

FACILITATING CHANGE

Research-led Watershed Experiences from Lingmuteychu Watershed



July 2006

**Renewable Natural Resources Research Center
Bajo, Wangduephodrang
Council for RNR Research of Bhutan
Ministry of Agriculture
BHUTAN**

Citation: RNR Research Centre, Bajo 2005.
Facilitating Change: Research-led Watershed Experiences from
Renewable Natural Resources Research Centre, Bajothang, Wangduephodrang,
Bhutan. 95 p

Content

ACRONYMS	v
EXECUTIVE SUMMARY	x
Chapter I: Introduction.....	1
Chapter II : Objectives	5
Chapter III: Status at Start.....	9
3.1 Introduction.....	9
3.2 Social background.....	9
3.3 Crops and livestock.....	9
3.4 Forest cover.....	11
3.5 Soils.....	11
3.6 Irrigation	12
3.7 Community organisation.....	14
3.8 Infrastructures and Services.....	14
Chapter IV: Methods and Methodological Approach.....	15
4.1 Introduction.....	15
4.2 Conceptual framework.....	15
4.3 Approach.....	17
4.4 Method	18
4.5 Evolution of Research Process.....	19
Chapter V: Village level organizations and capacity development	22
5.1 Introduction.....	22
5.2 Traditional Local Institutions.....	22
5.3 Formal Institutions	23
5.4 Small Farmer Saving Group	24
5.5 Upcoming Institutions.....	26
Chapter VI: Turning a new leaf : Enhancing Productivity and Resource Management...	28
6.1 Introduction.....	28
6.2 Productivity and Management of Forest Resources	30
6.3 Water Management.....	34
6.4 Crop Productivity and Management	38
6.5 Livestock.....	47
6.5.1 Breed improvement	47
6.5.2 Fodder development.....	48
6.6 Fruit crops for Cash	50
6.7 Summary	54

Chapter VII: Enhancing access to services, credit and marketing.....	55
7.1 Introduction.....	55
7.2 Access to technologies and information	55
7.3 Access to Credit	57
7.4 Access to Market.....	58
Chapter VIII: Major achievements	59
8.1 Household level achievements.....	59
8.2 Community	61
8.3 Watershed	63
8.4 RNRRC Bajo	64
8.5 National.....	65
Chapter IX: Monitoring & Evaluation.....	67
9.1 Introduction.....	67
9.2. Activity Level	67
9.3 Institutional Level	68
9.4. External evaluations.....	68
Chapter X: Budget allocation and expenditure for the watershed	70
10.1 Introduction.....	70
10.2 Comparative financial analysis for the watershed	70
Chapter XI: Lessons learnt.....	72
Chapter XII: Watershed Paradigm for Bhutan.....	77
12.1 Introduction.....	77
12.2 CBNRM experiences and its relevance	77
12.3 Watershed Management Paradigm	78
Chapter XIII: The way forward	83
13.1 Introduction.....	83
13.2 Watershed : Looking Ahead	84
13.3General Watershed Management Program for Bhutan.....	85
References.....	88
Suggested reading	90

List of Tables

Table 1. Crop Yields in 1997	10
Table 2. Village wise farming system and crops grown	10
Table 3: FYM Application rate per crops	12
Table 4. Village wise soil nutrient status and range	41
Table 5. Maize yields and characteristics.	42
Table 6. Soil variables from 1998 to 2005 from demonstration plot in Nabchey	44
Table 7. Issues and interventions	47
Table 8. Results of pasture species tested	49
Table 9. Fruit plants in demonstration orchard	52
Table 10 Fund utilization	70
Table 11. Fund support for watershed program (in Nu.)	71

List of Figures

Figure 1. Country Map with Research Centres	2
Figure 2: Lingmuteychu Watershed map	3
Figure 3. Livestock profile in watershed, 1997	10
Figure 4. Food Self-Sufficiency by village	11
Figure 5 Water sharing a rotation pattern for one complete cycle in Omteykha	13
Figure 6: Schematic representation of the conceptual model of watershed management research.	16
Figure 7: Spiral of process oriented intervention (CBNRM Approach – Adapted Version)	21
Figure 8: Integrated watershed intervention	28
Figure 10: Men and women members engaged planting for community forest plantation	32
Figure 11. Gully plugging after one year with drain pipes slightly visible and after two years with vegetation	35
Figure 12: Aquatic weed <i>Shochum</i> in rice field	42
Figure 13: Maize yield as affected by Trash lines	44
Figure 14. Model kitchen garden in Dompola	46
Figure 15: Mithun breeding bull and cross breed heifer	47
Figure 16. Lush green winter oat	49
Figure 17: Sub-tropical apple	51
Figure 18: Improved persimmon and pear cultivars	53
Figure 19. Watershed farmers in the weekly market	58
Figure 20: Reaping a richer harvest	59
Figure 21: Trashline development: A-Frame marking, trashline at start, after 2 and 7 years	61
Figure 22. Schematic Representation of Watershed Management Paradigm	81
Figure 23: Minister for Agriculture showing the way forward	83

ACRONYMS

AI	Artificial Insemination
asl	Above Sea Level
Av.P	Available Phosphorus (in the soil)
AVRDC	Asian Vegetable Research and Development Cooperation
BDFC	Bhutan Development Finance Cooperation
BG-SRDP	Bhutan German Sustainable RNR Development Project
BUCAP	Biodiversity Use and Conservation Asia Pacific Project
CARD	Centre for Agricultural Research and Development (Bajo, Bhutan)
CBNRM	Community Based Natural Resources Management
CD	Compact Disk
CFMG	Community Forest Management Group
CFP	Community Forest Plantation
CFUG	Community Forest User Group
CIMMYT	International Centre for Maize and Wheat Research
CIP	International Potato Centre (Centro Internacional de la Papa)
CISED	Centre for Interdisciplinary Studies in Environment and Development
CLSD	Crop and Livestock Services Division (Bhutan)
cm	centimetre
CORE	Council of Research & Extension
CoRRB	Council for RNR Research of Bhutan
CRI	Crown root initiation
DAO	Dzongkhag Agriculture Officer
DSA	Daily Subsistence Allowance (<i>per diem</i>)
DVDSFG	Dompola Village Development Small Farmers Group
DYT	Dzongkhag Yargay Tshogchung
EA	Extension Agent
EPINARM	Enhancing Productivity through Integrated Natural Resources Management
FAO	Food and Agriculture Organisation. UNDP (Rome)
FFS	Farmer Field School
FSG	Farmers Saving Group
FYM	Farmyard manure
gm	gram weight
GNH	Gross National Happiness
GNP	Gross National Product
GTZ	Deutsche Gesellschaft fuer Technische Zusammenarbeit (German Agency for Technical Collaboration)
GYT	Geog Yargay Tshogchung
ha	hectare
IARS	International Agriculture Research System
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (Hyderabad)

IDRC	International Development Research Centre (Canada)
IPM	Integrated Pest Management
IPNS	Integrated Plant Nutrient Study
IRRI	International Rice Research Institute (Los Baños, Philippines)
IWDP	Integrated Watershed Development Project
K	Potassium
Kg	Kilogram
Km ²	Kilometre square
LUPP	Land use and Planning Project (MoA, RGoB)
m	metre
M&E	Monitoring and Evaluation
M ²	Square meter (m ²)
MAS	Multi Agent Systems
MoA	Ministry of Agriculture
MoHA	Ministry of Home Affairs
MoP	Murate of Potash
MPTS	Multipurpose Tree Species
N	Nitrogen
NARS	National Agriculture Research System
NBC	National Biodiversity Centre (Bhutan)
NIP	National Irrigation Policy (Bhutan)
NRM	Natural Resource Management
NSSC	National Soil Service Centre, Bhutan
NTFP	Non-timber Forest Product
Nu	Ngultram (Nu. 43= US \$1.00)
P	Phosphorus
PDSR	Problem Diagnostic Survey Report
PM&E	Participatory Monitoring & Evaluation
PRA	Participatory Rural Appraisal
REID	Research Extension & Irrigation Division
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resources
RNR-ESP	RNR Extension Support Project
RNRRC	Renewable Natural Resources Research Centre
RPG	Role Play Game
SDC	Swiss Development Cooperation (Switzerland)
SHG	Self-help Group
SSP	Single Super Phosphate
T	Tonne
UG	User Group
VRMC	Village resource management committee
WM	Water Management
WMC	Watershed Management Committee
WMR	Water Management Research
WS	Watershed
WUA	Water Users Associations

Renewable Natural Resources Research Centre (RNRRC) Bajo

Established in 1982 as the Centre for Agricultural Research and Development (CARD) primarily to undertake research on rice and rice-based cropping system, was renamed as the Renewable Natural resources Research Centre (RNRRC) in 1995. Research on livestock and forest that are inseparable components of the Bhutanese farming systems were added to the mandate of the centre. The Centre is located at Bajo (1300m) in Wangduephodrang, which is about 70 km west of the capital Thimphu.

RNRRC Bajo is designated as the Co-ordinating Centre for Field Crops (cereals, oil crops, and legumes) Research and Water Management Research at the national level. At the regional level, this Centre is mandated to undertake relevant research for its client Dzongkhags of Wangduephodrang, Punakha, Gasa, Tsirang and Dagana in arable agriculture, livestock and forestry. The Centre has a dedicated 64 hectares research farm. Recently, the facilities of the Centre have been upgraded with the construction of the new administrative cum laboratory building.

The RNRRC Bajo undertakes intensive research and extension through its on-farm research program; training of extension personnel and farmers; and other interdisciplinary activities, both at the national and local levels. It introduces, adapts and develops technologies suitable for the local agro ecological environments and helps farmers raise their standard of living through sustainable farm production and increased incomes. Research is based on the policy guidelines of problem orientation, disciplinary and inter-disciplinary focus, relevance, environmental and institutional sustainability and equity. Research strategies aim at improving the productivity, profitability, stability and sustainability of farming systems while conserving the fragile environment and fostering development of an integrated crop-livestock-forest system. In 1997, RNRRC Bajo ventured in the uncharted path of participatory watershed development in Bhutan.

RNRRC Bajo receives technical support and improved germplasm from international research institutes like IRRI, AVRDC, CIMMYT, ICRISAT, ICARDA, CIP and a number of other regional agricultural institutes. In addition to the Royal Government of Bhutan (RGOB) core budget for recurrent expenditure, the Centre also received support in the form of field and laboratory equipment, vehicles and technical expertise from IDRC-SDC through the EPINARM project, RNR-ESP, BG-SRDP, BUCAP through NBC of the role it plays for agricultural research in this region, and other development projects of the region. The SDC and BUCAP financial material support continues to this day even though EPINARM project has run its course and ended.



Mailing address:

Renewable Natural Resources Research Centre
Bajothang, Wangduephodrang, Bhutan
Phone: (PABX): +975 2 481209
Program Director: +975 2 481361
Fax: +975 2 481311 E-mail: sduba@druknet.bt

Credits

Mr. Sangay Duba,
Program Director, RNRRC Bajo
Email sduba@druknet.bt

Mr. Tayan Raj Gurung
Senior Research Officer, RNRRC Bajo
Email traj_gurung@moa.gov.bt

Mr. Mahesh Ghimiray
Program Officer, Field Crops Research Program, RNRRC Bajo
Email mghimire@druknet.bt

Mr. Yonten Jamtsho
Research Communication Officer, RNRRC Bajo
Email yonten@druknet.bt

Mr. Gyambo Tshering
Program Officer, Horticulture Research Program, RNRRC Bajo
Email gtshering@druknet.bt

Mr. Doley Tshering
Program Officer, Forestry Research Program, RNRRC Bajo
Email doley@druknet.bt

Mr. Thinlay Gyamtsho
Program Officer, Farming System (WMR), RNRRC Bajo
Email tgyamtsho@druknet.bt

Mr. Dawa L. Sherpa
Research Assistant, Livestock Research Program, RNRRC Bajo
Email dals@druknet.bt

Mr. Aita Kumar Bhujel
Research Assistant, Farming System (Watershed), RNRRC Bajo
Email akbhujel@druknet.bt

Ms. Yeshey
Research Assistant, Farming System (IPNS), RNRRC Bajo
Email ybida@druknet.bt

Mrs. Tanka M. Pulami
Research Assistant, Agriculture Economics, RNRRC Bajo
Email tmpulami@druknet.bt

Dzongkha (Bhutanese) Terms

Bhutanese term	Meaning
Amtshoi Phanday Tshogpa	Women Welfare Association
Chathrim	Rules & By-laws
Chu	River, Stream, Water
Chu-lum	Watershed
Chimi	Elected representative who represents 2-3 geogs in the national assembly
Chusup	Village Water Caretaker
Drey	Local volumetric measure equivalent (for rice = 1.5 kg rice)
DYT (Dzongkhag Yargay Tshogchung)	District Development Committee
Dzong	Hill top Fortress now housing District Administration and the governing body of monks
Dzongkhag	District or jurisdiction of a Dzong
Geog	Administrative unit, usually consisting of 2-10 villages (equivalent to a development block)
Gup	Elected head of the geog
GYT (Geog Yargay Tshogchung)	Block Development Committee
Langdo	One langdo is the area ploughed by a pair of oxen in a day roughly equal to 0.1 hectare (0.25 acre wetland, 0.33 acre dryland)
Lumpa	Valley, gorge
Lhakhang	Buddhist Temple
Mangmi	Assistant Gup
Reesup	Village Forest Caretaker
Sokshing	Forest land with usufruct right to leaf litter. But registered under individual's name
Tsamdrog	Grazing land with usufruct rights of grazing registered under private individual's name or a community
Tshogpa	Village representative to the GYT usually appointed by the community by consensus.

EXECUTIVE SUMMARY

Ever since 1984 research focused on cropping system and commodity technologies at the station and then verified for their adaptability and acceptance through on-farm research. In 1997 RNRRC Bajo ventured into participatory watershed development in Bhutan for the very first time. Based on PRA Lingmuteychu was selected as the site for testing the new watershed approach. Initially water management, crop-livestock interaction, IPM, agro-forestry/community forestry and crop management were identified as possible areas of intervention.

In view of the low and unstable systems productivity, intervention in the watershed focuses on achieving four specific objectives of restoring the degraded resources; enhancing production efficiency; improving livelihood and developing capacity.

By 1999, the experiences gained in Lingmuteychu watershed gave momentum to CBNRM initiatives in Bhutan. Works in other watersheds like Radi was consolidated with experiences from Lingmuteychu helped in formulating CBNRM framework which was later approved as a program within research program. Within the framework of CBNRM, Research center worked very closely with the local institutions like GYT and other traditional institutions. The DYT, GYT and Chusup were important institutions in the watershed. It had no associations, credit societies or user groups. Method was developed based on intervention principles to promote participatory development. The beneficiaries were happy that they were consulted, not told what to do.

Village level organizations, both traditional and formal, play a role in development. Watershed evolves democratic grass-roots associations like FSGs, SHGs, USGs and WUAs. Credit availability increased and so did local entrepreneurship. Community forest management groups also formed important institution for resource management in the watershed.

Introduction of HYV rice, maize, soybean, oats, potatoes and vegetables has changed livelihood of communities. Low cost technologies like maize trash lines and water harvesting have greatly enhanced the productive capacity of the communities. Promotion of private nursery to locally produce planting materials of tree species has increased access to horticultural planting materials. Introduction of fruit crops has created a new set of entrepreneurs through a fruit plant nursery, fruit orchard, backyard cultivation. Top-working of existing fruit trees with better scion have helped in revitalizing the fruit crop production.

Through the consistent involvement in livestock research, community members have taken up community managed cattle breeding program which has helped in cross-breeding of cattle. Groups have been formed to collectively manage piggery production.

Despite numerous interventions conflict in irrigation water still continues to be major concern. Recently all the 7 communities in the watershed have formed watershed management committee to oversee activities to ensure sustainability of natural resources in the watershed.

The work in Lingmuteychu has been published in several forms (CD, reports, thesis and technical papers) for dissemination within and outside the country.

Based on the 7 years of involvement in Lingmuteychu watershed RNRRC proposes a new paradigm in watershed management research.

CHAPTER I: INTRODUCTION

Systematic agricultural research in Bhutan began only in 1982 with the creation of Centre for Agricultural Research and Development (CARD) with technical support of IRRI (Philippines) at Bajo. In the earlier years, cropping system and commodity focused technologies like new rice variety introduction, were generated at the station and then verified for their adaptability and acceptance through on-farm research. The farming system as a whole and the integrated management of resources did not receive much attention. While the objective was to develop technologies appropriate to the farming system, the research approach was still commodity focused. Farmer involvement was minimal and occurred only in the technology verification phase. On-farm research itself was limited to technology adaptation. This raised doubts as to whether the intended

Text box 1: Country Background

Bhutan is characterized by high mountains and deep valleys, from an elevation of about 100 metres in the south to over 7,550 metres in the north, resulting in extreme variation in climate, geography and bio-diversity. The 72% forest area represents a large and valuable pool of natural resources for the country. Seventy nine percent of the population depends on small-scale mountain agriculture and livestock farming for its livelihood. The total area under agriculture is estimated at 7.7 % (LUPP, 1997) of the total land in the country. Bhutan's development efforts revolve around its philosophy of Gross National Happiness (GNH). It embodies both material and non-material component of development which, Gross National Product (GNP) does not take into consideration.

integrated farming system related objectives could be realized while the earlier commodity research approach in use. By 1995, the centre had recognized that there was a need for a greater understanding about farmers' use and dependency on resources beyond the farm and for understanding the resource interactions at a higher level in totality. Meanwhile, CARD was upgraded into a Renewable Natural Resources Research Centre (RNRRC) to include research on forestry and livestock to field crops and irrigation components. An additional objective was to improve linkages between farmers, researchers and extension workers to expand the scope from solely on-farm research to include broader resource systems, and include participation of local communities.

These developments also mirrored global paradigm shifts from an individual farm-based approach to that of an area based approach to rural development. Consequently in 1997, RNRRC Bajo ventured into participatory watershed development in Bhutan for the very first time. Researchers then were not trained to work directly with communities and the idea of working with communities was very new to them. Also, farmers were rarely involved in setting research priorities, planning and implementation of research. It was a new experience for all.

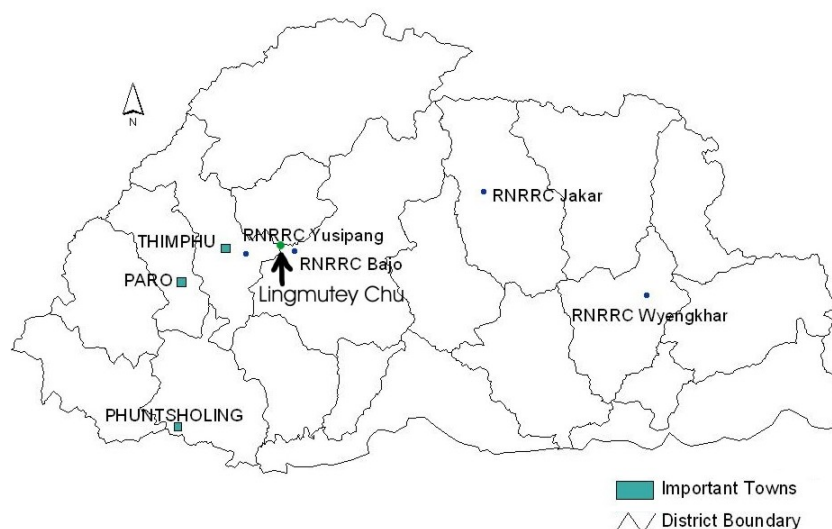


Figure 1. Country Map with Research Centres

Lingmuteychu was selected as the site for testing the new watershed approach. A quick PRA was carried out in all the villages to understand issues and the scope for farmer participation in research and development. The PRA identified water management, crop-livestock interaction, IPM, agro-forestry/community forestry and crop management as possible areas of intervention (RNRRC Bajo, 1999).

The Research team employed a multi-sectoral and integrated approach, linking crops, livestock, forests, and water, aiming to enhance productivity of resource-poor farmers of the watershed. Exposure to concepts of participatory approaches through learning-by-doing and on-farm research, trainings and workshops, and interactions with farmers were instrumental in changing mindsets of researchers and set the stage for greater interactions with the farmers.

Watershed: the Bhutan's first watershed pilot site

Watershed is located about 90 km from Thimphu and about 15 km away from RNRRC Bajo. The whole watershed is 34 km². The area under agriculture is approximately 6.3%. The watershed consists of seven villages of Limbukha, Dompola, Matalumchu, Omteykha, Nabchey, Wangjokha and Thangu, distributed from 1300m to 2170m asl. There are a total of 166 households. Forest cover varies from degraded Chir pine to good deciduous oak forests, which also provides leaf litters for FYM (Farm Yard Manure). Agriculture is a major source of livelihood in all villages. Wetland rice cropping dominates except for Nabchey village, where dryland maize farming is practiced. The main income is through sale of marketable surplus of potato and chilli for Limbukha, seasonal vegetables for Dompola, and Matalumchu and beaten maize and wild mushrooms for Nabchey. A dirt road constructed in 1996 serves as a feeder road to Wangdue and Punakha Dzongs.

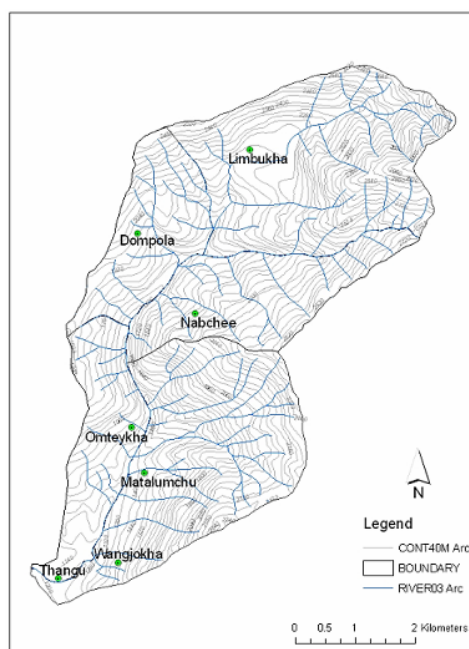


Figure 2: Lingmuteychu Watershed map

High run-off losses (particularly in dry lands) have led to development soil with variable organic carbon and total nitrogen, low phosphorus and high potash level. This together with shortage of irrigation water and low NPK fertilizer application has contributed to low agriculture productivity.

Some of the major issues include deficiency in winter feed and fodder for livestock, low crop productivity related to varieties, plant nutrients and pests. Inadequate availability of irrigation water especially during rice transplanting, is priority issue for the farmers.

The book: the spirit of our experiences.

The annual technical reports have remained sectoral and distributed over years. There was a genuine need to consolidate and share the experiences of watershed in a single publication. A write-shop was conceptualised as the relevant method to do so. Accordingly a 12 member team of people involved in the watershed work got together for a period of 10 days to come out with the book “Facilitating Change”. The book is intended for use by policy makers, watershed development practitioners, other RNR staff, researchers and academics in different disciplines and other interested individuals.

The book consists of a total of thirteen chapters. Chapter two explores how RNRRC Bajo details the objectives of the work in the watershed and how these evolved with changing situations and lessons from engagement in the work. The state of affairs at the start of adopting the watershed in terms of infrastructure,

access to services, resource situations and farming realities are described in chapter three. A participatory approach with the researchers and communities involved in a continuous circle of conceptualization, action, reflection and re-planning to adapt interventions to emerging issues and changing realities was adopted as the methodology (chapter four). Chapter five describes village institutions that existed before the start of the watershed study and those that were formed later. Major experiences are captured under broad categories of forests, crop production, and water resources and under chapter six. This chapter forms the bulk of the book. A separate chapter has been dedicated to allow consideration of how access to service and credit (chapter seven). Major achievements and impacts are then elucidated in chapter eight followed by the description of monitoring and evaluation process adopted in chapter nine. Watershed management requires investment of significant amount of financial resources to support work with the communities in terms of delivery of services, enhancing capacity and hardware development. A short write-up in chapter ten describes and maps out how these expenses have ensued. Broad lessons learnt with reference to specific experiences have been pulled out in chapter eleven. The watershed paradigm for Bhutan developed in chapter twelve is hoped to guide similar work on participatory watershed management in the country. The book ends with the way forward for and the country as a whole for watershed management in chapter thirteen.

