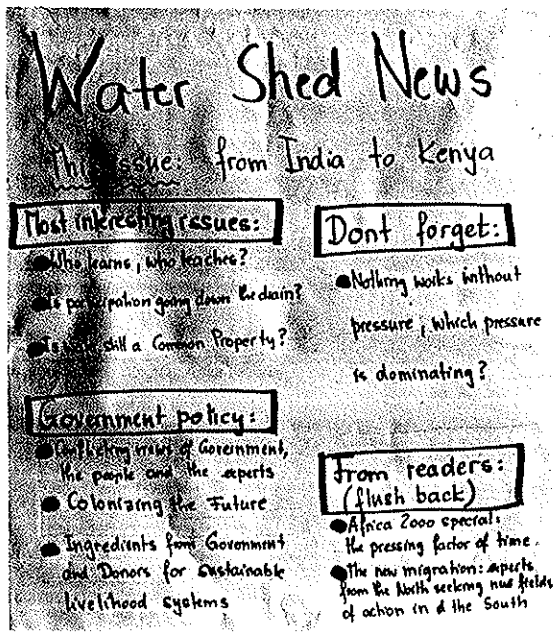
Ten Title Pages of Watershed News

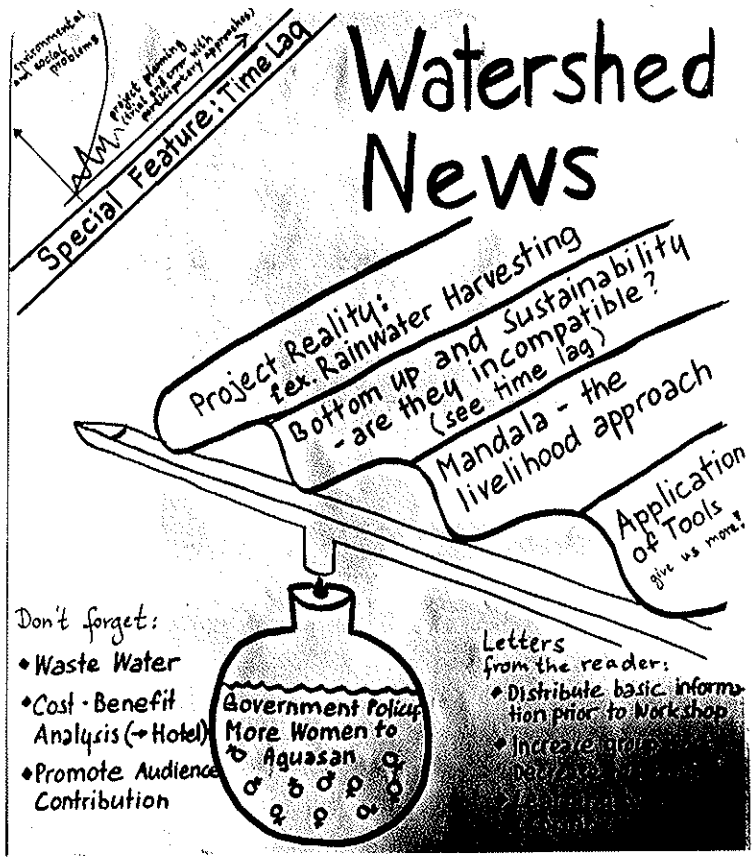
As a kind of review on highlights of the workshop and gained insights, all participants (in groups of two) have been asked at the end of the workshop to produce a front page of a newsletter. The results are as follows

