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Assessment of Participatory Land Use Planning for Watershed Management in a selected Watershed in Bhutan

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Declaration

I hereby declare that this master's thesis is my own work and effort. It has not been submitted in any other University for any other award. Due acknowledgements have been made to all materials cited in the text.

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Abstract

Buedulumchhu-Balaychhu-Zharingaychhu critical watershed under Dagana Dzongkhag has the highest human population density. The watershed areas are highly disturbed and degraded due to high human population, consequently exerting pressure to natural resources and agriculture land. The problem was further aggravated due to climate change, resulting in erratic timing and quantity of rainfall, directly affecting the livelihood of farmers. To mitigate the effects of land degradation, climate change and to improve livelihood, there is immediate need for action to improve the watershed conditions and services. The study was carried out to identify important land use types and water related problems in three Geogs of Dagana Dzongkhag, for the purpose of land use planning. This would help to achieve sustainable management of natural resources, and maintenance and improvement of watershed services. A participatory approach was used for land use planning. Participatory rural appraisal (PRA) methods like matrix, pair wise ranking, village timeline, resource mapping using 3-D model, semi-structured interviews and transect walks, were used for collecting data and to encourage effective participation of farmers in participatory land use planning processes. The use of selected PRA methods efficiently generated the required information on land use types, land use problems and interventions, and facilitated the implementation planning. This information is important for land use planning for the Dagana degraded watershed. The effectiveness and applicability of selected PRA methods were evaluated by assessing the participation of individual participants. The use of PRA methods encouraged effective participation of farmers and facilitated learning.

Keywords:

Climate change, land degradation, watershed, land use, critical watershed, participation, PRA methods, livelihood, farmers, participation.

Kurzfassung

Das kombinierte Einzugsgebiet der Bäche Buedulumchhu, Balaychhu und Zharingaychhu im Berzirk Dagana ist aufgrund von hoher Bevölkerungsdichte stark degradiert, was den Druck auf Naturresourcen und landwirtschaftliche Flächen erhöht. Das Problem wird durch Klimawandel und den damit verbundenen Schwankungen der Niederschlagsmenge und –periodizität verstärkt und beeinträchtigt dadurch die Lebensgrundlage der Bauern. Als Antwort darauf ist es unumgänglich, den Zustand und die Wasserrückhaltefunktion des Einzugsgebietes durch konkrete Maßnahmen zu bessern. Die vorliegende Studie identifiziert wichtige Arten der Landnutzung und wasserbezogene Probleme in drei Gemeinden der Provinz Dagana für den Zweck einer Landnutzungsplanung, was zu einer nachhaltigen Nutzung von Naturresourcen und dzur Verbesserung der Wasserrückhaltefunktion des Einzugsgebietes beitragen wird. Methoden von Participatory Rural Appraisal, wie Matrizen, paarweise Rangreihung, Dorfzeitachse, dreidimensionale Ressourcenkartierung, semi-strukturierte Interviews und die Transektmethode wurden angewendet, um relevante Daten zu sammeln und eine effektive Partizipation der Bauern im Prozess der Landnutzungsplanung zu erreichen. Die Verwendung ausgewählter PRA Methoden generierte die benötigte Information über Arten der Landnutzung, Landnutzungsprobleme und ihre Bekämpfung und unterstützte die Umsetzungsplanung. Die Effektivitaet und Anwendbarkeit verschiedener PRA Methoden wurde durch die Beurteilung der Partizipation individueller Teilnehmer beurteilt. Die Verwendung von PRA Methoden hat effektive Partizipation von Bauern gefördert und unterstützte den Lernprozess.

Schlagworte:

Klimawandel, Landdegradation, Einzugsgebiet, Landnutzung, Partizipation, PRA Methoden, Bauern, Lebensunterhalt

Table of Content

1 Introduction

This thesis is about the assessment of participation in land use planning for watershed management planning in Dagana degraded watershed. The human settlements are scattered throughout the watershed areas, and there is a need for watershed management. Watershed management planning fundamentally consists of identifying problems and potential improvements related to conservation, rehabilitation and sustainable use of natural resources within the perimeters of a geographically interdependent area. The watershed management would help to maintain and improve water resources and watershed conditions, and therefore, contributing to sustainable livelihood through the provision of watershed services like irrigation water as well as drinking water for human and animal population. Since local communities and other stakeholders should be involved in watershed management, it is important to develop appropriate methods and assess the effectiveness of the methods in bringing active participation of stakeholders, the identification of locally relevant problems and locally adequate solutions to them. The findings of the study shall help to recommend Royal government of Bhutan to adopt the Participatory Rural Appraisal (PRA) methods while carrying out participatory approach in watershed management planning in Bhutan in the future. The thesis reviews international best practices in participatory approaches in watershed management, derives a methodological approach to be tested in Bhutan, and practically tests this approach in one selected watershed. The results of the thesis are conclusions and recommendations on the suitability and applicability of certain PRA methods in the context of Bhutan. The results of participatory watershed planning are illustrated by the information obtained from the test watershed. Results are finally discussed in the light of local experiences and the internationally available literature and recommendations are provided for the future use of the approaches in Bhutan.

Bhutan has a population of 745,153 (NSB 2014) and almost 69 percent of the total population resides in rural areas, depending on subsistence agriculture for their livelihood (Dorji 2008; Kusters and Wangdi 2013). 12 percent of rural population is below national poverty line as per the Bhutan Poverty Assessment Report 2014 (NSB 2014). Agriculture and animal husbandry is an important sector for the Bhutanese economy, providing occupation and livelihood to 79 percent of population (Sangay and Vernes 2008). Paddy farming and dry land agriculture are the main farming systems practiced in Bhutan and farming is largely subsistence-oriented, relying on traditional knowledge with relatively low intensity of external input (Dorji 2008). 7.8 percent of the country's area is arable land, of which 17.7 percent is irrigated paddy, 62.2

percent is used for dry land agriculture, 5.9 percent for orchards and the rest constitutes dry land farming with periodic fallows and kitchen gardens (ibid). The farmers depend on nearby forests for non-wood forests products, fire wood, and livestock grazing in untended pasture and open forests (Sangay and Vernes 2008). Non-Wood Forest Products form a major source of off-farm income for people residing in the rural areas of the country (SFD 2008)

As shown above, Bhutan is mostly an agrarian and subsistence economy and a large share of the population critically depend on natural resources such as forests, streams and meadows for their livelihood (Rahut et al.). The melting of glaciers and changing patterns of rainfall due to global warming are expected to have serious impacts on the agricultural production of Bhutan and with the 70 percent of rural population depending on relatively small portions of arable land for livelihood, climate change will have direct impact on the majority of the population (Kusters and Wangdi 2013).

In Bhutan, being a mountainous country with steep slopes and rugged terrain, some forms of land degradation pose threats to limited resources of productive land (Norbu 2003). Forest fires, exploitation of forest resources, overgrazing, unsustainable agriculture practices, lack of proper irrigation systems, development of infrastructure without proper environmental measures, mining, industrial development and urbanization are the main causes of land degradation in Bhutan (Ministry of Agriculture and Forests 2014). In addition, climatic variations are also recognized as one of the major factors contributing to land degradation, which in turn contributes to a decline in the quantity and quality of fresh water supplies, a decrease in productivity of soil resulting in increased food insecurities, poverty and higher social costs (Aggarwal et al. 2010). It would be challenging to increase agriculture production and stimulate economic growth in rural areas having issues of depletion of natural resources, degrading environmental conditions, water related problems and soil erosion. Therefore, effective watershed planning can be undertaken to ensure well managed natural resources are available for sustainable regional development (Zhang et al. 2015).

1.1 Problem Statement

Bhutan is geographically divided into five major and two minor river basins, which are sub-divided into 186 watersheds, which are inhabited by people and where they practice agriculture for their livelihood. Punatshangchhu basin in western-central Bhutan is one of the largest and economically most important river basins in the country. According to the "Rapid Watershed Assessment" carried out by the Watershed Management Divison (WMD 2011), there are five

degraded watersheds within Punatshangchhu basin. The criteria like biophysical factors, climatic factors, demographic and socio-economic factors were considered for the classification of watersheds in Bhutan (WMD 2010).

The Buedulumchhu-Balaychhu-Zharingaychhu critical watershed is located in Dagana district and contains nine villages in three village blocks viz. Geserling, Kana and Goshi. The watershed is highly disturbed and degraded by anthropogenic activities, and needs immediate action to improve watershed conditions and services. The three blocks have the highest human population in Dagana district and the settlements are mostly scattered and primarily located along ridges and valley flanks. The farmers practice mixed farming by cultivating crops and rearing livestock. The watershed area has good forest cover and people living in the three blocks depend on timber, non-wood forest products, grazing areas and water resources for irrigation and drinking. Due to high population density, there is high pressure on natural resources and agriculture land. The consequences are visible in the form of landslides, soil erosion, and a shortage of water for irrigation and drinking purposes as well as diseases of citrus and cardamom. The shortage of water and land degradation may be aggravated by changes in the quantity and timing of rainfall due to climate change. This directly affects the livelihood of the people living in the watershed areas. To improve the watershed condition, a holistic watershed management plan shall be developed which is currently not available for the area. Among three components of the watershed plan, this study will focus on the topic of participatory land use planning. The process of watershed planning is interactive by definition and involves local farmers and other relevant stakeholders (WMD 2015). The participation of local farmers was made convenient by using PRA methods which were used in the other parts of the world for land use planning. Since there is limited literature on the assessment of specific PRA methods, this study will also focus on the assessment of selected PRA methods.

1.2 Research Objectives

This study, firstly, aims at developing and accessing the methodology for participatory land use planning by applying the methodology to land use planning for Dagana degraded watershed areas. Secondly, the study focuses on how others have used participatory rural appraisal methods in participatory land use planning in other parts of the world. Finally, the effectiveness of selected PRA methods in terms of providing sufficient space and motivation for people to get involved, as well as avoiding exclusion and discrimination, is assessed. The outcomes of participatory land use planning that is documentation of land use types, land use problems and local interventions, shall contribute to overall watershed planning, which is being carried out

by Watershed Management Division office in Bhutan. The results of the assessment of participatory rural appraisal methods shall help to provide recommendations to the Royal Government of Bhutan to adapt selected PRA methods in the further watershed planning processes in other parts of the country.

More concretely, the specific objectives of this study are as follows:

1. Development of a methodology for participatory land use planning
2. Application of the methodology to one concrete test watershed and documentation of results
3. To assess the effectiveness of PRA methods by assessing the participation of individual participants during the PRA exercises.

The overall goal of the study is to develop a participatory methodology for land use planning in Bhutan.

2 State of the Art

This part of thesis deals with the review of literature related to land use planning. The first chapter highlights the problem of land degradation and its impact on livelihood. The second chapter refers to various approaches to counter and reverse land degradation. The approaches like sustainable land management and watershed planning as sustainable land management are discussed. Finally, this chapter deals with participation in land use planning followed by a review of participatory land use planning processes around the world.

2.1 Land degradation and its impact on livelihood

Land degradation is considered as a main environmental problem which causes depletion of soil organic carbon and nitrogen stock resulting in direct adverse effects on fertility, productivity and overall quality of soil (Dlamini et al. 2014). The land degradation problem is prevalent in many parts of the world and it affects the natural resources like soil, water, natural vegetation and wildlife.

Human activities like burning of fossil fuels and change of land use patterns are changing the concentration of greenhouse gases and aerosol in the earth's atmosphere. This results in changes in temperature and the patterns of precipitation, causing a rising sea level, and in an increase of the number of extreme events (WMO 2005). According to the IPCC (2013), the global mean surface temperature of land and ocean combined has increased by 0.85 [0.65 to 1.06] °C from 1880 to 2012. Since 1950 changes in extreme weather and climate events have been observed and globally the number of cold days and nights are expected to decrease while the number of warmer days and nights is assumed to increase. In the major parts of Europe, Asia and Australia, the occurrence of heat wave events are likely to increase (IPCC 2013). The climate warming in the Himalayan region is greater than three times the global average. This further causes regional climate shifts which will potentially trigger large scale ecosystem changes ('landscape trap')(Xu and Grumbine 2014). Climate change is expected to affect the well-being of 20 percent of the human population living in the Himalayan region which is also a biodiversity hotspot, the source of important rivers of Asia and home to many sacred landscapes (Shrestha et al. 2012). The rising temperature and the retreat of glaciers and snow in the Himalaya is affecting the availability of water, of biodiversity and may result in a boundary shift of ecosystems and will hence also affect the agricultural production throughout Asia (Xu et al. 2009). The occurrence of erratic rainfall, unpredictable start of the monsoon season, the retreat of glaciers, increasing frequency of storms, landslides and drought are some of the impacts of climate change observed in mountain regions (Marston 2008). Asian

countries, including Bhutan, are going to experience various climate change related threats due to their unique geographical location and climate, growing industrial activities and the low per capita income (Sovacool et al. 2012).

Also land degradation might be aggravated by climate change due to changes in temperature, changes in rainfall pattern, in the solar radiation and in the frequency of storm events. Several climate models suggested that in future the soil water will be reduced due to global warming in semi-arid regions of North America and Asia. This would further aggravate problems of land degradation (Sivakumar and Ndiang'Ui 2007). Climate change is likely to increase the area of semi-arid landscapes (Yeo 1998).

Ecosystems are already put under many pressures by land use change, resource demands and increasing population. Climate change is putting additional pressure to ecosystems which threaten to destroy them resulting in a loss of goods and services which they provide. The increase in temperature will have influence on the quality of soils and on processes such as decomposition of organic matter, leaching of nutrients and on soil hydrology (WMO 2005). Soil erosion by water and wind is assumed to increase due to climate change in some regions, in particular due to heavy rainfall and high wind speeds (ibid).

The shift of cropland management towards more intense practices and the drastic changes in the use of land taking place at a global scale over the last decades, are considered main driving forces of land degradation (Foley et al. 2005). Karamesouti et al. (2015) also found out that the transformation in land use and land management practices have significant impact on soil erosion and land desertification risk. The mechanization and intensification also led to a higher sensitivity to land degradation (ibid). In many places in South-East Asia and tropical regions, the combination of globalization of food trade, local urban pressure on the country side, migration of people, land tenure insecurity, the opportunities offered by new forest roads and the displacement of people due to hydropower development and plantation establishment is leading to land degradation that are further influenced by climate change and environmental hazards (Douglas 2006). In the study by Jaquet et al. (2015) in the hills of Kaski district in Nepal, the author found that the increase in population in downstream due to migration, led to more intense land use, reduction of vegetation cover, soil fertility decline, and encroachment on land close to riverbeds. Land degradation can be caused by both natural elements and activities of humans. Natural conditions like fragile geological structure, occurrence of forest fires, landslides, avalanches and human activities like indiscriminate deforestation, overgrazing of forests by livestock, unsustainable farming in steep slopes, construction activities and

uncontrolled use of chemical fertilizers are the major factors contributing to land degradation in mountainous regions (Karkee 2004). According to Cleaver and Schreiber (1994) factors commonly responsible for inducing land degradation are poverty and economic pressure, high growth rates of population, uncertainty of land tenure, bad management of soil and water resources, a lack of improvement in agricultural practices, destruction of forest, shifting cultivation and overgrazing by livestock (Cleaver and Schreiber 1994).

Bhutan faces a scarcity of productive land, owing to its topography and elevation. Steep slopes have put the limited land resources under pressure by various forms of land degradation (Norbu 2003). Land degradation is recognized as a serious threat in Bhutan and the respective concerns are reflected in policies and review documents of the Royal Government of Bhutan (Norbu, 2003).

In recent years, land degradation has been among the greatest challenges faced worldwide (Karkee 2004). It has become a critical issue in the world, especially in many developing countries, resulting in concerns regarding livelihood and food security (Li et al. 2014). The capacity of the land to provide ecosystem services is effectively reduced by affecting different biophysical systems and subsystems by land degradation which causes a wide range of effects on the livelihoods of people who are dependent on natural resources (Reed et al. 2015). Over 250 million people are directly affected by land degradation according to the United Nations Convention to Combat Desertification (UNCCD) and additional about one billion people in over one hundred countries are at risk. Land degradation is responsible for deterioration in the quantity and quality of freshwater supplies, and soil productivity contributing to greater food insecurities, increased poverty and higher social costs (Aggarwal et al. 2010). Land degradation can affect the livelihoods as a result of an effectively permanent reduction of the ability of the land to provide ecosystem services like provisioning, supporting, regulating and cultural services (Reed et al. 2015). About 2 billion hectares of the world's agricultural fields, pasture and forests are affected by land degradation (Al-Dousari et al. 2000).The loss of productivity of land due to global land degradation in dry land is estimated at US$ 13-28 billion per year (Scherr and Yadav 1996). A study carried out by Lorent et al. (2008) in Northern Greece found out that cultivator households in the region with no or very little biophysical degradation earned higher profits as compared to cultivators in a region with low or moderate biophysical degradation (Lorent et al. 2008). Land degradation in a Mediterranean-like ecosystem resulted in decreased productive capacity of agriculture and natural systems, and is an important cause of income loss to rural populations (Salvati and Carlucci 2013). The study conducted by Reed et al. (2015) in Kalahari rangelands in southwest Botswana also concluded that the land

degradation can undermine livelihood as result of effectively permanent reduction in provision of ecosystem services from land.