CHAPTER II: OBJECTIVES

The holistic development of the people and communities living in the hydro-geographical area, known as a watershed, through participatory planning, implementation and evaluation was the primary objective of the intervention by RNRRC Bajo. There was set of objectives defined for the watershed study in 1997. As the study progressed, there was better understanding of the resource situations and community issues. To address these issues, it was imperative that the specific objectives were attuned to the realities. The broad and specific objectives are introduced and some achievements against each objective are highlighted, here below.

When the watershed study commenced in 1997 there were two important elements that were considered. The first element was to emphasise involvement of local communities in the management of natural resources including common resources beyond the farm level. The second element was to work within the research scope of the RNRRC Bajo. In view of those two considerations, the four broad objectives defined for the watershed study were to:

- a) strengthen farmer participation in research process,
- b) strengthen interdisciplinary approach to research;
- c) strengthen linkages between research, extension, and farmers in managing natural resources; and
- d) extend agricultural research in its scope and clients.

In the course of first three years of implementation, emphasis was given to involve farmers/communities in identifying issues in the natural resources management (NRM). Some of those activities included, a participatory forest resources use and management; soil fertility management; water sharing and water rights; organisational and institutional analysis. Since the farmers were involved as partners in carrying out all the activities, some of the achievements under the objective of improving farmer participation are manifested through increased farmer receptivity to involvement in research trials, their acceptance of researchers as partners which is evidenced by their approaching research centre for initiation of collaborative work, and more attention and care given by them in the implementation of on-farm research activities including quality data collection and feedback. Under the objective of improving interdisciplinary research, some of the achievements are institutionalisation of joint planning of research activities at the centre, increased interaction and greater openness of the researchers to discussion and peer critique.

Evolution of specific objectives

The specific objectives defined at the start of the study were as given below. In the absence of a proper understanding of the complex interaction of resources in the watershed, the specific objectives were designed to address the gap.

- To identify resources under pressure and assist in developing options;
- To understand community perceptions on resource use and status;
- To assist in land use planning in few selected households;
- To help develop homestead production systems;
- To mobilise community participation.

As the initial understanding of resources management improved, it was realised that the research should focus on specific issues in the watershed. Like the on-farm soil fertility and erosion control, rehabilitation of degraded areas, and improvement of crop productivity. Basically, to a large extent the specific objectives were realised and there was consensus among partners that the study should focus on specific issues. So the research team revisited the specific objectives in 1999 and attuned them to four objectives which guided the subsequent activities.

- to rehabilitate and improve the degraded resources in the watershed,
- to increase production efficiency of farming systems,
- to promote socio-economic well-being of communities, and
- to strengthen local capacity for natural resource management.

It is rather uncommon to change the objectives midway of the study, but the experience of this study shows that it is eminently necessary in a long duration participatory watershed study where the clarity of resource issues surfaces at a later stages. This reflects the process character of implementation adopted in the study. Further, the adjustment in the objectives coincided with the initiation of CBNRM approach which was adopted to enhance the participatory process.

As per the above objectives several achievements were realised and some highlights on these are presented in the table hereinafter.

	Objectives	Achievements through participatory process
	Broad objectives	
A	To strengthen farmer participation in the research process	Greater involvement of farmers in research process. Farmers are now more receptive of research trials and provide better data and feedback; farmers have begun to consult researchers
B	To strengthen interdisciplinary approach to research;	Greater linkages between sectors. Researchers more open to peer critique; Multi-agency interaction for problem identification and planning of remedial actions; Marked change in outlook towards farming systems. Researchers have gone beyond their disciplinary boundary e.g. water engineer's involvement in social aspects of water management; breeders have looked at socio-economic benefit aspects; etc
C	To strengthen linkages between research, extension, and farmers in managing natural resources;	Better appreciation of each other's strengths and weaknesses while forging greater interdependence. However, linkages also depended on the individual's interest and capacity.
D	To extend agricultural research in its scope and clients.	Research domain has moved off-farm to consider all natural resources used for on-farm production; research findings/learnings have fed into developing water Policies and Act; Forest resource assessment and inventory techniques is tested for national adoption
	Specific research objectives	
S1	To rehabilitate and improve the degraded resources in the watershed	Eight (8) suitable species identified, 37 ha plantation created, Grass resources regenerated and biomass production increased; soil conservation technique developed and soil erosion in 2 ha of area controlled; farmers are practicing balanced nutrition in their fields.
S2	To increase production efficiency of farming systems	New maize and rice varieties adopted and grown with higher yield under same management levels; Farmers are now aware of the seed replacement benefits and regularly rejuvenate their seed stocks of potato and maize; 12 new productive cattle breeds available with farmers of Nabchhey;

S3	To promote socio-economic well-being of communities	Peach and walnut trees topworked for improved production and income; 3 functional self help groups in place; Drinking water available throughout the year for group of Nabchhey farmers; Sale of fruit tree saplings has increased income and access to saplings
S4	To strengthen local capacity for natural resource management	Community-level breeding bull management committee exists and servicing frequency by bull is maintained. Watershed committee is in place to manage intercommunity resource use and management conflicts.

CHAPTER III: STATUS AT START

3.1 Introduction

Decentralization of governance in Bhutan began in 1987 with administrative and financial powers being delegated to the Dzongkhag and institutional levels. It seemed natural that the top-down planning and development model would give way to a participatory process wherein the beneficiary would be a part of the process to define the priorities. The intervention by Researchers from the Renewable Natural Resources Research Centre Bajo (RNRRC Bajo) in 1997 was, perhaps, the first real experience of the rural communities of this area in participatory planning.

This chapter describes the situation of farming practices and the livelihood aspects of watershed communities before the launching of research intervention and when the developmental services were more sectoral, without a participatory approach to development. It is the background in which the first attempt was made at a Participatory Rapid Appraisal (PRA) by Researchers who were as new to the process as the farmers.

3.2 Social background

The watershed communities consist of two ethnic groups, the predominant Ngalops, or the old settlers, and Sharchops in Nabchey who are recent settlers from the East. Dzongkha is the common language used by Ngalops, while people of Nabchey speak Kurtoekha. Rice is the staple food except for Nabchey, where maize is the staple diet.

Houses in the watershed form clusters, except in Dompola and Nabchey. The houses are permanent, made out of mud wall and wood with shingles or corrugated galvanized iron (CGI) sheet roofing in a typical Bhutanese architecture. All households conduct annual religious pujas (Lochey) for individual well-being and several joint rituals for the common good (better crop yield, rainfall and general well-being).

There was a tradition of exchanging farm products between upstream and downstream farmers. Upstream farmers provided red rice, potato and radish to the downstream farmers and received white rice and chili seedlings from them. The ratio of exchanges had remained the same for the last 10 years and they do it mostly on barter basis; but some people also sell and buy through cash.

3.3 Crops and livestock

Rice-based farming system was predominantly practiced in the entire watershed except in Nabchey, where dry land maize farming is the mainstay of the community. Farmers followed traditional crop production practices using locally

available inputs and indigenous crop varieties. The average crop yields then are shown in Table 1.

Table 1. Crop Yields in 1997

Crop	Yield (t/ha)	Straw (t/ha)
Rice	3.50	3.30
Wheat	0.75	0.89
Maize	2.50	2.60
Mustard	0.50	0.92

Major crops grown were rice, wheat, maize and mustard. A small quantity of potato was grown in Limbukha (Table 2). Vegetables such as sag, radish, chilli, beans and peas were grown in small kitchen gardens near the homestead for household consumption. Constrained by the lack of dry land and the importance then on rice cultivation horticultural activities were limited to few fruit plants in the backyard for household consumption. Low and unstable crop yields were major problems due to a combined effect of declining soil fertility, imbalance and low fertilizer use, shortage of irrigation water and pest problems.

Crops and cropping patterns differed between communities due to variation in elevation (Table 2).

Table 2. Village wise farming system and crops grown

Villages	Farming systems	Main crops
Limbukha	Rice based wetland	Rice, Wheat, Mustard & Potato
Dompola	Both rice & maize based	Rice, Maize, Wheat & Mustard
Nabchey	Maize based dry land	Maize, Rice, Wheat & Mustard
Omtékha	Rice based wetland	Rice, Wheat & Mustard
Matalumchu	Rice based wetland	Rice, Wheat & Mustard
Wangjukha	Rice based wetland	Rice, Wheat & Mustard
Thangu	Rice based wetland	Rice, Wheat & Mustard

Livestock consisted mostly of local breeds of cattle, horse, pig and poultry (figure 3). The cattle provided dairy products such as cheese and butter, draught power for agriculture and horses as means of transport. The communities in the upper catchments had better grazing resources as they owned community *Tsamdro* (grazing land) while lower communities grazed the animals in state forests. The livestock farming was constrained by ecto-parasite (ticks) infestation, epidemics prevalence such as foot and mouth disease (FMD), lack of improved breeding stock, feed and fodder shortage during winter, livestock predation by wild animals and undiagnosed disease outbreaks in poultry birds.

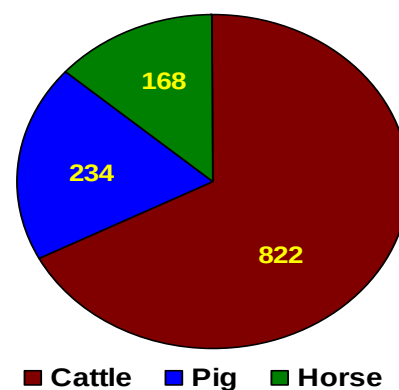


Figure 3. Livestock profile in watershed, 1997

Communities used timber, fuel wood and NTFPs (fern, cane, mushroom) from the forest. The upper catchment farmers used leaf litter from government forest and *sokshings* - forest land registered under individual tharm with user fact rights for leaf litter collection. *Sokshings* contained adequate and healthy stands of oak trees.

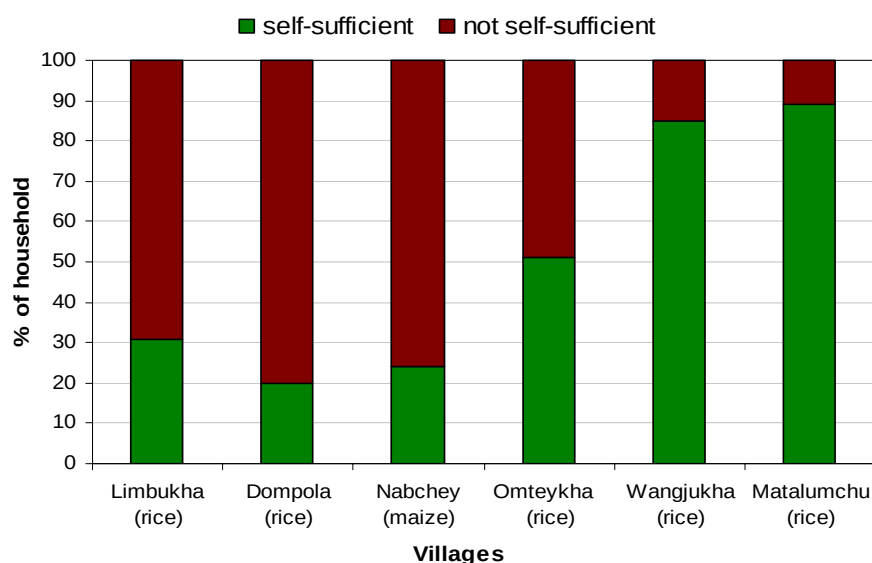


Figure 4. Food Self-Sufficiency by village

Households were not food self-sufficient and food deficit period ranged from 1 to 6 months (1st to 6th Bhutanese months). Farmers differed in their resource endowments in terms of access to land, labour and capital. Most depended on off-farm activities (wage labours) to generate cash income. Food self sufficiency was better for the communities in the lower region (Figure 4).

3.4 Forest cover

The upper catchments were characterized by substantial tree cover, consisting of broadleaf and deciduous trees such as *Scima spp*, *Quercus spp* and *Michelia spp*. The lower parts of the watershed had predominantly Chir pine forest, with large areas without sufficient vegetative cover resulting in large eroded gullies. The community in the lower region had very limited access to forest resources and depended on the upper catchments for its requirements, and also gets the forest resources from far away forests (Thimphu and Trongsa) and transported it by trucks.

3.5 Soils

In the upper catchments, soils were mostly alluvial (especially in Limbukha) with distinct and alternative layers of sand, silt and clay, and included some black organic layers at depth. In the middle, the main soils are grey and brown sandy

loams, and red clays which were readily erodible. In the lower terrace, the soils were silty, hard topsoils over loose white sand and beds of rounded river boulders at depth. The average soil pH (H₂O) was 5.75, which is slightly acidic, (Soil report, 1998).

Soil erosion and land slips during rains occurred in the dry lands due to sloping land terrain and upland agricultural practices. Land degradation and gully formation was common due to poor management of irrigation canals particularly at the tail end of the irrigation canals.

Soil nutrient management was inefficient with improper management and use of farm yard manure mainly because of shortage of labour. In the upper catchments, oak litter was used to make FYM while chir pine needle and local grasses were used in lower parts. The amount of FYM applications varied between crops based on the importance of the crop as shown in table 3 (FYM survey report, April 2001). In the lower communities besides use of FYM, Nitrogen based inorganic fertilizers were also used.

Table 3: FYM Application rate per crops

Crop	FYM application rate (Basket/langdo)	Yield (t/ha)
Rice	121	21.8
Mustard	106	19.1
Chilli	105	15.1
Maize	100	14.4
Wheat	85	15.3
Radish	75	10.8

Note: 1 basket of FYM = 18 kg (fresh weight)

3.6 Irrigation

Lingmutey Chu, a small perennial stream running across the watershed provided irrigation water. The upper and middle communities depended on this single source which was often not adequate for rice production. This stream feeds 14 diversion canals to different communities (Table 4). This led to conflicts between communities with water sharing based on principles of ***‘first come, first serve’*** and ***“any upstream scheme can divert all the flow into the irrigation canal regardless of need of the downstream users”*** ignoring equity aspects. The communities in the upper catchments had full access and right over water, leading to delayed transplanting, few tillers, less filled grains and low yield in the lower areas. The lower communities (Wangjukha and Thangu) irrigated their fields from Bajo canal.

Table 4 Irrigation scheme by village

Community	Name of irrigation canals
Limbukha	Jabsakha, Dompola, Mar, Bar
Dompola	Dompola
Nabchey	Nabchey
Omteykha	Omteykha
Matalumchu	Secchu, Tagtay, Bar, Tong, Gey, Dogangio
Wangjukha	Bajo
Thangu	Bajo

Generally, distribution of irrigation water between farmers within a scheme differed from one scheme to another in the watershed. Some factors that determined the household water share are a) Contribution to religious ceremonies, b) Participation of the (ancestors) household in the construction of the canal, c) Size of land holdings and d) Participation in the maintenance of canal.

Figure 5 Water sharing a rotation pattern for one complete cycle in Omteykha

Canal flow (%)	100						A						A	N
	75	D	B	H	E			D	B	H	E			P
							J						J	Q
	50					C						C		
			G	L			O		G	L			O	R
	25	I	K		F			I	K		F			
			M	T			S		M	T			S	V
	0		U						U					
		1	2	3	4	5	6	7	8	9	10	11	12	13
Day of the rotation period														

The irrigation water is also not equally shared among the farmers. The users are divided into four categories called “**Thruelpa, Chhep, Chatho** and **Hangchu**”, where Thruelpa is entitled twice the amount of Chhep; Chhep gets twice the amount of Chatho. Farmer belonging to Hangchu does not have own land but sharecrop and they receive water on request or beg as indicated by the literal meaning of the word and the sharing is done on a day rotation or turns by specified group of farmers. A typical water rotation pattern in Omteykha is shown in the figure 3.

Over the years, the crop yields had also declined due to lesser water availability, which was a result of degradation of forest resources. Farmers reported that four springs had dried up.

3.7 Community organisation

The GYT is the most important institution where village development plans are discussed and agreed. These plans then were submitted to DYT. Other institutions which existed include *Reesup* and *Chusup*. *Reesup* or the village forest caretaker was responsible to guard forest and ensure equal access and sustainable use of forest resources. The *Chusup*, or the village water caretaker, regularly monitored the irrigation system, engaged farmers in minor repair and maintenance of irrigation canals, and looked after water sharing. The government-sanctioned WUAs were not functional.

3.8 Infrastructures and Services

A farm road was started in 1996 linking the watershed to Shegana road. However, farmers of the upper and middle parts still relied on horses to reach their farm produce to the market. The lower communities in the watershed had easier excess to market due to the proximity to the Wangdue-Shegana road.

The infrastructure/facilities were strategically located at the centre of the geog at Tshochasa. There was a RNR centre and a school nearby. Communities in the lower part of the watershed could not avail RNR services as they were far from their geog centre.

No formal credit institutions existed and poor farmers borrowed small loans from their richer neighbours and paid back in kind (mostly as rice and labour). Food-deficit households also borrowed rice to tide over their lean period from within or outside the village but the amount paid back was high (for every 20 dreys of paddy borrowed, they paid back 3 dreys as interest annually). Farmers approached financial institutions like Bhutan Development Finance Corporation (BDFC) for bigger loans.

CHAPTER IV: METHODS AND METHODOLOGICAL APPROACH

4.1 Introduction

In 1997, when RNRRC Bajo ventured into an absolutely new research area, it was the conviction of the researchers and the forward-thinking research system that helped it in realizing the goal of watershed research. The emerging novel approach of CBNRM at the global level and the national commitment to better NRM through people participation also acted as an incentive to the research system. In absence of a prescribed approach, RNRRC Bajo consolidated ideas from both national and international researchers, conceptualized the study and worked through the process. After seven years of determined involvement in the watershed, the emergence of new paradigm can be experienced.

This chapter provides an explanation on the conceptualization of the study, the approach as well as its principles and the methods. The chapter closes with presentation of how the research process has evolved.

4.2 Conceptual framework

In view of the low and unstable systems productivity, intervention in the watershed focuses on achieving four specific objectives of restoring the degraded resources; enhancing production efficiency; improving livelihood and developing capacity. Considering the complexity of the objectives and their inter-connected nature, the study framework integrates the methods in relation to the four intervention principles. The intervention principles, emanating from the basic principles of the CBNRM approach, appropriately highlight the fundamental role of the community involvement and consultation in the process of collective learning thereby tackling the grassroot level issues impacting on the livelihood and natural resources of the watershed.

The conceptual framework of the study in Figure 6 provides the overview of the intervention principles based on which different tools were identified and used, either independently or by integrating them. Likewise, it is conceptualized that the core problem, which is directly influenced by the capacity of the people, their livelihood status, low production levels, and dwindling resource base, can be best addressed by accomplishing the intervention principles in a holistic manner. The two arrows, one on the top and the other at the bottom, are an attempt to depict the two-way process in a linear mode. The top arrow details the principles and sets of tools (methods) to address the issues, while the bottom arrow indicates the process that helps in generating research approaches towards improving the status of livelihood and natural resources in the watershed.

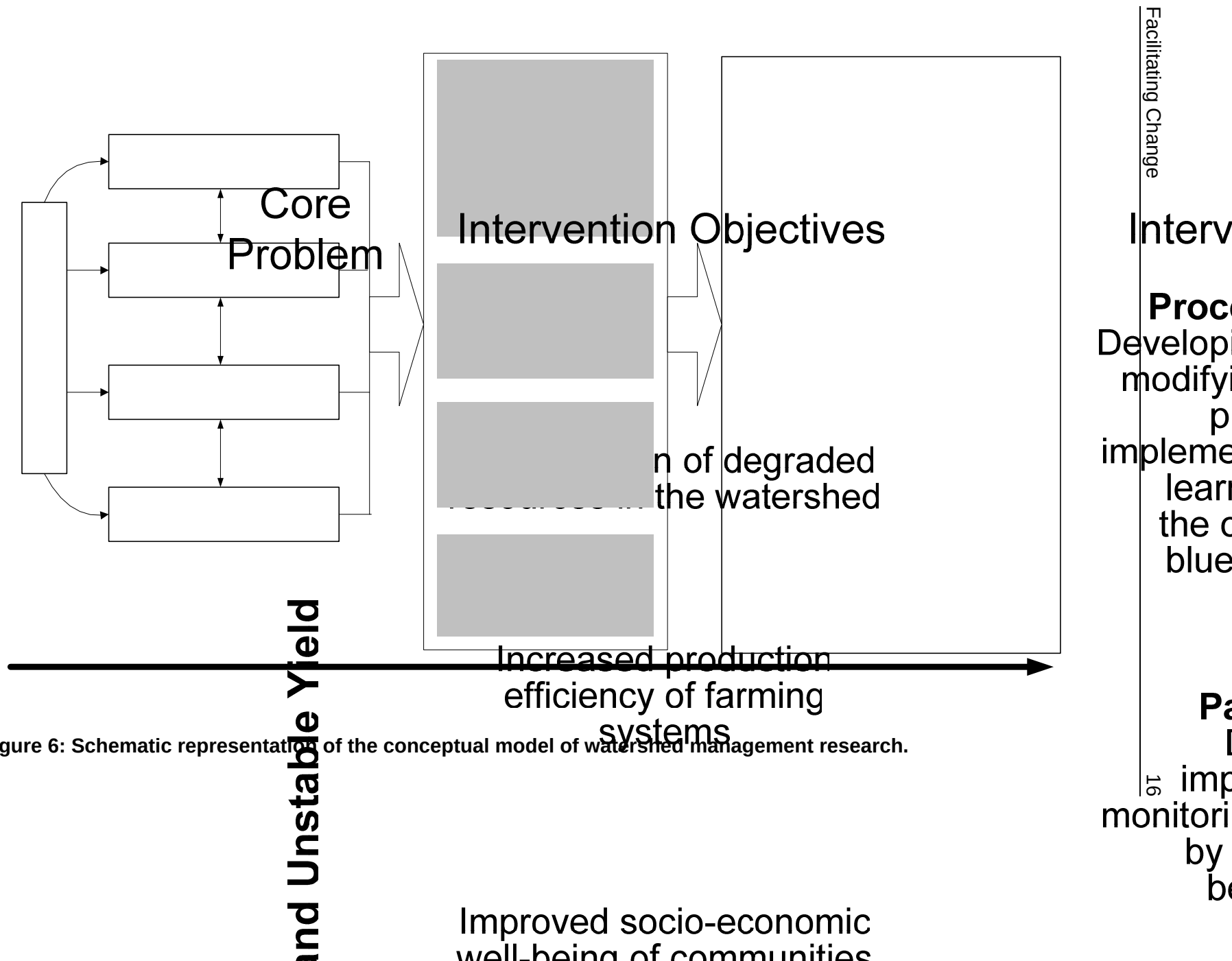


Figure 6: Schematic representation of the conceptual model of watershed management research.

4.3 Approach

In line with the conceptual framework, RNRRC Bajo started the intervention with participatory approaches and practices which facilitate people to express and analyze their individual and shared realities (Chambers, 1997). Such an approach was also necessary to bring local population to the center stage of the intervention, as only they can best express the realities which are characterized as localized, diverse, dynamic and unpredictable. The choice was more befitting, as it increased community motivation and commitment, leading to capacity development and empowerment which played a catalytic role in ensuring greater success. The study also needed a process oriented participation involving people from the initial stage of problem definition to completion of the problem solving process. This choice was considered valid as process oriented participation inspired people to accept ownership of the change process and to eventually lead the process.