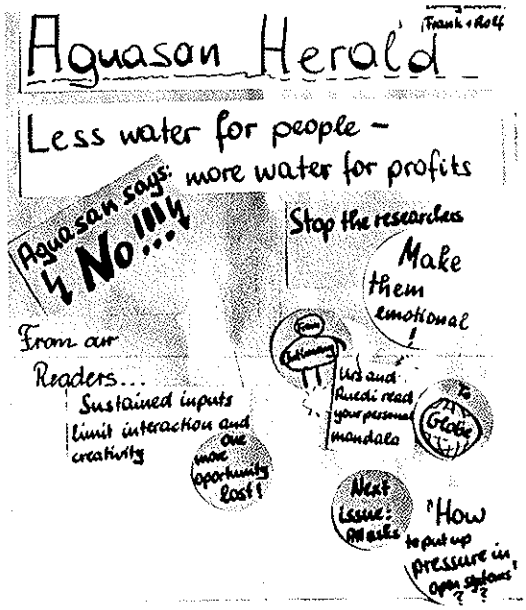


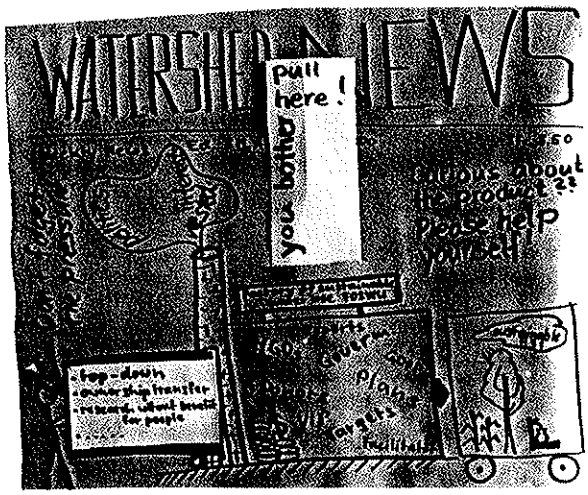


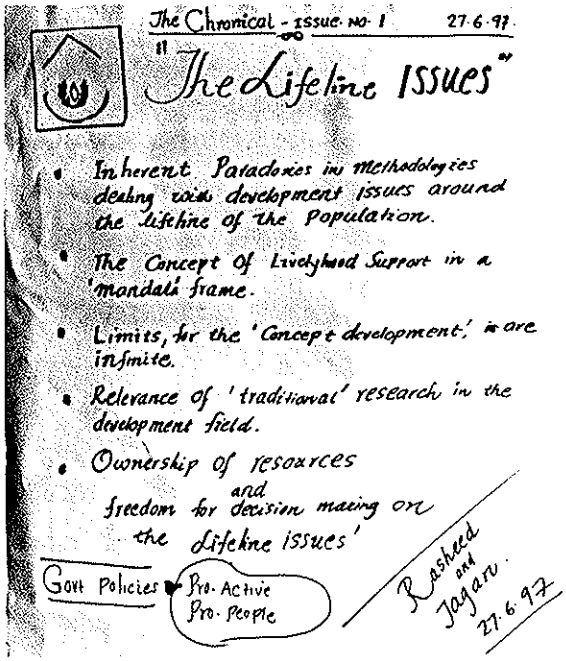


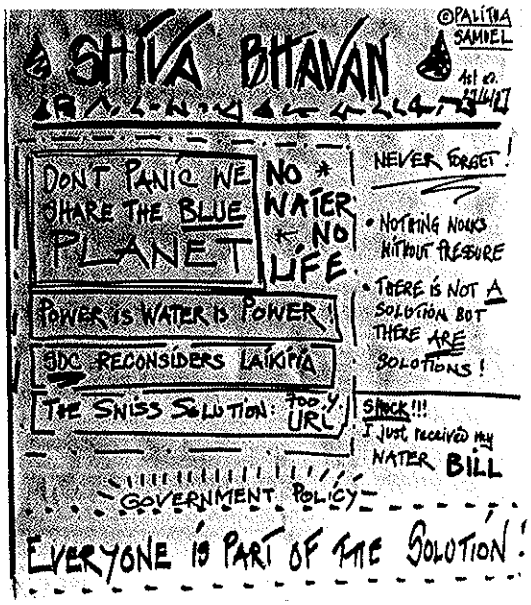


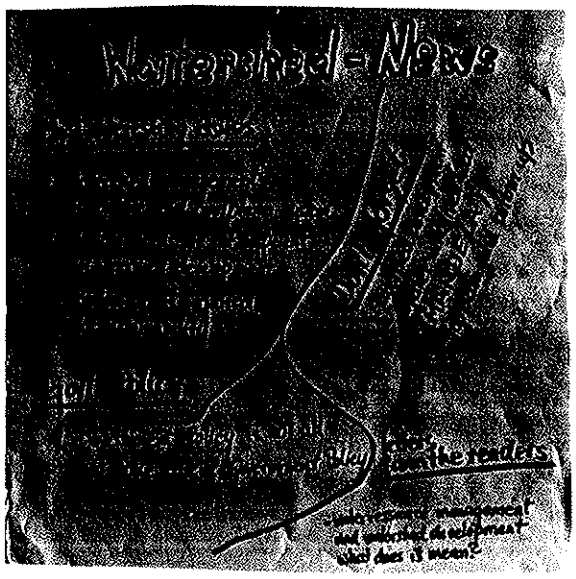

Watershed News
Special Feature: Time Lag
Project Reality: ex. Rainwater Harvesting
Bottom up and Sustainability - are they incompatible? (see time lag)
Mandala - the livelihood approach
Application of Tools give us more!
Don't forget:
• Waste Water
• Cost - Benefit Analysis (→ Hotel)
• Promote Audience Contribution
Government Policy: More Women to Aguasan
Letters from the reader:
• Distribute basic information prior to Workshop


Aguasan Herald
Less water for people - more water for profits
Aguasan says: No!!!
Stop the researches
Make them emotional!
From our Readers...
Sustained inputs limit interaction and our creativity
Next Issue: All asks
"How to put up pressure in open systems"


WATERSHED NEWS
Pull here!
you both
Please help yourself!


The Chronical - Issue No. 1 27.6.97
"The Lifeline Issues"
• Inherent Paradoxes in Methodologies dealing with development issues around the 'lifeline' of the Population.
• The Concept of Livelyhood Support in a 'mandala' frame.
• Limits, for the 'Concept development' are infinite.
• Relevance of 'traditional' research in the development field.
• Ownership of resources and freedom for decision making on the 'lifeline issues'
Govt Policies
Pro-Active Pro-People
Rashed and Jagan 27.6.97


SHIVA BHAVAN
©PALITHA SAMUEL
DON'T PANIC WE SHARE THE BLUE PLANET
NO WATER NO LIFE
NEVER FORGET!
• NOTHING MOVES WITHOUT PRESSURE
• THERE IS NOT A SOLUTION BUT THERE ARE SOLUTIONS!
POWER IS WATER IS POWER!
SDC RECONSIDERS LAIKIPIA
THE SWISS SOLUTION: TOO Y. URL
SHOCK!!! I just received my WATER BILL
GOVERNMENT POLICY
EVERYONE IS PART OF THE SOLUTION!


Watershed = Mars
For the readers

Less Water for More People

The most pressing global challenge

Proceedings of the 13th Aguasan Workshop in Gersau, Switzerland, 23-27 June 1997

Paper 3 : Information Bonanza

Contents

A Excursion to Geuensee, by Martin Fritsch
B Elements of Sustainability (barbecue brainstorming)
C Water - a Commodity in Short Supply, by J.B. Zehner
D Water and Bangladesh, by S.M.A. Rashid
E Watershed Situation in Highlands of Cameroon, by Humphrey Tah
F Play-Game on Water Scarcity, by Corinne Wacker

Regional Water Management

Visit of the municipality of Geuensee

Program Excursion

13.00 Departure Hotel Rotschuo

14.00 Arrival at Geuensee, Meeting Point „Altes Schulhaus"
Introduction
M. Fritsch, B. Strebel

14.30 Group work:
Contact and interviews with local consumers
„What is your demand?"

Walk to the reservoir

15.30 Visit of the reservoir:
- Discussion of the interview results
  M. Fritsch
- Introduction: conditions and problems of the water supply in the community -„What is our supply"
  A. Bucher

Walk to the centre of the community

16.15 Municipality of Geuensee: Presentation of the new urban drainage strategy on community level with special emphasis on cost recovery - „What is our disposal and treatment system?"
B. Strebel

Transfer to the local Waste Water Treatment Plant

17.00 The regional and local context: „The need for sustainability?"
- Introduction
  P. Stadelmann
- Discussion
  M. Fritsch

18.00 Barbecue

Dr. Martin Fritsch Assistant-Professor, Head of the Section Water and Soil at the Institute for Land Improvement and Water Management; Swiss Federal Institute of Technology Zurich (ETH)

Dr. Bruno Strebel Head of the municipal corporation of the community of Geuensee (Raporteur AGUASAN Workshop)

Dr. Pius Stadelmann Head of the scientific services of the Department for Environmental Protection, Canton Lucerne

Questionnaire

Demand: *Individual Consumer*

1. What is your daily water consumption?
2. What do you pay for 1000 l of drinking water? Do you think this is a reasonable price?
3. Do you drink the water from the tap? How would you react if you couldn't?
4. Have you ever thought about scarcity or about using too much water?
5. In case of scarcity: Would you prefer or afford to pay a much higher price for a continuing high supply? Or would you reduce consumption?
6. What is the maximum price you would or could pay for 1000l of water?

Supply: *Water Reservoir*

1. Problems concerning the availability of sufficient water quality or quantity?
2. Trends in the consumption and costs of water supply?
3. How do you supply the system (Water sources)?

Disposal: *Urban Drainage*

1. Strategy of urban drainage? Problems and Advantages?
2. Trends in the costs of waste water treatment?

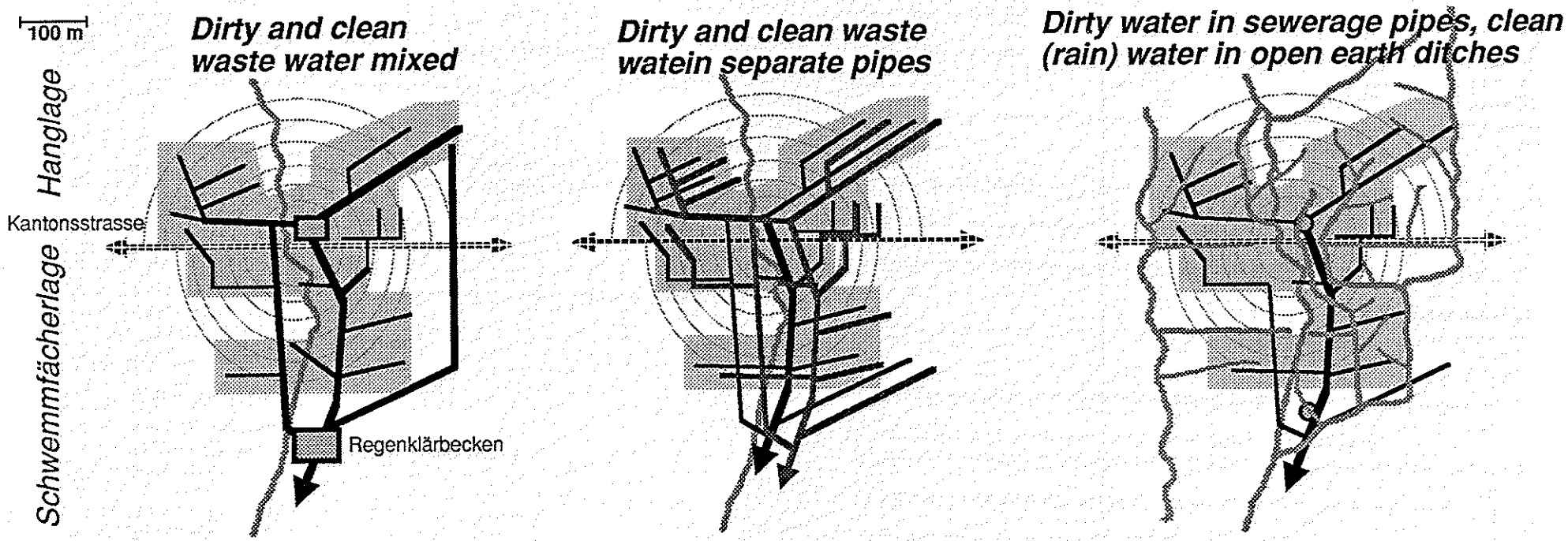
Treatment: *Waste Water Treatment Plant*