2.2 Approaches to counter and reverse land degradation

The following approaches are widely applied successfully for reversing the impacts of land degradation and facilitating sustainable management of lands in other parts of the world.

2.2.1 Sustainable land management

The concept of sustainable land management emerged in the last few decades as the most important response to deal with land degradation problems worldwide. Sustainable land management takes into consideration technical, ecological as well as socio-cultural aspects (Schwilch et al. 2012). The use of natural resources in a sustainable way can be achieved if relevant land management technologies, regional planning, and policy frameworks complement each other in a purposeful way as defined by the concept of sustainable land management (Hurni 1997).

Sustainable land management is defined as "*a system of technologies and/or planning that aims to integrate ecological with socio-economic and political principles in the management of land for agricultural and other purposes to achieve intra- and intergenerational equity*" (Hurni 1996) and it has been gaining increasing attention in the field of development co-operation worldwide (Hurni 2000). Technologies, policies and specifically land use planning are three development components of sustainable land management and should be target oriented, client oriented, process oriented and interdisciplinary (Hurni 1997). A multi-actor perspective participatory approach is seen to be central to sustainable land management and technologies should meet five pillars of sustainability; they should be ecologically protective, socially acceptable, economically productive, economically viable and effective in reducing risk (Hurni 2000). Other established approaches of sustainable land management include soil and water conservation, conservation agriculture, natural resource management, and integrated ecosystem management (Motavalli et al. 2013).

The detailed analysis of existing resources and an understanding of development characteristics, like resource needs and damages caused by development, is required for sustainable land use planning, in order to identify uses of natural resources that will not prejudice future development (Senes and Toccolini 1998). The activities for sustainable land management must be developed depending on the availability of natural resources and when the environment is capable of absorbing the impact of development (ibid).

A study carried out by Wickama et al. (2014) found out that implemented soil conservation measures as part of sustainable land management were effective in reducing soil degradation and also increased the productivity of crops (Wickama et al. 2014).

2.2.2 Watershed planning as sustainable land management

Watershed management is seen as a means to accomplish disparate objectives and this has resulted in multiple ideas of watershed approaches (German et al. 2007). Watershed management is seen as means of scaling out technologies for soil and water conservation or more generally protecting the environment. For the water resource sector and policy makers water shed management is viewed as a means for enhancing environmental services and public goods originating form upper watersheds for the whole society. Among conservationists, it is seen as a framework for enabling trans-boundary natural resource management in which concerns regarding livelihood are often addressed only to the extent that they further help to achieve conservation goals. However, watershed management is seen among social scientists and others as a framework for enhancing collective action and equity in natural resource access and governance, and as a means to address problems related to livelihood that cannot be addressed at the level of farm or household (ibid).

In recent years there has been common agreement that integrated planning and management is an effective way to control land degradation and to ensure sustainability of agriculture and rural communities (Qi and Altinakar 2011). Most of the watershed management studies focuses either on inter-temporal elements or on spatial dynamics but never on both aspects and therefore the knowledge based on spatial and temporal dynamics within watershed facilitates to take informed decisions for management and planning (Zhao and Fletcher 2011). One of the options is watershed management which enables integration of knowledge and views of social and natural sciences into planning, policy and decision making, and an important element of integrated watershed management approach is land use planning (Qi and Altinakar 2011). Land use planning, as part of watershed management, can be used for countering land degradation and achieving food security (Hessel et al. 2009). Land use planning is multi-objective resource management as it deals with human activities within the watershed that are often motivated by contradictory objectives and constraints like enhancement of farm income, protection of soil and water, supply of drinking water and urban development (Prato et al. 1995). Land use planning can affect social and economic development in the region besides influencing the environmental processes like soil and stream bed erosion, sediments and nutrient concentration in streams, surface and ground water quality in a watershed (Qi and

Altinakar 2011). The effective involvement of stakeholders in developing and implementing plans can enhance the success of watershed plans. Failure to involve watershed stakeholders may impede implementation of watershed plans (Bosch et al. 2012).

2.2.3 Participatory land use planning

Participatory land-use planning (PLUP) is essentially land-use planning carried out with active involvement of the affected community in a bottom up approach. PLUP is assumed to asses and come out with the best possible uses of land resources like soil, water and plants to enhance the livelihood of communities (Darabant 2013).

Several studies on participatory processes have been carried in this regard, on various issues of land use planning, such as soil fertility management and natural resource management. The role of participatory approaches for the success of research and development projects in land management and conservation is recognized worldwide (Hoang Fagerström et al. 2003). Hence, participatory land use planning has become a widely used approach to combat or reverse land degradation across the globe (Hessel et al. 2009) and also to find out best possible solution for alternative land uses which would contribute to a balanced socio-economic development by empowering communities (Darabant 2013).

Liu et al. (2008) carried out integrated water resource management activities in highly degraded watersheds in the semi-arid Amhara region of Ethiopia by involving local communities. They found out that due to bottom up participatory approaches the community organization was able to manage watershed development themselves and that the early involvement of local farmers contributed to the success of the project (ibid). Further, in a study by Stringer et al. (2009) in Romania, the research suggested the importance of participation of local stakeholders in efforts to combat desertification, to conserve biodiversity and to mitigate the effects of climate change. Hessel et al. (2009) carried out participatory land use planning in combination with GIS in the eastern region of Burkino Faso to find out land use problems, their causes, effects and possible interventions. They found out that local communities are well aware about the causes of land degradation, that they took some measures for mitigation, and that they had concrete ideas of alternative land use options (ibid). The use of maps has led to discussions between local communities and other stakeholders at the regional level about land use problems and alternative land use options (ibid.). This study pointed out that an improvement of the participatory methods is still possible and would further increase their usefulness. A similar approach was used by Fagerstrom et al. (2003) for integrated participatory conservation planning in a small catchment in Loess, China with the aim to define suitable alternatives for

sustainable land uses and it was concluded that a participatory approach involved interactive learning processes between farmers and professionals and has led to active participation. According to research carried out by Chaturvedi et al. (2015) in a tribal area in India, the participatory land use planning has brought significant improvement in the productivity of land due to the introduction of scientific interventions which resulted in economic development (Chaturvedi et al. 2015)

2.3 Participation

The past decades has seen more shifts in the rhetoric of rural development than in its practices. These shift include the popular reversals from top-down to bottom-up approaches, from centralized standardization to local diversity, and from blueprint approaches to learning processes (Chambers 1994). The changes begun in mode of learning, and this includes change from old practices of extractive survey questionnaires to new approaches and methods for participatory appraisal and analysis in which most of the activities carried out by outsiders instead of being carried out by local rural or urban people themselves (ibid). According to Verhagen (1980), participation is defined as a special form of interaction and communication which implies the sharing of powers and responsibilities with researcher and development workers. *"Participation is normally described as the active involvement of target groups in the planning, implementation and control programs and projects and not merely their passive acquiescence in performing predetermined tasks, not merely their exploitation in order to reduce the labour cost. Participation should thus guarantee that the beneficiaries' own interests are taken into account. This is meant to enhance the likelihood that programs and projects will prove effective in meeting felt development needs and that participants share equitably in all benefits"* (Bagdi and Kurothe 2014).

The use of participatory methods in social sciences as well as in the field of sustainable development and natural resources management has become popular since the 1970ies (Bell, Morse, & Shah, 2012). The views of local communities with regards to sustainable development are increasingly given importance not only from the point of human rights but also as a way of making interventions more effective (ibid). Participation is assumed to help taking well-informed and justified decisions, which are easier to implement than traditional "top down" decisions (Saarikoski et al. 2010).

Several authors have used different terms to describe different degrees and kinds of participation. Arnstein (1969) described eighth different types of participation in her eight rungs of the "ladder" of citizen participation viz. citizen control, delegated power, partnership,

placation, consultation, informing, therapy and manipulation where citizen control occupies top of the ladder and therapy and manipulation grouped under the category of "non-participation" are placed at the bottom. Arnstein differentiated between citizen power and tokenism (ibid.). Citizen power includes citizen control, delegated power and partnership, and tokenism includes consultation, informing and placation. The bottom rungs of the ladders, i.e. manipulation and therapy, are used by some to substitute genuine participation. Their real objective is to enable power holders to "educate" or "cure" participants. The rungs 3) informing and 4) consultation, progress to the level of "tokenism" where participant are allowed to hear and have voice but cannot ensure that their views are heeded by powerful. The higher level of tokenism is rung 5) placation, where ground rules allow have-nots to advise but rights to decide remain with power holders. The top portion of the ladder show the level of citizen power with increasing degree of power in decision making. The rung 6) partnership helps citizen to negotiate with traditional power holders. At the top most rungs 7) delegated power and 8) citizen control the have-nots citizen retain full decision-making power (Arnstein 1969). In Jules Pretty's (1995) typology of participation, participation ranges from "bad" forms of participation to "better" ones. Participation with no real power such as manipulative and passive participation which occur after decisions have been already taken is seen as a "bad form" of participation. The "better" forms of participation include participation by consultation and for material incentives. Three more 'better' forms of participation described by Pretty (1995) include functional participation where people participate to meet the predetermined objectives of a project, interactive participation where people take control of local decisions and decide how available resources are used, and self-mobilization where people participate by taking the initiative to change a system without the influence of external institutions.

The typologies differentiate kinds of participation but do not talk about the kinds of participants taking part in community development projects. However, the question of whom to exclude and include from participation is an important one, because of the call for empowering the poor plays a central role in the development rhetoric (Cornwall 2008).

Farrington and Bebbington (1993) proposed a way to assess forms of participation according to depth and breadth. In this normative reading, participatory processes must involve a wide range of participants in all stages of given activities, from identification of problems to decision making (Cornwall 2008). Deep and wide participatory processes are assumed ideal in theory but in reality this ideal is virtually impossible to achieve. Therefore, it is appropriate to think of optimum levels of participation which put emphasis on a balance between depth and inclusion rights for the purpose at hand (ibid).

Participatory process can lead to the exclusion of particular groups unless specific efforts are made to include them. The identification of predetermined categories of stakeholders, whose views represent others of their kind, is one way of inclusion used frequently. It is important to create space for dialogue through invitation but it is anyway not sufficient for ensuring effective participation (ibid). Participation depends on several factors like how people take up and make use of what is offered, and supportive processes which can help to build capacity, nurture voice and help to empower themselves (Perkins 2011). Further, the participation depends on people who have time and energy to participate, so it is more or less class-biased and favours dominant cultures or ethnicities. The language used in meetings, the timing of meetings, the provision of facilities like childcare, meals, transportation, stipends and other factors, can strongly influence who participates and who is excluded (Perkins 2011). There is an assumption by those who initiate participatory processes that getting mechanisms and methodologies right brings full participation. But there may be many reasons for non-participation (Cornwall 2008). People may simply not take part due to timing and duration of activities, which may coincide with their daily works like feeding and putting children to bed, the nature of their work, where people have to go outside community and return at night to eat and sleep (ibid). Another reason for non-participation may be that participants do not belong to the cultural background in which participatory events are associated with or activities are not familiar to them. In recent times, 'participation fatigue' is reported to lead to more active exclusion because people were consulted many times without any good result (ibid).

The intention of participatory approaches is to treat people as central to development by involving them in interventions that affect them and over which they had limited control before (Bill Cooke 2001). And the broad aim of the participatory development is to enhance the involvement of people who are socially and economically marginalized in decision-making over their lives (Guijt and Shah 1998). The participatory approaches can be flexible and continuously developed further, whenever problems related to their application arise. Such approaches can help people to take collective decisions which would be more risky when taken individually (ibid). The participatory intervention can lead to effects that were never envisaged in the beginning (Cornwall 2008). Some forms of public consultation can also serve as a forum to express grievances, which would become difficult for people in power to ignore (ibid).

2.3.1 Participatory approaches in Bhutan

With the strong traditional institutions in place to utilize and manage forests, before modern development started in 1961, people had free access to forest resources from which most of

their basic necessities came. Due to the concern of depleting forests in some parts of the country and about its long term sustainability, the government slowly replaced the traditional customary laws and institutions by modern legislation. This restricted the people's rights to use the forests and these restrictions led to problems of illegal harvesting, poaching and encroachments. As a result, the government changed its policy and decided to involve local communities into forest management. Therefore, the government adopted a participatory forest policy to involve communities in forest management (Penjore and Rapten 2004). Since the nationalization of forest in 1969 the Bhutanese policy makers and foresters came to realize that participation of local communities is key to conservation and sustainable management of forest resources (Chhetri et al. 2009). There has been shift towards a more decentralized and people-centred approach to forestry following the Royal Decree in 1979, which states that people's participation is key to the conservation and utilization of forest resources, and also the concept of social forestry emerged in Bhutan since then (ibid). The forest policy of 1991 and the Forest Act of 1995 (Royal Government of Bhutan 1995), emphasized the need to have traditional forestry institutions and to engage local communities in forest management, thereby retracting to the shortcomings of centralized approaches of forest management as promoted by previous forest polices and Acts (Nurse and Malla 2006). Further, the responsibility for managing natural resources has been passed on to the communities and local institutions with the ratification of the District Development Committee and the Block Development Committee governance Act (Gurung et al. 2006). In line with the Forest Act of 1995, the Forests and Nature Conservation Rules framed in 2003, (revised in 2006 and 2012) include specific chapter on social and community forestry programmes (Chhetri et al. 2009) that shall facilitate the implementation of participatory forest management (Nurse and Malla 2006).

Besides practicing participatory approaches in the management of community forests, non-wood forest products, the public were also involved in sustainable land management, watershed management, and in agriculture research in Bhutan. Participatory approaches were used in several studies (Tshering Gyeltshen 2013; Dawa Lakpa Sherpa 2014; Yeshey 2014).

2.3.2 Methods applied in participatory land use planning

This chapter reviews the various PRA methods used in land use planning exercise in other parts of the world. Hoang Fagerström et al. (2003) used transect walks, pair wise ranking, problem and solution flows, village maps and trend lines, for integrated conservation planning in the Danangou in China. They also successfully used 3-models constructed from stone, water, soil, leaves and crushed chalk, for group discussions. The authors could get their required

information by using these PRA methods but didn't mention any feedback regarding the PRA methods they employed. Hessel et al. (2009) tested GIS based participatory land use planning in a village in the eastern Burkina Faso. They found out that the GIS application added value in the participatory process as stakeholders proved able to work with maps. The maps also facilitated discussions between community members, researchers and government representatives during land use planning process (ibid.). They also used other participatory methods like a pair-wise ranking matrix and sensitization of communities. The pair-wise ranking matrix was used for analysing conflicts between land use options but has not proven suitable in this case. Hoang Fagerström et al. (2003) used a participatory approach for problem definition, planning and implementation of watershed management in the highlands of eastern Africa. Individual interviews and focus group discussion were also utilized for problem definition (ibid.). The individual interviews were reported as more advantageous for understanding how views differ within groups while focus group discussions were found to bring good interaction and debate over elicited responses (ibid.). In a study by Chaturvedi et al. (2015) carried out in three villages in Deori Talukaa, India, methods like transect walks, night meetings and village resource mapping were used for creating awareness about the project and to collect primary data for participatory land use planning. Here the authors used the PRA methods to extract information from local communities. Participatory resource mapping, historical timelines, semi-structured interviews and transect walks were also used by Kalibo and Medley (2007) in a study to investigate how participatory research methods can be used to validate ethno-ecological knowledge on the distribution of forest resources as an important first step towards adaptive collaborative management at Mt. Kasgau in Kenya. In this case people tried to draw village resource maps on the open ground by using sticks, stones, twigs and soil but strong winds prevented them from completing the maps. Hence, they ended up with drawing maps on paper. Anyway, the methods helped the authors to gain the viewpoints of local communities as well as to cross check the opinions provided by men and women. In a study by Fagerström et al. (2003), transect walks, semi-structured interviews, a pair-wise ranking, village timelines and many other methods were used for integrated conservation planning. The authors concluded that the participatory approaches were suitable for involving farmers as research partners and resulted in highly effective participation processes in terms of involvement of farmers in whole conservation planning process. As per the Participatory Land Use Planning hand book by NAFRI (2012), 3-D models have several advantages: they enhances the level of participation, villagers can readily recognize the topographic features and add information to the model, and villager can easily build 3-D

models from inexpensive materials. Overall the use of 3-D models proved to be user friendly and a comparatively accurate research, planning and management means (DENRS 2000).