During early 1990s, when many IARS and NARS exploring possibilities to develop approaches for NRM centering on the theme of “Community Participation”, CBNRM was emerging as an extensively tested process-oriented approach. This led way to recognition of CBNRM as an approach which fulfilled the above criteria. As the effectiveness of the process is highly dependent on the efficiency of facilitator, RNRRC Bajo facilitated the purposeful interaction among stakeholders ensuring evolution of the process.

The RNRRC Bajo initiated integrated research following the CBNRM approach. Interventions in the watershed have followed a process approach, which can be stated as *“a process by which people themselves are provided with the opportunity and/or responsibility to manage their own resources, define their needs, goals and aspirations, and make decisions affecting their well-being”*. The four basic intervention principles of the approach are given in Figure 6.

Thus the process adopted in the watershed is demonstrated by a cyclical, ongoing decision-making process, reflection and action that seek to include local people and their insights, experiences, knowledge and interests in diagnosis, planning and joint actions. Approach followed in Lingmutey Chu can be summarized as in Box 2.

Text box 2: Approach in Lingmutey Chu - Summary

This approach

- recognises a village as a community;
- recognises that many natural resources are held and managed by individual village households;
- focuses on natural resource management (NRM) issues specific to a community and/or groups/individuals;
- community participation is the key to activity planning, implementation, and evaluation;
- local institutions are to be recognized, studied, and strengthened.

4.4 Method

Within the basic principles of CBNRM approach, the study used different participatory tools such as mapping, household stratification, transect, topical PRA and focus group discussions during a baseline diagnostic study 1997. Community elders, both male and female, from all the villages within the watershed participated in the diagnosis. The baseline study helped in identification of problems and defining the opportunities. Subsequent adjustment to the interventions to best meet the requirements and resources of the community were achieved through continuous and concurrent cycles of problem specific information gathering, activity implementation, monitoring and evaluation. Some of the specific methods used in the process are:

1. *Participatory Rural Appraisal*: To establish the baseline information on the watershed, a multi-disciplinary team was composed to conduct PRA in all the villages within the watershed in March 1997. The diagnostic study helped in identification of problems and defining the intervention objectives. The team used PRA tools like resource mapping, transect, seasonal calendar, matrix ranking and trend analysis.
2. *Wealth Ranking*: Wealth ranking was used to categorize households within the watershed into three different wealth groups depending on the resources (i.e., land, labour, livestock) they owned (RNRRC Bajo, 2000). This categorization has helped in focusing the intervention to benefit the poor.
3. *Structured survey*: Both structured and semi-structured surveys have been extensively used to understand and document specific issues and practices relating to soil fertility, nutrient management, income analysis, crop production and crop budgeting.
4. *Participatory resource management studies*: The community members were involved in the natural resource management activities like forest management (RNRRC Bajo, 1998), watershed management, water-sharing, and water harvesting to enhance understanding and improve management strategies.
5. *Participatory technology development methods*: While the RNR technologies are normally tested and evolved in the research centre, on-farm research still continues to act as a vehicle to test and demonstrate technologies in farmers' fields. In the watershed, on-farm research like Maize trash line, farmer field school, participatory varietal selection and in-situ agro biodiversity conservation, have been extensively used to promote beneficiary participation, ownership of the technology and ensure greater applicability of the technology.
6. *Companion Modelling*: In view of resource use conflict as a major issue in the watershed, the research team used Role-playing game (RPG) and Multi-Agent systems (MAS) to collectively learn the problem situation and establish forward looking strategies in resource use and management.
7. *Community mobilization*: RNRRC Bajo also worked with community members and facilitated the development of some new local institutions while

- strengthening existing institutions for local resource management. Some of the successful groups are Farmers' Saving Group in Dompola, and Women's association in Limbukha.
8. *Community consultation*: Consultation and consensus building with the community in the decision making has been the unique feature of the process. All the interventions have been implemented in consultation with the communities or households concerned, for planning, implementation and assessing results (Box 2).
 9. *Capacity development* – The capacity development of the community members in natural resource management has been the decisive intervention in the watershed. The RNRRC Bajo conducted series of farmers' training on new technologies (new crop varieties and their agronomic practices, cultivation of new crops such as asparagus and oak mushrooms). These trainings have also helped in enhancing the awareness and establishing common understanding of the issues and future actions.

Text box 3: Farmer Consulted

"Never in my life was I consulted.... I was always asked to do..... This is the first time that people are asking my views on our needs."

- Farmer Ap Wangda,

4.5 Evolution of Research Process

Traditionally in Bhutanese context, participation signifies passive one time presence at the occasion. It was also a malapropos, in the name of participation, people wanted government agencies to be a source of free (or sometimes subsidised) inputs or '*kidu*'. Despite the decentralization initiative of His Majesty the King in 1987, there was no explicit platform or process (prescription) where

Text box 4: Process Ownership

The decentralization and participation mechanisms should encourage the view that local communities 'own' the development process, thereby reducing their reliance on the Royal Government as the main agent of development.

- Bhutan's Vision 2020

people could participate (Box 4). Similarly, the institutions (Government agencies) did not have clear idea about the concept of participation. During early 1990s, a new paradigm of uncertainty in the scope of participation was emerging. It was then that, many government agencies initiated collaborative activities and supported local development initiatives. On a similar line, RNRRC Bajo initiated collaborative RNR research activities in different locations.

While disciplinary (sectoral) focus was maintained in research, blending of the sectoral approach into an integrated method was inevitable at the field and community level.

The approach followed by the centre can be best depicted by a spiral which is process oriented (Figure 7). It can be considered a representation adapted from Participatory Learning Approach, Participatory Action Research and Participatory Extension Approach where interventions follow a progressive cycle building on

the learning experience of the past. As shown in the Figure 7, in case of watershed the entry point was the conceptualization of the study intervention approach. The formalization of approach and site was done through consultative process with the local administration. The initial phase which was first 2 years (1997-1998) was devoted heavily on joint learning and understanding of situation, problem definition and action planning. As the RNRRC Bajo lead the intervention, majority of the activities were research oriented activities. The actions were reviewed and the initial phase advanced into the second phase, where different stakeholders were consulted on possible support. The second phase activities were generally of research and extension categories. Again reflecting on the experience of second phase, it was evident that once the livelihood issues were (being) addressed, higher level issues emerged. Therefore, the following phase (current phase for RNRRC Bajo) focused on institutional and capacity development, infrastructure developments, and adaptive research. The third phase can be recognized as one when approach gets mainstreamed in the formal protocol of the watershed. By the time approach/process gets mainstreamed, the new directions will emerge, which will catalyze the process to advance further.

The vital strength of the process has been the leak in the system, considered here as an “off-shoots”. Conventionally, such leaks are either ignored or assumed to be taken care. However, in this process such off-shoots can be already be used in out-scaling and up-scaling the process before a cycle (phase) is completed.

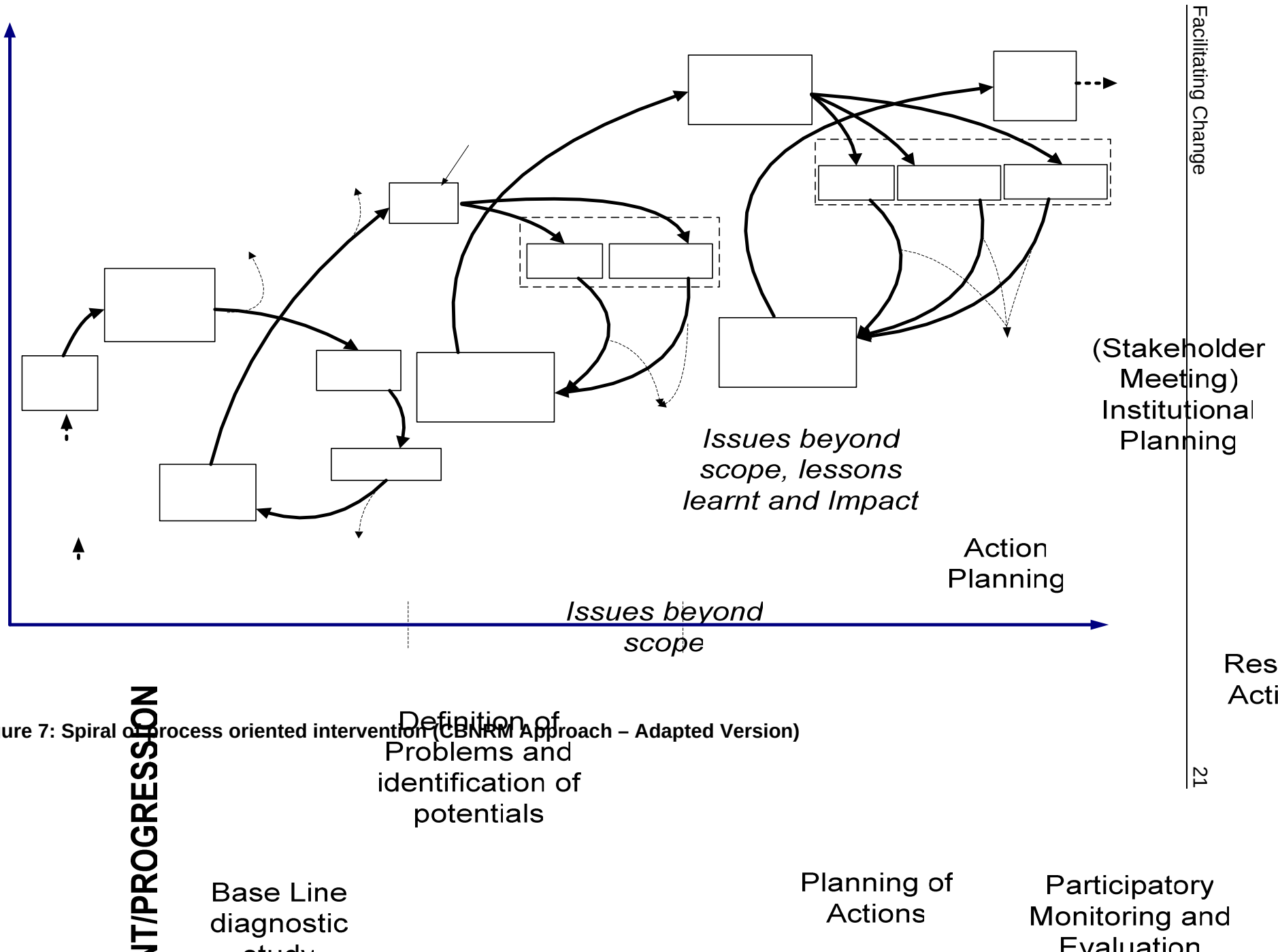


Figure 7: Spiral of process oriented intervention (CBNRM Approach – Adapted Version)

CHAPTER V: VILLAGE LEVEL ORGANIZATIONS AND CAPACITY DEVELOPMENT

5.1 Introduction

Since 1987, Royal Government has adequately emphasized in the decentralization policy on people's participation in development activities. This is mainly due to unsustainability of development activities when planned and implemented by the government agencies only. As such the Royal Government has decentralized and set up local governments all over the country and encouraged farmers organizations and cooperative formations to finally take over the development activities. Lingmutey Chu watershed is no exception and has local governing body and good mix of traditional and formal organizations which are described below.

5.2 Traditional Local Institutions

a) *Reesup (Village Forest Caretaker)*

Before 1969, a typical *Reesup* appointed by the community managed the forest. The *Reesup* ensured that every household had equal access to forest resource as and when required besides enforcing prohibitory activities laid down in the community agreement with *Reesup*. The *Reesup* in turn was paid in kind by the communities and exempted from obligatory services to the government and community. With Forest Act of 1969, *Reesup* was replaced by government appointed forest official and all the traditional rights and practices were abolished. During this transitional period, neither government could monitor the resource management nor did the *Reesup* have role. This resulted in degradation of forest. After fifteen years the Department of Forest realized the need for the institution of *Reesup*. Therefore, in 1985, some adaptations were made and the selection of *Reesup* was done the Forest Service Division with fixed salary from the government. His responsibilities included distributing the message of the government policies on the sustainable use of forests, explain rules and regulations under in the Forest Act, encourage the local people to abide by government rules and regulations on the use of forest products and assist local Forest Officials to detect forest offences (Wangchuk, 2000).

b) *Chusup (Village Water Caretaker)*

Almost parallel to *Reesup*, Community also had *Chusup* to take care of water resources. The community collectively used to construct irrigation channel and drinking water sources. Their regular monitoring, minor repair and maintenance were done by *Chusup*. The water sharing system then was based on their traditional rights which were not based on the landholding size. This institution is now replaced by Water Users' Associations (WUAs), as a result of government interventions.

5.3 Formal Institutions

a. *Geog Yargay Tshogchung*(GYT)

Lingmutey Chu watershed is spread over three geogs which are under three different Dzongkhags (Punakha, Wangdue and Thimphu). Like in any other geogs of Bhutan, the three geogs of Lingmutey Chu watershed, each has a geog level development committee known as *Geog Yargay Tshogchung* (GYT). The GYT was instituted in 1987 with a royal initiative to promote people's participation in planning and implementation of Geog development activities. The committee comprises of three elected members *Gup*, *Mangmi*, and *Tshogpa* with *Chimi*, geog clerk, and representatives of various sectors in the geogs as observers. The committee under the chairmanship of the *Gup* is responsible for overall development and welfare of the Geog (GYT Chathrim, 2002).

The implementation of watershed activity in Lingmutey Chu, including monitoring and evaluation, is always carried out in direct or indirect consultation with GYT. The information of our intervention routes through geog Extension Agent (EA) who in turn informs the *Tshogpa* or *Mangmi* for their consent and information. This process is useful particularly for the GYT to screen useful and better intervention for their geog and discard some of the not worthwhile interventions. In involving GYT in this process, it has greatly enhanced people's empowerment and gained ownership over the development activities, unlike in the past when people were mere implementers of Government plans. Although working through GYT ensures relevancy of intervention to their need, it was little difficult in Lingmutey Chu watershed to strictly follow this process because Lingmutey Chu is under three different administrative jurisdictions. Particularly community mobilization for collective effort for watershed management as a whole was difficult when all three geogs are to be involved in decision making.

Nevertheless, GYT came as a blessing from the throne to appropriately develop local plans for the geog since GYT and local communities know their problems, needs and aspirations best. This development committee and others, including watershed management committee, would be appropriate organizations to take over any projects for future sustainability.

b. *Water Users Associations*

Water resource is crucial for crop production, especially in the rain-fed areas. It was always a scarce commodity and required proper management and sharing system. In the past, government has provided full support for establishing irrigation channel but they did not operate for long as the communities failed to maintain and renovate them. Responding to this problem, the government developed National Irrigation Policy (NIP) in 1991, to lay the foundation for a sustainable approach to irrigation development through the effective participation of the Water Users. One of the pre- requisites of NIP is the commitment from the

community to save some amount to be spent during the time of repair and maintenance which should be managed by forming Water Users Association (WUA). Otherwise, the government would not support construction of irrigation channel.

Following policy development, all Extension Agents are trained on National Irrigation policy and entrusted the responsibility of implementing the policy document. As of now, there are four WUA in the watershed with four communities, Limbukha, Dompola, Omtékha and Matalumchu. The water sharing system of Dompola was changed following the system of NIP which is based on the land holding size but this did not find farmers acceptance. The problem was reported to Dzongkhag administration and they were advised to revert back to the old system.

At present, WUAs are not operating as envisaged in the NIP. This may be attributed to the absence of participatory approach when pre-set of conditions laid in the NIP by the government had to be followed for irrigation scheme management (see box). The water shortage is still an issue in watershed and further intervention in future would be required in water management in watershed level with participatory approaches.

Text box 5: Farmers perspective on project intervention

Projects come with solutions without understanding the problems..... We accept it because it comes with inputs.

Ap Kuencho

5.4 Small Farmer Saving Group

In the past, with limited cash income in the village, communities had faced dire need of cash when they had to incur cash for various social and development activities. Taking advantage and charging very high interest rate by few money lenders worsen the situation for the poor communities. Rural credit from BDFC was either not easily accessible due to lengthy procedure or very little amount needed for credit would not be provided by BDFC. To overcome this unfavorable situation, small farmers saving groups were promoted.

a) Dompola Village Development Small Farmer Saving Group

RNRRC Bajo conducted awareness campaign to the communities for saving group formation option to build credit source within them. Out of 35 households in the village 22 interested households having limited cash income volunteered to take up saving group formation option. The rest of households were not interested to participate in the group mainly because of their higher standard comparatively, which they thought can do of their own without joining the group.

Year	2002	2003	2004	2005	Total
Membership fee (Nu)	4400	0	0	0	4400
Monthly contribution (Nu)	11880	15840	14400	5700	47820
Donation (Nu)	2500	2000	2500	3500	10500
Interest (Nu)	00	1200	1500	2700	5400
Penalty (Nu)	00	500	500	200	1200
Total (Nu)	18780	19540	18900	12100	69320

Capacity building on organizational management such as leadership, risk management and book keeping were given during the inception period. Besides this capacity development, the group was also provided with cash box to set up their own bank, housed in their community *lhakhang*. By-laws and constitutions were developed with the facilitation support from Research Centre, Bajo. This document serves as the legal guide for functioning and management of group in all respect. Formally Dompola Village Development Small Farmers Group (DVDSFSG) was formed in April, 2002, with 22 founding members.

Text box 6: Unique features of Dompola saving's group

- ✓ Household membership ensures greater participation in the meetings and other group efforts. Other family members can represent for participation during the absence of member, unlike the individual membership.
- ✓ Savings are kept with the group and finances micro-credit for members. This generates interest from the credit plus they can have easy access anytime and any little amount.
- ✓ Their savings are backed by the income generated from economic activities (mushroom enterprise) implemented collectively.

After just three years of its formation, DVDSFSG has achieved a total saving of Nu 69,320 as of May, 2005 through, membership fee of Nu 200, monthly saving of Nu 60, interest from the loan, penalties and donations. At least the members do not have credit problem any more, when they are in need of credit. Members can avail loan up to Nu. 10,000 for long term and have different rates for other short and medium term loans (Refer

By-laws and constitution of DVDSFG). According to their monthly meeting

minutes, members have taken credit mainly for children's education, buying agriculture implements and livelihood e.g. electricity. As of now the group is functioning well. They have built sufficient capital to micro-finance their credit requirement. Their social capital is enhanced too. Three members have resigned with this three years to time and remained with just 19 members. They have resigned so either due lower capacity to contribute both cash and labour or little better than others, leaving rest of the members as more homogenous group. It is learnt that group will last together if they are homogenous in terms of need, priorities and their aspirations.

Replicating the idea of group formation from Dompola, several other groups were formed in the watershed. These include Limbukha Village Development Group, Limbukha Amtshoi Phanday Tshogpa and Nabchey Saving Group.

b) Community Breeding Bull Management Committee

Earlier the communities were provided with public bull and it was solely managed by the government appointed caretaker with some incentives given to him. Communities were never involved in this bull management and the motivation for the caretaker was not adequate and landed up in disregard of bull. However, owing to low livestock production and the need to improve cattle breeds in the village through improved bull was still relevant. RNRRC Bajo thus supplied an improved bull with the financial support from BG-SRDP and suggested the present community bull management committee with involvement of all beneficiaries.

A committee was formed to manage this bull and appointed bull care taker from among the members. Community has established improved pasture for fodder and contributes feed regularly with in their turn wise contribution mechanism. For the better management and sustainability of this bull, committee has also made a mechanism to build capital. The beneficiaries are made to contribute to the fund when the progeny was born as a service charge. Collection of penalties from irregularities of bull management is another source for their capital building. The capital is being used not only for bull management but also used for micro-financing the members. Building capital through micro-financing is already a lesson learnt from Dompola saving's group. This bull management approach is functioning well.

5.5 Upcoming Institutions

Watershed Committee

The Watershed Committee (WC) is the managing body for the watershed. A WC is being constituted for Lingmutay Chu watershed to sustain activities beyond the project phase. The Village Resource Management Committee (VRMCs) in the six villages of Limbukha, Dompola, Nabchey, Matalumchu, Omtexha and Wanjokha

will form feeder to the WC. The VRMCs in each village will look after the WUA, Forest users group and saving groups. Formation of more SHGs and users group will be encouraged in the Lingmuteychu watershed areas.

Capacity building exercises to develop local managers, who are confident and empowered to deal with local issues, is integral to any successful watershed paradigm.

CHAPTER VI: TURNING A NEW LEAF : ENHANCING PRODUCTIVITY AND RESOURCE MANAGEMENT

6.1 Introduction

In order to understand the existing natural resource management and production practices of major food crops so as to assist the farmers in the watershed, a participatory diagnostic survey was conducted in March 1997. A number of issues emerged from the survey (Chapter 3). To holistically understand and deal with the issues, RNRRC Bajo started a participatory watershed approach and involved a number of other development partners and projects to work together with the communities. This chapter presents the major initiatives undertaken thus far to enhance the productivity and management of forests, water, food crops, horticultural crops and livestock (Figure 8). A conscious attempt is made to present the results in an integrated way so as to reflect the integrated and interdisciplinary approach used in the study and project implementation.

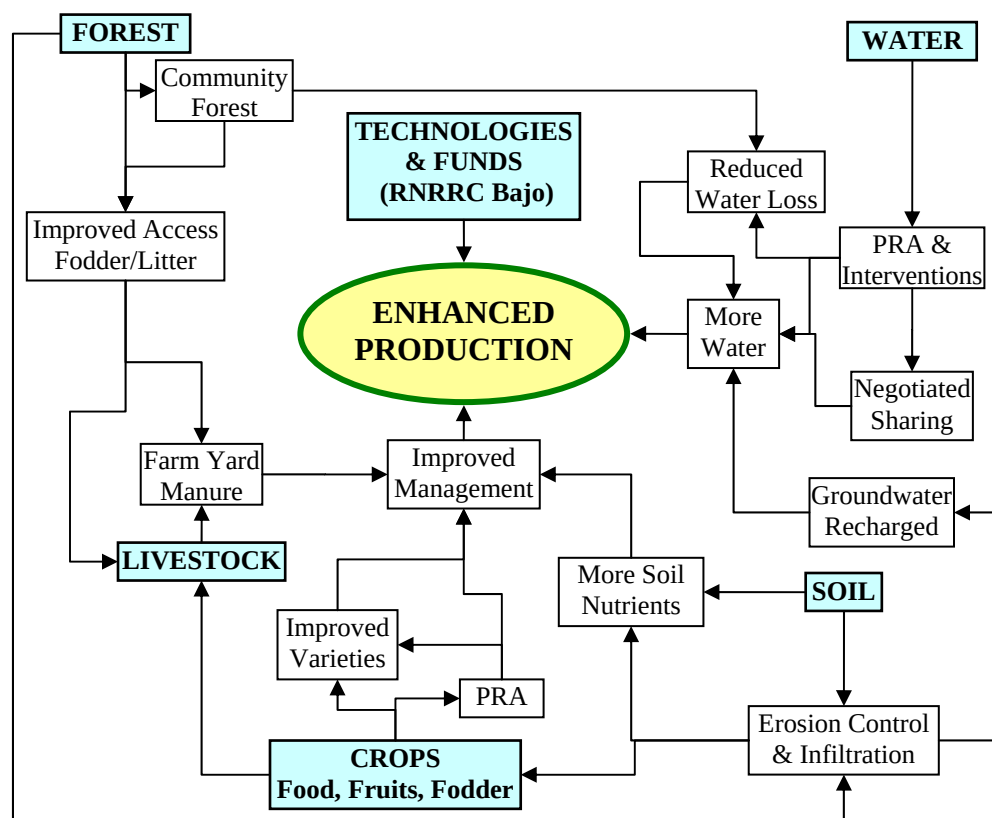


Figure 8: Integrated watershed intervention

Forests and forest land account for about 95 percent of the total area in the watershed. The watershed has Chir Pine forest in the lower slopes, mixed Chir Pine and broadleaf oak forest in the medium slopes and cool broad-leaved forest in the upper parts. A large part of this 'forest' is, in reality, degraded forest land

subject to large-scale erosion and gully formation. Some of the degraded areas have been rehabilitated through community forest plantation (CFP). A community forest management plan has been developed through participatory process involving the community, Department of Forest and RNRRC Bajo. A community forest management group (CFMG) has been constituted and is functional.