1. Feacal sludge disposal/recycling?
2. Energy consumption per 1000 l treated water?
3. What would you call the basic elements of sustainability of regional and communical water resource management?

During the excursion to Geuensee, a more efficient system ofvillage seweragewas also discussed, among other aspects of communal water supply and disposal. The following figure shows the variant choosen in Geuensee:

Non-Conventional, low cost high impact variant !!

Three Principal Variants for the new design of the communal sewerage system



Dirty and clean waste water mixed

Two additional main sewers and one retaining bassin required, additional investment costs 6 million SFrancs, negative influence on water balance

Dirty and clean waste watein separate pipes

Additional sewerage required for entire village, investmentcosts approx. 12 million SFrancs, natural streamsshort of water flow!

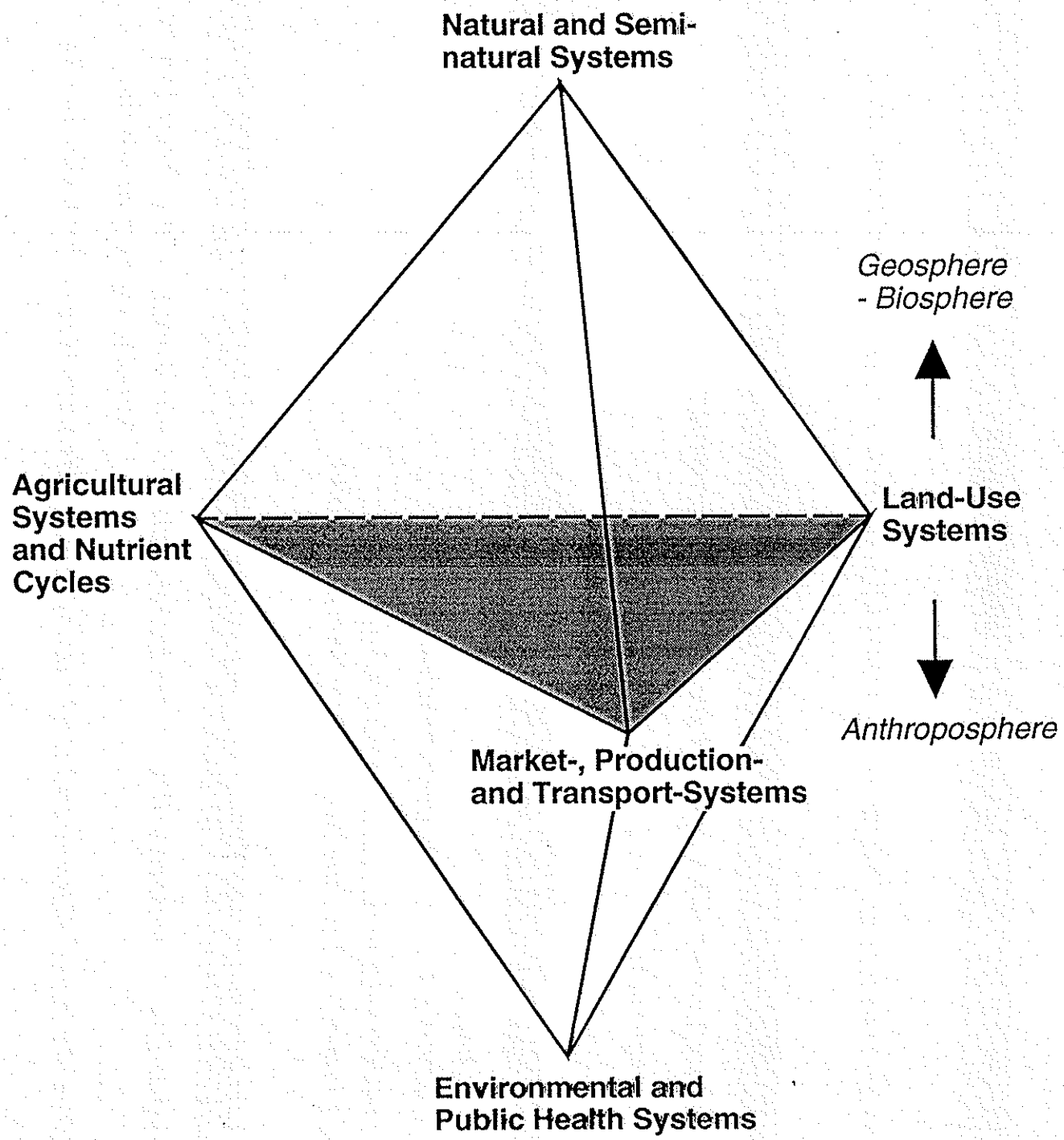
Dirty water in sewerage pipes, clean (rain) water in open earth ditches

Only limited adaptations required, simple earth work ditches, promotion of nature and bio-diversity, investment costs less than 3 millions SFrancs!

Strebel, October 97

Peri-Urban Land-Use

Thematical Fields of Transdisciplinarity



MF/IfK/FWB, 23.3.97

Sustainable Water Resource Management and Scarcity

The complexity requires an integrated systems approach on a regional level including

- all actors (key Stakeholders), groups of interest and their activities/responsibilities:

  settlements (households), agriculture, industries, transport

  human resource (!)