3 Materials and methods

3.1 Site description

Three streams viz. Baleygangchhu, Buedulumchhu and Zharingaychhu of Dagachu watershed have been identified as degraded watersheds during the Rapid Watershed Assessment carried out by the Watershed Management Division. The Dagana degraded watershed shown in Figure 1 covers an area of 6421.73 ha in Kana, Goshi and Gaserling blocks of the Dagana district (WMD 2015). The whole area consists of nine villages viz. Tashithang and Phunsumgang of Geserling block, Lower Goshi, Middle Goshi, Upper Goshi, Balaygaon and Dogag of Goshi block, and Khagochen and Pungzhi village of Kana blocks (ibid). The altitude of the watershed ranges from 500m to 2475m above the mean sea level. Slope varies from 0% to 189%. The watershed area has different land use types: paddy fields (4.16%), dry land (10.46 %), bare areas (0.46 %), degraded areas (0.30 %), broadleaved forests (75.99%), meadows (2.06 %), citrus orchards (3.47%), rock outcrop (0.03 %), shrub (2.88 %) and water (0.20 %) (MoAF 2011).

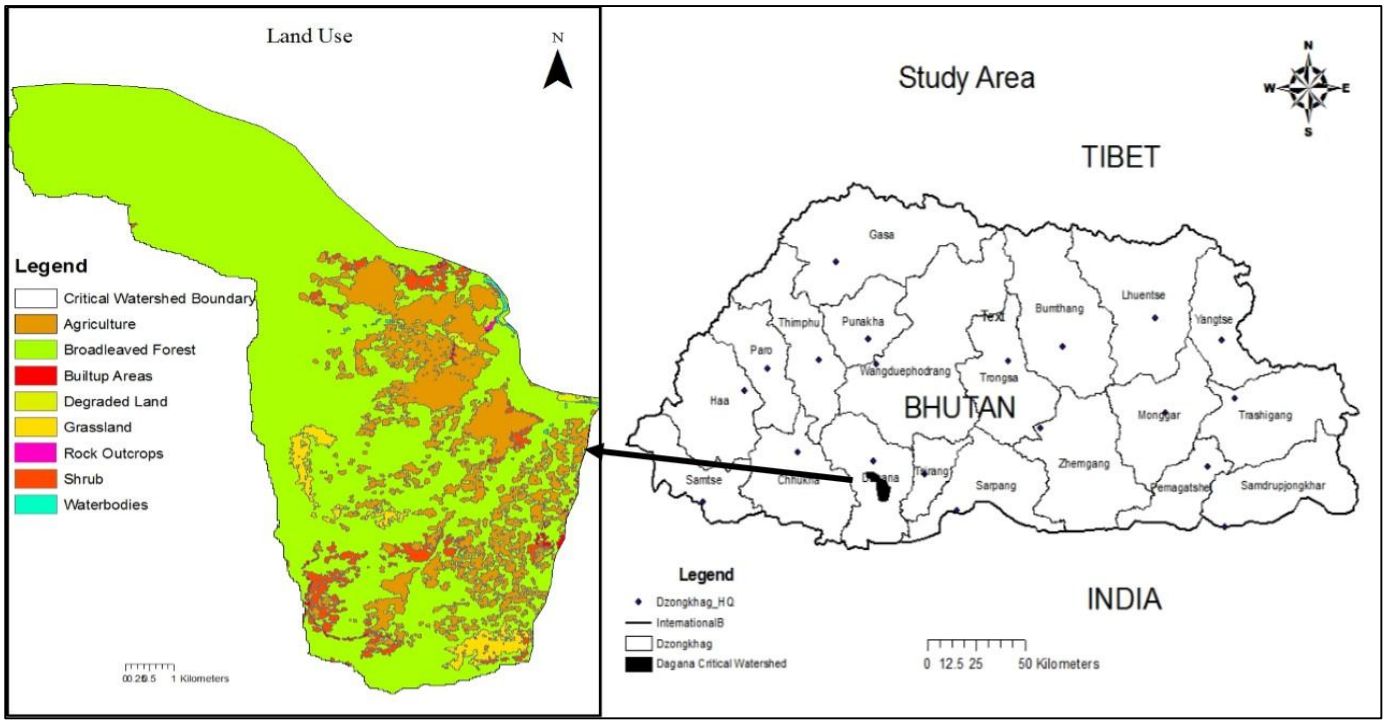

Figure 1: Map of Dagana Degraded Watershed (Source: National Land commission secretariat, 2014)

3.1.1 Climate

The degraded watershed is situated from the low to mid elevation mountain ranges of the country and ranges from the warm to cool temperate climatic zone. The area receives relatively higher total annual rainfall compared to the temperate zone. The monsoon season in the area begins by about June and lasts till September. The maximum mean precipitation is observed during these months. In Dagana Dzong station, which is 1460 m above mean sea level, the total mean precipitation observed was 2019.1 mm and 1765.5 mm at Drujaygang station situated at 1140m above mean sea level (DoFPS 2015). The highest mean temperature (20.7 ^{o}C) was recorded in July and minimum mean temperature recorded was 9.3^{o}C in January at Dagana. Likewise, in Drujaygang the highest temperature (24.2 ^{o}C) was recorded in July and a minimum of 12.7 ^{o}C was recorded in January (WMD 2015).

3.1.2 Flora and Fauna

The watershed area comprises of three main forest types viz. warm temperate broadleaf forest, cool-temperate broadleaf forest and sub-tropical forest. The various forest types with the dominant tree species are listed in Table 1. Invasive species like *Ageratina adenophora*, *Mikania micrantha and Chromolaena odorata* are commonly found in the watershed. The watershed is also home to some wild animals like sambar, deer, wild boar, assamese macaque, barking deer, porcupines, squirrels and bears. These animals, primarily macaques and boars are reported to damage crops in the villages. The greater hornbill are commonly found in the watershed (DoFPS 2015).

Table 1: Forest types with dominant species

Forest type	Altitude (m.a.s.l.)	Dominant tree species	
Cool-temperate Broadleaved forests	>2000	• *Acer campbellii* • *Symplocos ramosissima* • *Beilschmiedia* sp. • *Castanopsis tribuloides* • *Castanopsis hystrix* • *Lithocarpus elegans* • *Casearia glomerata*	• *Lindera pulcherrima* • *Lyonia ovalifolia* • *Persea clarkeana* • *Rhododendron grande* • *Symplocos lucia* • *Terpena* sp.
Warm-temperate Broadleaved forests	1000 – 2000	• *Schima wallichii* • *Alnus nepalensis* • *Beilschimiedia sp.* • *Alseodaphne sp.* • *Casearia glomerata* • *Cinnamomum bejolgotha* • *Dalbergia sericea* • *Engelhardia spicata* • *Terminalia myriocarpa*	• *Eurya acuminate* • *Ficus auriculata* • *Macaranga indica* • *Macaranga pustulata* • *Michelia cathcartii* • *Ostodes paniculata* • *Quercus glauca* • *Toona ciliata* • *Phoebe sp*
Sub-tropical forests	<1000	• *Schima wallichii* • *Rhus succedanea* • *Ostodes paniculata* • *Grewia* sp.	• *Albizia gambelii* • *Ficus semicordata* • *Bombax ceiba* • *Alangium chinense*

(Source: Jigme Tenzin, 2015, page 43).

3.1.3 Selected social and economic aspects

The nine villages within the watershed area have a total population of 6788 living in 555 households (Block office, 2015). The settlements are mostly scattered and primarily located along ridges and valley flanks (Figure 2) and the people practice mixed farming that is cultivating agriculture crops as well as rearing of livestock like pig, cattle, goats etc. to support their livelihood. Cardamom and oranges are widely grown by the farmers and are the major sources of income for the people living within the watershed. They also depend on forest for timber, non-wood forest products, grazing area and water for irrigation and drinking purposes. The agriculture crops like maize and paddy are main crops cultivated besides growing

buckwheat, millet and barley in small quantities. Dagana district is one of the least developed districts in Bhutan (NSB 2014).

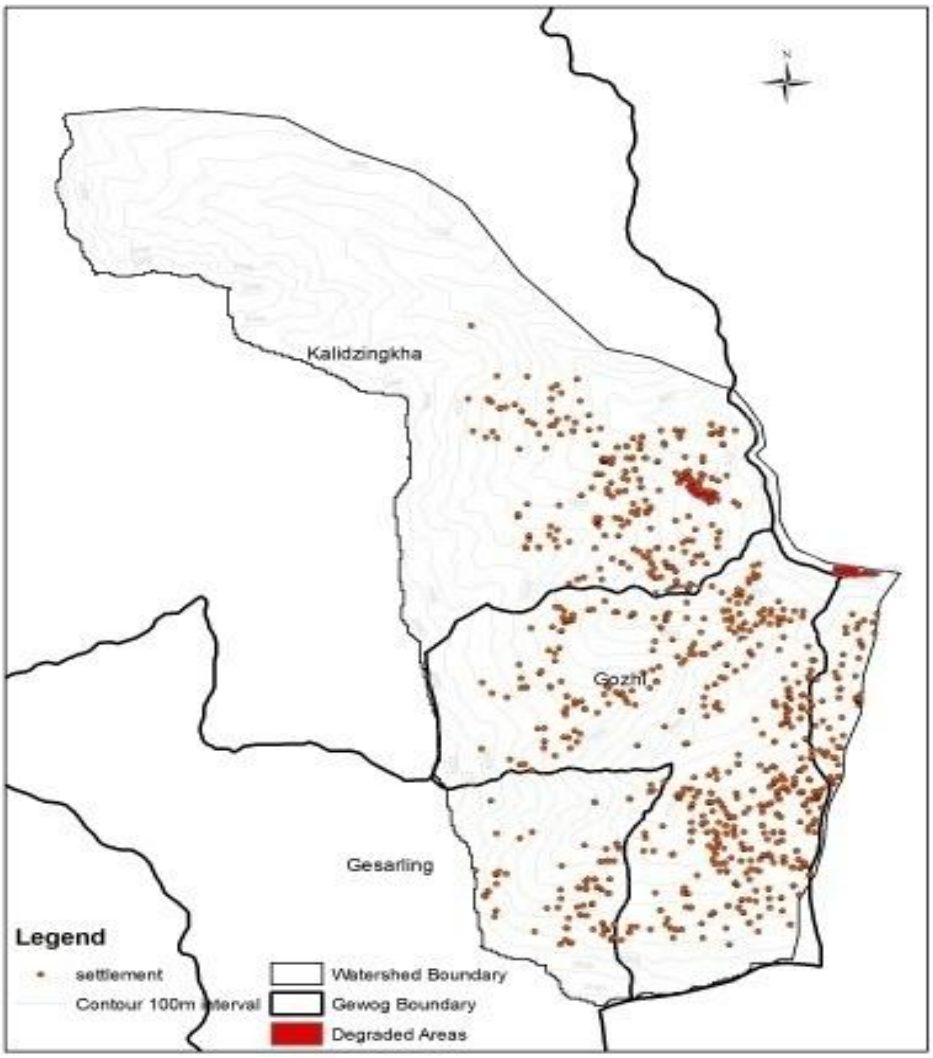

Figure 2**:** Settlements in the degraded watershed of Dagana (Source: Watershed Management Division, 2015).

3.2 Methods

Two methods were used for collecting information for this study. The background information about the Dagana degraded watershed was collected from secondary sources and information from the local farmers was collected by selected PRA methods.

3.2.1 Collection of background information

Before going to the field for land use planning exercises, background information related to the watershed was collected from the following sources:

- The information regarding population, households and geographical information was collected from the district forest office
- The contour map showing the degraded watershed areas was collected from GIS section of National Land Commission Secretariat.
- Socio-economic information was provided by Renewable Natural Resources statistics (NSB 2014).
- Rainfall data of Dagana degraded watershed was provided by the Hydromet Division of the Ministry of Economic Affairs, Bhutan.

The following participatory appraisal methods were applied in the field for participatory land use planning: A total of 57 participants from nine villages in the Dagana degraded watershed participated in the exercises and the total of five sets of exercises were conducted in two to three villages combined. These five sets of indoor exercises were carried out in groups using PRA methods (participatory land use identification and land use ranking, identification of land use problems and interventions, preparation of action plan, preparation of village timelines and resource mapping).Transact walks and semi-structured interviews of randomly selected people and filling up of questionnaires by participants were carried out after the completion of indoor exercises.

3.2.2 Nomination of participants for the PRA exercises

The participants for the rural appraisal exercises were nominated by local village leaders. The local leaders were requested to selected participants based on the following set of criteria: gender, income, education back ground, responsibility in the community, and farmers owning different land use types. This approach was taken since time was limited to carry out the socio-economic surveys.

A total of nine groups with numbers of participants ranging from 3 to 15 participated in the PRA exercises for land use planning. From one village only three participants attended the exercise although the leaders were request to nominate at least 8. We were told that many participants were unable to participate because most people of the lower Goshi were engaged in agriculture works at the time of field research. The groups' members were selected in such a way that there were representatives from all possible socio-economic levels according to the criteria listed above, including gender, income, literacy levels, local leadership and people owing different land use types. The nomination of participants was cross checked with the forestry extension officials who are employed in the villages by the Royal Government of

Bhutan. These officials are well aware of the villages' population and deal closely with local communities in forestry related extension services. The nominated participants were fairly fulfilling most of the criteria set for forming focus groups.

Participatory exercise in degraded watershed

The Dagana degraded watershed area is a large area consisting of nine villages. Since the settlements are spread over a large area, the four different sets of land use planning exercises were carried out in different occasion as shown in table 1. The whole set of participatory exercises was carried out four times covering a total of nine villages. The nine villages were divided into four groups according to the proximity to each other. This allowed active participation of relatively large proportions of the population, the identification of problems and fine tuning of interventions on a small scale. In addition, the venue being in the vicinity of their villages shortened the distance to walk, thereby allowing farmers to participate in the whole set of exercises.

Table 2: Time table for PRA exercises

No.	Participatory exercise	Khagochen and Pungzhi	Balaygaon and Dogag	Phunsumgang and Tashithang	Lower, Upper and Middle Goshi
1. 2. 3. 4.	Drawing of team contract Land use identification and land use ranking Identification of land use problems and interventions Preparation of action plan	14/08/2014	17/08/2014	20/08/2014	23/08/2014
5. 6	Preparation of village timeline Resource mapping	15/08/2014	18/08/2014	21/08/2014	24/08/2014
7 8.	Transect walk Semi-structure interview	16/08/2014	19/08/2014	22/08/2014	25/08/2014

The construction of 3-D models of Dagana degraded watershed areas was carried out by 17 participants from nine villages. The construction was started from 11/08/2014 to 13/08/2014.

3.2.3 Introduction to the process

The participants were made aware of the situation in the area in which they are residing in terms of land degradation and water related issues and informed about how land use planning might benefit them. The introduction was generally focussed on the process to be followed throughout exercise. The PRA exercise and its objectives for participatory land use planning were explained to participants. The representatives from the watershed management division office, the local district forest office (Photo 1) and I carried out the sensitization of participants.

Photo 1: Representative from WMD explaining the watershed to participants from Pungzhi and Khagochen

3.2.4 Drawing of team contracts

The participants were asked to write down "Do's and Don'ts" to be followed throughout the land use planning activities. This was done to enable them to participate smoothly throughout the participatory exercises and to avoid unwanted behaviour like talking on phone, disturbing other members during group works, turning to meeting late and gossiping. For example, as shown in the photo 2 below, the group agreed to maintain their attendance from 9:00 AM till 4:00 PM and to keep their cell phones switched off while carrying out group discussion and other group work.