Water is a critical resource in the development of rain-fed production systems including forest, crops and livestock. It also is a major destructive force in the form of soil erosion. Watershed practices are designed to make running water to creep and creeping water to stop, percolate and recharge the water sources. Gully plugging with live posts followed by revegetation of silted gullies with trees and grasses, reduced soil erosion on the steep hill slopes in the middle reaches of the watershed. Maize trash lines worked wonders with soil erosion control in cultivated areas with less than 40% slopes. Both the practices have increased soil nutrients and water availability for crop production in the watershed.

Cultivation of rice, maize, wheat, potato, chilli and vegetables is the predominant occupation of the watershed communities, which are largely comprised of subsistence farmers. Rice is the staple food of the majority of the inhabitants, whereas maize forms the diet in Nabchey village. Several studies such as sequential crop cuts in rice, evaluation of suitability of improved rice, maize and soybean varieties, and better crop husbandry practices (soil nutrients, water) in cereals have been made. Productivity of crops has been enhanced through participatory action of farming communities in all the villages. The farming community enjoys a greater sense of well being now than ever before. Households across the watershed enjoy fresh home grown fruits and vegetable as also sell the marketable surplus to earn the much needed cash incomes.

Livestock is a major source of milk, cheese, butter, meat, manure, and draught power to the watershed communities. Through introduction of cereal and legume fodder crops as well as by promoting cross-bred cattle, the yield of milk and availability of draught power for farm operations has been enhanced.

Fruits have a ready market due to demand from local population and tourists. Cultivation and group marketing of fruits offers a possibility of raising the cash income of the watershed community. Fruit cultivation is promoted as backyard as well as orchard crop. A fruit plant nursery has been established by a farmer to make grafts of improved varieties available locally.

Some of the significant interventions and achievements in forestry, crop husbandry, livestock management and cash crop cultivation are described below.

6.2 Productivity and Management of Forest Resources

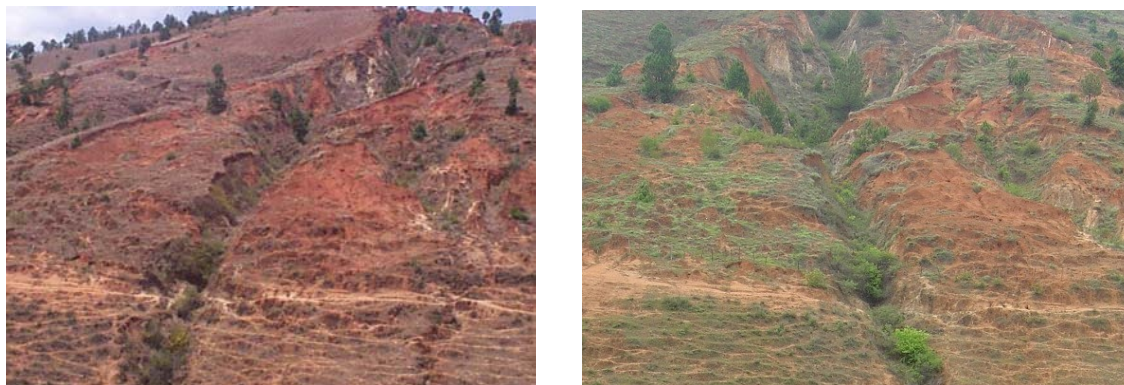


Figure 9 Before and after picture of gully stabilization via reforestation

Degradation of forest and forest areas was identified as the major issues during the diagnostic PRA in 1997. The first objective of the watershed development “to rehabilitate and improve the degraded resources in the watershed” emphasized the need to address this. The fourth objective “to strengthen local capacity for natural resource management” was formulated in line with the government’s policy of decentralization with a focus on giving a greater role to local communities for managing natural resources. These two objectives decidedly influenced the choice of forestry activities in the watershed.

The trend of forest product usage is changing with the development of infrastructure and urbanization. While firewood still remains the major source of fuel, households increasingly use electricity and liquid petroleum gas (LPG). Motorable roads now connect most villages and, with increasing disposable income, households bring in truckloads of firewood and timber from areas outside the watershed. Although these developments have positive effect on forest resources in the watershed, they have implications on the way forest resources, particularly fuel wood and timber, are used, accessed and are given precedence over other concerns.

The RNRRC Bajo worked together with the local communities and other partners to rehabilitate degraded areas and to develop simple methods for watershed forest assessment and management.

6.2.1 Building Partnerships: Working together to rehabilitate degraded land

The degradation of the forest areas was a major concern for the communities in Omtékha and Matalumchu villages in the lower part of the watershed. These areas are characterized by heavily eroded soils with very little vegetation cover, resulting in formation of deep gullies. Local people expressed the need to establish plantations on these areas to halt the land degradation process. They also expressed their concern about not getting ownership of their plantations.

The RNRRC Bajo took up this issue with the Divisional Forest Office. The latter assured that with the provisions provided in the Forest and Nature Conservation Act 1995 (Box 1) property ownership and use right will be given to the concerned communities.

Box 1 : The Legal Basis for Community Forestry in Bhutan

The following provisions in the Forest and Nature Conservation Act, 1995 supports community forestry:

- the Ministry of Agriculture may make rules for the establishment of community forestry on Government Reserved Forest [section 17 (a)];
- the rules for community forestry may provide for transfer of ownership of forest produce to appropriate groups of inhabitants of communities adjoining the forest [section 17 (a)]
- the groups to which community forests have been transferred shall manage them for sustainable use in accordance with the rules for community forests and approved management plans [section 17 (c)]

(Forest and Nature Conservation Act 1995. MoA, RGoB)

An immediate constraint that emerged then was the need for fencing to protect the newly planted trees from browsing by livestock and wild animals. Since RNRRC Bajo did not have the resources to provide all the required inputs the Bhutan-German Sustainable RNR Development Project (BG-SRDP) based at Lobesa (about 20 km away from the watershed) was approached for assistance. The BGSRDP has since then provided professional and financial support for the forestry activities in the watershed. Resource strapped communities require some external material/financial support to get the process started. Seedlings of jointly agreed species (Box 2) were obtained from the community nursery (established to generate planting materials for successive years on an individual farmer's land) or brought from the Punakha Dzongkhag Forestry nursery and planted at the selected site with barbed wire fencing to prevent browsing.

The two communities of Omtékha and Matalumchu organized themselves into two Community Forestry Management Groups (CFMG) and each CFMG committee consisting of 6 community leaders, with at least one woman). Each CFMG committee member was assigned a particular responsibility (Chairperson, three secretaries, a treasurer). The *Tshogpa* is an

Box 2 : Tree Species Planted in CFP

1. <i>Acacia arabica</i>	2. <i>Ficus roxburghii</i>	✓
3. <i>Acacia farnesinea</i>	4. <i>Leucaena diversifolia</i>	
5. <i>Acrocarpus fraxinifolius</i>	6. <i>Leucaena leucocephala</i>	
7. <i>Ailanthus excelsa</i>	8. <i>Macaranga denticulata</i>	
9. <i>Albizia lebbeck</i>	10. <i>Melia azedarach</i>	✓
11. <i>Albizia procera</i>	12. <i>Morus indica</i>	
13. <i>Albizia stipulata</i>	14. <i>Poplar spp.</i>	✓
15. <i>Alnus nepalensis</i>	16. <i>Quercus gluca</i>	✓
17. <i>Castanopsis spp.</i>	18. <i>Quercus griffithii</i>	✓
19. <i>Cupressus spp.</i>	✓ 20. <i>Quercus lanata</i>	✓
21. <i>Dendrocalamus strictus</i>	✓ 22. <i>Robina pseudoacacia</i>	
23. <i>Dodonea viscosa</i>	24. <i>Salix babylonica</i>	✓
25. <i>Eriolobus indica</i>	26. <i>Schima wallichii</i>	✓
27. <i>Erythrina variegata</i>	28. <i>Spondias axillaris</i>	

✓ indicates species preferred by farmers

ex-officio member of the CFMG Committee. A user group constitution drafted in consultation with the CFMG members defined the rights and responsibilities of the members and the committee.

The degraded forest land was proposed for rehabilitation. Permission was sought from the Department of Forests (then Forestry Services Division – FSD) for the use of this land. Selected CFMG members accompanied RNR-RC Bajo and BG-SRDP staff to survey the site. Men and women typically participated equally in all the CFP activities. The participating institutions only provided technical advice and demonstrated the techniques in planting, marking for fencing, species layout and also supervised the work (Figure 9). The Community Forestry plantation (CFP) is managed according to the prescriptions of a community forestry management plan (CFMP) approved by the DoF. This plan specifies the rights and responsibilities of the CFMG members, the management system for the CFP and meets the three principles of protection, production and social equity.

A total of 37 hectares of community plantation has been established with about 27 selected tree species growing therein. The CFMG committee regularly meets and monitors the plantation. The Omtékha CFMG in particular was dynamic and well organized certain tensions appeared and changes were made. None of the three women CFMG members remained on the committees which are entirely male. In Matalumchu, the CFMG changed the whole committee, giving as their reason the need to spread experience among the CFMG members.



Figure 10: Men and women members engaged planting for community forest plantation

Rehabilitating completely degraded lands as the ones in the watershed entail considerable effort. Large pits (unusual for forestry planting) were dug and filled with sufficient amount of manure to give the planted saplings a better chance of survival and growth. Fencing accounted for the major capital costs but was beneficial for two reasons. First, it protects the area from browsing animals which inherently increases the biomass cover which in turn helps conserve soil and improves the site growing conditions; and second, this investment indicates commitment from the implementing agencies and can enable overcoming of the initial community's skepticism and encourage effective participation. A number of degradation problems can be attributed to grazing and the vicious circle of problems it entails. A simple effort such as fencing can bring in lot of vegetation cover and aid rehabilitation. Farmers immediately point to the successful growth of grass cover in the fenced area as a major achievement.

Although farmers are not deriving much benefit from the plantation at the moment, they are happy with the plantation because of the good growth of grass which they collect for feeding their livestock. A lot of attention was paid to farmers' priorities and needs in planning the plantation. This has been reflected in the choice of tree species that includes all species preferred by farmers and a few other species. However some species, particularly cypress (*Cupressus* spp.), selected by the communities do not perform well under the conditions of dry south facing and very exposed slopes. Seedlings planted on the leeward side of some trees existing on the slope selected for CFP have shown manifold higher growth, thereby indicating that wind may have a role in limiting seedling growth. Agencies undertaking plantations in similar areas could do well to avoid choice of this species. Fast growing species such as *Leucaena leucocephala*, *Acacia arabica*, *Melia Azaderach* and *Albizza* spp. grow in the degraded areas. Farmer selected tree species such as *Quercus* spp and *Salix* spp are better performers.

6.2.2 Co-management of Forests: Practicing the rhetoric

The 1998 PRA to identify the forest resources, forest use, views on the existing centralised management system, and interest in developing participatory watershed management revealed a number of issues such as the time required for permit processing; the occasional delay of tree marking and their inability to protect their local forest from legal extraction by outsiders. The communities were keen on being involved in the management and protection of the forest in their immediate neighbourhood provided the enforcement functions remained with the Department of Forests. Implementing agencies also agreed that the watershed forest was not directed by any scientific management approach and relied on tree marking rules which more often than not were hard to apply in practice as communities pressured the local forest official to mark trees that were closer to their home for ease of transport. A consensus was then reached on developing a novel approach of managing the watershed forest jointly by the local forest official and communities were essential. The stress on the local forest official in the geog is because of his extensive knowledge of the local forest area and its

potentials by virtue of being stationed there. The concept of the watershed forest management plan was thus born to guide forest area usage in the watershed (RNRRC Bajo, 1998).

The immediate action then was to focus on identifying critical forest areas with the local communities. This was achieved through a forest function mapping exercise. The main difference of this exercise with compared with similar ones elsewhere was the continuous and extensive discussions and involvement of local people through out the process. Forest function mapping defines for watershed forest various functions to allow a balance between the oftentimes conflicting management interest of the local forest users, nature conservation and environmental protection. Five categories of forest function were developed: soil conservation function; water and watershed conservation; social function; nature conservation function; and road buffer function. Details of classification criteria, methods used and results are described elsewhere (RNRRC Bajo 2003).

A simple forest assessment technique developed with the support of BGSRD P was used and forest areas were classified as production forest in terms of current use, potential for rural supply and management options. Results from this exercise were used with those of the participatory demand assessment that forecasted demands for specific forest products (various sizes of timber, poles, firewood) in the next ten years, to derive management prescriptions that were then documented in a watershed forest management plan (WFMP). Presentations on this new participatory approach by RNRRC Bajo and BGSRD P have led to its recent adoption for use in similar areas by the Department of Forests.

6.3 Water Management

After tree cover in the forests to prevent erosion in cultivated areas, the next important issue for rural communities is water management and availability of water, especially for puddling and transplanting their staple food crop, rice.

6.3.1 Understanding traditional systems

Knowing and documenting the traditional irrigation water sharing system regulated by the village appointed *chusup* (caretaker) has been the corner stone in understanding the resources use dynamics in the watershed. A lot of the time and effort had gone into in understanding and characterizing the sharing system. The understanding has been generated at two levels- the mechanism within a community and between the communities in the watershed. The study revealed that the traditional water sharing systems are not based on equity and efficiency, but on two principles - “first come, first served” and “upstream users can divert all the flow into their irrigation canal regardless of the need of downstream users”. This rationale clearly favours upstream users in terms of access and leaves downstream users to depend more on seepage or natural recharge to the stream from the lower catchments. Such arrangement prevented improving conveyance efficiency of canal which is less than 50%.

Within a community water rights are defined by several factors including household contribution to religious ceremonies; participation of their ancestors in constructing the canal; in some cases related to size of the landholding; and participation in the maintenance of the canal. These factors are interdependent and their relative importance varies from village to village (Brand *et al.*, 2000).

Irrigation canal conveyance study indicated that the conveyance efficiency of main canal ranges from 30 to 50 percent. The low conveyance efficiency was due to the fact that all water flows through earthen dug canals. Like anywhere else in Bhutan most of the irrigation distribution systems run down the slope characterized by soil erosion and gully formation. The problems are prominent in Dompola, Omtékha and Matalumchu. Every year a farmer loses a terrace due to deposition of sediments.

Basically, two types of interventions were made in water management front. The first type was local and site specific interventions which did not require the participation of whole watershed community. The second type of intervention required the participation of other communities to address broader cross-cutting issues.

6.3.2 Gully Stabilization

Due to the topography, the distribution irrigation canal in Dompola runs down a steep slope resulting soil erosion and gully formation. Sedimentation on downstream lands cause decline. Farmers usually dig sedimentation ponds to trap the sediments which need to be emptied very frequently exerting pressure on the labour availability for farm work.



Figure 11. Gully plugging after one year with drain pipes slightly visible and after two years with vegetation

In the RNRRC Bajo assisted interventions, pipes were used to convey water through the gully while series of check dams were built using live post of local tree species like Chhatsheshing (*Erythrina indica*) and Langmashing across the gullies in Dompola Village. The grass species like Napier (*Pennisetum purpureum*) and Vetiver were planted to stabilize gully slopes. The concept was to minimize soil erosion by developing root network before the pipe gets worn out.

6.3.3 Water distribution

The conveyance of water from the source to the tail-end users brings many issues to the fore: conveyance systems, conveyance efficiency, water rights, social issues and management roles in distribution of water as well as funding to ensure the working of the system.

i) Replacing old MS Flumes

Breaching of earthen canal walls led to erosion and gully formation on steep slopes. The traditional wooden flumes used by farmers for conveying irrigation water were replaced by MS flumes, which have since become old and leakages have caused landslip and soil erosions. Farmers cannot afford new MS flumes, hence RNRRC Bajo has provided old pipes from serviceable scrap to replace some of old flumes as a short term solution. Long term strengthening of canals still needs attention of the Dzongkhag Administration.

ii) Dompola Irrigation Scheme-NIP Impact

The 5 km long Dompola Irrigation System was built by the farmers. Its intake lies in the middle of Limbukha and the canal conveying water at 80lit/s benefits about 25 households irrigating 16 hectares of wetland. Dompola community received government assistance for renovation in 1999 for the main canal only. As per the NIP the water sharing was done based on the landholding size, however, after two years of operation, the majority of farmers were not satisfied with the new sharing arrangement as they were getting less water and at much longer interval compared to their traditional system. Hence they were permitted by the Dzongkhag Administration to switch back to the old system.

iii) Water Sharing

Limbukha and Dompola communities are located on the upper reaches of the watershed. The intake of Dompola irrigation canal lies in Limbukha and 50% of the flow in the stream is diverted into the Dompola irrigation scheme.

Over the last five years potato cultivation in Limbukha has increased. As the harvesting of potato overlaps with the rice transplanting season it delays transplanting due to additional labour requirement. No water is released from Limbukha to Dompola till transplanting is finished in Limbukha. As Bhutanese

follow lunar calendar, the dates fluctuates in relation to Julian calendar. However, the release of water is on dates as per the Bhutanese calendar.

6.3.4 Water Harvesting in Nabchey

Since Nabchey's Community comprises of settlers in 1950s from east, they have relatively less access to the water resources for irrigation (as per the second principle water right in the watershed). Access to water for drinking was adequate then. Over the years water resources have dwindled and even access to drinking water has become a pressing problem. RNRRC Bajo assisted the Nabchey Community to have drinking and backyard irrigation water conveyed through pipes laid with the participation of the beneficiaries in the labour and financing of the work.

6.3.5 Role Play Game

The Role Play Game is efficient to make people express individual perceptions on the resources and making them to forge common perceptions for sustainable management of the resources. By developing common understanding on the resources stimulates to people to have single goal. The process of forging common perception is very critical part of the overall process, as it demands understanding of interactions between societies and their environment. Thus RPG provides simple representations of the real world through a very interactive bottom-up modeling process. Such artificial conditions allow people to act as farmer allowing them to understand the co-viability of environmental or resources and socioeconomic dynamics. Because it focuses on the understanding of interactions between various (individual or collective) agents acting in a given common environment, to identify with them better coordination and negotiation mechanism to improve the viability of the agro-ecosystems, the approach seems well adapted to dealing with this core problem.

It was successfully used to convince Limbukha farmers agree to give Dompola share of irrigation water by five days earlier (i.e., on 5th day of 5th Bhutanese Calendar instead on 10th day of the 5th Bhutanese Month).

6.3.6 Overall Process

The ultimate aim of water resource management is to increase the water availability for enhancing livelihood production in the Lingmutey Chu Watershed. Although the interventions until now has been limited few activities which have contributed in a small way to enhance water availability, the door to do more interventions has been opened which will ultimately address the water shortage problem in the Watershed.

Within the last seven years, the physical impact from the above interventions may not be very prominent, but the positive change in social attitude has been an outstanding achievement. This is reflected by the fact that all the communities in the Watershed now have a common understanding and vision towards the

natural resources management. The watershed communities are now in the process of constituting Watershed Management Group.

This has happened only because of the increasing capacity development of communities through training and constant interactions with the communities. Empowerment of communities to enhance the grass root decision making process has always been in the forefront of the RNRRC Bajo's watershed development approach.

Such social metamorphosis is critical process for implementing large scale development activities that will then bring about tangible developmental changes in the watershed has been fuelled by increased understanding of socio-biophysical dynamics- a holistic watershed approach. The uniqueness in this approach is that the common vision is founded based on the watershed level resources and social dynamics which are understood by the common people.

6.4 Crop Productivity and Management

Rice is the staple food crop and its cultivation is the primary occupation of most farmers in the watershed. The major water sharing issues arise from the high water requirement for land preparation (puddling) and transplanting of rice in June-July each year.

6.4.1 Water and seed management in rice

During the diagnostic study in 1997 the watershed communities expressed that irrigation water shortage during rice transplanting season is the main constraint in rice production. To understand the problem better, a number of participatory studies such as water balance, on-farm water use practices, conveyance and water sharing systems were undertaken. Information was also gathered via informal interactions with the farmers and observing the field practices. In the initial stages of the watershed studies, two teams of researchers from RNRRC Bajo spent the whole rice transplanting season in the watershed. Living with the communities and discussing these issues were crucial in building the confidence of the farmers. Their basic concept of water management for rice is "*jha chugi, pho jhago*" indicating more water means higher yield. The participatory water balance study showed the shortage of irrigation water for rice transplanting is due to the irrigation sources being small and seasonal; transplanting season being earlier than peak rainfall time; and short transplanting season at higher altitudes.

Farm water balance study revealed a water high consumption for rice cultivation. The quantity of water used varies in relation to the access to the water source and the soil type. For puddling farmers nearer the source generally use more water (471mm) than those further away towards the tail-end (133mm). During the growing season farmers tend to keep higher level of standing water than actually needed as insurance against unreliable water supply from a rotation system of five to six days interval. Researchers have demonstrated through extensive trials in the watershed that intermittent flooding and drying of the paddy fields reduces

water and labour requirements, as also *Shochum* weeds (see section 6.4.5). However, this practice has not yet been adopted by the farmers.

To validate if there was a yield loss from late rice transplanting, a sequential crop cut was done in which 22 farmers participated. In Matalumchu, the local Maap varieties (with longer maturity period) are planted in the early season while shorter duration white varieties (local and improved) are planted late in the season. The results demonstrated that there are both local and improved rice varieties of short duration that could be used as a strategy to maximize yield if the planting is delayed. In Limbukha (1900 m), 19 farmers participated in the rice crop-cut exercise. The crop-cut data showed a declining trend in yield with every delay in transplanting. However, the reason for late planting may be associated more with the changed cropping pattern; from buckwheat/wheat-rice to potato-rice; than shortage of water. Due to late planting, farmers do sacrifice some rice yield but it is compensated by higher cash income from potatoes.

RNRRC Bajo provided farmers with free seeds of early and improved rice varieties that could be transplanted later in the season, without sacrificing yield. Field demonstrations were also done with the farmers to show that rice could be successfully cultivated with lesser amount of water than what they would ideally prefer.

6.4.2 Providing rice variety options

In 1997, with a better insight of the farmers' rice varieties and planting times, 3 varieties were assessed against the local cultivar, Kaap. Although the yield performance of the varieties, IR61331 (5.21t/ha), IR 56346 (4.28), CARD21-14 (5.49), IR 64 (6.30) and Local Kaap (5.16) was comparable, farmers preferred some of the new varieties for other traits such as early maturity. The test entries could very well serve as alternative varieties even under late planting condition. The cooperator-farmer stated that CARD24-14 is an early maturing variety and suitable under late planting situation. Over the years, a number of participatory variety evaluations have been done in the watershed, and till today, farmers have retained and maintained in their farm several varieties initially provided by the RNRRC Bajo researchers.

This experience revealed that there are ample alternative varieties if the planting is delayed due to delayed harvesting of potato or shortage of water in the early planting season. If appropriate varieties are chosen, yield loss is not much. The experience also demonstrates that if some of the short duration white varieties, especially improved ones are planted early in the season, farmers will harvest about one tonne additional rice from the same unit of land.

In Limbukha and Dompola (1800-2170m asl) as well, seeds of several improved varieties from RNRRC Bajo were provided to interested farmers. During the crop growth stage co-operating farmer and researchers invited other farmers to give

their views and identify the potential varieties. Several test entries were identified as promising by farmers: viz Yunan-13, Yunan-16, Hexi-24, Kunming-217, Kunming-830 and Chummro. These varieties yielded higher than their local cultivars and were comparable in straw production, grain shape, size and other traits. Many continue to grow them today.