- all relevant natural resources (fate and changes)

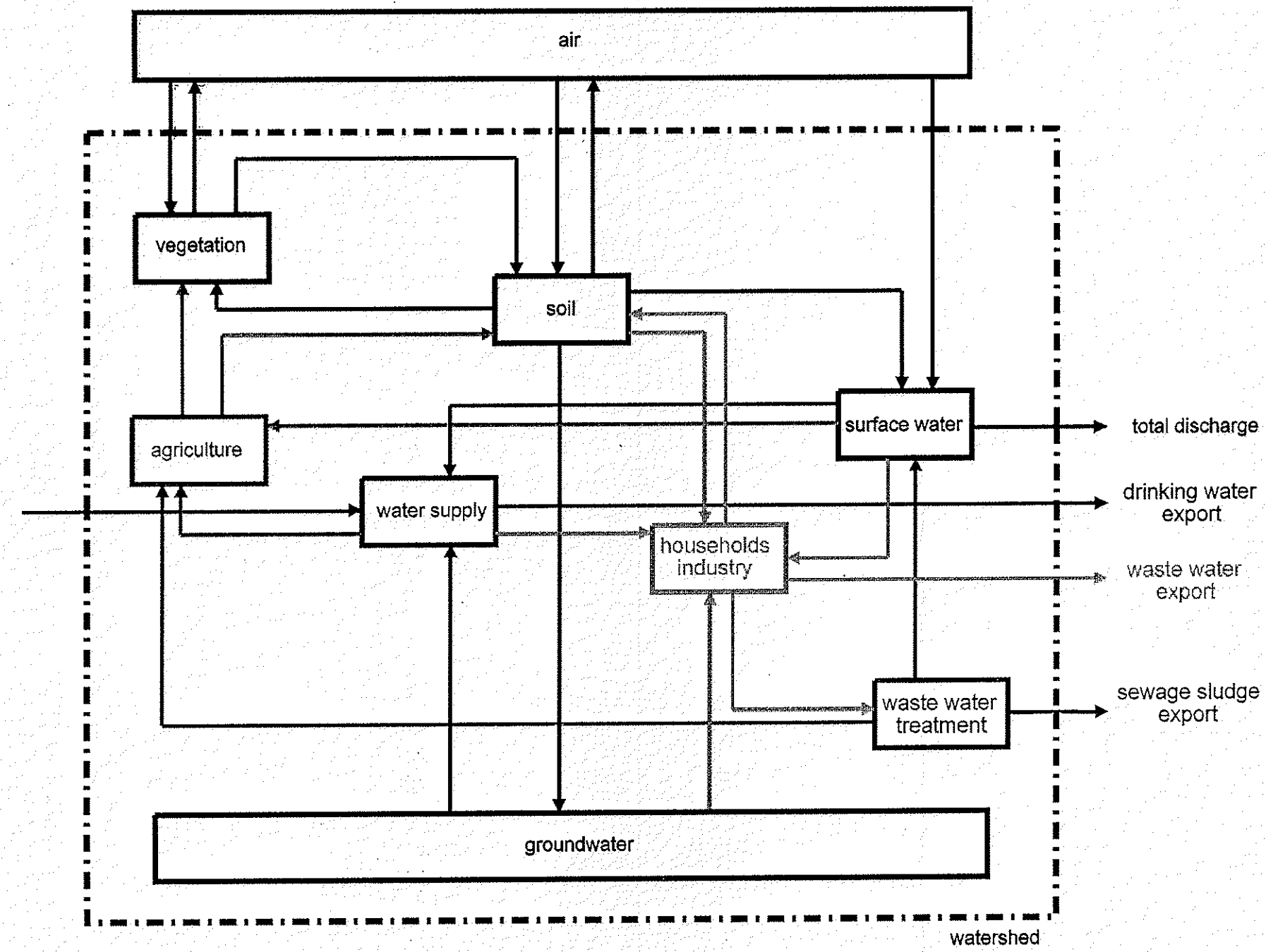
  soil, land, landscape:
  soil quality, land use, land cover, morphology

  water (different sources, types and qualities):
  surface run-off, lakes, aquifers, soil-water (interflow)

- different qualities of scarcity:

  waterquantity / waterquality / financialmeans / environmental perception or knowledge responsibility

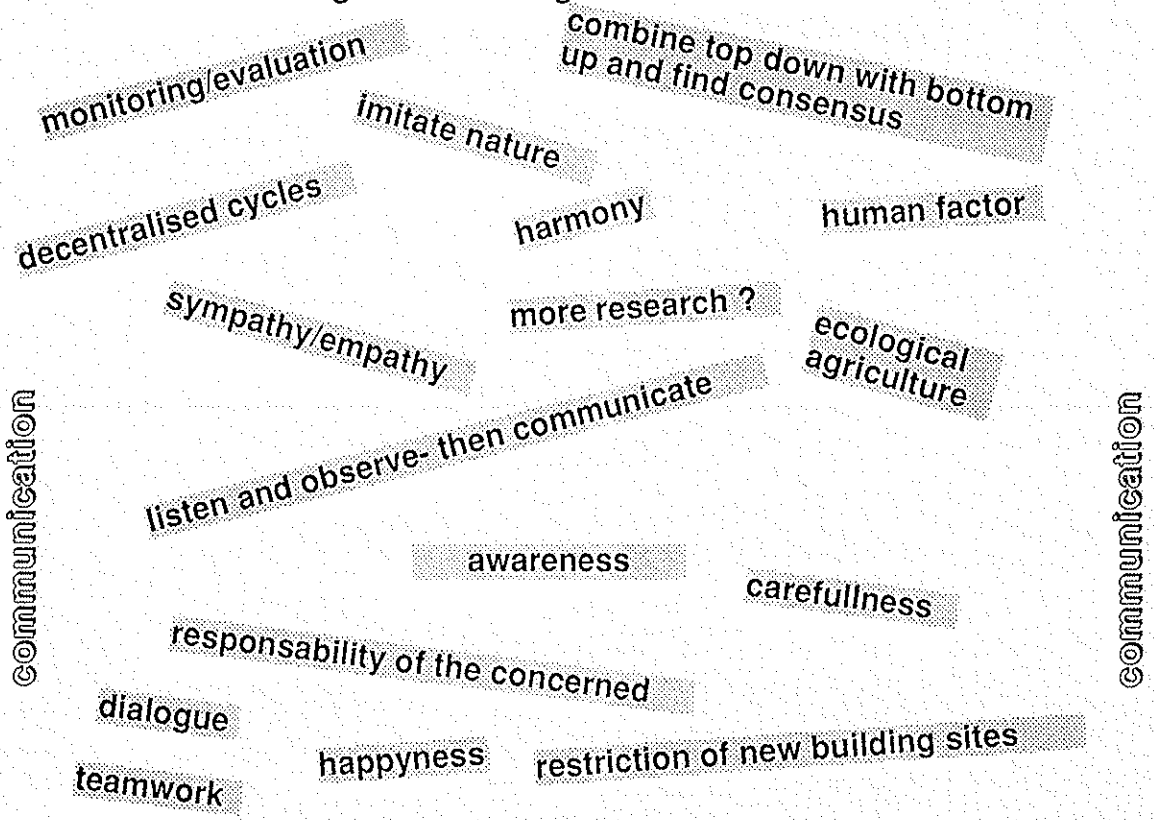
  on different scales of space and time / on different infrastructural and social levels


air
vegetation
soil
agriculture
surface water
total discharge
water supply
drinking water
export
households
industry
waste water
export
waste water
treatment
sewage sludge
export
groundwater
watershed

Information Bonanza B

Elements of Sustainability ??

Brain-storming results during dinner after excursion



The semantics on the meaning of "water management" has confused the participants right from the beginning of the workshop. Stephan Niederer has proposed the following definition:

What is water management ??

productive

use for: energy, agriculture, consumption

water supply systems

waste water disposal

protective

reforestration

torrent control

sewage plant

groundwater protection and recharge

Alexander J.B. Zehnder

Water, a Commodity in Short Supply

Fresh water is the first resource that will be in short supply on a global scale. If demographic predictions are correct, it will be only 20-40 years before humankind will consume more water than is replenished by rainfall. Strict and careful reuse of fresh water could, however, boost available supplies by as much as 70%.