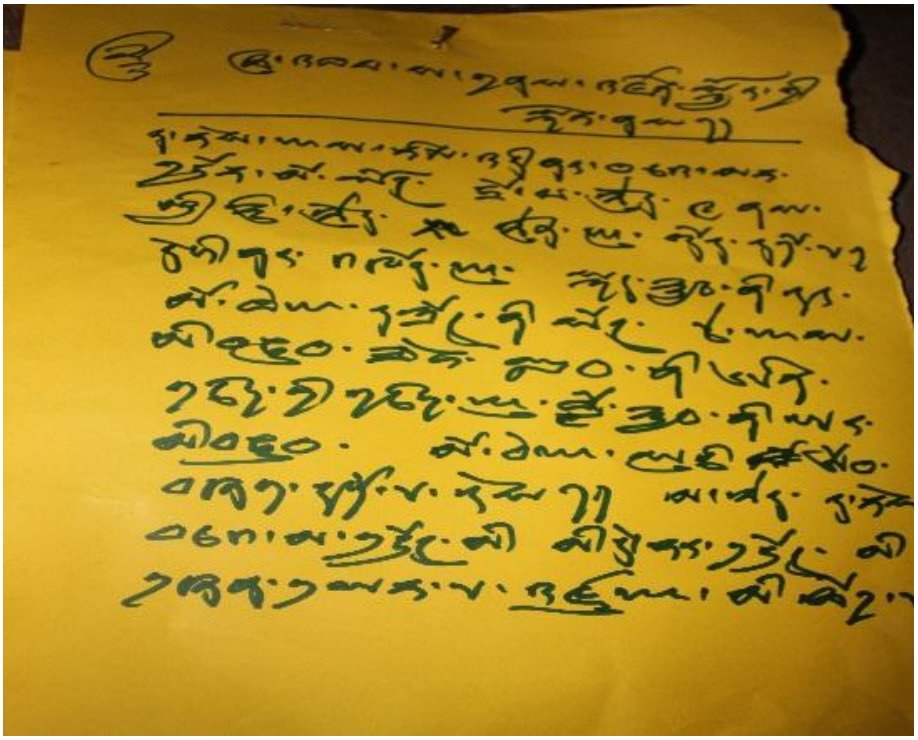

Photo 2: Team contract drawn by participants

3.2.5 Identification of land use types and pair wise ranking

The participants were divided into groups. Participants coming from the same village were made to form one group. After the groups were formed, the exercises to identify land use types and the ranking of land use types in accordance to the importance to their livelihoods were explained by facilitators. Each group was provided with a chart paper and marker pens to list down land use types, and to do the ranking of land use types. The identification of land use types was carried out by using a matrix (FAO 2006), and ranking was carried out using a pair-wise ranking matrix (National Environment Secretariat 1991). Firstly, the land use types were listed down in the matrix (see the example shown in Table 3).

Table 3: Land use types as listed by participants in Pungzhi village

No.	Land use	Commodities
1.	Cardamom	Cardamom
2.	Orange	Orange
3.	Dry land	Maize, millet, lentil, mustard plant, Chillies, orange, cabbage, onion, radish, pear, peach, mango, jack fruit, papaya, pomegranate, broom.
4.	Paddy field	Potatoes, paddy
5.	Community Forest	Firewood, fern, mushroom, timber
6.	Government reserved forest	Timber, grazing, fodder harvesting
7.	Pasture	grazing

After the completion of identifying land use types, their ranking was carried out with the help of a pair-wise ranking matrix (National Environment Secretariat 1991). The ranking of land use types was carried out based on the perceived importance to the livelihood of the farmers residing within the respective watershed area. The result of such a pair-wise ranking is shown in photo 3.

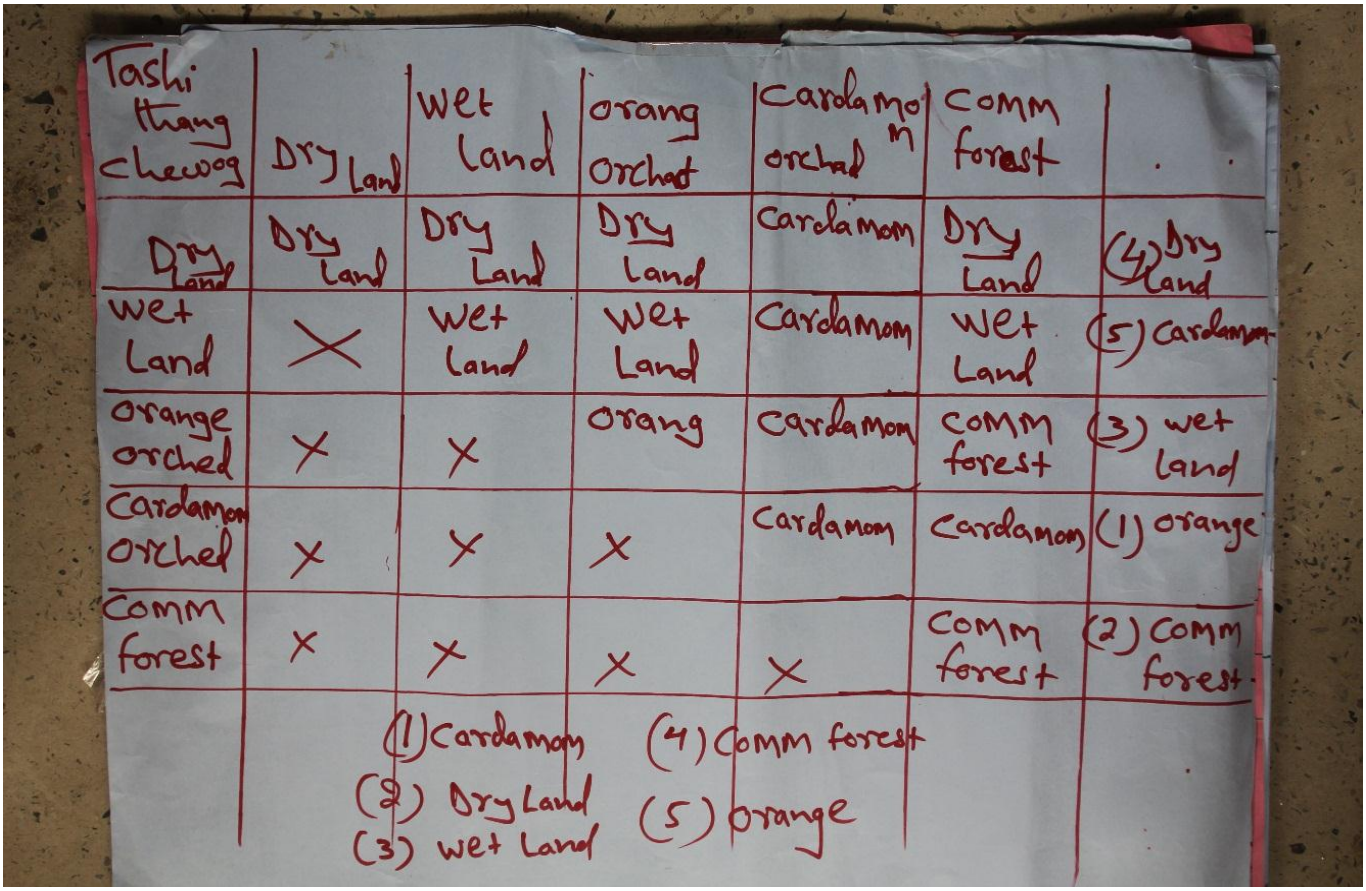

Photo 3: A pair-wise ranking of land use type

3.2.6 Identification of land use problems and promising interventions

The groups were assigned to identify land use problems associated with water, forests and soil. The group members discussed elaborately and listed down the various land use problems on the chart paper. After the land use problems were listed down, the groups discussed various interventions for solving the land use problems they faced in their respective villages. The opportunity matrix (FAO 2006) was used for this exercise. Results are shown in Table 4.

Table 4: Land use problems and proposed intervention as listed by participants of Dogag, in land use planning exercise.

No	Land use type	Problem	Solution	location
1	Cardamom	Water shortage Insect infestation Frost Depredation by wild boar and monkeys Low fertility	Sourcing water by using pipe Application of insecticide Fencing Use of fertilizer	Upper Dogag Dogag Dogag
2.	Paddy field	Water shortage Erosion Crop depredation by wild boar and monkeys	Use of pipe to source water Construction of wall and drain Fencing	Lower Dogag Dogag Dogag
3.	Dry land	Crop depredation by wild boar and monkey Erosion Low soil fertility	Fencing Proving proper drainage Use of fertilizer	Dogag
4.	Orange orchard	Insect infestation Crop depredation by money Low soil fertility Shortage of water	use of insecticide Electric fencing Use of fertilizer Use of pipe to source water	Lower Dogag Lower Dogag Lower Dogag
5.	Community forest	-shortage of firewood Drying of water source	Plantation	Dogag

3.2.7 Preparation of action plans

The groups were guided to plan detailed activities for implementation. This involved the identification of stakeholders for technical and administrative support, of the lead agency to initiate and coordinate the implementation of specific intervention activities, and the prioritization of activities. The participants listed the detailed activities for each identified intervention. The details of activities for each intervention and the implementation deadlines were discussed and noted. The lead agency and relevant stakeholders were identified and finally, the prioritization of activities for implementation was completed. An example result is shown in table 5.

Table 5: Action plan of Balaygaon village

Sl.No	Action	How to do	location	Lead agency	collaborator	Time	Priority
1.	Improvement of irrigation water supply	-Repair of irrigation channel -use of pipe -repair of water source tank	Balaygaon	Tshogpa	DAO, Public	Feb- March 2015	1
2.	Prevention of damages by wild animals	Electric fencing	-do-	-do-	Forestry officer , public	Jan-March 2015	2
3	Control of citrus disease	Spray of insecticide Replantation	-do-	Farmers	Agriculture extension	April-June 2015	3
4.	Control of cardamom disease	Replantation	-do-	Farmer	Agriculture extension	May 2015	4
6	Stabilization of land slide area	-plantation -land replacement -construction of terraces	Lower Balaygaon Balay khola Dungsungma Garigang	Farmers	Agriculture extension Geog administration	June 2015 June 2015	5
7	Improvement of community forest	Plantation	Balaygaon	Farmers	DzFO	June 2015	6

3.2.8 Preparation of village timelines

The participants were furthermore asked to prepare a village timeline of their respective village. Such a village timeline is a series of events of the past, listed down with approximate dates in chronological order as remembered by people (Chambers 1994). This was meant to help to see how things like agriculture, land use, population, crop patterns, natural resources etc. have changed over the time. The village timeline was prepared with regard to water resources, forest cover, agriculture practices, natural calamities, population changes, changes in income, and land use problems. This exercised was carried out to get past information about the village and how events have affected the village. The result of a sample village timeline is shown in the

Table 6.

Table 6: Village timeline of Lower Goshi village

Lower Goshi	1995-2000	2000-2005	2005-2010	2010-2014
Agriculture	Good production of oranges, paddy, maize, mustard plants	Orange production declined. However paddy and maize production was good	Oranges and paddy production declined	Orange production declined, started cultivating cardamom. Maize and paddy production declined
Water	No good supply of drinking water and irrigation water	Drinking water supply reached door steps and the supply of irrigation water improved due to water pipe	Insufficient water for drinking and irrigation as source started drying up	Started planting trees at the water source
Forest	Good forest and they collected mushroom and edible fern	Used to collect fodder and firewood	Trees were chopped down while installing power lines	Need to plant trees
Natural calamity		Storm blew away the roofs of houses	Earthquake	Earthquake damaged the houses
Population	700	725	775	809
Income	Good production but price was low	Had good production and got good price	Production and price declined	Production declined and price increased
Problem	Lacked water pipe	Crop depredation by wild animals		Insufficient drinking and irrigation water

3.2.9 Resource mapping

After completion of planning detailed activities for each intervention to address land use problems the participants were taken to a 3-D model of the watershed area. The 3-D model was constructed by participants before the start of actual participatory land use planning exercise at a scale of 1:10000. The participants marked the place on the 3-D model where intervention activities were needed to be carried out. Materials like different coloured threads and pins were used for marking the problem areas where intervention activities needed to be implemented. A sample of a 3-D model is shown in photo 4. Photo 5 shows the participants marking the exact location of proposed interventions with different coloured threads on the 3-D model.

Photo 4: 3-D model of Dagana degraded watershed

Photo 5: Participants marking the areas for implementation of intervention activities

3.2.10 Group work

All five sets of PRA exercises were carried out in groups. The participants from the same village were made to form groups. Hence, each village is represented by one group, in total there were nine groups representing nine villages within Dagana degraded watershed areas. I facilitated the groups in carrying out the PRA exercises sequentially. The groups were provided with enough time to discuss, debate among them and to write down the results of their group work. Photo 6 shows the participants working in groups.

Photo 6: Participants from Khagochen and Pungzhi working in groups

3.2.11 Participatory transect walks

The transect walks (Chambers 1994) were conducted in the study area. "Transect walk" is one of the PRA methods where people walk through an area, observing, listening, discussing, identifying land use problem areas, land use types, possible interventions etc. The information gathered through observation and discussion were noted down and photographed when appropriate (see e.g. the photos 7 and 8). Additional information obtained from the participants was also carefully noted. The transect trails were selected by the participants in such a way that they passed through different land use types, problem areas and areas where interventions were ask for. The participants were asked to select the transect trail as they were most familiar with the paths in their village as well as with the real geographical features of their area. This

avoided the risk of getting lost during the walk due to a lack of knowledge about paths and it made sure we passed through many perceived land use problems prevalent in the village. This method helped to validate the information provided during the delineation of land use types, challenges and interventions in the course of indoors exercises.

Photo 7: Landslide in Dogag village

Photo 8: A woman participant pointing at habitat of monkey in Dogag village

3.2.12 Compilation and presentation of results

The results of all groups work were compiled and presented to the rest of the participants by one of the participants. Discussions took place whenever required. The result of the group work was compiled by the participants themselves in a given format. The person to present the group work was selected by the group members after reaching common agreement in the discussions. Presentations were provided to inform the participants of other groups as well as facilitators about the progress of group work, and to encourage further discussions on various issues related to land use types, if it is necessary.

Photo 7: A woman participant presenting results of her group works

3.2.13 Semi-structured interviews

Semi-structured interviews were carried out while conducting the transect walks in the villages. Brief stops were made to carry the interviews due to lack of time. The interviewees were randomly selected from people who did not participate in the indoor participatory land use planning exercises. The permission to conduct interviews was sought from interviewees whenever we came across people while conducting transect walks. The interviewees were explained about the objectives and purpose of the exercise before proceeding with interviews.

In the beginning questions related to their general background were asked, followed by questions related to forest, water, soil and climate change.

The semi-structured interview was started by asking the questions about the following aspects without following any specific sequence to get a brief background of the interviewees.

a) Brief introduction about the interviewee and his family background
b) Which land use types do you own?
c) What is the main source of income for your family and what is your approximate annual income?
d) What are the land use problems related to water, soil and forest which you face?
e) What did you do to mitigate or solve the land use problems you faced?
f) What sorts of interventions are required in your opinion?

A digital voice recorder was used for recording interviews and the information was noted in an excel sheet later on. This method was applied to validate the information obtained during group discussions and to derive opinions of as many people as possible.

3.2.14 Evaluation of the participatory land use planning exercise

The evaluation of participatory land use planning was carried out to assess the effectiveness of PRA methods in terms of facilitating active participation of local communities, and to find out appropriate time for such exercises, so that such exercise can be better planned in the future. Since the availability of participants also depends on timing of the exercises, it would be important for whoever initiates a participatory process to make conditions favourable for farmers to participate. The participants were asked to answer the following questions:

a. Do you like the exercise?
b. Did you learn from the exercise?
c. Is the exercise easy to understand?
d. What do you think about the duration of the exercise?
e. How did you perceive the timing of the exercise?
f. Which season would be most appropriate to carry out the exercise?

3.2.15 External assessment of the level participation in the various exercises

Observations were made to evaluate the participation of each participant in each of PRA exercise. These observations were made without the knowledge of participants (non-participatory) by me as a facilitator whereby participation levels of individuals during group works in various stages of the PRA exercise was assessed. This was done to get the fair assessment of participation of individuals which otherwise participants tend to show that they

are participating when they feel that they are being observed. The following criteria or categories and symbols were used while making the observations and taking notes:

- P: Active participation
- O: Absent
- i: Not taking parting in discussions but observing attentively
- l: Inactive
- w: Attending to works other than participatory land use planning exercises.

The participation of individuals was assessed twice in each group exercise: First, briefly after the start and, second, towards the end of the focus group discussions. The assessment of the participation was later on recorded in an excel sheet.

3.2.16 Data analysis

The analysis of data collected from the field was carried out in a descriptive form in combination with GIS maps. The data on land use types, land use problems and participation were compiled in excel spread sheet. The GIS map, rainfall data of Dagana district of the years from 1996 to 2014, and population of nine villages were used in analysing the causes of land use problems. For PRA approaches, the participation of individuals in terms of gender, educational background and different PRA methods were carried out by assessing the number of people taking part in discussion.