6.4.3 Increasing rice variety diversity

In collaboration with the National Biodiversity Centre, a participatory study of the existing rice genetic resources in the lower part of the watershed was done. The study enabled researchers to gain insights into the types of varieties farmers wished to have in terms of grain and straw yields, culinary characteristics and agronomic traits. Such information has been useful for rice breeders in their variety development work. The RNRRC Bajo also collected rice varieties, which are not widely grown now for conservation in the gene bank. In order to promote continued cultivation of indigenous rice varieties in the farmers' fields, many popular cultivars were rehabilitated through appropriate selection procedures employing participatory methods, which increased the grain yield. For instance, 2-3 seasons of seed selection in the local cultivars improved grain yields considerably (Apa Dogo 4.70 t/ha from 4.05, Dago Yankum 3.70 from 3.35, Nabja 5.25 from 4.55). Farmers also received technical tips and on-the-job skills in selection procedures to improve yields of their local varieties. In addition, a number of elite improved germplasm from the research centre were given to the farmers for participatory variety assessment. These efforts certainly broadened the rice genetic base in the area and added diversity for systems resilience.

As a diversification in rice ecosystem itself, upland rice was tried for the first time with the farmers of Nabchhe village, which is a dryland system suited for non-irrigated crops such as maize. Farmers showed interest in trying upland rice and RNRRC Bajo provided seeds of Khangma Maap, an upland variety grown in eastern parts of the country. The farmer cooperators managed the crop following recommended practices and saved seeds for succeeding years. From an area of about 1400m², the variety yielded 196 kg (1.4 t/ha), which is good in upland condition. A few farmers continue to grow upland rice in Nabchhe today.

6.4.5 Improving rice management practices

Nutrients

There had been no systematic awareness programme for farmers on balanced fertilizer use, despite the widespread use of urea for crop yield improvement. Through Farmer Field School (FFS) approach, simple fertilizer trials were planned together and managed by the farmers with some technical assistance from the researchers and dzongkhag extension staff. The results showed higher rice production by split application of recommended fertilisers at land preparation and during tiller formation than by the farmers' practice of using just one dose at

tiller formation. By using split doses of recommended fertilizers, farmers have boosted their rice yield from 5.30 t/ha to 6.75 t/ha, an increase of about 28%. This suggests that there is potential to substantially increase crop yields, and profitability, of rice production. The soil fertility status is widely variable within the Lingmutecy Chu watershed with even intra-village differences in N, P, and K availability and pH of the soil. Table 4 presents the soil fertility status of three villages in 1999.

Table 4. Village wise soil nutrient status and range

Village	Range	pH (H ₂ O)	Total N %	Av. P (mg/kg)	Av. K (mg/kg)	Organic Carbon %
Omteykha	Maximum	6.65	0.19	36.12	211.00	1.7
	Minimum	5.27	0.09	6.28	34.68	1.0
Matalumchu	Maximum	6.76	0.16	42.18	123.23	1.3
	Minimum	4.86	0.08	13.12	37.70	1.0
Wangjokha	Maximum	6.60	0.22	28.16	64.40	1.5
	Minimum	4.20	0.05	5.19	17.60	1.8

Although, extent of adoption of research recommended fertilizer rate of 70:40:20 NPK kg/ha for transplanted rice crop was limited by their affordability, about half of the farmers in the watershed have already adopted this package, increasing the yields substantially. This is an encouraging step. With tangible results within the season, these on-farm trials have created awareness among the farmers about the importance of balanced fertilizer use. The adoption rate of the practice is increasing and the availability of credit will have a role to play in this.

Weeds

Locally called *Shochum*, *Potamogeton distinctus* is a noxious aquatic weed (Figure 11) in rice fields reducing yields by over 35% (RNRRC Bajo, 1992). The commonly used weedicide, Butachlor, is ineffective against *Shochum*, leaving hand weeding as the only effective solution. Farmers usually weed their rice crop once or twice; however, for suppressing *Shochum* 3-4 weedings are needed. Over the years, RNRRC Bajo has been actively promoting intensive hand weeding to reduce the pressure of *Shochum* in the watershed fields. The emphasis is also on timely weeding, for instance first weeding 2 weeks after transplanting and weekly thereafter. Experience with farmers shows that rice yields improve with more weedings (5.87 t/ha) than what farmers normally do (5.08 t/ha). Field days and farmer-farmer visits were organized to demonstrate the effectiveness of more weedings and to share farmers' views. Farmers commented that the weed pressure greatly reduces after the second year of intensive weeding, thereby reducing labour and overall cost of rice production.



Figure 12: Aquatic weed *Shochum* in rice field

6.4.6 Enhancing maize yields in Nabchey

The farmers of Nabchey village, who are recent settlers in the upper part of the watershed own only drylands and grow maize for food. They reported problems in their fields like taller plants, lodging, decreasing yield and barrenness with their local maize variety. To help mitigate these problems, new maize varieties were field tested. The improved maize varieties came from RNRRC Khangma in East Bhutan. Three test varieties (Pool 9B C1, Suwan 8528 and Palmirah 8528) were compared against local variety. Seeds were provided by the researchers with all recommended practices. Researchers monitored the crop at different stages and carried out yield assessment at harvest. A matrix ranking was used as a tool to seek farmers' views on variety performance. Table 5 summarizes the grain yields calculated from crop cuts in the farmers' fields at Lingmutey Chu watershed.

Table 5. Maize yields and characteristics.

Variety	Yield (t/ha)	Characteristics	Farmers' ranking
Palmirah 8528	6.3	White flint	2
Pool 9B C1	5.8	Yellow flint	1
\Suwan 8528	1.9	Yellow flint	4
Local	5.4	Yellow flint	3

Farmers' assessment parameters included ear size, easiness in shelling, tolerance to lodging, taste, grain colour, earliness and husk cover. Farmers selected Palmirah 8528 and Pool 9 BC1 as acceptable varieties. Many neighbouring farmers showed keen interest to grow the selected varieties in their own fields.

Since maize is cross-pollinated, the seeds deteriorate genetically if seed selection is not practiced or seeds are not replaced after about 3 years. It was observed that maize farmers of Nabchey continued using the same seeds for several years and stated that there was a decline in yield. Researchers then supplied seed of Yangtsipa variety and renewed the entire genetic stock in the

village. Farmers reaped better maize yields in the following year. They now appreciate the value of seed renewal and practice it.

6.4.7 Conserving soils and nutrients

On farm soil erosion was the main contributing factor for soil fertility decline and hence maize yield. RNRRC Bajo provided implements such as crowbar, pickaxe and spade to farmers for terracing. However, it was difficult to get support from all farmers to terrace their fields, given that they already have a labour shortage. In addition, terracing was both difficult and inappropriate in some steeply sloping areas. In such a situation, other options were suggested to the farmers and of the technologies presented, farmers opted for low cost maize trash lines. (Box 4).

Box 4: Maize Trash Lines

Soil conservation with maize trash lines basically consists of laying harvested maize stalks along (not across) contour lines made by an A-frame and creating a bund to check run-off water. It also eliminates the need to burn the maize trash after crop harvest thereby reducing labour, tedium and environmental pollution caused by burning of trash. This method of soil and water conservation is suitable for land with up to 40 % (36°) slope. It was tried with one farmer in Nabchey as demonstration cum trial.

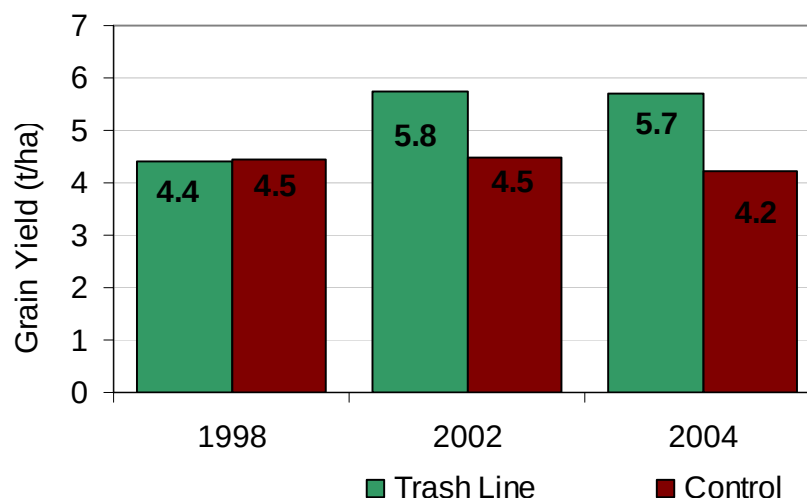
Appreciable amount of soil accumulated behind the trash lines that had helped in slowing down of surface run-off velocity. Bench terraces developed with the average height of the raisers 1.3 meters tall after seven years. It showed that maize trash lines could be used as an effective and simple method for controlling surface run-off. Soil samples were collected annually and results showed that there is a gradual improvement in soil physical and chemical properties in changing water holding capacity and fertility with time. This technology is first of its kind to be tested in the country and it is one option for low cost soil and water conservation for farming sloping land.

Many farmers said that this was the first time they saw for themselves how much soil was lost from their fields through surface run-off each year and how it could be saved at almost no cost, save labour. They said that the technology is less expensive, with no direct initial cost or maintenance later on. They found that the technology is not complicated to follow and hence is 'farmer-friendly'.

Table 6. Soil variables from 1998 to 2005 from demonstration plot in Nabchey

Year	pH (H ₂ O)	Total N %	Av. P (mg/kg)	Av. K (mg/kg)	% Organic Carbon	CEC (me/100g)	% Base saturation
1998	6.9	0.12	7.00	80.98	1.10	10.50	68.00
1999	6.8	0.19	10.00	80.10	1.11	10.10	66.00
2000	6.9	0.11	9.10	77.50	1.14	10.75	72.80
2001	6.5	0.12	8.00	98.13	1.10	11.10	80.17
2003	6.2	0.18	10.11	82.00	1.18	10.32	79.58
2004	6.9	0.14	9.65	87.19	2.10	11.78	88.29
2005	6.6	0.26	13.00	92.00	2.00	12.60	104.00

Maize crop cuts were taken from 1998 onwards to monitor yield trends with maize trash lines. The initial crop cut results showed similar yields from field with and without trash lines as indicated in Figure 13. However, the crop cut results of 2002 and 2004 showed yield higher by 28% and 34% in the field with trashlines compared to fields without trash line respectively. Impressed by the held-back soil and the increase in maize growth and yield in the field with trash lines, other farmers came forward to make contour lines for trash lining in their fields. Therefore, the number of farmers adopting trash lines has risen from one in 1998 to five in 1999 and twelve in 2000 covering an estimated area of 3.2 hectares.

**Figure 13: Maize yield as affected by Trash lines**

The major constraint with maize trash line is that it is feasible only on fields with slope gradient less than 40% (36°). When established on steeper slope, a trash line cannot withstand the surface run-off velocity of water and is often washed away. The other problem that was encountered is damage caused by cattle trampling on the trash lines during the initial period (first year) when the trash lines are still not stabilized. This requires close monitoring and frequent

maintenance. However, where cattle are not grazed in the maize field, this problem is not encountered.

6.4.8 Improving wheat production

Poor plant population and low yield in wheat were observed. It was therefore decided to seek improvement in plant stand and yield of wheat per unit area. Interested farmers were provided with seeds and package of practice. Two improved practices were tried against farmers' normal practice of using a seed rate 75 kg/ha, no seed treatment and pre-sowing irrigation. The farmer's experience clearly indicated that by using quality seed with a seed rate of 100-125 kg/ha, seed treatment with Vitavax and irrigation 2 times at CRI and booting and topdress of urea @ of 30kg/ha; the yield increased by 49%, over the normal practice. This information has been packaged and provided to the farmers through the district agricultural extension system.

6.4.9 Popularising soybean for food and cash

Some farmers in the watershed grow soybeans, but only on a limited scale and area. The farmers in the locality grew 3 improved varieties provided by RNRRC Bajo for soil fertility maintenance and as cash crops in Nabchey and Dompola. The soybean variety AGS313 matured earlier and was harvested in the first week of September. AGS327 and AGS286 were harvested in the last week of September. Only AGS313 did well in Dompola, while in Nabchey, AGS327 and AGS286 performed very well and are preferred by the farmers. In addition, AGS286 is an early maturing variety and this allows farmers to get a higher price in the market when sold as boiled pods. Seed yield was the most important criterion for farmers' assessment and according to them, all the three soybean varieties yielded as much as their local cultivar. Farmers are also convinced that soybean cultivation improves soil structure and they relate this to rotting of leaves and adding fertility to the soil.

6.4.10 Improving vegetable production

Traditionally, farmers grow local varieties vegetables like potato, radish, chilli, beans and cucurbits at a homestead level to partly meet the household's vegetable requirement. The marginally surplus vegetables, produced mainly by the downstream communities of the watershed, are sold in the local market and weekly markets at Wangdue (Sundays) and Khuruthang (Saturdays).

Through demonstrations of nutrition garden and capacity building by participatory on-farm vegetable action research, a plan to fulfil the year-round vegetable needs of the farm family was developed jointly with farmers in Dompola, Omteykha and Nabchey in the upstream communities. The continuous interaction between the farmers and the researchers also educated each of them on various techniques of vegetable cultivation suitable for the area.



Figure 14. Model kitchen garden in Dompola

A model garden was established in Dompola (Figure 14) to demonstrate in a participatory manner to the other farmers the year-round vegetable cultivation techniques. Nursery raising techniques using plastic and nylon nets was demonstrated. Different types of vegetable crops were grown and therefore it proved to be a practical training ground for the farmers to learn hands-on cultural techniques of vegetable cultivation. A field day was organized for other farmers in the community to see and adopt the method in their own gardens. Thirty one farmers of watershed communities attended hands-on-training on year round vegetable production. They were also supplied 25 asparagus seedlings each for growing in their kitchen gardens to understand the new crop. Few farmers in the upstream communities now grow varieties of vegetables at kitchen garden level and not many farmers picked up commercial scale vegetable production due to farm labour shortage. However, there is semi-commercial vegetable farming in the downstream communities which is marketed locally.

6.4.11 Making a difference

The introduction of improved and high yielding varieties of rice, maize, wheat and other crops in the watershed has helped farmers, especially those with small land holdings, to increase their total production. The improved and short duration crop varieties have helped to raise the households food self-sufficiency level now from a range of 24 to 85% estimated in 1997 (see chapter 3).

Farmers in the watershed today grow research recommended improved varieties of rice such as IR64, Bajo Kaap, Bajo Maap, Khangma Maap and IR 20913 which yield at least one t/ha higher (average 5.5 t/ha) than the local cultivars (average 4.2 t/ha) under parallel management systems. Recent estimates show that 40-50% of the rice area is now sown with these high yielding varieties. This has definitely enhanced the overall rice production in the watershed. New varieties of maize grown by farmers include Yangtsipa, Palmirah 8528 and Pool 9BC1 which produce higher yields than the farmers' varieties. Popular improved wheat varieties are Sonalika, Bajoka1 and Bajoka 2. Besides crop varieties, improvement in management practices such as better weed control and other

husbandry methods has led to better farm productivity. Vegetables have contributed to household nutrition and cash incomes of the farmers.

6.5 Livestock

Livestock is a major source of milk, cheese, butter, meat, manure, and draught power to the watershed communities. A total cattle population in the seven villages was 822 heads of cattle, out of which 82 % cattle were local breeds while rest were crossbreeds, including 8% Jersey cross and 10 % Mithun cross. Other livestock species include 234 pigs (58% local, 10% improved, 32% crossbreed), 352 local chicken and 168 horses.

This section mainly deals with major livestock issues reported (Table 7, PDSR, 1997), research intervention and its trickle down effect on the watershed communities.

Table 7. Issues and interventions

Issues	Research Interventions
Poor breed	Bull & AI facility
Breeding bull	Mithun bulls supply
Winter fodder shortage	Oat adoption

From Problem Diagnostic Survey Report, 1997

6.5.1 Breed improvement

Jersey breeding bulls were supplied by the Department of Livestock (the then CLSD) for crossbreeding with local breed. While the bulls are supplied for the farmers beyond the reach of artificial insemination (AI) service, while the road head areas are covered by AI program from the veterinary centres at Wangdue and Punakha. There were 65 Jersey cross bred cows in till 2000. This intervention was to address the problem of low producing dairy breed. The required stocks were supplied through RGOB and donor support as immediate intervention and for early impacts.



Figure 15: Mithun breeding bull and cross breed heifer

Mithun Bull (*Bos frontalis*) cross was another breed of preference for dairy. The livestock breeding policy does support this program but there is no subsidy on the cost of bull. The farmers have to buy the bull at full cost from the breeding farm. The transportation costs of bull from the breeding farm to the village are borne by the Dzongkhag. Based on the need expressed by the Nabchey community a Mithun breeding bull (Figure 14) was bought through financial support of GTZ project. The RNR Research Centre, Bajo, helped to seek project finance and procured the bull to reach to the community in 1999. Proper management and care of breeding bulls is rather uncommon when the bulls are supplied free of cost. Therefore, RNRRC Bajo also facilitated for formation of a management committee to manage the bull with a Caretaker taking care of the bull and a committee maintaining the records. This is a rare case of a community managing the breeding stock successfully. The record showed a birth of 20 (8 males + 12 females) calves up till 2004. At least five calves were borne yearly since the bull first started service in 2001 after the placement with the community in April 1999. The community preferred this crossbreed mainly because:

- the crossbred born to local cows are strong and hardy in nature
- they are best adapted to forest grazing in the difficult terrain,
- crossbred cow provides milk with higher butter fat, and
- crossbred bulls are more powerful for draft power .

To produce sufficient feed for the Mithun bull, 0.4 hectare of land was converted into an improved pasture by the community. The 22 households in the community benefit from the bull service for the stock of less than 150 heads of local cattle population.

6.5.2 Fodder development

The main constraint to pasture development is the small landholding size. Winter fodder shortage is the emerging problem. This is a critical component of milk production strategy and needed attention.

Participatory efforts were made to deliver appropriate technologies to enhance livestock productivity by improving the fodder resource base and gear up livestock development. Major feed resources are dependent on day grazing in the nearby forest and along the field boundaries. Pasture development in arable land is not practiced owing to small land holding meant solely for food crop cultivation. There is only a narrow scope for pasture development. Owing to such limitation, pasture production is limited to tree fodder production and winter fodder development for off-season use as green supplement with straw.

The fodder tree (*Ficus roxburghii* and *Leucaena leucocephala*) seedlings were supplied to produce off-season fodder in winter. Different sub-tropical pasture species were evaluated and found suitable. However, the pasture development as such has little scope due to small landholding size.

Based on the species tested (Table 8) and their performances Paspalum, Setaria, Ruzi and Molasses grasses were recommended. Though Sudan grass produced high biomass, it could not be recommended for being a summer fodder as summer fodder is not seen as a problem by the communities in the watershed.

Table 8. Results of pasture species tested

Species	Av. yield, t/ha	Remarks
<i>Sorghum sudanese</i>	14	annual
<i>Paspalum atratum</i>	8	perennial
<i>Setaria sphacelata</i>	5	perennial
<i>Milinis minutiflora</i>	4	perennial
<i>Brachiaria ruzizensis</i>	3	perennial
<i>Panicum maximum</i>	4	perennial

Other option of rice-straw mixed with chopped green fodder was also tried. Though a bit laborious and time consuming, the results showed increased intake (90%) and reduced wastage compared to untreated straw.

Various test results proved that oat had outperformed other species, followed by Rye grass. Farmers were attracted more by oat owing to its multicut attribute. Oat (Figure 15) is considered as most suitable winter fodder in the watershed. Trial result revealed oat has this potential. Oat grows well in fallow paddy land and was found to deplete soil fertility thereby affect the paddy yield if not manured additionally to replace nutrient uptake by oats. It was therefore thought that growing legume mixed with oat partly compensate the nutrient absorption by oat.



Figure 16. Lush green winter oat

Test results of oat mixed with Lathyrus emerged as the best fodder crop combination. Crop cut results showed 60t/ha of fresh matter from oat and Lathyrus. It grows well in winter after paddy harvest, starting from October till March. It grows rapidly as robust, succulent and palatable vegetation. It can be cut and fed within 60 days of sowing under irrigated and fertilised condition. Experiments showed a probability to 2-5 cuttings depending on the management.

Years of trial have proven oat as an ideal fodder. Evaluation results showed an average yield of 25.5t/ha of fresh matter yield. This is the highest among all the winter fodder species tested. It is now widely adopted in watershed.

Perennial grasses and legumes are good bioengineering tools too. These plant species were used through slips and direct seeding on terrace bunds for erosion control in Nabchey. It was first tried with two test farmers for contour terracing with maize trash line. Species tested were Setaria, Napier, Guinea grass, as well as the hedge shrub species like Leucaena and Flemingia.

6.6 Fruit crops for Cash

Horticulture, particularly fruits, had not gained importance as a cash crop in the watershed according to the 1997 base line information. Fruits have a ready market, driven by demand from both the local populace and tourists, and present an exciting opportunity to raise the cash income of the watershed community. However, in the absence of suitable improved varieties and practices, farmers grew only native varieties of fruit trees. The lack of cultivable dry lands in the lower reaches of the watershed also makes commercial fruit cultivation difficult. Inadequate information, ownership of limited land, difficult access to market, farm labour shortage and, above all, the farmers' priority of rice self-sufficiency in a subsistence system, are factors still limiting the development of fruit crops.

6.6.1 *Improving fruit crops production*

Fruit crops, unlike cereal and vegetable crops, are perennial and have longer juvenile phase. A fruit tree cannot be changed at the end of the season and, hence, its planting requires long term planning. This is a handicap when promoting fruit crop cultivation. However, placing these plant materials early under on-farm trials would not only gain time but would result in identification of materials appropriate to specific agro-ecologies. With the objective of diversifying fruit and nuts production in the watershed, the best and internationally popular fruit varieties were introduced, on-station tested and vegetatively propagated by RNRRC Bajo. They were ready to be tested under a wider agro-climatic conditions and management levels.

To improve the fruit production in Lingmutey Chu, consultative discussions were held with the communities on the participatory action planning for horticulture research and development. A two-pronged approach was adopted to distribute superior fruit crops cultivars and disseminate production technology through capacity building and demonstrations. Fruit plants were distributed to households for backyard production. A permanent test site in Omtékha village to demonstrate and showcase the improved fruit crops and their management practices was selected for a long term trial.

The different fruit crops such as peach, pomegranates, satsuma mandarin, other mandarin and orange varieties were distributed to the 39 households in the watershed for testing under the backyard fruit production approach. Each household received 3 to 5 plants (Figure 16). It had the twin objectives of testing crops performance at different micro-sites under farmer's management practices and to study farmer's preferences and acceptability of the new fruit crops. In this approach, the monitoring was extremely difficult. In addition the trees were subjected to variable management levels by the different farmers. Backyard fruit crops promotion is not easy under mixed farming system where domestic animals browse. Farmers failed to provide consistent care to the fruit crops since the backyard orchard is a secondary option for the subsistence farmers, food crops being the first option. The success with this approach was limited as most of plants were damaged by stray cattle and suffered from farmer's poor care and management of crops. However, this initial participatory fruit crops evaluation raised farmers' interest on fruit crops and demand for fruit crops planting materials increased.



Figure 17:Sub-tropical apple

6.6.3 Showcasing new varieties and cultivation practices

Simultaneously with the backyard trials, a permanent site was identified in Omtekhha village. It was preferred over the first approach for demonstrating fruit crops cultivation to the farmers. In 2000, a farmer co-operator, representing the dry cool subtropical to warm temperate agro-ecology, was identified for establishing an orchard by Punakha Dzongkhag along with RNRRC-Bajo. A written contract, with the terms and conditions laid down (in the selection criteria) being agreeable to all the parties, was signed by RNRRC-Bajo, Dzongkhag Agriculture Extension Officer and farmer co-operator. The fencing materials, initial planting materials and supplementary inorganic fertilizers were provided free of cost as incentives to the co-operator since he has to bear risks of testing new materials of uncertain performance in this locale and loses the opportunity cost of his land for a minimum of 10 years.