Global Water Balance

Approximately 2.5% of the earth's total water is present as fresh water. About 95% of that is bound in polar ice caps, glaciers, permanent snowfields and in groundwater aquifers deeper than 1 km below the earth's surface. Only about 5% is directly usable by humans and other organisms [1].

Sustainable management of freshwater must be based on the only renewable source of fresh water; namely, rainfall. Rain is produced exclusively by solar energy and thus meets the criterion of sustainability. When more water is withdrawn from ground water and surface waters than is replaced by rainfall, the sources of fresh water are depleted in the long term. Examples include Lake Aral, which has lost 80% of its volume since 1950, and ground water aquifers in the Sahara beneath Libya which are thousands of years old, but will be depleted within the next few years.

Annually, the earth's continents and islands receive between 90,000 and 120,000 km^3 of rainfall, the average being 113,000 km^3. Of this total volume, 65% evaporates and another 25% reaches the oceans without ever being available as fresh water. Roughly 14,000 km^3 are actually usable. A significant portion of this remaining volume falls in sparsely populated areas (e. g., Siberia) and is, therefore, difficult to access. In reality, 9,000 to 12,000 km^3 of fresh water are available for use in agriculture, for drinking water and in industrial processes [2].

Water for Food Production

The current annual worldwide consumption of fresh water is about 5,500 km^3. Approximately two-thirds of this amount is used by agriculture; that is, it is used in food production. As a rule of thumb it can be stated that:

- 2 kg of wheat (dry weight of the whole plant) yields 1 kg of bread. In order to produce this amount of plant material, 1 m^3 water is needed. The plant absorbs this amount of water, but loses a large portion of it to the atmosphere through evapotranspiration. This loss is difficult to reduce, although selection of smaller plants and genetic engineering could possibly reduce the loss by 25%. American farmers typically use about 4 m^3 water per kg of wheat, while farmers in tropical areas use about 5 m^3 of water to grow 1 kg of rice [3].
- One kg of wheat flour provides approximately 3,500 kcal [4], which means that supplying a vegetarian diet of 1,000 kcal per person per day requires an annual water consumption of 100 m^3. This is a very optimistic estimate which ignores losses that occur during harvest and processing or due to pests and spoilage, all of which increase water demand accordingly. Typically, losses are between 20 and 50%, with 40% being the current average value.
- To produce 1 kcal of meat, 4.5 to 16 kcal of plant material is needed, with 10 kcal being the average. A daily diet of 2,500 kcal requires an annual water consumption of 350 m^3 if the diet is completely vegetarian. If the diet is only 80% vegetarian and 20% of the diet is supplied by meat, the water consumption increases to 980 m^3. These numbers include a 40% overall loss in production and processing of the plant material for both humans and animals.

Water in Households and Industry

Western European countries use an additional 250 m^3 of water per person per year. 140 m^3 are used for industrial production, while the balance goes into drinking water production or other domestic and related uses (e.g., service industry, hotels, restaurants, hospitals). In North America, the same activities require 380 m^3, while the number for Africa is around 30 m^3. The higher consumption levels for North America are primarily due to higher consumption in private households and in the service industry [5].

How Much Water Does One Need?

The total annual water consumption per person is somewhere between 800 and 1,200 m^3, with outliers both on the high and low ends. According to [6], countries with less than 1,700 m^3 of renewable water per person per year can no longer afford to allow unrestricted use of fresh water. Below 1,000 m^3, there are some first signs of shortage; below 500 m^3, there is very clearly a shortage. Switzerland has water in abundance. If Germany were dependent on rainfall alone, it would have to economize the use of fresh water to avoid shortages, while The Netherlands would have to worry about some serious shortages. Rivers originating outside these countries tend to equalize the national water budgets (Table 1).

For How Long Will We Have Water?

Based on existing data and the nutritional habits of the industrialized world, the annual water consumption in the year 2020 is projected to be nearly 9,000 m^3 and approaching 12,000 m^3 by the year 2040 (Fig. 1).

Depending on the assumptions used in the projections, the renewable portion of our water resources could be globally in short supply as soon as 20-40 years from now. Regionally, many countries are already dealing with shortages in freshwater supplies.

Where Do We Go From Here?

Water is the first resource in which a shortage will challenge humanity as a whole. Most of us will be confronted with the problem of fresh water in one form or another within the next 20-30 years. Water plays an essential role in most aspects of our lives. Without political, legal and social measures, water shortages will hinder economic development, increase the potential of conflicts and amplify the negative effects of population growth. As long as women and children continue to spend a large portion of their day securing the necessary supply of fresh water, they will not contribute to the economic development of a region. This is exacerbated by the fact that poorer and less educated families often have more children [7]. Possible consequences of water shortages (and subsequent food shortages), poverty and population pressures include economic and political conflicts as well as migratory tendencies with effects that will be felt far outside the immediately impacted regions.

Through strict and careful re-use of water, the volume of available water in areas with immediate shortages could be increased by as much as 70%. In order to reach this goal, economic tools are needed. Water must be viewed as a precious commodity instead of being freely available. Unfortunately, at this point in time, we do not have a clear strategy for inducing such an attitudinal transition. Even developed countries like Switzerland struggle when trying to legislate and implement complex changes (e. g., CO_2 legislation). The public, scientists and decision-making bodies all must become sensitized to the challenge of supplying fresh water. Only in this way will we be become aware of the problem and contribute to its solution. Adequate water supplies will continue to be a fundamental requirement for the survival of humankind. Since the regeneration of fresh water through rainfall is directly linked to solar energy, the water budget is an excellent example of the development of criteria for sustainable use as well as the responsible management of a resource.

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Alexander J.B. Zehnder

Figure 1
Annual water consumption for an increasing global population at a diet of 2,500 kcal per person per day. The solid line represents an 80% vegetarian/20% meat diet, while the dotted line represents a completely vegetarian diet. Both lines include an extra 250 m^3 of water for households, the service sector and industry. The dashed lines at 9,000 and 14,000 km^3 indicate the minimum and the maximum annual value for the globally available volume of renewable fresh water. The heavy solid line represents the estimated actual global water consumption.