4 Results

4.1 Implementation of Participatory Rural Appraisal methods

4.1.1 Drawing of team contract

The drawing of team contracts was carried out by participants themselves. The participants readily agreed to the idea of agreeing on do(s) and don't(s) as they wanted the exercises to run smoothly and complete on time. They generally found the process simple and understood the exercise easily. They completed discussion and noted down all rules on a chart paper within the allotted time. Although all participants followed the rules, which they had laid out in the team contracts, one woman from Lower Goshi was found less concerned and skipped the last two days of participatory exercises. The summary of team contracts is shown in Table 7.

Table 7: Summary of team contracts

No	Team contracts
1.	The session starts at 9:00AM and ends at 4:00PM in the evening.
2.	All participants must be punctual.
3.	Mobile phone are to be either kept in silent mode or completely switched off.
4.	Do not talk or gossip while the session is going on.
5.	Same person must attend all sessions.
6.	Sending of different person in middle of session is not allowed unless necessary.
7.	Avoid playing with mobile phones.
8.	All participants must be present from 9:00AM till 4:00 PM.

4.1.2 Identification and pair-wise ranking of land use types

The identification of land use types and a pair wise ranking exercise was followed after the completion of drawing the team contract. The exercise was carried out in groups and the participants found the exercise simple and easy to understand. Listing down of land use types was quickly done as it is straight forward. The participants were exposed to a pairwise ranking exercise for the first time but they understood the exercise without any difficulty. They felt that the procedure of a pair-wise ranking exercise was simple while carrying out the exercise themselves. There was free and frank interaction within members within groups and the exercise was completed within the given time. The participants felt the duration of the exercise appropriate.

4.1.3 Identification of land use problems, proposed interventions, and preparation of action plans

The participants were well aware of the land use problems they were facing and have applied traditional mitigation measures themselves, such which were within their means. They knew not only land use problems but also highlighted the cause of land use problems. They know very well about what kind of intervention is required to address their land use related problems and hence readily proposed several possible mitigation measures. It is interesting to point out that the participants were well informed about the latest prevention measures which were successfully implemented in other parts of the country. For instance, they knew about the use of electric fencing to prevent damages of crops by wild animals like elephants as applied in the southern part of the country.

With regards to the preparation of action plans, some participants could not get what to do in the beginning. However, they understood the procedure after another explanation. However, they came out with detailed activities to be implemented within given time and also knew which relevant stakeholders to contact during the implementation of the proposed activities. The also clearly referred to the respective agencies and communities and the roles and responsibilities to be carried out and taken. Overall, the participants were comfortable with the exercise. Both exercises kept the participants engaged and provided room for good discussions among the group members. The results of the groups' works was compiled in opportunity matrices which the participants could easily fill up.

4.1.4 Preparation of village timelines

The preparation of village timelines to see the changes in terms of population, water resources, income, agricultural practices, forest cover, incidents of natural calamities and land use problems, was perceived a rather tough to understand exercise. It took them more than the allotted time. The participants were mostly re-settlers coming to the area based on the resettlement programme initiated by Royal Government of Bhutan in the late 1990ies. The participants who resettled a decade ago and representatives of the young generation of native settlers didn't know the past history of their village, of course. Although the few old native settlers could remember some previous events they often failed to correctly recall the exact date of incidents. Accordingly, participants found this exercise a bit difficult as compared to all other exercises. For example, the Pungzhi village has no re-settlers but the village members still could not remember the date of events. In case of Balaygaon village the re-settlers were over represented and they didn't know the past history of their new village. The participants from Balaygaon village remarked

that the exercise was bit difficult to understand too. Participants from other villages understood the exercise but took a bit longer time as they could not clearly remember all events and dates of events. Some participants lost interest in this exercise and hence paid less attention after about halfway of the exercise.

4.1.5 Resource mapping with a 3-D model

The resource mapping exercise was carried out by using a 3-D model of the Dagana degraded watershed area. The construction of the 3-D model was tedious and time consuming. The construction of 3-D model of Dagana degraded watershed took almost three days attendance of 17 participants. A lot of materials were required for constructing the model but the materials required were easily available. The total cost of procurement of materials are much higher as compared to other simple maps but 3-D models give the detailed information of geographical features of the area and participants can pin point the exact location of problems and proposed measures.

The participants found resource mapping with the 3-D model interesting and they got a clear picture of the area. It made easier for them to mark the precise location with land use problems and guided them how to implement the planned activities in the field. Some participants said that the 3-D model is easy to understand by the illiterate person. The participants were observed taking part in intense discussion and negotiation among themselves during resource mapping which was completed by most of the groups in the given time. A group from Middle Goshi, Tashithang and Khagochen villages took longer time as participants were involved in negotiations with regards to the area for constructing an irrigation channel, the installation of a drinking water pump and it took much time to reach common agreement on these issues. However, the resource mapping with the help of the 3-D model never let down the participants and they found it very comfortable to work with.

4.1.6 Transect walks

The transect walk was the last exercise for the participants. The walks passed through the middle of villages and also led to specific locations where land use problems were perceived most severe. The transect walks helped to cross check the information on land use types and land use problems as provided by participants during group discussions. They also provided the participants the opportunity to show to the facilitators and other stakeholders (representatives of government agencies, donor agencies) the “real” problem areas and how they have applied traditional mitigation measures to deal with the land use problems. Transect walks also encouraged some participants to take more actively part in discussions on various

issues, participants who otherwise remained quite most of the time during the group discussions. Although most information was provided during the various exercise carried out in groups, the transect walks helped participants to come up with additional information. For instance, the participants from Dogag village mentioned the damages caused by wildlife during group discussion but never said anything regarding the survey carried out to count the number of monkeys in their village until we came across the monkeys during the transect walk. Since the choice to select a best transect trail was given to participants, they organized and coordinated well among themselves, and therefore, we could cover many problem areas. The participants felt very happy when the plan of transect walk was announced the day before the actual field visit as they felt that visiting their village is the best opportunity to convey the reality of their problems to government representatives and that this would put the village in better position for gaining financial and technical support.

4.1.7 Semi-structured Interviews

The interviewees were selected randomly during the visit to the villages. They were recorded in writing and with a digital voice recorder. The interviews lasted from minimum of half an hour to more than one hour, depending on the severity of land use problems faced by individual interviewees. The semi-structured interviews helped to get the views of individuals on the issues of land use problem and how they have tried to address the problems. In addition, individual interviews helped to extract information about specific problems faced by individuals. For example, issue of earthworms and crabs that cause a shortage of irrigation water was never mentioned duration the group discussions but two interviewees highlighted these issues. Hence, this method not only helped to validate the information provided during the group discussions but also provided additional information.

Some interviewees were reluctant to share information on their income but expressed their problems freely. While carrying out the semi-structured interviews one needs not to worry about whether an interviewee is literate or not. Since the interviewees were picked randomly without any prior information, either at their house or fields, it was sometimes hard to find interviews. Picking interviewees by chance, without prior communication runs the risk of ending up with interviewing less people than originally planned within a pre-defined time budget.

4.2 Participatory Land Use Planning Results

4.2.1 Land use type

Table 6 below shows the land use types and ranking in different villages. In total 10 different types of land use were identified. Cardamom orchard, orange orchard, dry land and paddy field were found to be the most important land use types in most of the villages. These land use types were direct sources for farmers' income and their livelihood directly depended on these land use types as evident from the result of land use ranking as well from people's opinion expressed during semi-structured interviews. The priority ranking attached to different land uses by each village and important land use types owned by the respondents of semi-structured interviews are shown Table 8 and Figure 3 respectively.

Table 8: Land use priority ranking

Land use/Village	Dogag	Balaygaon	Lower Goshi	Middle Goshi	Upper Goshi	Khagochen	Pungzhi	Tashithang	Phunsumgang
Cardamom orchard	+++	++	+++	+++	+++	+++	+++	+++	+++
Community forest	++	++	+	NA	NA	++	+	++	++
Drinking water source protection	NA	NA	NA	NA	NA	+++	NA	NA	NA
Dry land	+++	+++	++	+++	+++	+++	++	+++	++
Government reserved forest	NA	+	NA	NA	++	++	+	NA	NA
Orange orchard	++	+++	+++	+++		+++	+++	+	+++
Pasture	NA	NA	NA	NA	NA	+	+	NA	++
Private forest	NA	NA	NA	NA	NA	++	NA	NA	NA
Vegetable field	NA	NA	NA	NA	++	NA	NA	NA	+++
Paddy field	++	+++	++	+++	+++	+++	++	++	+++

Legend: +++……Very important, ++….important, +….least important, NA….land use not available

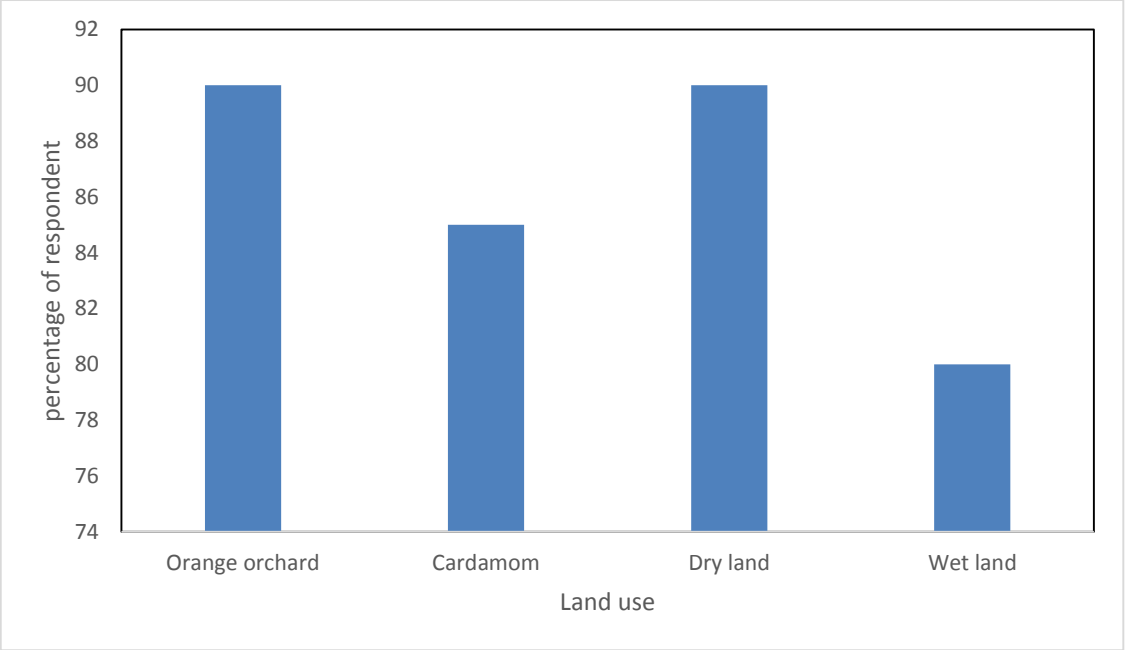

Figure 3: Important land use types owned by respondents

Figure 3 shows the important land uses owned by respondents of semi-structured interviews and it clearly supports the finding of important land use types identified in a focus group discussion. The paddy and maize were two most important cereal crops grown in wet land and dry land respectively besides growing other crops in small quantities. Cardamom and orange forms the major source of cash income for the people living in the watershed.

4.2.2 Land use related problems

Table 9 shows the land use related problems prevalent in the watershed. The most important problem faced by all farmers of the nine villages was a shortage of irrigation water followed by problems of insect and pest attacks on orange and cardamom as reported in eight and seven villages respectively. The problem of crop depredation by wild animals was prevalent in seven villages and insufficient drinking water was prevalent in 6 villages (Table 9). Water related problems, insect and pest diseases and crop depredation by wild animals were the major problems faced by most of the villages although other lands use problems also exists.

As stated above, a shortage of irrigation water was the most prominent land use problem highlighted by all nine villages. This was also stressed by farmers during personal interviews (Figure 5). Increasing population, deforestation, decreasing amount of rainfall due to climate change, damage of irrigation channels by landslides, a lack of resources to source water from

the stream and changes in land use are the reasons contributing to the shortage of irrigation water, as also reported by farmers during focal group discussions and individual interviews.

Table 9: Land use problems faced by villages

Sl. No	Land use problems	No. of villages
1	Insufficient drinking water	6
2	Shortage of irrigation water	9
3	Insect and pest attack on Cardamom	7
4	Insect and pest attack on orange	8
5	Crop depredation by wildlife	7
6	Landslide	4
7	Drinking water with debris	1
8	Damages to orange by wild animal	2
9	Low fertility of soil	4
10	Erosion	2
11	Deforestation	5
12	Shortage of saplings	2
13	Frost	3
14	Encroachment on pasture	1
15	Pest problem	2

The Figure 5 shows the various land use problems faced by the respondents of semi-structured interviewees. Most respondents reported a shortage of irrigation water, followed by crop depredation by wild animals, soil erosion, insect and pest disease, a shortage of drinking water, low soil fertility and landslide.

The farmers reported that they increasingly faced a shortage of irrigation water in recent years especially during paddy cultivation season that is in June, July and August. One of the main reasons mentioned by farmers was the untimely and decreasing quantity of rainfall. An analysis of rainfall data of Dagana district from 1996 to 2014 for the peak monsoon months also shows the respective trend (Figure 4).

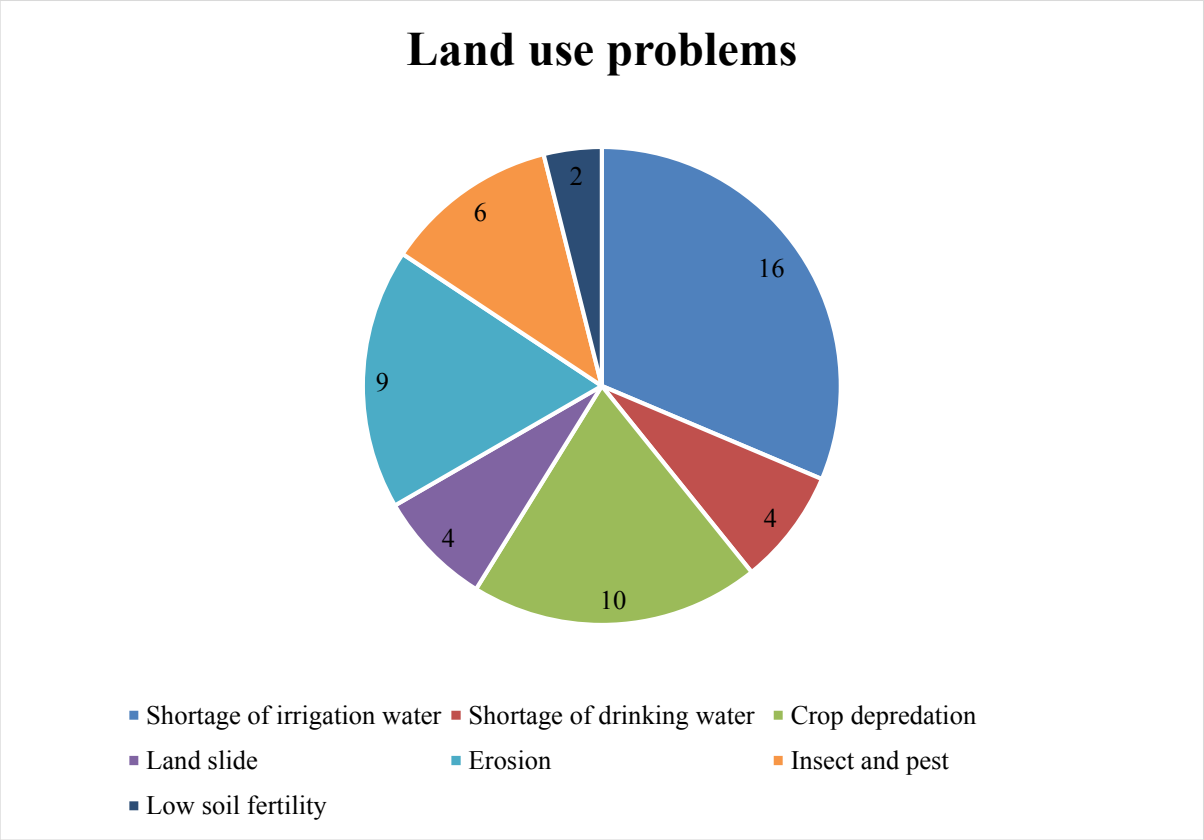

Figure 5: land use problems faced by respondents (number of respondents)