Table 9. Fruit plants in demonstration orchard

Crop/species	No. Planted
Satsuma mandarin	10
Mandarin	40
Sweet orange	10
Tangelo	5
Tangor	5
Lime	5
Sub-tropical Apple	38
Apricot	5
Pomegranate	5
Chestnut	3
Walnut	5
Mango	5
Asian pear	5

The main purpose of on-farm testing in the permanent test site is to identify superior genotypes of fruit crops that perform best under different agro-ecologies and farmers' management conditions. The test site also serves as a demonstration plot for showcasing of new fruits and cultivars and their management practices. Various fruit crops being tested are given in Table 9. Field implementation, monitoring and reporting of performance are being done jointly by the farmer, extension staff and researchers.

Farmer's field days and participatory evaluation of the various fruits and nuts are planned to be conducted at the end of the trials. Planting in some sites was delayed until 2004 due to non-availability of planting materials. Bajo apple, peach, pomegranates, citrus and chestnut were planted in the trial sites in 2001 and some have started yielding fruit. Among the various fruit crops, low chilled Bajo apple (Fig.16) performance is good. Farmer could harvest 5-10 kg of fruit per tree, sold in local market without any difficulty @ Nu. 70 per kg. The farmer wished to expand cultivation of Bajo apple compared to other fruit crops and RNRRC Bajo supported in this. Chestnut fruited but lots of unfilled nuts were observed which may be due to poor pollination since only one cultivar has fruited. Peach (Bajokham-1) has fruited and farmer feels that the new peach cultivar is better than the local cultivars and he had no difficulty in marketing the peaches. Bajokham-1 appears first in the market and fetches premium price. Citrus performance is very poor under Omtekhha condition and most of it has been replaced by Bajo apple. The major problem in this site is severe depredation of crops especially apple, peach, apricot and pear by deer and repeated replanting had to be done.

6.6.4 Need for grafted plants

Farmers are gaining experience from fruit crops research and development. There is an increased demand for new and improved fruit plants. Planting materials are, however, in short supply. The idea of initiating a private nursery with technical support from RNRRC Bajo was discussed, which resulted in the setting up of a fruit plant nursery in Omtekha. This nursery produces walnut, peach and apricot planting materials. Plants were sold in January 2005. These planting materials were sold to other farmers in the watershed, Punakha and Wangdue Dzongkhag and to Natural Resource Training Institute (NRTI), Lobesa, earning an income of about Nu. 12000 for the first year of operation. This year the nursery has about a thousand grafts of peach, apricot and walnut worth about Nu 150,000 in retail.

6.6.5 Improving the existing backyard fruit crops

Using the technique of top working, existing fruit trees of inferior quality were top worked with scion material from elite varieties tested at Bajo. The top working of local pear, persimmon and walnut were done in Limbukha, Dompola and Nabchhey villages. In total 90 fruit plants were top-worked consisting of 44 local pear, 31 Persimmon and 15 hard shell walnut. Initially 100% top-working success (Figure 17) was reported for all above crops and some of the farmers also managed to do it on their own. In Limbukha, walnut top-working failed because top-worked walnuts were manhandled by children and damaged by stray cattle. Seventeen households from Limbukha, six from Dompola and sixteen from Nabji community participated in the process of top-working.



Figure 18: Improved persimmon and pear cultivars

Comparatively, Nabchey farmers had better success rate in top working than Limbukha and Dompola farmers. This is because of better aftercare and management done by Nabchey farmers. There was 70-93% success rate for pear, 44-70 % for persimmon and lowest success rate (about 30%) for walnut. It was observed some of the farmers have started practicing the technique and performed top-working of local pear and walnut successfully. In general, farmers

showed keen interest in improving their backyard fruit plants, following hands-on-training on top-working.

The horticulture programme has now realigned its approach for participatory transfer of technology. The striking difference between the earlier and recent approaches is that there is now a focus on impact-oriented and location-specific interventions and outputs. For instance, all the farmers in Nabchey community have planted walnut for larger scale of production and collective marketing. Concerted effort on participatory planning, implementation, monitoring and evaluation is emphasized. Another advantage of it is that commercial scale of production is made possible through the concept of produce pooling for group marketing, since the same crop is produced by many individual growers in the vicinity. The performance of this approach is good based on the crop performance and farmers' aftercare and management of orchards.

6.7 Summary

The communities in the watershed, as elsewhere in Bhutan, depend on forests, water, crops and livestock for their livelihoods. From a subsistence lifestyle in the not so distant past, communities are gradually gearing up to a more efficient and cash-oriented farming practices. This invariably increases the competition for resources, generally leading to a decline in their productivity and conflicts over their sharing. The communities consider themselves fortunate that they were spared from such a plight due to timely interventions. RNRRC Bajo and a host of other partners assisted the communities in their quest to sustain and enhance the productivity and management of renewable natural resources (RNR).

Timely research and development interventions by RNRRC Bajo to assist the communities re-vegetate the badly eroded forest lands have encouraged the people to be fully prepared to manage these plantations. The availability of water for rice and other crops has been considerably improved with gully plugging in eroded strips, replacement of flumes, better canal linings and terracing with trash lines. Water harvesting in Nabchey ensures quality drinking water for the people as well as for cultivation of backyard vegetables. New and high yielding varieties of rice and maize in tandem with better nutrient management, allow farmers to reap bigger harvests making them almost self-sufficient in food. Better crop husbandry practices such as maize trash lines to trap soil and intercropping maize with soybeans lead to higher production. Livestock farmers have increased their dairy production from nutrition provided by oats and lathyrus. Local cattle have been improved by cross breeding, thanks to the provision of a Mithun breeding bull. A diversity of fruit plants given by RNRRC Bajo has, quite literally, begun to bear fruit and earn cash for many farmers.

CHAPTER VII: ENHANCING ACCESS TO SERVICES, CREDIT AND MARKETING

7.1 Introduction

In 1997, a participatory watershed management was started in watershed. During the planning phase of the watershed study, the only service facilities that existed in the watershed were, an RNR extension Centre, a Primary school, and an Outreach Clinic (ORC). Then, the issue of access to inputs, technologies, information, credit, and market were expressed as concerns by the watershed communities.

Within a span of five years, many service facilities were added to the watershed through the normal development plan program. Today, the watershed has a feeder road connection, a Basic Health Unit (BHU), electricity supply and telephone connection. As part of the watershed management study, the RNRRC Bajo facilitated in improving access to technologies, information, inputs, and credit which are reported hereunder.

7.2 Access to technologies and information

The watershed communities had limited access to RNR services due to its remoteness and that some technologies needed adaptation to the local farming and agro-ecological conditions.

With the start of the watershed management in 1997, the RNRRC Bajo initiated livelihood improvement programs through adaptation of new crop and livestock technologies, sharing of information, promotion of improved seeds, and conducting field days and study visits. As a result, watershed farmers were able to access improved rice, maize, and soybean varieties under field crops, fodder oat and tree seedlings under livestock, a range of new vegetable crops seeds, and improved fruits crops such as walnut, peach, apricot, pear, pomegranate, persimmon and sub-tropical apple.

Further, in Limbukha where potato is the main cash crop, use of Metribuzin (trade name Sencor), a selective weedicide's use in control of potato weeds was demonstrated and today all the growers are accessing it. In Nabchey, access to mithun breeding bull was facilitated by providing a bull to the community. Today the bull service is not only accessed by Nabchey farmers but it also provides services to the neighbouring communities of Dompola, Limbukha and Omtékha. Again over in Nabchey, access to drinking water was improved through water harvesting techniques for about 12 households. The community uses the excess water for vegetable cultivation which has helped to generate cash income.

The RNRRC Bajo also facilitated the communities to access financial resources from various projects and programs by articulating community issues in relevant

fora. The Bhutan-German Sustainable RNR Development Project (BG-SRDP) financed the cost of a breeding bull, fencing materials for community plantation and the cost for widening of the road to watershed. Similarly, the RNR Extension Support Project (RNR-ESP) supported water harvesting costs, mushroom training and production, and the cost of safe box for the FSG. And the Sustainable Soil Fertility and Plant Nutrition Project (SSF &PNMP) for their contribution in soil fertility survey.

The program also made an effort to improve access to inputs for poorer households by targeting free inputs supply such as improved fruit plants and seeds.

Through regular visits and contact by researchers, and through meetings and training, the access to information on Forest Act (1995), Social Forestry Rules and Regulations (2000), Water Policy and Act (draft), were improved. Farmers in the watershed have heightened awareness of the RNR policy and programs including the Hon'ble Minister's vision of improving Production, Accessibility and Marketing (PAM).

Although not intended, the watershed management program brought the farmers of the watershed in direct contact with many visitors both local and outsiders. These visitors include research scholars from Bajo and others doing postgraduate studies in Bhutan or abroad, representative of foreign development agencies and others with skills or knowledge beneficial to the watershed community.

Access to Resources

The watershed communities now have access to fodder from the community forest Programme on a cut-and carry basis. Their access to water has been enhanced by inter-village interaction for better sharing of water at rice transplanting.

Access to plants and seeds

The establishment of a private fruit nursery in the watershed with the support of Dzongkhag Agriculture Office and RNRRC Bajo, has created a new source of genuine plant material of field tested, improved and exotic fruit plants. This will boost the availability and, thereby, encourage the cultivation of fruit trees to generate cash income for the watershed communities.

Access to research support

The watershed programme has forged a strong partnership between the RNRRC Bajo and the farming communities in the watershed. The farmers, today walk-in to the RNRRC office seeking advice and information.

7.3 Access to Credit

The Bhutan Development Finance Corporation (BDFC) is the only financial institute that provides rural credit for agriculture development. In spite of its existence, farmers are unable to avail credits for reasons of high interest rate (13%), loan amount not being flexible, lengthy procedure, the need for collateral and the institute being far away from the community. So more often the farmers landed up borrowing from local money lenders whose interest rates are exorbitantly high.

Farmer Savings Group (FSG)

An awareness campaign to promote forming of Farmers' Savings Group (FSG) to build credit source within village changed lives since 2002. The RNRRC Bajo facilitated the process of forming the first FSG at Dompola village. The initial focus of the group was to save and create capital for borrowing by needy members with a monthly interest rate acceptable to them. Today the group has savings fund more than Nu.60,000 which is almost entirely given out as loans to members each month at the meeting of the FSG. The collections are from the membership fee, monthly contribution, interest from loan, penalties on default of monthly interest payment and donations from non-members and visitors recognising the services of the SHG. Each member can avail of cumulative loan up to Nu 10,000 at an interest rate of 1.1% per annum. The loan is usually availed for scaling up agriculture activities and supporting children's education. This FSG has a self help group producing mushrooms.

Self-help Groups

Following Dompola experiences, now there are four SHGs each with a with a different enterprise in the watershed. Two groups in Limbukha were formed in 2004 to venture into growing vegetables while the Nabchey group was formed in 2005 for piggery production while Dompola SHG has taken up oak mushroom cultivation. All these groups have savings and credit components, which has greatly improved access to credit for watershed farmers. They are linked together for the production and marketing of a common crop or livestock.



7.4 Access to Market

The watershed communities access the well established weekly markets in Wangdue (Figure 18), Khuruthang in Punakha and sometimes in Thimphu to sell their farm produce. At present, market is not seen as a major problem for the volume that is produced in the watershed. However, the RNRRC Bajo has facilitated in linking mushroom and vegetable growers to the local hotels in Punakha and in Wangdue. The idea here was to expose farmers to such markets and make them aware of such future opportunities.



Figure 19. Watershed farmers in the weekly market

In the area of marketing, the idea of group marketing was encouraged for efficient and effective marketing of small household surpluses. All 19 households in Nabchey raise pigs for meat and they were encouraged to synchronize their slaughtering and invite retailers to the village instead of individually bringing the meat to the market. Similarly, the group farming of walnut- farmers growing the same commodity in varying acreages - in Nabchey was in keeping the group marketing concept. MUSHROOM

Further, to facilitate marketing the motor road access to Matalumchu village was improved. The RNRRC Bajo assisted in establishing the road alignment and getting the cost estimates for construction of the road. The estimates were later used by the community to negotiate with the Department of Roads for hire of a bulldozer on fuelling basis.

CHAPTER VIII: MAJOR ACHIEVEMENTS

The objectives of the watershed study (see Chapter 2) guided the research and developmental interventions through participatory methods and methodological approach (chapter 4) to achieve the desired outputs (chapter 6). These outputs can be categorized at different levels such as farm or household, community, watershed and beyond watershed levels. This chapter summarizes and highlights major achievements made so far according to the level of impact.

8.1 Household level achievements

8.1.1 *Crop production and food sufficiency*

The adoption of new and improved rice varieties has led to significant increase in total rice production in the watershed (Figure 19). Farmers now grow improved varieties in almost half the total rice area and harvest about a tonne of additional rice from the same fields. Besides, the productivity of the local cultivars has been raised through participatory selection and improvement using simple procedures.

A balanced application of plant nutrients, as opposed to using nitrogen alone, was demonstrated and is now adopted widely by the rice and maize farmers, leading to higher crop productivity. In the area of land management, farmers in Nabchhey were assisted in bench terracing their sloping land for better and sustainable management.



Figure 20: Reaping a richer harvest

Cropping intensity has increased to include new crops such as potato, vegetables, rapeseed-mustard and wheat in the traditional rice-fallow system. Potato and a number of vegetables such as tomato, beans, cabbages, cauliflower, radish and leafy greens are produced for local markets and household consumption. Intercropping soybean with maize in Nabchhey village has been introduced for crop diversification and fertility maintenance.

Increasing cultivation of new crops and their varieties has certainly resulted in increasing the level of food self-sufficiency at the household level, with a positive effect at community and higher levels.

8.1.2 Feed resources and livestock productivity

The scarcity of winter feed and fodder for livestock was a major concern of the communities from the beginning. RNRRC Bajo successfully tested and introduced oats (*Avena sativa*) as a winter fodder which has helped to raise livestock productivity. Oat is an easily managed green fodder with sufficient biomass production and can be cut several times. Oats grown with *Lathyrus* as mixed crop emerged as the best fodder combination for milch animals. It has now been widely adopted by the watershed farmers.

The genetic stock of the local cattle is improved in Nabchey through the provision of a Mithun breeding bull as preferred by the farmers. The new and improved progenies help to raise the overall livestock productivity.

8.1.3 Horticultural development for cash and nutrition

A significant improvement in the diversity of fruits and vegetables grown in the homestead and backyard gardens, promoted initially by the research centre, has led to higher cash incomes and households nutrition of watershed farmers. There is a greater flow of fruits and vegetables in the local markets from the watershed, diversifying sources of incomes of the farmers.

The promotion and setting up of a private fruit nursery in Omtékha not only improved the availability of planting materials in the locality but also developed the entrepreneurial skills of the village. The nursery grower also earns substantial income from this activity.

Participatory top-working of poor quality local fruit crops in the watershed with improved superior quality fruit crops has helped in the transfer of technology from lab to land effectively, particularly within a short span of time with demonstrable impacts in the community.



8.1.4 Awareness and capacity improvement

Owing to constant interactions with researchers, extensionists, visitors and other outsiders, there has been a remarkable improvement in the outlook and awareness of the farmers towards national policies and development approaches, besides specific gains in skills and knowledge related to horticulture, agriculture and forestry.

8.2 Community

8.2.1 Water and soils

Gully stabilization through planting of trees and grasses along highly degraded canals in Dompola and using a series of live post check dams helped to reduce soil erosion and restore vegetation. This has also helped to revive rice cultivation in previously abandoned fields below the eroded canals.

Through the provision of pipes and with the community involvement, the irrigation canals in Dompola, Matalumchu and Wanjokha were rehabilitated which greatly improved water conveyance efficiency thereby improving the overall water availability for crops.

Soil conservation using maize trash line has effectively control soil erosion and improved soil fertility in Nabchey village (Figure 20). Most importantly, this technology is simple, environment-friendly, affordable and appropriate for the maize farming community (see chapter 6).



Figure 21: Trashline development: A-Frame marking, trashline at start, after 2 and 7 years

With the technical and materials support from the research centre, the access and use of water, both for household use and for crops in a small scale, has vastly improved in Nabchey village. More than the water itself, the community was exposed to the principles and practices of catchment/watershed management, expanding the farmer conception previously limited to outlet protection.

8.2.2 Self Help Groups

Four functional farmers' Self Help Groups (SHGs) have been established in the watershed each with its own Farmers Savings Group (FSG). Such groups are engaged in economic enterprises such as mushroom production and marketing, vegetables cultivation, piggery and marketing of solar dryers. A committee formed for management of community bull in Nabchey also raises funds through fees and provides credit. It is now easier to mobilize community for their participation for any watershed management activities. The foundation for formation of higher groups and associations is laid. And local leadership is being built for upscaling. Technologies and information can be disseminated more efficiently through the groups. The capacity for organizational management is also enhanced besides improving their income through their collective efforts in various business enterprises. Above all, the organization of the community as a group has improved their bargaining power and it has started receiving external support both in terms of materials, funds and technologies.

Community level forest user and management groups (CFUGs and CFMGs) have been formed and are active in the watershed. Further the new institutions have facilitated the community to organize themselves better in asking for developmental assistance from other government agencies. For instance, the Matalumchu group constructed a motorable road to their village through loans acquired based on their group collaterals.

8.2.3 Rehabilitating degraded areas

A total of 37 hectares of community plantation has been established on degraded areas surrounding Omtékha and Matalumchu villages. About 27 tree species are growing and farmers are involved in the selection of their preferred species. The luxuriant growth of grasses was observed under the plantation and grasses are being collected from them by the community for livestock feeding.

8.2.4 Awareness and capacity improvement

At the community level, there has been a notable improvement in the perspectives and awareness on national policies and development approaches owing to constant interactions with researchers, extensionists, visitors and other outsiders. The community also improved their skills and knowledge on horticulture, agriculture and forestry.

8.3 Watershed

8.3.1 Forest resource management

Forest resources in the watershed have improved over the years. A forest function mapping done together with the community defined ecological, environmental and social functions, allowing a balance between sometimes conflicting management interest of the local forest users, nature conservation and environmental protection.

Participatory watershed management has strengthened the inter-community cooperation and relationships, forcing collective action.

8.3.2 Water resources

An in-depth understanding and documentation of the traditional systems and practices of water use and management by the watershed communities has provided entry points for effective interventions for improvements. The watershed experience has been elaborately documented, which is a first in the country. The importance of understanding traditional systems for successfully implementing any new development activities is appreciated and practiced now.

From working at the household and community levels, the stage has now been set for the formation of a watershed level committee for resource management. Called the Watershed Management Committee, it is the apex body responsible for judicious management and improvement of natural resources, emphasizing forest and water. The Group will sustain watershed activities beyond the project phase. To support this apex body, six Village Development Committees (VDCs) in Limbukha, Dompola, Nabchey, Matalumchu, Omtékha and Wanjokha are being constituted.

8.3.3 Awareness and capacity improvement

Owing to constant interactions with researchers, extensionists, visitors and other outsiders, there has been a remarkable improvement in the outlook and awareness of the farmers towards national policies and development approaches,

Besides gaining specific skills and knowledge in farming, the watershed communities have appreciably enhanced their knowledge and general awareness on national policies, laws, rules and regulations governing natural resources, resource interactions and new technologies.

8.4 RNRRC Bajo

8.4.1 Expanding the horizon

Through the watershed approach, understanding and appreciation of interdisciplinary and multi-sectoral dependencies in improvement of community livelihoods and management of natural resources have been greatly enhanced among research scientists.

Initially equipped with knowledge of only natural science, the researchers have gained greater capacity and confidence in dealing with social issues in the absence of full-time socio-anthropologists. The participatory approaches also help to understand farmers' views better and lead to a significant improvement in the facilitation skills.

8.4.2 Networking and linkages

The watershed approach necessitated collaborating and working together with national partners working in similar fields to tap on their areas of expertise and utilize for the benefit of the watershed communities. Fruitful collaborations evolved with many institutions and projects, especially the EU-supported Sustainable Soil Fertility and Plant Nutrient Management, GTZ-supported Sustainable RNR Development project, National Soils Service Centre and Dzongkhags, which continue to grow.

RNRRC Bajo has also been very active in networking with international organizations, research institutes and donor agencies which are associated with NRM and global watershed management. This has helped in harnessing technical and financial resources for the centre.

At the local levels, the participatory approach has improved the linkages between research, extension and farmers, leading to greater appreciation of interdependency, increased confidence and better delivery of services.

8.4.3 Publications

The works in the watershed have been documented in the centre's annual reports and as separate documents from time to time. In addition, efforts were made to synthesize available information in a more user-friendly way in a CD-ROM and distributed widely. The CD-ROM is also hosted in the International Development Research Centre's (IDRC) website (www.idrc.org).

8.4.4 Watershed paradigm

As field experiences of watershed development and management are a rarity in the country, RNRRC Bajo has contributed to the development of a watershed paradigm for Bhutan. This model was born out of practical experiences in the watershed and would be very useful for practitioners trying to scale out the work.



8.5 National

8.5.1 Contributing to enactment of national framework and policies

RNRRC Bajo was the first institution in the country to pilot a watershed CBNRM approach in Lingmutey Chu watershed, which had profound effects beyond Bajo on policy enactment in the RNR sector. Many staff who had gained experiences working in Lingmutey Chu later moved out and championed the CBNRM approach. RNRRC Bajo thus played a pivotal role in the formulation of a National CBNRM Framework, which now guides the development and management of NRM.

The study triggered the formulation of National Water Policy and Water Act which are being finalized now. The understanding gained and inputs from the field studies in the watershed form the basis of the policies and acts on water resources.

The watershed experience has also been instrumental in bringing stakeholders from different ministries to form an inter-ministerial Bhutan Water Partnership in the country to coordinate judicious use of water resource.

An experience from self help groups has indirectly contributed to the Cooperatives Act of Bhutan, 2001.

8.5.2 Leading by example

Following Bajo, learning projects on NRM and watershed were developed and implemented in other parts of the country. For instance, in the Eastern part of Bhutan, RC Khangma decided that a CBNRM approach had the strengths required to address the complex integrated natural resource management challenges in a badly degraded watershed in Radhi. CBNRM approaches in other areas as part of the local planning and decentralization programming approach also became a norm.

RNRRC Bajo is now involved in coordinating and running a national level program on CBNRM which focuses on improving varied natural resources such as NTFPs, pastures, crops, water and forests mainly through action research.

CHAPTER IX: MONITORING & EVALUATION

9.1 Introduction

Monitoring and evaluation keeps track of progress in achieving objectives of the intervention through a set of pre-determined success indicators and verifiers. Monitoring was done in three levels for evaluation and course correction in the watershed. At the activity level participatory monitoring, evaluation and regular feedback from farmers helped assess impacts and enable adaptation where required. At the institution level, the annual planning and review workshops helped focus interventions and report achievements. External reviews and feedback (both formal and informal) that generated objective evaluations allowed the RNRRC Bajo to attune objectives and interventions in light of the changing situations. These reviews and feedback also helped to re-look at the watershed as a whole. This was very often not possible for the RNRRC Bajo staff, who were increasingly immersed in the watershed realities that made objectivity at the watershed level difficult.

9.2. Activity Level

Following the diagnostic PRA of 1997, intervention planning focused on relevant entry points. Both, at the household level and at a community level, a number of activities were planned to address issues discussed and identified during the PRA. For instance, household level activities included evaluating improved crop varieties, soil nutrient status and backyard fruit development, while activities at the community level included community breeding bull management, community forestry plantation and formation of Self Help Groups (SHGs). Regular visits and interactions with the participating farmers involved allowed a process of continuous joint evaluation of the various activities.