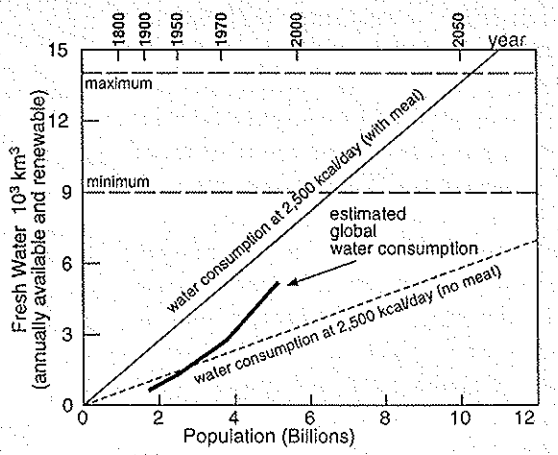
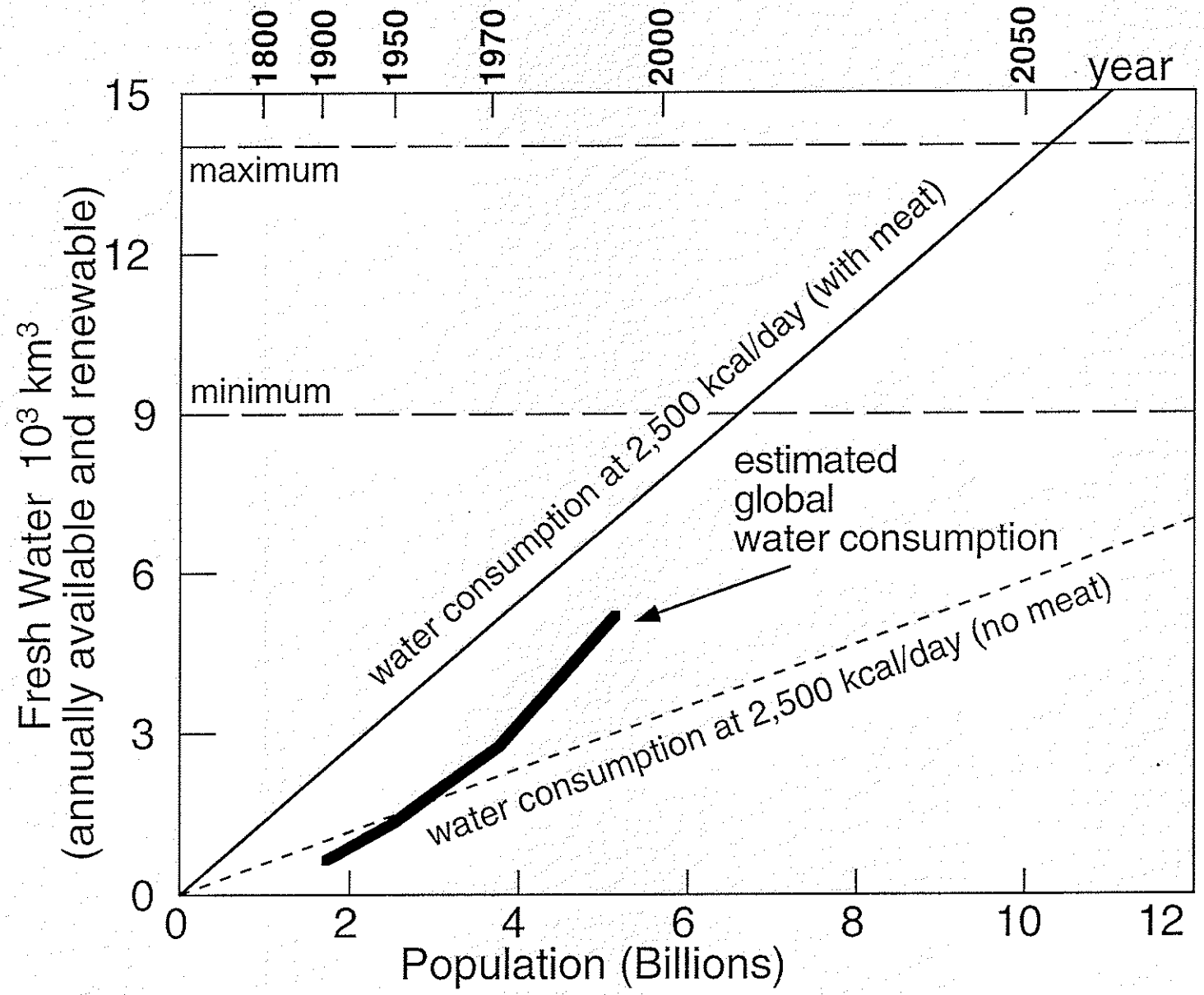


Table 1
Renewable fresh water volume in m^3 per person peryear.
River Input = input from rivers originating outside the country. Numbers are calculated based on data from [5] and [8].

Country	Rainfall	River Input	Total
Egypt	35	1,075	1,110
Algeria	735	35	770
Germany	1,235	965	2,200
The Netherlands	670	5,350	6,020
Israel	370	100	470
Morocco	1,200	–	1,200
Switzerland	6,430	1,130	7,560
Spain	2,815	25	2,840
USA	9,940	–	9,940


1800
1900
1950
1970
2000
2050
year
15
12
9
6
3
0
maximum
minimum
Fresh Water 10^3 km^3
(annually available and renewable)
water consumption at 2,500 kcal/day (with meat)
estimated
global
water consumption
water consumption at 2,500 kcal/day (no meat)
0
2
4
6
8
10
12
Population (Billions)

WATER AND BANGLADESH

S.M.A. Rashid
Director
NGO Forum for Drinking Water Supply and Sanitation

Introduction:

Water is the basic demand of human life. It is also one of the fundamental rights of human being. It has been widely recognized that human being can survive three weeks without food, but only three days without water and about three minutes without oxygen?, impossible. From this concept it becomes evident that the human being can no longer survive without water. Therefore, this issue is presently related to our existence as the total life cycle on earth is being regulated keeping water in the centre, and this leads to define water as life.

Water and Bangladesh:

Bangladesh is a country which has full of water, yet it is without water. Paradoxically, indeed! It is a major part of the biggest delta of the world created by the silt of three mighty rivers like the Ganges, the Brahmaputra and the Meghna. Those rivers also fall into category of the large rivers of the world. These three rivers' combined flood-flow brings into Bangladesh nearly 6 millions cusec of water considering their normal and flood flows alongwith annually 2.5 billion of tons of silt. It is to be mentioned that, the greater portion of the catchment areas of these rivers amounting to nearly 600,000 sq. miles lies in Bangladesh's neighbouring countries such as India, Nepal, Bhutan and China. These rivers bring in annually such a volume of water that if it could be stored in a plain land, it could create a lake 34 feet deep.

The hydrology of Bangladesh in characterized by the water of these three rivers abandoned downpour of which 80-85% fall between the months of June and September. Water becomes really a scarce resource in Bangladesh during the dry months of the year. However, in the dry season flood water recede and the levels of pond and ground water, but general water availability remains high in most of the parts of the country. Thus the people install various types of handpump to get water. Apart from the coastal belt and some parts of the Chittagong Hill Tracts, irrigation and hand pumps draw water from the same aquifer.

Sources of Water:

With regard to sources of water, Bangladesh can be divided mainly in three of the following manners:

1. Rainfall
2. Surface Water
3. Underground Water

1. Rainfall:

Rainfall is being considered as one of the mentionable sources of water in Bangladesh. It has extreme closeness with other related sources of water as like - yearly seasonal rainfall, river-tide and the flood water upon which the re-filling of underground reservoirs depends. The rainfall is one of the momentous segments of the surface water. The average yearly rainfall from 1951 to 1980 was 2320 millimeters in Bangladesh. The yearly rainfall recorded in one of the north-east parts of Bangladesh was 5690, and it has still been considered as the highest. However, the availability of water, from the rainfall, has been found for a few period of time in each year, and on the other side the insufficiency of water exists in most of the time in each year. As a result, the country faces many adverse situations like flood, drought, etc.

2. Surface Water:

The various parts of the surface water are as follows:

a) Stream Flow
b) Static Water
c) Instream Storage

Still there is no proper reservoir in Bangladesh through which the flood flow can be preserved for the dry season. The use of surface water with regard to irrigation, water transportation, internal industries and salt prevention remains confined during the dry season, and this enables in creating complex situation in the country.

In addition to the rivers, a mentionable number of water sources has also been found throughout Bangladesh. Among those lake, quagmire and whirlpool are the notable ones. Those have been used starting from simple to major purposes sometimes. The amount of water found in these sources is around 79 square meter/cusec.