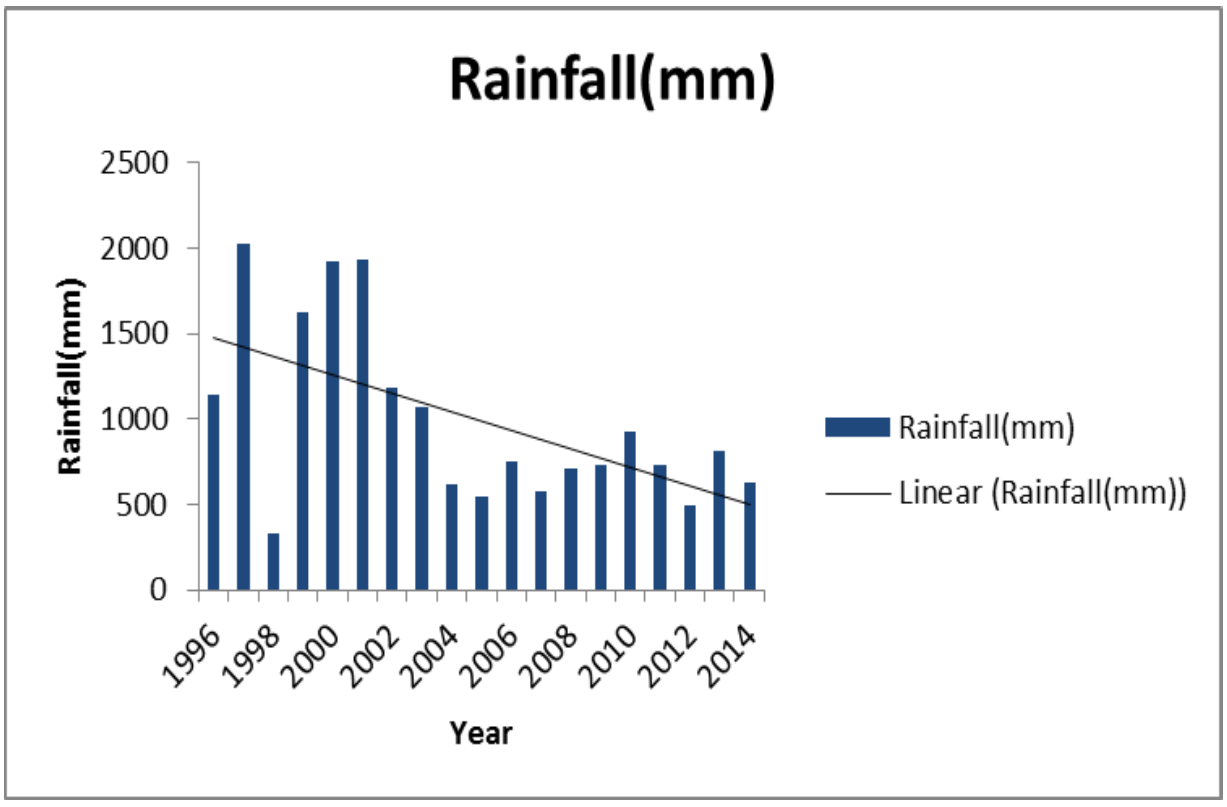

Figure 4: Total rainfall for peak monsoon months. (Source: Department of Hydromet Services, 2015).

4.2.3 Proposed solution to land use problems

The participants were asked to find out possible interventions for each land use problem they mentioned. They were well aware of land use problems and had a good knowledge on how to address the land use problems. They had several solutions in their mind and some of the mitigation measures were already tried locally. They could not implement all the potential solutions due to a lack of financial resources. However, they came out with solutions which are very practical and easy to implement. Table 10 shows the summary of solutions against each land use problem as proposed by participants during group discussions. The solutions to each land use problem were identified in each village but here only a summery is presented for illustration.

Table 10: Summary of proposed interventions by land use problems

No	Land use problems	Solutions proposed by farmers
1	Insufficient drinking water	• Pipe supply • Construction of tap stand • Installation of water pump • Protection of water source by fencing and plantation
2	Shortage of irrigation water	• Construction of new irrigation channel • Maintenance of old irrigation channel • Pipe supply and construction of water storage tank • Installation of water pump • Plantation at water source
3	Insect and pest attack on Cardamom	• Use of insecticide • Plantation of new seedlings • Use of improved variety
4	Insect and pest attack on orange	• Use of insecticide • Disease resistant variety
5	Crop depredation by wildlife	• Barbed wire fencing • Installation of electric fencing
6	Landslide	• Stabilization plantation • Construction of wall
7	Drinking water with debris	• Construction of distribution tank
8	Damages to orange by wild animal	• Electric fencing
9	Low fertility of soil	• Use of fertilizer • Use of organic manure
10	Erosion	• Hedge row plantation • Construction of proper drainage and terraces
11	Deforestation	• Establishment of community forest • Plantation • Plantation in space left by felled trees
12	Shortage of saplings	• Establishment of nursery
13	Frost	• Use of frost resistant variety
14	Encroachment on pasture	• Barbed wire fencing
15	Pest problem	• Use of pesticide

4.2.4 Length of irrigation channels and areas of paddy fields

Seven of nine villages have paddy fields which consume large quantities of irrigation water during the paddy plantation seasons. From the analysis of Figure 6 and Figure 7 it is found that the total length of irrigation channels per village corresponds to the areas of paddy field. However in case of middle Goshi, this is different which indicates that the water source might be quite far away from the fields. The Khagochen, Dogag, Balaygaon and middle Goshi has longer irrigation channels as compared to the other five villages.

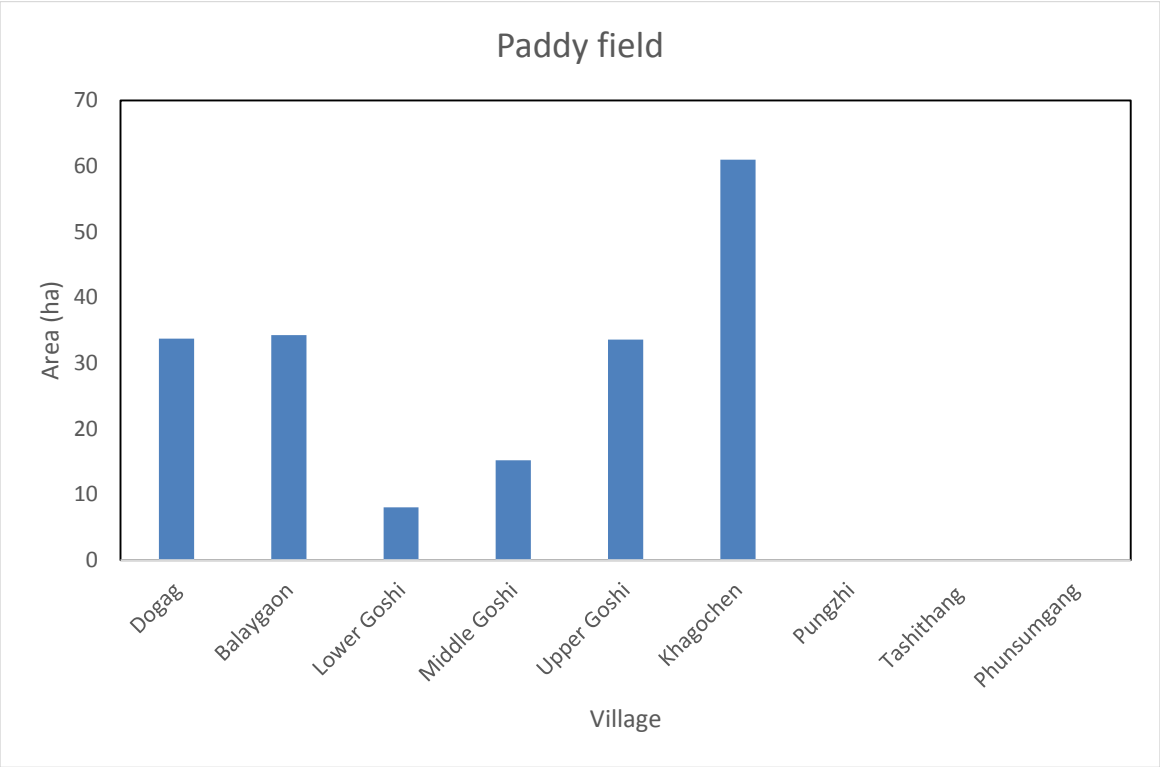

Figure 6: Areas of paddy fields

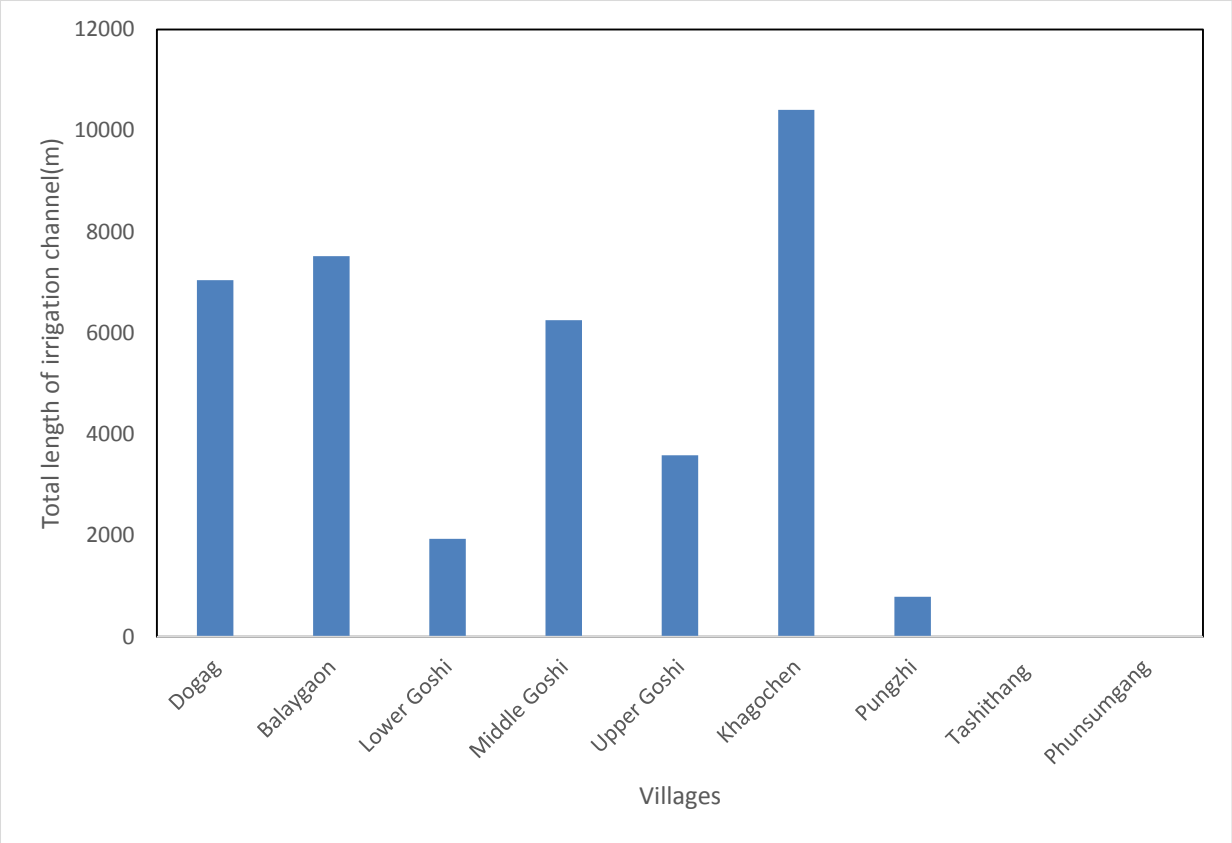

Figure 7 : The length of irrigation channels

4.2.5 Water availability and households

Figure 8 shows the number of households in the nine villages within Dagana degraded watershed areas. The shortage of drinking water was a priority problem for seven of the nine villages, i.e. for all villages except for Dogag and Balaygaon village. Reportedly, the main reason for the shortage in these villages was the lack of pipes to bring water from the source. The existing water supply was not sufficient due to the large number of households (Figure 8).

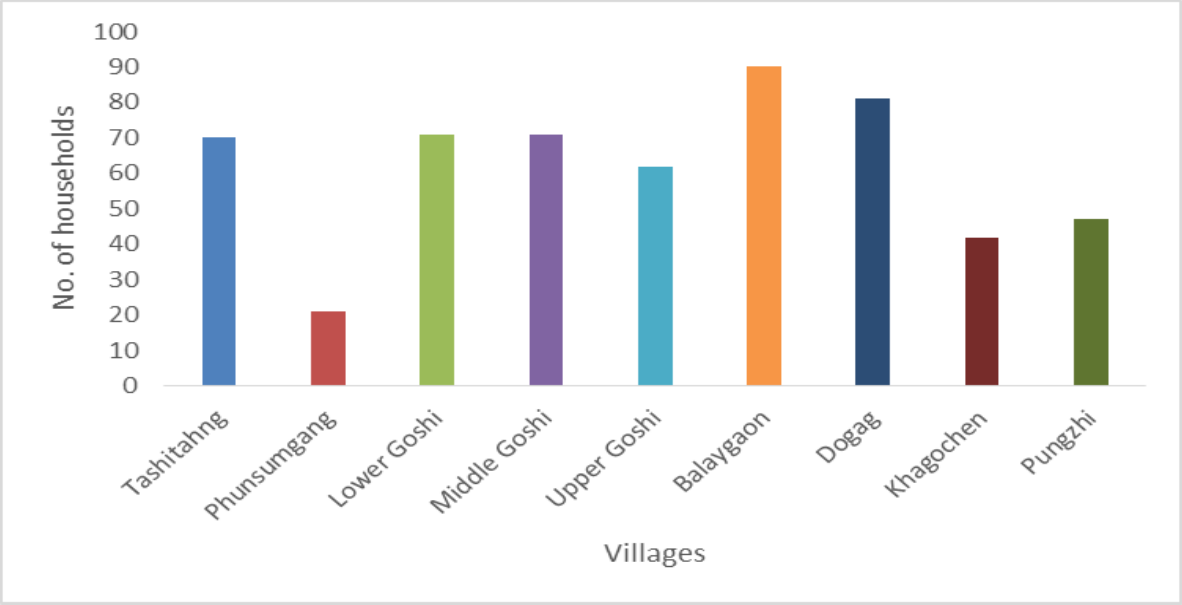

Figure 8: Number of household

4.2.6 Crop depredation by wild animals

The problem of crop depredation by wildlife was reported by seven villages (Lower Goshi, Upper Goshi, Pungzhi, Dogag, Balaygaon, Phunsumgang and Tashithang). Dogag village reported to have the most severe problem of crop depredation by wild animals. From the observation of the land use map as shown in Figure 10, all villages have comparable forest cover. Overall 67.5% of the total watershed area is under broad leaved forests (Figure 9). However, Middle Goshi and Khagochen villages were not affected by human-wildlife conflicts, largely due to their central location surrounded by other villages (Figure 10).