Periodic purposeful evaluations were also made to enable assessment of impact and course corrections. The following examples illustrate this:

- Participatory evaluation of 5 maize varieties including the local check with the Nabchey farmers indicated that the *Pool 9BC1* (5.8 t/ha) variety, with the second highest yield was rated best by the farmers. Their criteria for variety evaluation included other characteristics like the ease of management, grain quality etc., besides yield. The researcher alone would have considered only yield in the evaluation criteria and *Palmirah* with the highest yield (6.3 t/ha) would have been selected for cultivation (RNRRC Bajo, 2000).
- The popular adoption of oat as a winter fodder instead of their traditionally grown wheat fodder in all the villages of the watershed indicate that farmers prefer this species because it is suitable for multiple cuts and can generate a high fodder yield (Chapter 6).
- The development of maize trashline demonstrates a participatory development of technology. Among the various options offered, farmers chose the trashline for a two main reasons: it was both cheap and farmer-

friendly. Through our development, farmers and researchers evaluated trashlines for stability, effectiveness against surface run-off and labour input required. Yield of maize in fields with trashlines compared well against those without trashlines. There was also an increase in bund height and soil fertility status. This demonstrates the need for such technologies to be developed and tried on-farm with the farmers who continuously changed or added evaluation criteria until they finally accepted it. Currently farmers are exploring options to improve the long-term stability of the terraces by reinforcing the risers by planting fodder grasses.

- A joint assessment of the community forestry plantation indicated that farmers were content with the increase in grass growth but realized that their most preferred choice of tree species, *Cupressus*, was not suitable for the currently very exposed condition of the plantation areas (RNRRC Bajo, 2000).

9.3 Institutional Level

RNRRC Bajo annually conducts a planning workshop, where partners from the Dzongkhag, projects and other partners participate and critically review achievements and adopt plans for the implementation for the next year. This allows an annual cycle of reflection and for planning afresh. This serves as a means to make strategic changes in the course of watershed project program implementation. It is complemented by an in-house review of all new and follow-up activities of RNRRC Bajo the centre (including those in the watershed) whereby activities are put to the peer test and necessary adjustments made.

The results and findings of first phase of project were presented to, and discussed with the communities in the watershed during 1999. Specific issues related to particular communities, together with generic issues common to all communities, in the watershed were presented during a 3 day interaction to generate feedback on the first phase. It also facilitated discussion and analysis of results with the communities to refine the process or strategies for formulating the next project phase. This, combined with the in-house reflection exercise led to the change in the objectives for work in the watershed in 1999 from the initial ones in 1997 (see chapter 2 for details).

9.4. External evaluations

There were number of external evaluations. These helped in validating the interventions and re-defining priorities for RNRRC Bajo's work in the watershed. They also made suggestions on future activities that could be carried out. The "Mid-term Review of Wetlands Production Systems Research" in 1998 served as a formative evaluation. This defined future directions for integrating CBNRM approach in the watershed. The report commended the achievements on the initiation of the of CBNRM/watershed approach. It also gave broad recommendations on how interventions in the watershed could be improved (e.g. development of a management plan for reclamation of degraded land) and

possible specific experiments such as the fodder tree fertilization trials (Schreier *et al.*, 1998).

The “grass roots approach” taken up RNRRC Bajo in managing natural resources and the “continuing transformation” demonstrating the extent of “change the country accomplished in a fairly short time” illustrates the trend towards participatory approach in the context of changing situations (Gorsuch, 2001).

Besides, these informal feedbacks received from visiting IDRC and IRRI professionals reinforced some of the observations by the formal review teams and generated ideas for implementation for the centre.

CHAPTER X. BUDGET ALLOCATION AND EXPENDITURE FOR THE WATERSHED

10.1 Introduction

Participatory watershed development entails fund for enhanced community participation, capacity building and to implement related watershed developmental activities. Over the last seven years in watershed although RNRRC Bajo did not have the funds, the centre contacted for support from various donors and area development projects mainly the IDRC, SDC, BGSRD (GTZ), IHDP, RNR-ESP and the RGoB.

A financial analysis and breakups of the funds utilized in the Lingmutey Chu watershed is presented below.

10.2 Comparative financial analysis for the watershed

The total financial expense for seven years in the watershed amounts to Nu. 2.45 million (Table 10). The hardware amounts to Nu. 1.32 million (54%) of the total expenditure. The hardware support component focused on materials support for community forestry plantation and nursery creation, water harvesting activity, establishment of fruit demonstration orchard, mushroom activity for self help group, road widening activity, supply of saving box for savings group, supply of breeding bull and pasture seeds and creation of private fruits nursery.

Table 10 Fund support and utilization for Lingmutey Chu Watershed

Expenditure items	Amount (Nu.)	%
Hardware support	1,320,435	54
Capacity building	180,830	7
DSA and Transport*	952,000	39
Total	2,453,265	100
Expenditure per km ² in 7 years	72,155	
Hardware support per year	188634	
Manpower support per year	161832	
Total expenditure per year	350,466	
Hardware support per km ² per year	5548	
Capacity building & Manpower support per km ² per year	4760	
Total Expenditure per km² per year	10308	

Capacity building amounted to Nu.0.18 million or 7% of the total expenditure. Capacity building included conduction of various participatory research and development technologies related trainings, workshops, field days, cross-visits and surveys.

Thirty nine percent amounted to about 0.95 million of the total funds estimated here to DSA and transport expenses. This included payment of DSA and provision of transport for RNRRC Bajo staff. The estimate was calculated on rough estimates of RNRRC Bajo staff timed to the watershed.

The majority of fund was used to provide material support and payment of DSA and transport. Expenditure for hardware support is essential in ensuring community participation and keeps them motivated and to reliance some tangible impact out of the process. Of the total expenditure (Nu. 10,308 per km² per year) only Nu. 5548 per km² per year was used for hardware. Capacity development, manpower and transport amounted to Nu. 4760 per km² per year.

In India, an estimate for similar watershed work is of about Rs. 100,000 per sq km² per year (ICRISAT, 2004). The total fund estimated for Lingmuty Chu watershed is well below these estimates. However in India, watershed area is calculated to include only non-forest areas (Miguel, pers.com, 2005). In the case of Lingmuty Chu watershed, the whole watershed area (inclusive of forest) has been used. Excluding forest areas which forms about 95% of the area could push up the figure.

Table 11 represents the fund support and its break down for the watershed research and development program through various donor agencies.

Table 11. Fund support for Lingmuty Chu watershed program (in Nu.)

Sl no	Donor Agencies	Material Support		Capacity		Total	
		Amt (Nu.)	(%)	Amt (Nu.)	(%)	Amt (Nu.)	(%)
1	EPINARM (IDRC & SDC)	2,000	0.1	112,330	6.8	114,330	6.9
2	BGSRDP (GTZ)	936,142	56.8	0	0.0	936,142	56.8
3	RNR ESP (EU)	312,293	19.0	104,500	6.3	416,793	25.3
4	IHDP (UNDP)	70,000	4.2	0	0.0	70,000	4.2
5	BWP (DANIDA)	0	0.0	15,000	0.9	15,000	0.9
6	RGoB	0	0	95,200	5.8	95,200	5.8
Total		1,320,435	80.1	231,830	19.9	1,647,465	100.0

CHAPTER XI: LESSONS LEARNT

The participatory project of watershed development is a learning process. Beginning with the Participatory Rural Appraisal (PRA) through the formulation of objectives, the project implementation and monitoring to evaluation the learning experience is a constant companion of all the stakeholders. Some of the lessons learnt in watershed are documented below to indicate the type of experience. The interventions are described in chapter 6 “Turning a New Leaf”. The lessons are illustrative. They are neither exhaustive nor necessarily applicable to another watershed.

1. **Participation creates ownership:** The rural farmer may be poor and illiterate but he is experienced in growing crops and knows the local context and traditions better than any researcher. He lives in the situation that the researcher intends to intervene. He prefers to be consulted and involved in making his choice from among the options available. It is his field, his work and his life that the researcher seeks to change. He needs to be consulted, not told what to do. Once he chooses an option, he owns it as his own and will work to achieve the objective. If the researcher dictates the option, he has to work for its success. The farmer will now own the (forced) decision as his own. The rapid adoption of maize trash lines for soil conservation and management of breeding bull in Nabchey, the rapid growth of the Farmers Savings Groups and mushroom SHG in Dompola and the success of the fruit plant nursery in Omtékha are just some examples of what ownership developed through participation can do.
2. **Gifts are neither demanded nor forcibly given:** Participatory development is more than just transfer of technology; it is transfer of appropriate and acceptable technology through a consultative and mutually acceptable process. The farmer is the King in his Kingdom. The researcher is an ambassador from the world of science with precious gifts for the farmer. He has to accept the gifts; it cannot be dumped in his backyard. The researcher needs to sit down, have tea and talk to the farmer and only then present the gift in a manner acceptable to the farmer. If a farmer is expected to give a gift to another farmer at the behest of the researcher, he has to be requested. It should never be demanded or insisted upon. It is an exchange of gifts among friends. It must be treated accordingly. The adoption of fodder oats and lathyrus mixed crop by farmers in all villages across the watershed, the planting of 37 hectares of community forest by farmers of Omtékha and Matalumchu as well as the release of irrigation water by farmers of Limbukha almost a month (Bhutanese calendar) earlier than it was due to the farmers of Dompola stand out among the constant flow of gifts.
3. **The farmer is a friend not an acquaintance:** Watershed experience is not a one-off transfer of technology and the farmer is not a one season “contact

farmer". Watershed development work is about changing lives, not merely upgrading the technology level of the farmer. The farmer is a friend whose wellbeing the researcher is genuinely interested in. The farmer accepts and treats the researcher as a friend. The continuous interaction between RNRRC Bajo staff and the farmers of the watershed led to the adoption of improved varieties for greater productivity, risers have been stabilized by growing fodder grasses, formation of a Community Forestry Management Group and even provision of piped drinking water is one friendship. The setting up of fruit plant nursery, a nursery, a demonstration fruit orchard, backyard and field cultivation of vegetables in Omtekha is another one.

4. **It is better to discuss, than to dispute:** Resources especially RNR like rain water, are limited and have multiple uses. Conflicts arise when sharing of resources is not equitable (not necessarily proportionate to other assets). No person can get everything that he wants. As the English poet H.W. Longfellow puts it, "Unmingled joys to no man befall; who least, has to no man befall; who least has some; who most has never all". The watershed institutions and process provide a platform for discussion and conflict resolution. Water sharing conflict between Limbukha and Dompola was sorted out in 2000 by the Role Play Game (RPG) with farmers from both the villages to understand the others' view. When the Dompola farmers had a water sharing dispute amongst themselves they sorted it out by resolving to the appointment of the traditional referee, the *Chusup*.
5. **It is better to hold the hand than stamp on the foot:** Farmers often know what they want to do but do not have the confidence to do it. They look at the researcher for support to take the first few steps. Like a toddler who wants to stand on his own feet and walk, they look for a hand to hold as guarantee that they will not fall if they falter. The researcher has to play the role of the elder and lend a hand to the farmer. It builds confidence. In NGO jargon this process is simply called "hand holding". It requires no financial but can generate huge returns in social capital. It creates local leadership and builds local institutions. The Dompola FSG with assets in excess of Nu. 60,000, active participation of its members and healthy credit-to-loan ratio is a good example. The woman SHG of Limbukha producing and marketing RSPN model solar dryer is another.
6. **Many small ripples do not make a splash:** In participatory development there are many small interventions that change lives but have very low visibility. A visitor to the watershed may not "see" or be impressed by the progress. The farmer whose family went to sleep hungry for two to six months or had to borrow grain at 15 percent interest from neighbours and now has enough to eat the whole year through "knows" what progress his life has seen. He is grateful. His smile is the best "success indicator". No statistical model can create a happy farmer: a participatory approach can. It does. A terrace of oats and lathyrus mixed crop does not stand out amidst terraces of

- wheat in winter. However, the fodder can be harvested 3 to 5 times to yield 60 t/ha instead of just 0.75 t/ha of wheat. The oat fodder is converted to a lot more milk per day by *Jatsha* or cross-bred cow as against that from a local breed.
7. **Rights are not wrongs:** The socio-economic impacts of new systems are sometimes not anticipated by researchers. These modern systems can have disastrous consequences if not properly contextualized and implemented. The researcher should not dither when remedial action is claimed as a right by the farmers. To avail of financial support for canal maintenance, the farmers from Dompola agreed to form a Water Users Association (WUA) and adopt its rules as per the National Irrigation Policy (NIP). The principle of proportionate (not equitable) distribution of water almost destroyed the smaller farmers, while big farmers got more water than they needed. The farmers opted to revert to traditional system monitored by the *Chusup* and the Dzongkhag consented. The issue was resolved to everyone's satisfaction. In exchange for the right to forest produce farmers from Omtekha and Matalumchu established a 37 hectare community forest in the degraded forest land.
 8. **Good neighbours make better SHGs:** The SHG members need regular contact for them to bond and grow as a group to operate the selected enterprise. Proximity of houses makes it easy to meet and work at short notices. The enterprise develops better. The Dompola SHG and Limbukha women SHG are good examples of proximity building success.
 9. **Multi-disciplined is not in-disciplined:** Since the participatory process of the watershed development is about changing lives, it needs a multi-disciplinary approach. This requires coordination among researchers in various disciplines of natural and physical sciences like crop production, livestock husbandry, soil science, forest science and engineering with defined leadership in each area of operation. The leadership of water resources officer in a water redistribution intervention at Limbukha with officers from crop production and soils sector in assessing the impact of mixed cropping, soil nutrient and moisture status on yields of a mixed maize and soybean crop in Nabchey are good examples.
 10. **What you sow, you should be able to reap:** Rural farmers are often not well endowed with resources. They cannot afford to invest the limited resources in a venture if the benefits from that will not accrue to them. Avoidance is a usual risk minimizing strategy that they employ. Only when they are reasonably convinced that they are putting their resources (human and financial) into something that would yield some benefit for them would they be interested in that. No amount of persuasion can help. The initial lack of enthusiasm by the farmers of Matalumchu and Omtekha to establish community forestry plantations which was later replaced by eager participation when they were made aware of the legal provisions for their

- property under the Forest and Nature Conservation Act of 1995 illustrates this.
11. **Protect the trees, trees protect:** Big problems can sometimes be solved by tackling the less obvious but smaller ones. The problem of degrading lands is a common issue in most of the watershed due to a lack of vegetation cover and an absence of tail water management. Experience with the community forest plantations in the watershed indicates that very often simply excluding grazing from these areas through fencing would contribute immensely towards halting the process of degradation. Regeneration of adequate cover of grass and other vegetation after 1-2 years of fencing helps keep the soil together making it fit for growing trees or other measures to rehabilitate these lands.
 12. **Off-farm research helps on-farm production:** Complementing participatory research with the communities with conventional research, on-station, helped generate better interventions. The project team was able to introduce technical knowledge and research results related to crops, soil fertility, soil erosion control, water, feed and fodder from work on the station which was then integrated in designing interventions to address the community's expressed needs and resource problems. Bajo Maap and Bajo Kaap, high yielding varieties bred and developed through long duration trials at the station helped increase rice production in the villages of Wanjukha, Matalumchu and Omtékha. This would not have been possible if the research was to be carried out in the farmers' fields.
 13. **A friend should not overstay his welcome:** Watershed development can stretch over years as complex interactions between resources need to be understood to address communities' concern. This however should not mean that the researcher stays in the watershed forever. As the Bhutanese proverb "*drana ami om ya dhu*" or even mother's milk in excess is toxic illustrates the implementing agency should at some point withdraw. An "exit time" with the development of local capacity should be planned so that interventions can be focused and are time bound. Institution building should begin from day one to prevent collapse of watershed development on exit of the implementing agency. Local institutions need to be built up and helped to generate funds to maintain assets created during initial period of interventions to enable a gradual scale down and move withdrawal.
 14. **You can't get something for nothing:** Watershed development that focuses on working with the communities to improve the resource and social situations in the watershed requires a lot of money (see Ch 10) for a number of reasons. For instance, the community plantations could not proceed without the support for fencing from BGSRD. The project also supported construction of a water tank for the nursery in 2000. Gathering communities to discuss on group issues entail providing some minimal logistics such as lunch

and refreshments for effective participation. Besides, group activities such as those of SHGs depend a lot on external funding support. Research alone cannot sustain farmer participation. Funds are needed to help farmer implement activities in cash-strapped watershed communities.

15. **You need the fingers to implement the thumb rule:** A participatory approach to watershed management throws up a host of issues that requires the intervention of multiple agencies within and out of the Ministry of Agriculture. There will be forestry issues, livestock issues, agriculture issues, communication issues and health and sanitation issues to name a few. The experience in indicates that watershed management cannot be handled by a single agency's mandate. A core implementing agency could coordinate activities but this agency/organization would need to link to other sectors for developmental interventions beyond the scope of the organizational mandate. This multi-agency approach should happen in a open-minded and inclusive mode and all collaborators including the communities should have equal bargaining powers.

CHAPTER XII: WATERSHED PARADIGM FOR BHUTAN

12.1 Introduction

Bhutan can be considered as mosaic of micro-catchments, which converge into five major river systems. As watershed management is considered as a critical element in the development vision of the country, a suitable watershed paradigm is inevitable to support the development goal. The experience gained through participatory intervention in Lingmutey Chu watershed for all-round well-being of the community through CBNRM approach gives RNRRC Bajo team the confidence to propose a possible watershed paradigm suitable to the Bhutanese watershed.

This chapter draws specific experiences from the work in Lingmutey Chu watershed.

12.2 CBNRM experiences and its relevance

The involvement of RNRRC Bajo in watershed management activities in Lingmutey Chu watershed has generated a wealth of experiences that can be consolidated and packaged into a research approach for interventions in other watersheds in Bhutan and elsewhere. The effective management of watersheds has been considered as a key component in the national development effort (Vision 2020) and hence the research findings from Lingmutey Chu watershed can form a crucial input to the management strategy.

The course in, as in any social change process, was complicated and sometimes discouraging. However, some hope of accomplishment like land management, fodder improvement, water harvesting, and animal breed improvement provided the essential inspiration to both researchers and the community members to maintain the momentum. The process undoubtedly was lengthy, but it has been worth the time and resource expended, as the seven years of involvement has generated concrete experiences and lessons which, because of their success, can be used for up- and out-scaling the approach.

In the very early stage of involvement, it was apparent that priority in addressing the immediate concerns (primarily household food security and resource use conflict) of the community was vital to motivate them to organize themselves and to establish a common understanding needed to define common vision. Beyond all the possible external support, ultimately the change in natural resource management (NRM) regime was dependent on the decisions of the community members. Normally, such collective decision can occur when people attain expectable level of uniform understanding and capacity. In other words, it can be confirmed that effectiveness of the approach in NRM will depend on its influence on people's decision-making processes to achieve CBNRM capacities. Largely, the decisive impact expected of the intervention in the watershed has been the

enhancement of livelihoods and the management of the natural resources in a sustainable way.

The holistic and constructivist outlook of the process through negotiation, facilitation and appropriate methods in complex realities of rural setting ensured the success of the intervention. The research and development intervention through CBNRM approach enhanced the resource users' and other stakeholders' own learning and capabilities thus supporting knowledge-based decisions in enhancement of livelihood and natural resources.

Experiences in the watershed demonstrate the competence of the approach in developing knowledge through critical reflection and experiential learning in an ongoing process of action in a real life context. The outstanding advantages of the approach can be summarized as:

- The process has increased capacity of the community for articulation and negotiation of interests, leadership, collective action, as well as critical consciousness, and self-esteem among community members.
- It promotes co-creation of innovations through collective inquiry, practical knowledge and solutions which are directly useful to practitioners and people in the process,
- The process has immensely contributed in disciplinary progression of the researchers, who with natural science background, tirelessly worked through the process and gained ample opportunity to experience the social science perspective of their interventions.
- As it directly influences the construction process of social reality, it helped in behavioural change in the community,
- It helped in enhancement of people's capacity for experimentation and adaptive management, and
- It helped in generation of scientific knowledge concerning action, reaction, links, and factors that influence processes of change in a real life context.
- Considering the success in use of the diverse tools within pre-defined intervention principles, the approach can be replicated in any watershed in Bhutan.

12.3 Watershed Management Paradigm

Considering the experiences gained on watershed management (WM) over seven years, it is time to consolidate the understanding of the experiences into a management paradigm for watershed development in Bhutan. In developing the paradigm, the conventional prescriptive approach is avoided to guarantee flexibility of the process and to continuously harness community participation. In coherence with the decentralization policies of the Royal Government, the WM paradigm is perceived as a holistic process, which inspires people to collectively discover for themselves a continual progression of their livelihood and natural resources.

The CBNRM approach in effect *blends numerous participatory approaches in a manner that allows iterative process for knowledge-based decisions in local actions*. The distinctive feature of the approach has been the increased level and scope of people participation in the process. While the skills gained in the watershed contributed in formulation of the *geog* based planning approach for the RNR sector, it is perhaps opportune to up-scale and out-scale the approach.

The critical elements of the emerging paradigm in watershed management can be summarised as:

Holistic approach: The separation between society and natural environment becomes irrelevant in a country where livelihood and way of life is heavily integrated with environment. In the changing scenario of resource dependence, the interaction between upstream and down-stream communities further critically challenges the resilient capacity and sustainability of the watershed. Not undermining the strength of disciplinary intervention, the integrated approach to coordinating actions harnesses greater and lasting impacts in the watershed.

Institutional development: Organizing the individuals into consortium of common aspirations within a definite boundary (physical and social) ensures the sustainability of the watershed institutions. The community needs to be facilitated to develop their own institutions (Cooperative Act, 2001), which can be nested within higher-level institutions (Ostrom, 1990) to guarantee relevance of such institutions.

Facilitation: High quality process facilitation led by strong vision, understanding and a 'culture of inquiry' is fundamental to ensure the success of the process approaches. The role of the facilitating agency in coordinating the interventions, constant follow-up, strong technical support and resource mobilization are pre-requisites for success of such crosscutting intervention.

Participatory monitoring and evaluation: The iterative process often depends on reflection on the action, which can be achieved by mechanism of monitoring and evaluation. Building the M&E system based on the components of goal, objectives and involving the community ensures greater success of the activities and ownership.

Learning Tool: The participatory approach is centered on socio-organizational strengthening and farmer learning through experimentation and discovery, both integrated into a coherent intervention process design.

Participation: Participation of community members in decision making, implementation, benefit and evaluation of the process is the principle element of the approach. All forms of participation (contractual, consultative, collaborative and collegiate) can fit in the approach.

Livelihood improvement: It was imperative to first address the immediate issues that influenced their livelihood. For instance, addressing the issue of household food security, income sources, and access were fundamental to consolidate the community for collective actions.

Capacity development: Institutional facilitation is not a perpetual process, the participatory watershed development is perpetual. Capacity must be enhanced within the social capital of the watershed to participate, lead and manage the institution. Enhanced skill and capacity of the community can fuel the process of development. Importantly, it promotes knowledge-based decision-making, which ensure appropriateness of the actions. Enhancing capacity also helps in building the social capital which empowers people to continue the process independently.

Thus the ability to continue the process independently by the community, promotes exit of the agency from the process.

Reciprocity: Reciprocity contributes to the development of long term obligations among people through simultaneous exchange of goods and knowledge, which help in achieving positive outcomes.

Multi-disciplinary, multi-dimensional: In view of the multi-faceted problems, the role of multi-disciplinary capacity to back-up the process cannot be ignored. As the focus moves from single commodity to natural resources management, the dimensions widens making it highly integrated and complex.