The formation of surface reservoir through building dam cross-wisely with canal is one of the introduced systems in Bangladesh, through which water can be stored. It reveals through topographic map and areal photography that around 500 million square meter of water can be stored following the instream storage.

3. Underground Water:

The underground water reservoir can be divided mainly into three layers. The first layer stretches out from 2 meter to 100 meter depth area-wise which usually consists of silt and gluey mud, while the second layer stretches out from 3 meter to 60 meter depth place-wise which consists of silt and fine sand. The drinking water is drawn through hand operated pumps from this layer. The third and final layer is the main reservoir which is widen from 6 meter to 120 meter depth area-wise, and it usually consists of thick sand and stone-clips. The water is pumped out from this layer for using in the irrigation, industries and large scale of water supply.

The underground water layer decreases during the dry season because of the gradual augmentation of water uses. As a result, a difference in water layer takes place between the reservoir and river, and it enables the water to flow towards the river and sea. Apart from that, the stage of most of the rivers of Bangladesh stands below the underground surface water during the dry season. As a result, the surface water becomes downwards during the dry season. The underground reservoirs usually becomes re-filled during the following rainy season due to heavy rainfall and flood.

It is apparent from the above discussion that water seems to be available in abundance in Bangladesh. But if glance at the practical scenario of Bangladesh with regard to water, we would find that the water is now becoming scarce due to improper management and policy. The water problem is now very much acute in the country. Our life and total atmosphere even now is being victimized due to use of contaminated water which cause various diarrhoeal diseases. A countless people are suffering from diarrhoeal diseases while a major portion of them are children. 300,000 children are facing death every year due to diarrhoea. The malnutrition rate of Bangladeshi people has already exceeded than the people of Ethiopia due to improper use of safe water and sanitation. Apart from that, another problem has been gradually stretching out throughout the country i.e. the ground water table is declining gradually, but not slowly, and therefore the safe water crisis appears to us as the dreadful enemy. The surface water is salty, polluted and totally unworthy for drinking. On the other hand, ground water lifting is going out of our capacity as it is declining day by day. The hand pumps are getting dried up and we are being pushed to drink unhygienic water. Consequently, we are very easily being affected with water-borne diseases.

The Government of Bangladesh (GOB) is very alert in ensuring safe water supply for its 12 million people. The GOB alongwith other international donor agencies have been working continuously so that each and every people living specially at the rural areas can have access to safe water. There are many sided problems exist in relation to water in the country. For ameliorating the problematic situation, the GOB, various NGOs and external support agencies, sector specialists, researchers and many other concerned are working their best to get rid of the water related problems. In addition, detailed programmes and action plans, both short and long terms, have been chalked out to tackle the situations by the concerned.

New and appropriate technologies have become indispensable for the better management of water resources in Bangladesh. In addition, the existing technologies should be improved in such manner so that the proper use of limited water resources can fully be ensured. Apart from that, necessary and effective measures need to be taken up for keeping water free from pollution. Moreover, the water resources should be conjoined with national economic and social policies where the planned use and maintenance of land and forest resources would exist. However, in order to improve the overall situation of the water resources of Bangladesh, the following measures need to be taken into account with due importance:

01. Requires to have water reservoir & adequate supply of water through using modern technology for drinking & other purposes.

02. Steps need to be taken for dragging the ponds, lakes, quagmires and whirlpools in order to preserve the water for aquaculture & artificial water supply for the better food production, through Food for Volunteer Work Programme.

03. Steps to be taken to construct dam and reservoir in order to have protection from flood and to have appropriate artificial water supply.

04. Necessary steps require to be taken for deepening sedimented rivers through dragging, so that the rivers could flow with its high current and consequently to obstruct the sea saline water's instruction into the river.

05. Intrusion of saline water needs to be controlled through applying modern appropriate technology.

06. Water pollution must be controlled and water quality must be ensured.

07. Water must be preserved from the industrial and other pollutions.

08. Laws are to be enforced to prevent deforestation for maintaining ecological balance.

09. Permanent agreement must be signed by the concerned by surveying the land and sea border.

10. It requires to construct deep dam and reservoir by dragging the inland rivers of the country, regularly in order to have a year round water supply for various purpose.

11. Finally, a well defined national water resource management policy needs to be formulated and developed taking into consideration the existing problems in the water sector of Bangladesh.

Information
BONANZA E

AGUASAN 1997 "Less water for more people"

PRESENT SITUATION IN THE WATERSHEDS OF THE WESTERN HIGHLANDS OF CAMEROON
Evening presentation of 24.06.97 by Humphrey Tah (Helvetas Cameroon)

(1) Introduction:

CAMEROON has a population of 12 million people, distributed in a surface area of 475.000 km^2. It has ten provinces which can be grouped into three geographic regions, viz.:

Northern region: This area has a dry climate, a hash Harmatan wind during the dry season and the zone is semi arid. Serious drinking water shortage is experienced in the region all round the year.

Southern and Eastern Forests region: A humid climate, wet land with a lot of tropical forests which is under severe timber exploitation for export. Some places in this region have as much as 6'000 ml. of rain fall per year. (Debuncha and Mount Cameroon).

The Adamawa plateau and the Western highlands: This area is generally called the Savanna grass land. The Western Highlands is made up of the North West and part of the West Provinces (Helvetas is active in these two provinces). Rain fall in the Western Highlands is distributed between the months of March - November, with an average of 2'500 ml/Year.

The Western Highlands are characterised by upland and hilly watersheds, with patches and pockets of indigenous forests distributed in their combinations here and there in the grass field. Some combinations lie on mountains like the Kilum which is 3011 m. (the Kilum mountain project is sponsored by WWF and ICBP). The Kilum is a watershed for the river Katsina Ala flowing into Nigeria, river Noun, the Bamendjing dam and some streams and rivers in the Province.
Generally, the vegetation in the watersheds of the region is not yet deplorable, but it is assumed that if the rampant and uncontrolled livelihood activities like cattle grazing which is an important activity of the Fulani nomads and subsistent agriculture which is practised on steep slopes as well as on river and stream basins due to population pressure continue at the same rate, then, the situation will be alarming in the next ten years.

(2) Visualisation of the existing situation:

Some slides drawn from the Mendankwe and Tubah Watersheds were shown, depicting the existing problems and solutions in the two watersheds. Helvetas Cameroon has been assisting these communities to develop their watersheds since 1993 and 1996, respectively.

A picture album, compiled with recent photographs showing the topography, problems and field activities of Helvetas Cameroon and the executing agencies in the watershed development programme and catchment protection was displaced for participants to visualised.
The slides and photographs depicted the causes - effects - solutions as summarised below:

(2.1) Sources of major problems in the development of watersheds:

(2.1.1) Deforestation:

The forest vegetation has reduced very dramatically since the past 25 years in this region. Areas which use to be covered with thick and untouched forests like Mendankwe have been encroached by farmers in search for new farm land, due to population growth and the quest for fertile soil.

(2.1.2) Farming on steep slopes:

Subsistent agriculture is the main occupation of the people and it is practised mostly by the women. The principal crops include maize, beans, vegetable and tuber crops like cocoyam, groundnuts and potatoes. These basic crops are farmed in all the watersheds, including the stream strips and steep valleys up to about 70%. (see picture 1). Existing farm land is becoming limited and worn-out, thus farmers are forced to move to steep slopes and on stream valleys.