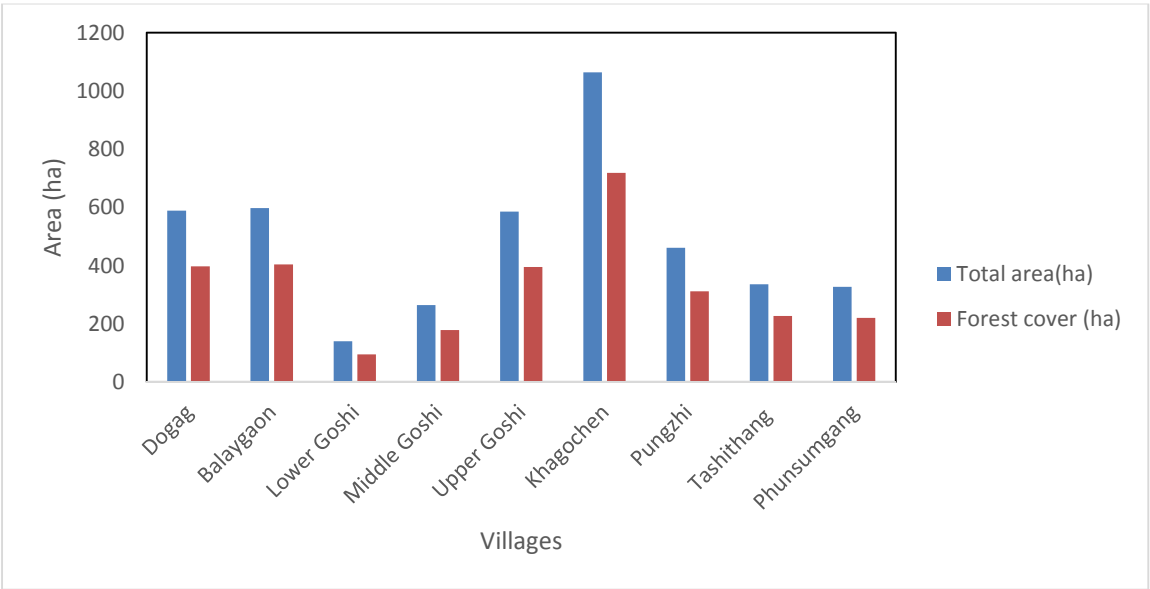

Figure 9: Total area and forest cover

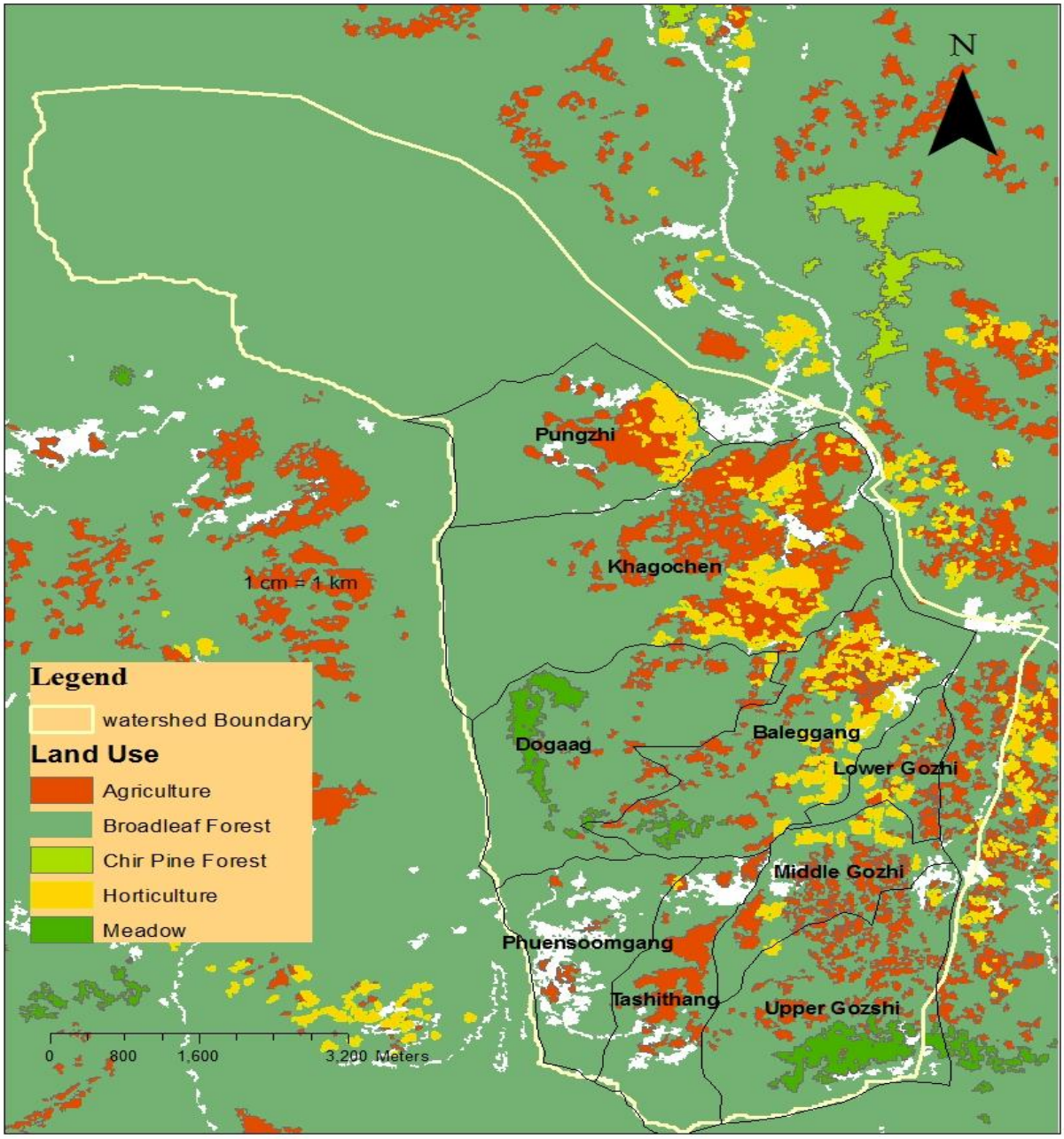

Figure 10: Land use map of Dagana degraded watershed (Source: National Land Commission Secretariat, 2014)

4.2.7 Water availability and land use

In all nine villages all four prominent land use types are practiced (Figure 3). These land use types require irrigation water in different seasons. The shortage of irrigation water was not solely linked to the availability of wetland as some village like Tashithang and Phunsumgang have no paddy fields (Figure 11). As figure 11 shows there is no wetland in Pungzhi. However, few acres of wetland were observed during the transect walk. Irrigation water was required for cardamom and orange orchard during winter months and for wetland. Irrigation water is also required during the paddy cultivation season that is from June to September.

Some villages, like upper Goshi and Phunsumgang, have started cultivating vegetables in dry land for commercial purposes which increased the need of irrigation water.

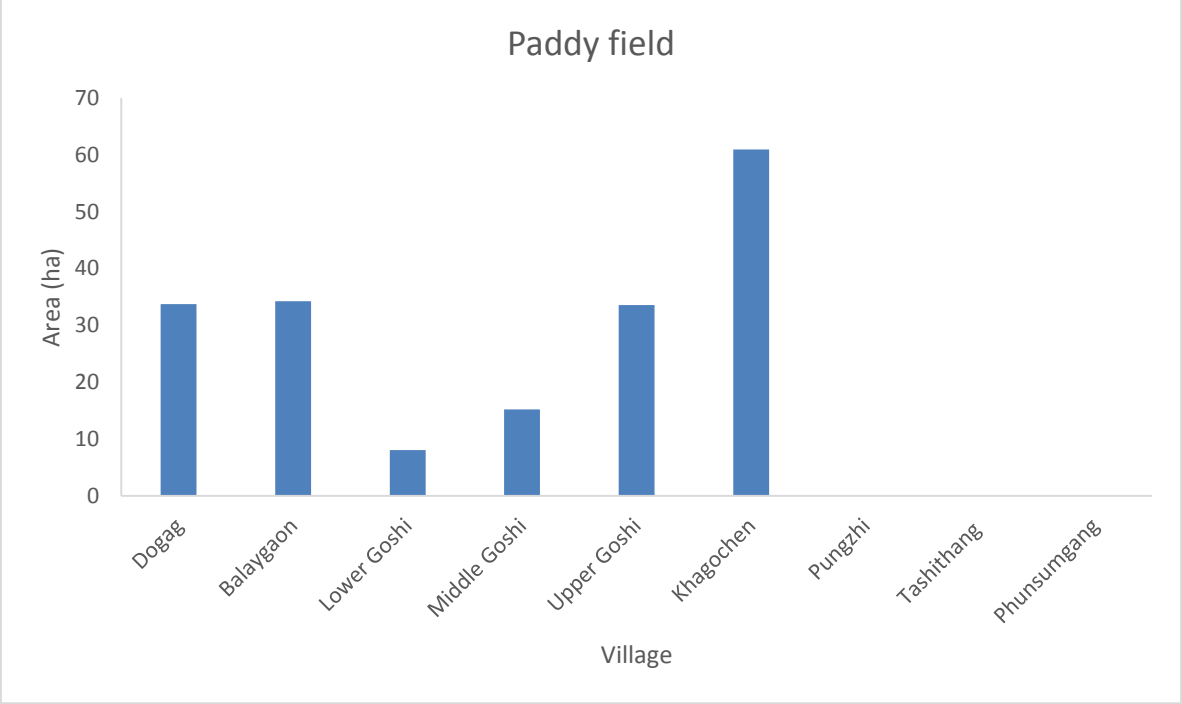

Figure 11: Area under paddy fields

4.2.8 Problem of Landslides and erosion

Problems with landslides and erosion were reported in Dogag, Balaygaon, Khagochen, Upper Goshi and Phunsumgang. Among these four villages, Balaygaon was affected most severely. Most of the landslides occurred along the Balaychhu. The occurrence of erosion was also reported in a few villages on land with steep slope, but the problem was not considered severe. The analysis of the area under steep slopes (i.e. more than 35 degrees) showed that these villages have more areas under steep slope. Balaygaon was affected most as it has the most land under steep slope (Figure 12).

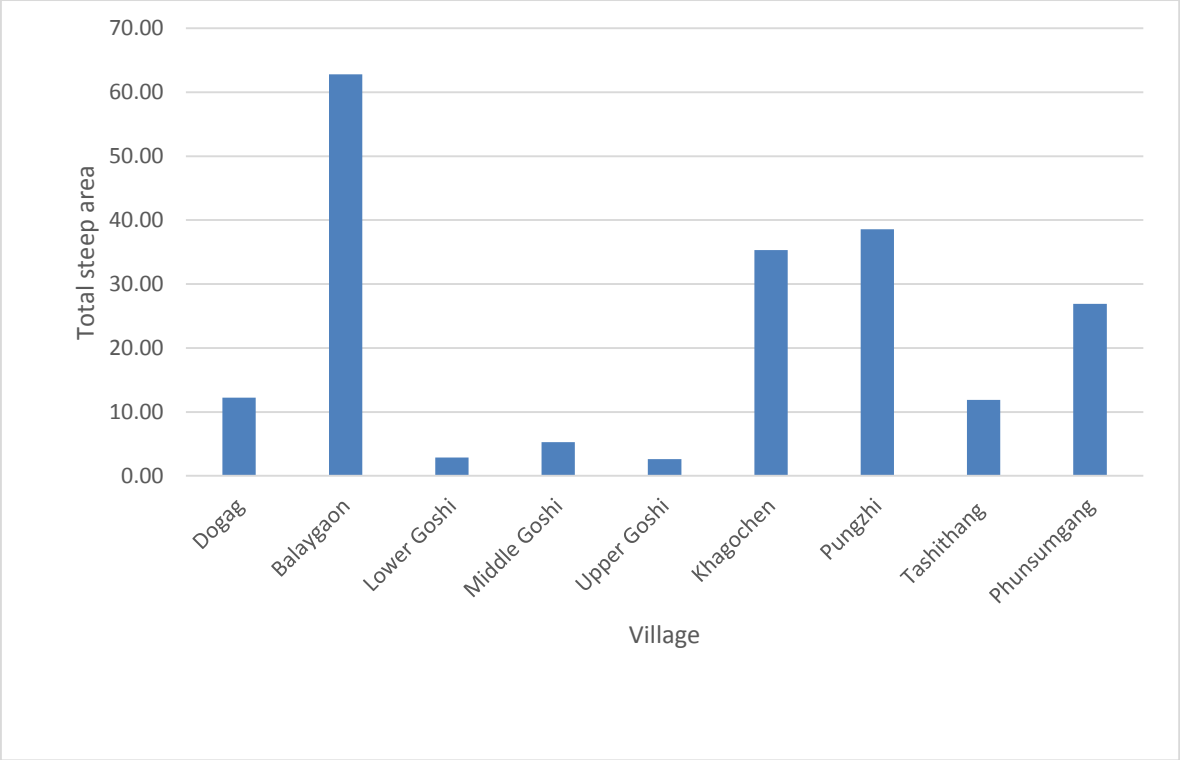

Figure 12: Steep areas per village (more than 35 degrees slope)

4.2.9 Summary result of the village timeline exercises

Table 11 shows the summary result of village timelines as prepared by participants from the nine villages. There was a change of agricultural practices, from subsistence to commercial purposes. All villages started growing some kinds of cash crops like cardamom, oranges, and vegetables for commercial purposes. There was a fluctuation of the yield of crops due to diseases. This subsequently affected the income of the farmers. The drinking water and irrigation water supply reached to villages but with commercial production of agriculture crops as well as cash crops farmers started facing shortages of drinking and irrigation water.

Forests were used for timber extraction, grazing, firewood production and other natural resources. The utilization of forests without proper management plans and developmental works in the area have contributed to a decrease in forest cover over the time. At the same time the human population has increased in eight villages (the population in Dogag village decreased). The incident of natural calamities like storms, earthquakes, hailstones damaged houses and crops. Landslides have not only washed away agricultural fields but also washed away irrigation channels which led to a shortage of irrigation water in the villages.

Table 11: Summary of the village timeline exercises

Village	Agriculture	Water	Forest	Population	Natural calamities	Income
Pungzhi	Changed from subsistence to commercial crops like vegetables, cardamom and oranges .	Got drinking water supply	Decreasing forest cover	Population increased from 26 to 46 households	A hail stone storm and an earthquake destroyed crops and houses	Cardamom, oranges have become source of cash income
Khagochen	Increased cultivation of paddy and oranges	Supply of irrigation and drinking water reached village	Plantation of seedlings carried out; establishment of community forest is under process	Population increased from 100 to 160 households	There were incidents of hail stone and landslides	Income has increased
Balaygaon	The oranges and cardamom production started declining due to diseases	Water source damaged	Started facing shortage of timber	Population decreased	Landslide damaged the road and irrigation channel	Income decreased
Dogag	Started cultivating cardamom, orange, maize and vegetables for commercial purposes	Started facing shortage of irrigation water	Forest exploited for timber and firewood	Population increased	There were incident of earthquake, landslide and hail stones	Started earning cash income
Phunsumgang	Production of agricultural crops fluctuated over time due to diseases	Plantation at water source carried out	Timber production decreased and pasture land increased	Population increased	Landslide, earthquake, hail stone and storm occurred	Income increased due to increase in cardamom production
Tashithang	Agricultural crop production decreased	The quantity of irrigation water decreased	Forest cover decreasing	Population increased	Hailstones damaged the potatoes	Income decreased due to decline of cardamom yield
Lower Goshi	Orange and paddy yield declined; started cultivating cardamom and paddy	Started facing shortage of drinking and irrigation water	Destruction of forest due to developmental works	Population increased from 700 to 809 people	Earthquake and storm damaged houses	Income from cardamom
Middle Goshi	Production of maize and rice declined	Good water supply	Exploited forest for timber	Population increased	Landslides, storm, earthquake and hail stones occurred	Income from employment
Upper Goshi	Maize and potatoes cultivation declined; increased cultivation of cardamom	Water source started drying up	Forest cover decreased	Population increased from 600 to 805 people	Earthquake and storm damaged houses	Decrease of income due to decline in yield from maize and potatoes

4.3 Assessment of the level of participation

4.3.1 Participation by gender

The total of 57 participants comprising 20 females and 37 males took part in the PRA exercises, namely the identification and matrix ranking of land uses, the identification of problems and potential interventions, the preparation of action plans, the preparation of village timelines and resource mapping. The results of the assessment of participation are shown in Table 12.

Table 12: Assessment of participation

Gender		Exercise 1		Exercise 2		Exercise 3		Exercise 4		Exercise 5	
		Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)
Female (21)	P	67	62	76	81	67	81	71	57	52	33
	i	33	38	19	19	24	19	24	24	19	33
	w	0	0	0	0	0	0	0	0	0	0
	l	0	0	0	0	5	0	5	14	19	14
	o	0	0	5	0	5	0	0	5	10	19
Male (36)	P	83	83	75	78	86	81	86	81	92	86
	i	6	6	19	17	11	17	11	17	8	8
	w	3	1	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	3	0	3	0	0
	o	8	3	6	6	3	0	3	0	0	3

Exercises and Symbols:

- Exercise 1: Land use identification and ranking
- Exercise 2: Problem identification and Solution
- Exercise 3: preparation of action plan
- Exercise 4: Preparation of village timeline
- Exercise 5: Resource mapping
- P: Actively participating
- i: Attentively observing
- w: Going out in between group discussion to attend to other work
- l: Inactive
- o: Absent

The share of females involved by active participation varied from 33% to 81% whereas active participation of male ranged from 75% to 92 % during different exercises. There were almost equal shares of males and females who were attentively observing in all exercises, except in exercise one where more female participants remained silent. The reason stated by some participants for remaining silent was that whatever their village leader said was fine with them. However, the PRA exercise encouraged good discussion among participants and in one instance one female participant was found insisting her male participants to voice their

concerns. The difference in share of active participation of female and male participants, at the start and in the end of each PRA exercise is not huge.