Blending Intervention: Often separating the intervention into research and development acts as deterrents to participation and ultimately success of the action, coordination of research, capacity development, and infrastructure development within a common framework promotes long lasting impacts. This can be further enhanced by provision of adequate financial support for implementation.

The above elements of the watershed paradigm can be organized into 5 steps within the cycle of intervention. The five stages in the cycle (Figure 21) are explained below:

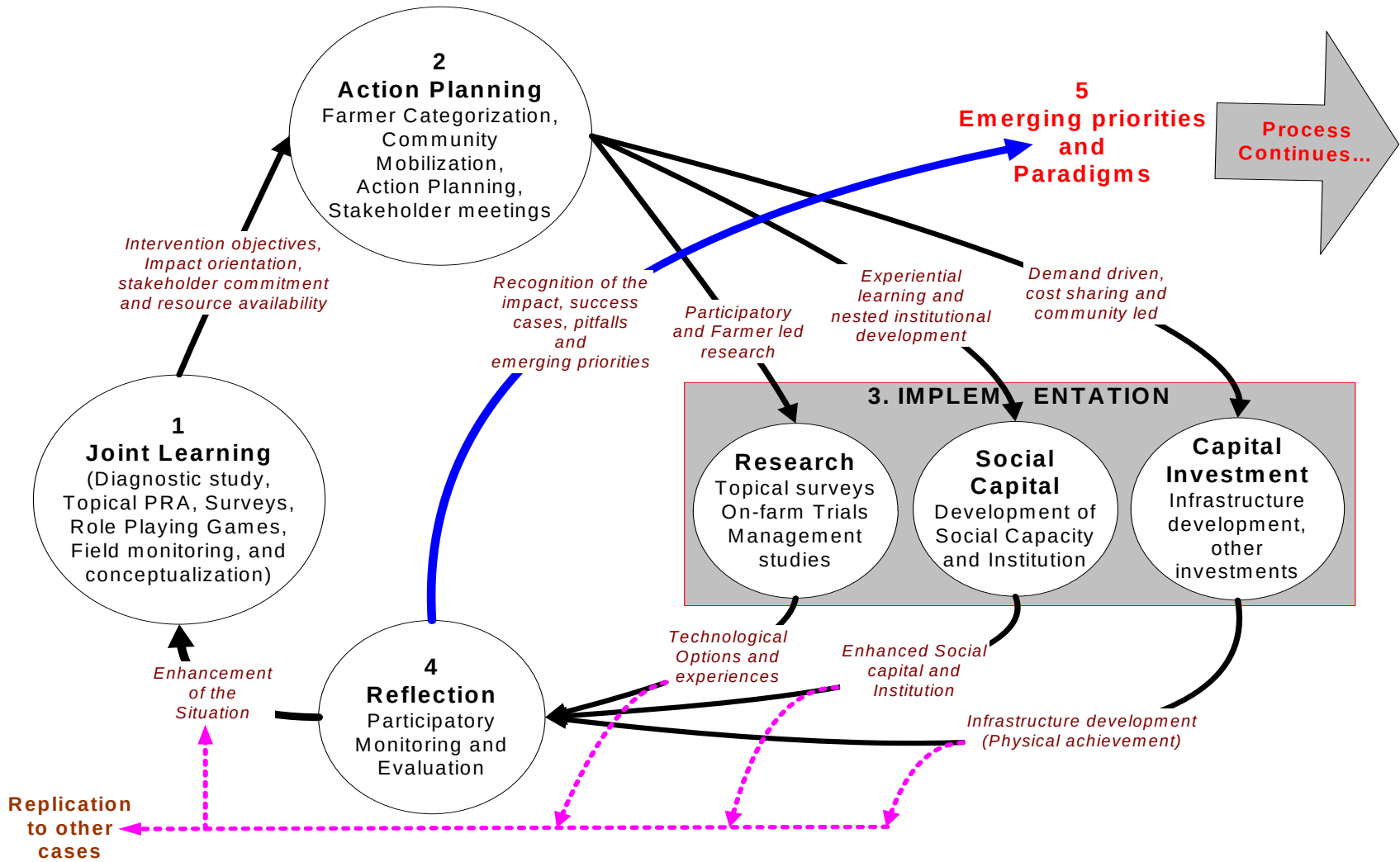


Figure 22. Schematic Representation of Watershed Management Paradigm

- 1. Joint Learning:** The entry point to the WSM process is the understanding created by joint (collaborative) learning. It helps in building the crucial trust between community and agency and harnessing community participation. The learning can be accomplished by diagnostic studies, topical PRAs, surveys, field monitoring and role-playing games. The enhanced understanding will guide in defining needs and aspirations thus conceptualizing the intervention.

As indicated in the figure, the conceptualisation should generate intervention objectives oriented to specific impacts, resource availability and stakeholder commitments.

- 2. Action Planning:** Concrete action plans are drawn based on the intervention objectives, resource availability and commitment. A vital strategy in focusing the actions is stratification of the beneficiaries. Clustering the communities and identifying the local institutions to assign the actions. Stakeholder meetings can be organized to assign responsibilities, consolidate resources and coordinate the actions.
- 3. Implementation:** The WSM program implementation agency has to ensure proper coordination in implementation of research, institutional, and infrastructure development. The imbalance in intervention can jeopardize the success of the intervention.

It is encouraged to follow participatory research approaches and engage farmer to led research on NRM. Development of local institutions should be built on the experiences of traditional organization. Any upcoming institution has a greater possibility to succeed if it is nested (associated) to existing (formal) higher-level institution. Capacity development should also be viewed at as a process oriented learning, otherwise an experiential learning that ensures long lasting impact of the enhanced capacity. In line with decentralization polices, infrastructure development should be demand driven, impact oriented, and resource assured (cost-sharing) intervention.

- 4. Reflection:** Learning and Reflection is the key element, which permits participatory learning and aligning the course of intervention. Unlike conventional M&E system, the participatory M&E should encompass the broad principles of participation, negotiation, learning, and flexibility.
- 5. Next Cycle:** Completion of the cycle of intervention and reflection often allows community to recognize the impact and success. Ideally with the improvement of situation, new paradigm emerges for which new strategies and actions are needed. Thus the similar cycle emerges indicating the progression in development. The distinctive feature of the process is the emergence from each step being used within and outside the system.

CHAPTER XIII: THE WAY FORWARD



Figure 23: Minister for Agriculture showing the way forward

13.1 Introduction

The experience of watershed management is first of its kind in Bhutan. It started in 1997 as a part of CBNRM project co-funded by IDRC-Canada and SDC/Helvetas. It was a new initiative and a very enriching experience for the RNRRC Bajo which carried out the study. Many lessons were learnt (see Chapter 10) and a lot was achieved in the process (see Chapter 8). The experience shows that, even after seven years of working in the watershed, a lot remains to be done. Understanding this, the team could not disagree with the comment of a watershed practitioner who said that “watershed work has no entry and no exit”. However, does not mean that it has remained status quo. A lot has evolved for the better. However, new dimensions of problems have surfaced which require attention. This chapter provides some direction for future watershed management undertakings. The suggestions are categorized into two – one for watershed and the other for watershed program in general for Bhutan.

13.2 Watershed: Looking Ahead

With the benefit of hindsight and deep introspection, the RNRRC Bajo team, after a weeklong interaction exclusively on the subject, has determined that the best way forward is with the following steps.

Support resource management institutions at watershed level

Participation in the watershed management in the past seven years has made the communities to realize that a collective effort is required to manage the resources in the watershed. The recent constitution of a Watershed Management Committee (WC) is an example of a collective vision of the communities. It is, therefore imperative that the process be facilitated by capacity building within the purview of existing laws, rules and regulations on CBNRM while ensuring sustainable and equitable resource management practices. The Watershed Management Committee must be enabled to co-ordinate activities before exit of RNRRC Bajo as the facilitator, while continuing to provide research support.

Make running water creep and creeping water to stop

The answer to water shortage during rice transplanting through redistribution of water and staggered planting by growing early maturing rice varieties has not adequately eased the water shortage problem. Yet another alternative is to explore improving the discharge from the catchment through interventions of structures that will help water to infiltrate, percolate and recharge the watershed's water harvesting systems.

Intensify livelihood improvement programs

As the farming system is largely subsistence in nature, it is important to emphasize on livelihood activities. Farmers are aware and exposed to improved horticultural crops for generating cash income. This needs support in the area of converting poor quality local plants to improved varieties. The fruit crops nursery needs to be enabled to make the improved grafts/saplings available in greater numbers to watershed farmers. As fruits take minimum of three years to give benefits, it is imperative that proper planning is undertaken to ensure quality of scion and rootstock material and ensure availability of skilled personnel for grafting operations.

Encourage women to form SHGs

Empowering women through Women's SHG route is an option that must be pursued with renewed vigour. These women can then play a positive role in CFMGs and other bodies.

Develop capacities in SHGs

Non-farm activities like handloom, handicrafts from bamboo, wood and other locally available materials, processed fruit products and other value added products can supplement household's incomes. Skills can be developed by sourcing appropriate training centres.

Link FSGs to formal credit institutions

While there is a growing interest among communities to form additional Farmer Saving Group, it is equally important that existing FSGs mature. In some of the FSGs the savings are substantial and it is important to re-look at their capacity to handle the credit schemes locally. Further, it would be prudent to ensure that schemes are within the purview of Acts of formal credit institutions.

Establish legal status of existing Community plantations

The ownership for 37 ha community plantations, in purview of the Social Forestry Rules and Regulations of 2000 needs regularization. Ownership certificate gives confidence to the members and will dispel any mistrust on the program at large.

Reinforce rehabilitation sites

Biomass over severely degraded rehabilitated sites has improved manifold. This is an encouraging trend. Now that soil conditions have improved, it will be important to enrich the sites with plantations of tree species of user group's choice. Assessing critically the performance of earlier planted tree species might be the way to move forward along with the communities to establish community forests managed by CFMGs. Use "Live fencing" to reduce dependence on expensive GI barbed wire in the long run.

Strengthen Monitoring and collection of time series data

Time series data for long duration studies such as watershed need to be gathered objectively. Data speak and without data the results and learning from the watershed cannot be shared with other practitioners. There is a need to pay greater attention to this at Lingmutey Chu watershed.

13.3 General Watershed Management Program for Bhutan**Develop Implementation framework for Bhutan watersheds**

Bhutan has five major river systems and several streams running north to south in a fragile mountainous terrain. These river systems also are the major catchments/watersheds where people live and farm. Recognizing this fact, the Bhutan 2020 emphasizes the need to manage Bhutan watersheds. At present

watershed management initiatives are under way in Wang, Radhi and in Lingmutey Chu Watershed. The scale and implementation approaches vary greatly among these watersheds. It has been difficult to implement and share experiences in the absence of a broad implementation framework. Therefore, there is a need to develop broad implementation framework for Bhutan's watershed development which will serve as a guide within which watershed management could be initiated.

Recognize watershed management as multi-sectoral undertaking

Watershed management is not limited to management of natural resources only. It also has to manage the human resource and develop it. The people living in the watershed require other sectoral support such as roads, telecommunication, electricity, health and education. The electricity connection to the watershed communities for example reduces the pressure on the forest resources for fuel. Similarly improving road improves access to marketing of goods and services thereby improving people's livelihoods through increased cash earnings.

The RNR sector is the key player in the management of natural resources in the watershed. Within the RNR sector, multi-agency and multidisciplinary involvement is a necessity. Watershed management requires a livestock specialist, soil scientist, crop specialist, forest specialist, socio-economist, hydrologist, extension staff and SHG animators for watershed development to reach "take-off" momentum.

Recognize participatory watershed approach

The natural resources in the watershed are used and managed by and for the people in the watershed. The local people know the resource status; causes of degradation; and also solutions to problems. It is important that people's livelihood needs are attended to ensure participation of local communities. The intended beneficiaries must necessarily be involved in planning and implementing action to their benefit.

Ensure separate budget commitment

Watershed management involves investment of effort and funds in building check dams; gully plugging; vegetative barriers, percolation tanks, and income generating activities. The village communities are too poor to afford such interventions initially. Such investments cannot be taken up under normal budget allocated to the RNR sector. In the absence of a committed budget, the watershed management prolongs, thus depriving/delaying the benefits to communities. In view of this, the government must ensure separate budget provision for management of 'critical' watersheds. It could also be possible for arrangement of complementary investment from donors and communities themselves.

Direct plough back of revenues from hydropower

Watershed development reduces soil erosion in the catchment and siltation downstream. The Department of Power, for its hydropower generation, is the main beneficiary of a sustainable watershed management programs. While the revenue generated from the export of excess power is ploughed back in providing public services including rural electrification, it will be worthwhile to allocate certain percentage of the power export revenue directly for funding the watershed management programs. Such arrangements will motivate the community members in watershed management and help improve their local incomes.

Promote low cost technologies

In cash-strapped watershed communities, which also suffer from labour shortages during peak rice transplanting season, low-cost technologies that can be implemented before or beyond this period need to be promoted. Live posts, gully plugs with *Erythrina indica*, *Jatropha curcus*, and other plant species, maize trashlines or *Opunria spp.* planted along the contour lines are some such practices. The plants can also serve as “live fences” and reduce the need to replace barbed wire fences which corrode over a period of a few years. Jatropha oil is also emerging as a source of the bio-fuel Jatropha Methyl Ester (JME) to replace diesel (India Today, 03 May 2003).

Need for specialized expertise and people

The current implicit understanding that watershed management should be implemented through the existing extension program may not be the right way. While extension can play a role but they lack time and capacity in many fronts. As such, for a watershed management program, allocation of additional staff with required expertise is desirable. It may be desirable to designate a lead agency as Program Implementing Agency (PIA) to co-ordinate development till a local Watershed Management Committee is in place.

Identify priority watersheds

All the river systems in Bhutan are watersheds of varying sizes, degree of degradation, and population. All watersheds are inhabited and justify implementation of watershed management programs. However, for efficacy and effectiveness it would be important to identify critical watersheds – critical by Bhutan standards, for management. Criteria for selection may be based on: severity of bio-physical resources degradation, relative importance to local inhabitants, importance of the watershed to national economy, etc. Classifying watersheds into, mini- watershed, micro-watershed and river basin systems may help to order the experiences gained at different levels.

REFERENCES

- BG-SRDP Lobesa & RNR-RC Bajo. 1998. Participatory forest management for local use Wangdue Bhutan.
- Brand, Leo Van den & Jamtsho, Kezang. 2002. Water management in small farmer managed irrigation schemes in the Lingmutedy Chu watershed in Bhutan. Wageningen University, The Netherlands.
- Chamber, R. 1989. In search of water revolution: Questions for managing canal irrigation in the 1980s. In: IRRI Report of a planning workshop on irrigation water management. IRRI, Philippines. pp. 23-37.
- D'Silva E, Wani SP and Naganath B. 2004. The making of new Powerguda: community empowerment and new technologies transform a problem in Andhra Pradesh. Global Theme on Agro ecosystems Report no. 11. Patancheru 502 324. Andhra Pradesh, India: ICRISAT.
- Duba, S. and R. Swinkles. 2001. Farm household categorization in the Lingmutedy Chu watershed, Wangduephodrang. Journal of Renewable Natural Resources, Thimphu, Bhutan. 1(3): 36-46.
- GYT Chatrim, 2000. Geog Yargay Tshogchung. MoHA, RGoB, Thimphu Bhutan
- Gurung, T. R. 2004. Use of Multi-Agent System to improve irrigation water sharing in watershed, Bhutan. Graduate School, Chiang Mai University, Thailand
- Joy, K.J & Suhas Paranjape. 2004. Watershed Development Review: Issues and Prospects. CISED, Bangalore 560 072, India.
- Kotru. R. 1998. A short appraisal of the M&E system. BG-SRDP, Thimphu, Bhutan.
- LUPP. 1997. Atlas of Bhutan. Land cover and area.
- Ministry of Home Affairs RGoB. 2002. Geog Yargay Tshogchung Chathrim, 2002. Thimphu, Bhutan.
- MoA, RGoB and IRRI. 1999. Enhancing Productivity through Integrated Natural Resources Management (EPINARM) in Bhutan: A project Proposal. RNRRC Bajo, Bhutan.
- NSSC, Semtokha. 1999. Technical report of Semi-detailed soil survey of Lingmutedy Chhu watershed, Report No. SS.5(a), REID, MoA, Thimphu Bhutan.
- Ostrom, E. 1990. Governing the commons: evolution of institutions for collective actions. Cambridge university press. New York, USA. 279p.
- Planning Commission, RGoB. 1999. Bhutan 2020: A vision for Peace, Prosperity and Happiness. Thimphu, Bhutan.
- Pretty, J. 2003. Social capital and the collective management of resources. Science. 302: 1912-1914.
- RNRRC Bajo. 1999. Annual Report 1998-1999. REID, MoA, RGoB, Wangdue, Bhutan.
- RNRRC Bajo. 1997 Community-Based Natural Resources Management (CBNRM) Research in Lingmutedy Chu watershed – Characteristics of Lingmutedy Chu, Problem Diagnosis & Major Research Themes. Wangdue, Bhutan.

- RNRRC Bajo. 1997. Characteristics of Lingmutey Chu, problem diagnosis and major research themes. In: Community based natural resources management (CBNRM) research in Lingmutey Chu watershed. Bajo, Bhutan.
- RNRRC Bajo. 1998. Annual Report 1997-98. REID, MoA, RGoB, Wangdue, Bhutan.
- RNRRC Bajo. 1999. Research Protocols 1997-98 and 1998-99. Wangdue, Bhutan.
- RNRRC Bajo. 2000. Annual Report 1999-2000. DRDS, MoA, RGoB, Wangdue, Bhutan.
- RNRRC Bajo. 2000. CBNRM Research in the Lingmutey Chu watershed-annexure I technical report 1997-1999, Wangdue, Bhutan.
- RNRRC Bajo. 2000. Farm household categorization in watershed, Wangdue-phodrang, Bhutan. 44 p
- RNRRC Bajo. 2000. Community Based Natural Resources Management Research in the Lingmutey Chu watershed - A process documentation. Wangdue, Bhutan.
- RNRRC Bajo. 2001. Annual Report 2000-2001. DRDS, MoA, RGoB, Wangdue, Bhutan.
- RNRRC Bajo. 2002. Annual Report 2001-2002. DRDS, MoA, RGOB, Wangdue, Bhutan.
- RNRRC Bajo. 2002. Lingmutey Chu watershed, Bhutan. Himalayan Andean collaborative watershed project. Multimedia CD - Disk 4 of 9. RNRRC, Bajo, Ministry of Agriculture, Bajo, Bhutan.
- RNRRC Bajo. 2003. Annual Report (2002-2003). Core, MoA, Thimphu, Bhutan.
- RNRRC Bajo. 2004. Annual Report 2003-2004. CoRRB, MoA, RGoB, Wangdue, Bhutan.
- RNRRC Bajo & SSF&PNM. 2001 Management and use of Farm Yard manure in the Watershed. Results from a household survey
- Wangchuk, S. 2000. Local Resources Management Institutions: A case study on Shokshing Management. Journal of Bhutan Studies

SUGGESTED READING

- Bhujel, A.K and Tshering, D. (Editors). 2004 Proceedings of CBNRM: Next Phase Design Workshop, RNRRC Bajo, Bhutan. 80 p.
- Bhutan Water Partnership. 2003. Water resources management in Bhutan: a country status report. Thimphu, Bhutan. 23p.
- Bousquet, F., Gurung, T.R., and Trebuil, G. 2005. The Game of Life, Rice Today, Vol. 4 No. 1, IRRI.
- Dorji, L. and E.L. Webb. 2001. The status and role of local-level institutions in natural resource management: A concept of forest management in Bhutan. <http://www.wms2001.ch/cd/contributions/Lam%20Dorji.pdf>
- Gorsuch, Joyce. 2001. Local Traditional meets Modern Know-How. International Rice Research Institute. Los Baños, Philippines. 37p.
- Gurung, T.R. and Turkelboom, F. 2000. A framework for community-based natural resource management for Bhutan. A discussion paper.
- Department of IWDP. 2003. Draft Withdrawal Strategy. Integrated Watershed Development Project. Kandi. Solan Himachal Pradesh; India. 20p.
- ICIMOD and TML. 2003. Her Way Forward: Voices of Mountain Women. International Centre for Integrated Mountain Development. Kathmandu Nepal, and the Missing Link, Guwahati, India.
- Ministry of Agriculture (MoA). 1999. Renewable Natural Resources Sector: The last 25 Years. Thimphu, Bhutan: Ministry of Agriculture. 25p.
- Ministry of Agriculture (MoA). 2002a. RNR Census 2000. Volume 1. Ministry of Agriculture, Royal Government of Bhutan, Thimphu, Bhutan. 121p.
- Ministry of Agriculture (MoA). 2002b. Community-based Natural Resource Management in Bhutan. A Framework. Department of Research and Development Services, Ministry of Agriculture, Royal Government of Bhutan, Thimphu, Bhutan. 150p.
- Ministry of Agriculture (MoA). 2003. Facts and Figures of RNR Sector 2003. Ministry of Agriculture, Thimphu, Bhutan. 19p.
- Ministry of Agriculture. 2003. Community-based Natural Resource Management. Workshop Report. 296p.
- Ministry of Home Affairs (MoHA). 2002. Draft DYT Chatrim. MoHA, Royal Government of Bhutan, Thimphu, Bhutan. 50p.
- National Environment Commission (NEC). 1998. The middle path: national environment strategy for Bhutan. Thimphu (Bhutan): NEC. 95p.
- OIKOS and IIRR. 2000. Social and institutional Issues in Watershed Management in India in Watershed Management in India. OIKOS, India and International Institute of Rural Reconstruction, Silang, Cavite, Philippines. 407p
- Planning Commission Secretariat (PCS). 1993. Decentralization. PCS, Royal Government of Bhutan, Thimphu, Bhutan. 15p.
- Planning Commission Secretariat (PCS). 2002. 9th Five-Year Plan Document (2002-2007). PCS, Royal Government of Bhutan, Thimphu, Bhutan. 130p.
- REID. MoA. 1995. Role of the Irrigation Programme in the 8th FYP and Beyond: Discussion papers. Thimphu, Bhutan

- Renewable Natural Resources Research Center (RNRRC). 2001. National field crops research strategy and program: 9th Five Year Plan (2002-2007). RNRRC, Bajo, Ministry of Agriculture, Bajo, Bhutan. 22p.
- Renewable Natural Resources Research Center (RNRRC). 2005. Proceedings of Seventh National Field Crops Workshop, RNRRC Bajo, 85p
- Royal Government of Bhutan (RGOB). 2003a. Bhutan 2003: people at the centre of development. Ministry of Finance, Thimphu, Bhutan. 49p.
- Royal Government of Bhutan (RGOB). 2003b. Millennium development goals, progress report 2002. Thimphu (Bhutan): RGOB.
- Royal Government of Bhutan (RGOB). 2003c. Bhutan Water Policy, Royal Government of Bhutan (RGOB), Bhutan Water Partnership, Thimphu, Bhutan.15p.
- Shrestha, S. 2004. An Economic Impact Assessment of Rice Research Program in Bhutan. IRRI, Los Baños Philippines. 51p
- Sharma, P.N. and Wagley, M.P. (Editor) 1997. The state of Watershed Management in Asia. PWMTA-FARM, FAO. Kathmandu, Nepal. 82p
- Schreier, H. et.al. 1998. Mid-Term Review: Wetland Production Systems Research Project, Bhutan
- Scheidegger, U. 2004. Mission Report, BH 10. Bhutan RNR Research System Project Phase III
- Tshering, D. 2003. Role of Indigenous Knowledge Systems in Community Forest: Cases From Bhutan. M.Sc Thesis. Wagenigen University. The Netherlands.
- Tshering, D. 2001. Case study on bamboo and cane in Punakha and Wangdue Valley.Bajo (Bhutan): Renewable Natural Resources Research Center. 25p.