(2.1.3) Over grazing:

Cattle grazing in the Western Highlands is done mostly on the hills . Since the watersheds are hilly and upland, grazing is practised in all of them in an over grazed manner, thus causing massive soil erosion (see picture 2). When fodder become scarce in the dry season the Fulani grazers move into more fertile lands, especially the river valleys. Consequently, some stream fed water supply schemes are affected, because the filters become blocked with run-off mud caused by the stampeding of cattle up stream.

(2.1.4) Bush fire:

Annual burning of grass is practised between the months of December - February (dry season). The graziers burn the grass so that their animals can enjoy fresh grass when the rains start and also to kill some of the insects like "ticks" which are a pest to the health of cattle. Farmers on their part burn the bush during land preparation for the planting season to set a space to till new and fallow farms. They burn the soil (see picture 1) to improve plants nutrients, so as to have good yield within the short possible time.

(2.1.5) Conflict:

Watershed development in the Western Highlands of Cameroon is often beset with conflicting interest, ideas, approaches and local acceptance. Although conflict is part of project management, this sometimes disturb a smooth functioning of activities, especially when this become so heavy and force implementation to be slowed down as the case in the Tubah Watershed Development (sponsored by Helvetas). Some identified conflicts which are sources of problems in the watershed:

- conflict of land ownership by the defferent local communities ,
- farmers - graziers conflict,
- conflict of approach by the external stakeholders,
- conflict of participation and local acceptance.

(2.2) Solutions

In looking for appropriate solutions to the above problems, it is considered that Watershed development in the region requires a great deal of foresight, imagination and patience, especially considering the fact that such projects often come from outside. Thus, a lot of time is required for education and trials before the people can accept the project as a felt need. The most important components considered are:

- Stable financial/technical assistance and education of the communities.

- Capacity building to empower the rural communities in watershed management.

- Interactive planning of activities for watershed development together with the local communities

Picture 1

Farming on a very steep slope
Mendankwe Watershed

Picture 2

Massive soil erosion / Ntamandam-Akum Watershed

Play Game on Water Scarcity

Effects of modernity and demographic change on water management systems

Playing options for four generations of villagers

Setting

The play is situated in a village with traditional water supply system managed as common property. Six participants play each a head of households and take decisions on the allocation of labour and on the operation and maintenance of the water supply system. The game is played for four generations. After each round the participants discuss effects of demographic transition and modernity on decision making and labour allocation for the operation and maintenance of the village water supply system.

The operation and management of the water supply system requests the work of one unit per family.

The production of subsistence crops for the family and household tasks requests the work of two units per family. This work can be substituted by money; one money unit is equivalent of one work unit.

The work unit of a member can be invested in cash crop production or in wage labour. The equivalent is: one work units generates two money units.

The children can go to school. The school fee cost one money unit. A child who went to school will earn the double income (i.e. four money units) in cash crop production or of wage labour in the next generation.

The production of cash crops and wage labour increases the use of water. One work unit invested in cash crop production leads to the use of nine times more water[1]. The work invested in wage labour leads to the use of three times more water.

The size of the cards indicates the work unit. One adult is an equivalent of two old people and of four children in terms of labour.

Demography

The game is played for four generations; which corresponds to approx. 60 years..

Generation one lives in the traditional demographic context. The family composition [2] is one old person, two adults and two children.

Generation two and three are situated in the context of demographic transition· The composition of the family is three old people, two adults and four children.

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[1] the relationship between 1 unit for household and subsistence needs, 9 units for cash crop production and 3 units for wage labour (industry and tertiary sector) is derived from world wide statistics, stating that in the last 50 years the increase of water use is due to 8% for increased household consumption, 69% for agriculture and 23% for industry and tertiary sector. These figures correspond with the relation 1 :) : 3. Scarcity of water arises because of the more use as well as from water pollution (quality). The game simulates that more water is used. It is left to the players to discuss the water quality problems related to it.

[2] the relationship between the number of members per age group per family is derived from statistical figures on demographic change

Generation four is situated in the modern and post modern demographic context. The composition of the family is four old people, two adults and one child.

Rules

The participants invest the labour force of the family for one generation after the other. They choose between work allocation for water supply, for household and subsistence work, for cash crop production, for wage labour, for school education.

Once all six players have set the cards, the team discusses the choices made in terms of their effect on the operation and maintenance of the water supply system - on the politics of water in a context of "less water for more people".

Suggestions to the players

1 Play the second generation (situation of demographic transition) twice to assess well the dynamics in decision making related to labour allocation for operation and maintenance of water supply systems.

2 Encourage the players to find a solution (= to define rules and regulations) for the operation and maintenance of the water supply system after every generation and use these rules for playing the next generation discussion process.

3 Induce the rule that the water supply system is collapsing after the second generation of over-use without appropriate rules for operation and maintenance by stating: "As we can see, the village has overused the water supply system and neglected to invest the labour necessary for operation and maintenance. Thus the system breaks down. The village has now to define options either to repair the system (which needs 3 labour units per family) or to buy and construct a new one a) of the same scale = costing 6 money units or b) of a larger scale = costing 10 money units per family.
Encourage the players to define their choice and to agree among themselves on who has to contribute how much for it.

4 Additional options for the game are:
- shortages of wage labour and cash crop production labour arisen due to the degradation of the water supply;
- the government induces a policy according to which the village has to internalise the externality costs produced by its use of water = the village has to find a solution for the excessive use of water related to modern water use options (cash crops and wage labour). Ask the team to develop a policy in the village to share the additional costs (Money and labour) arising from it.

Ho to make the material needed to play the game

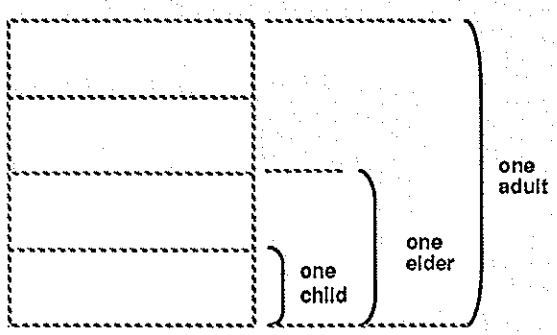
1. Prepare 4 sheets of A4 paper in different colours. Suggestion: green for cash crop, yellow for wage labour, grey for school and red for household/subsistence.

2. Prepare one blue sheet for the water supply system the following way. Select a A4 sheet and shape it by cutting in a square.

3. Prepare additional blue paper sheets to visualise the additional water use (approx. 35 sheets for a game of 4 generations).

4 Prepare the labour units for each family (6)

2	full scale business cards	= 2 adults	= total need 12 cards
4	half scale business cards	= 4 elders	= total need 2 cards
4	one quarter scale business cards	= 4 children	= total need 6 cards



Give each family a number (numbers 1 to 6) and write the number on each labour unit card belonging to the family.

Example: family 1 has: 2 full scale business cards with a "1" on them, 4 half scale business cards with a "1" on them and 4 quarter Business cards with a "1" on them.

After every round of playing (i.e. after every generation) the cards are recollected and used again.

Paying option

To recall well the development in the village four series of labour allocation cards per family can be made; the setting can be left on the ground (= on the coloured papers for "water", "cash", "crop", "wage labour" and "school") and after the game the settings of 4 generations can be compared.

For this option a total of 120 business cards and 16 colour sheets are needed plus additional of 4 times 35 blue sheets (= total 150 sheets) for the additional water use derived from the modern labour investment option (= cash crop farming and wage labour related additional use of water).

Corinne Wacker
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