4.3.2 Participation by level of education

Table 13 shows the level of participation in different land use planning exercises in relation to the educational background of the participants.

Table 13: Participation by level of education

Level of Education		Exercise 1		Exercise 2		Exercise 3		Exercise 4		Exercise 5	
Illiterate Total : 27		Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)
	P	63.0	74.1	77.8	74.1	59.3	70.4	74.1	59.3	66.7	59.3
	i	29.6	22.2	18.5	18.5	33.3	25.9	22.2	25.9	14.8	14.8
	w	3.7	0	0	3.7	0	0	0	0	0	0
	l	0	0	0	0	3.7	0	0	14.8	14.8	11.1
	o	3.7	3.7	3.7	3.7	3.7	3.7	3.7	0	3.7	14.8
Class 1-6 Total: 9	P	100	66.7	77.8	88.9	77.8	88.9	77.8	66.7	88.9	66.7
	i	0	22.2	22.2	11.1	22.2	11.1	22.2	33.3	11.1	33.3
	w	0	11.1	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	0	0	0	0	0
	o	0	0	0	0	0	0	0	0	0	0
Secondary (7-10) Total : 6	P	66.7	66.7	83.3	83.3	83.3	83.3	83.3	100	100	83.3
	i	0	0	0	0	0	0	16.7	0	0	16.7
	w	0	0	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	0	0	0	0	0
	o	33.3	33.3	16.7	16.7	16.7	16.7	0	0	0	0
Higher secondary (11-12) Total :1	P	100	0	100	100	100	100	100	100	100	100
	i	0	100	0	0	0	0	0	0	0	0
	w	0	0	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	0	0	0	0	0
	o	0	0	0	0	0	0	0	0	0	0
Graduate Total : 2	P	100	100	100	100	100	100	100	100	100	100
	i	0	0	0	0	0	0	0	0	0	0
	w	0	0	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	0	0	0	0	0
	o	0	0	0	0	0	0	0	0	0	0
Non Formal Education (NFE) Total :11	P	90.9	100	100	100	90.9	90.9	100	100	81.8	72.7
	i	9.1	0	0	0	9.1	9.1	0	0	18.2	18.2
	w	0	0	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	0	0	0	0	9.1
	o	0	0	0	0	0	0	0	0	0	0

Exercises and Symbols:

- Exercise 1: Land use identification and ranking
- Exercise 2: Problem identification and Solution
- Exercise 3: preparation of action plan
- Exercise 4: Preparation of village timeline
- Exercise 5: Resource mapping
- P: Actively participating
- i: Attentively observing
- w: Going out in between group discussion to attend to other work
- l: Inactive
- o: Absent

As Table 13 shows, there was not much of a difference in the level of participation among participants with different educational backgrounds. A minimum average of 80 percent of participants was found actively participating in all five groups of educational backgrounds. However, there is difference in the level of participation between illiterate and literate. The average participation level of illiterate was approximately 68 percent. The maximum level of participation observed was 74.1 percent and minimum was 59.3 percent in the illiterate category. On average 23 percent of illiterate participants were found silently observing the group discussion in five different exercises.

4.3.3 Level of participation in different villages

Table 14 shows the level of participation of farmers by village in five sets of land use planning exercises. The overall level of participation displayed by participants from the nine villages was generally high. The villages Phunsumgang and Upper Goshi displayed higher levels of participation with an average level of 91.5 percent and 92.5 percent respectively. The Khagochen village showed the lowest level of participation with an average of 57.9 percent. However, 100 percent attendance of participants was observed in all villages except Lower Goshi (67 percent). The seven villages displayed more or less consistent share of active participation from the start to end of each PRA exercise. Whereas, the Khagochen and Pungzhi villages displayed drastic fluctuation in the share of active participation.

Table 14: Level of participation level by village

Village		Exercise 1		Exercise 2		Exercise 3		Exercise 4		Exercise 5	
Balaygaon		Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)	Start (%)	End (%)
Total :7	P	86	86	86	86	86	71	100	100	86	86
	i	0	0	0	0	0	14	0	0	14	14
	o	14	14	14	14	14	14	0	0	14	14
Dogag Total : 7	P	43	57	71	86	71	86	86	86	86	71
	i	29	14	14	0	14	0	14	14	14	29
	w	29	29	14	14	14	14	0	0	0	0
	l	0	0	0	0	0	0	0	0	0	0
	o	0	0	0	0	0	0	0	0	0	0
Khagochen	P	67	44	67	67	56	78	78	44	56	22
	i	33	44	33	33	44	22	22	33	22	33
Total : 9	w	0	11	0	0	0	0	0	0	0	0
	l	0	0	0	0	0	0	0	22	11	22
	o	0	0	0	0	0	0	0	0	11	22
Lower Goshi	P	100	67	67	67	67	67	67	67	67	67
	i	0	33	0	33	0	33	0	0	0	0
Total: 3	o	0	0	33	0	33	0	33	33	33	33
Middle Goshi	P	100	57	86	71	57	71	57	57	100	100
Total : 7	i	0	43	14	29	43	29	43	43	0	0
Phunsumgang	P	83	100	100	100	83	83	100	83	100	83
	i	17	0	0	0	17	17	0	17	0	0
Total: 6	l	0	0	0	0	0	0	0	0	0	17
	o	0	0	0	0	0	0	0	0	0	0
	P	83	83	67	83	50	100	67	33	17	33
Pungzhi Total:6	i	17	17	33	17	33	0	33	33	33	17
	l	0	0	0	0	17	0	0	33	50	17
	o	0	0	0	0	0	0	0	0	0	33
Tashithang	P	63	100	100	88	88	88	88	88	88	63
	i	25	0	0	0	13	13	0	13	13	38
Total: 8	w	13	0	0	13	0	0	0	0	0	0
	l	0	0	0	0	0	0	13	0	0	0
Upper Goshi	P	100	100	100	100	100	50	75	100	100	100
Total: 4	i	0	0	0	0	0	50	25	0	0	0

Exercises and Symbols:

- Exercise 1: Land use identification and ranking
- Exercise 2: Problem identification and Solution
- Exercise 3: preparation of action plan
- Exercise 4: Preparation of village timeline
- Exercise 5: Resource mapping
- P: Actively participating
- i: Attentively observing
- w: Going out in between group discussion to attend to other work
- l: Inactive
- o: Absent

Figure 13, Figure 14 and Figure 15 shows the changes in the level of participation from the start to the end of the PRA exercises by village. Generally, either a slight decrease or increase of participation was observed in all the PRA methods. However, a huge decrease is displayed for Khagochen village in the case of the village timeline and the resource mapping exercise (Figure 13). Upper Goshi displayed a significant decrease of participation in the preparation of the action plan (Figure 14), whereas Pungzhi showed a significant increase of participation in course of the same PRA method.

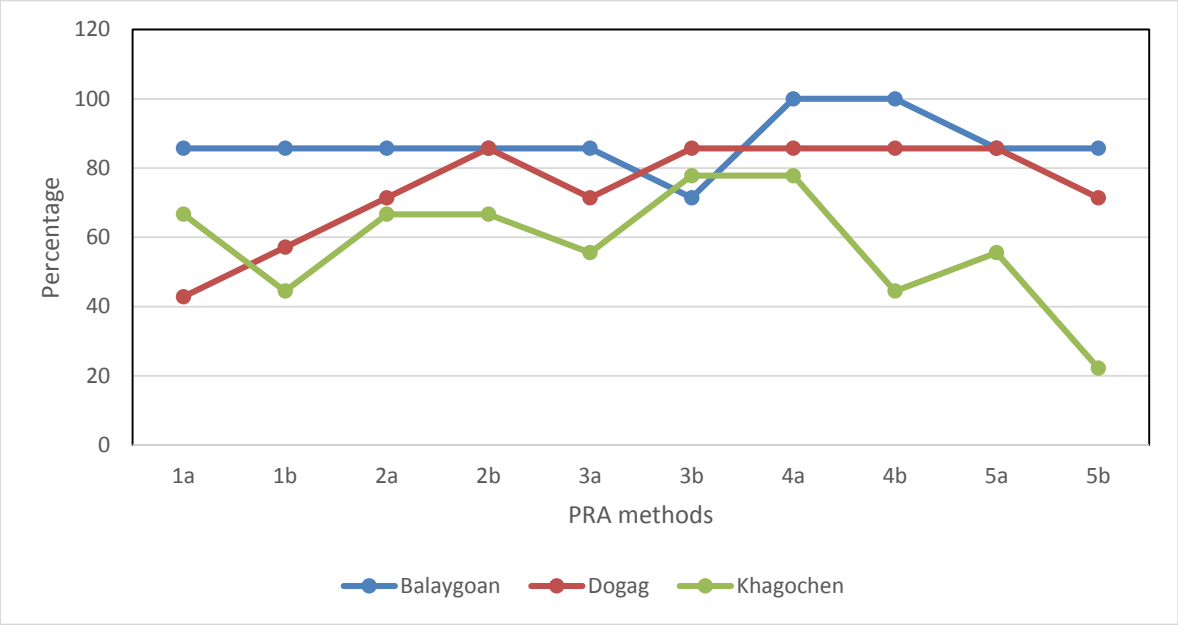

Figure 13: Village wise Participation trend in PRA methods, part I.

Figure 14: Change in participation by village and PRA methods, part II

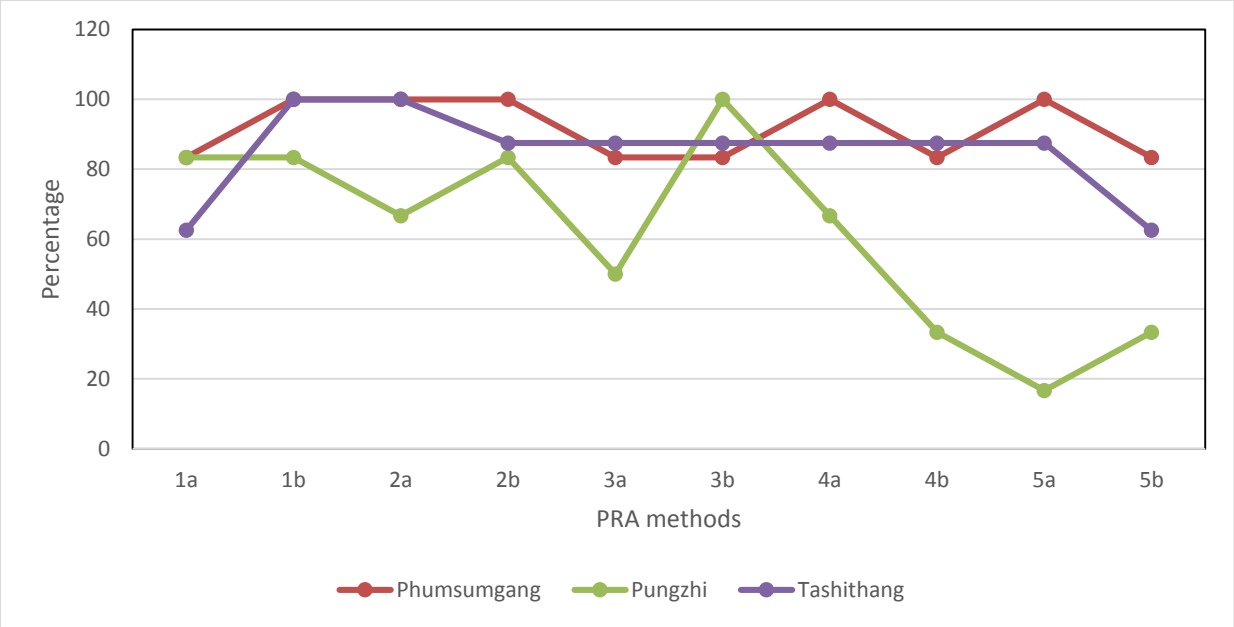

Figure 15: Change in participation by village and PRA methods (part III)

Exercises and Symbols:
Exercise 1: Land use identification and ranking
Exercise 2: Problem identification and Solution
Exercise 3: Preparation of action plan
Exercise 4: Preparation of village time line
Exercise 5: Resource mapping
a: Observation made at the start of exercises
b: Observation made at the end of exercises

4.3.4 Participation by PRA method

Figure 16 shows the general change of participation in each PRA exercise. The change in the level of participation was studied to find out how effective the PRA methods is in motivating participation from the start to the end of exercises.

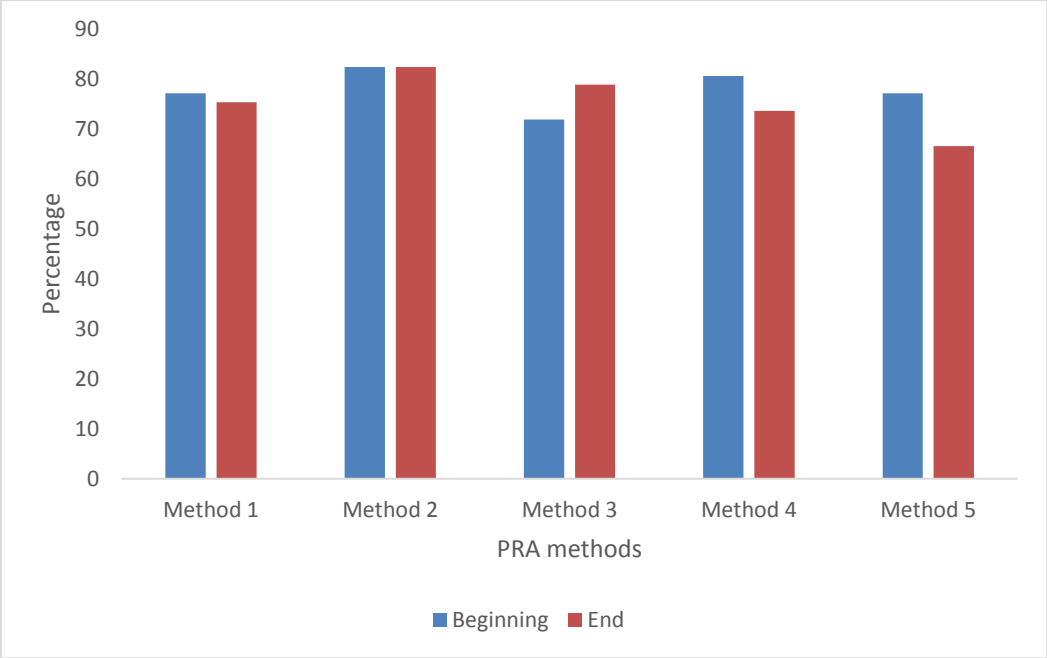

Figure 6: Participation observed at the start and at the end of the application of PRA methods

Explanation:
Method 1: identification of land use and land use ranking using pairwise ranking
Method 2: Identification of land use problems and interventions using opportunity matrix.
Method 3: Preparation of action plan using opportunity matrix.
Method 4: Preparation of village timeline
Method 5: Resource mapping using 3-D modelling

The participation of individuals was observed twice while using different PRA methods. The first observation was made after few moments in the beginning of an exercise, and the second observation was made towards the end of each exercise. It is found that the participation in each PRA method was good with comparatively lowest participation of 67 percent towards the end of PRA method 5 (resource mapping exercise). A slight drop in the number of participants in discussions were observed in some PRA methods viz. land use identification and ranking, preparation of village timelines and resource mapping using 3-D modelling. Increases in participation were observed in PRA method 3 (preparation of action plans). No changes in participation were observed in PRA method 2 (identification of land use problems and interventions).

4.3.5 Observations during transect walks

The non-participatory assessment of participation was also carried out during the transect walks along the villages. It showed that that the participants were engaged in active discussions and were eager to show as many land use related problem areas affecting them as possible. The most striking development during transect walks was that the participants who were silent during focus group discussions started taking part in conversations. They felt homely and comfortable in their own villages and wanted to show their genuine problems in the hope of getting support from their government. For instance, two female participants who remained silent most of the time in focus groups became very vocal and expressive during the transect walk and even dominated the discussions.

Another Other important observation was that all participants spontaneously interacted among themselves as well as with the facilitators without any external persuasion. There was an incident where one participant was very determined to show destructions caused by a landslide to a paddy field as a result of burrows made by crabs.

4.3.6 The timing of PRA exercises

Figure 16 shows the participants' evaluation of the timing of the PRA exercises. This evaluation was conducted to find out the most appropriate timing to conduct PRA exercises in the future. This should ideally allow participation of a larger population.

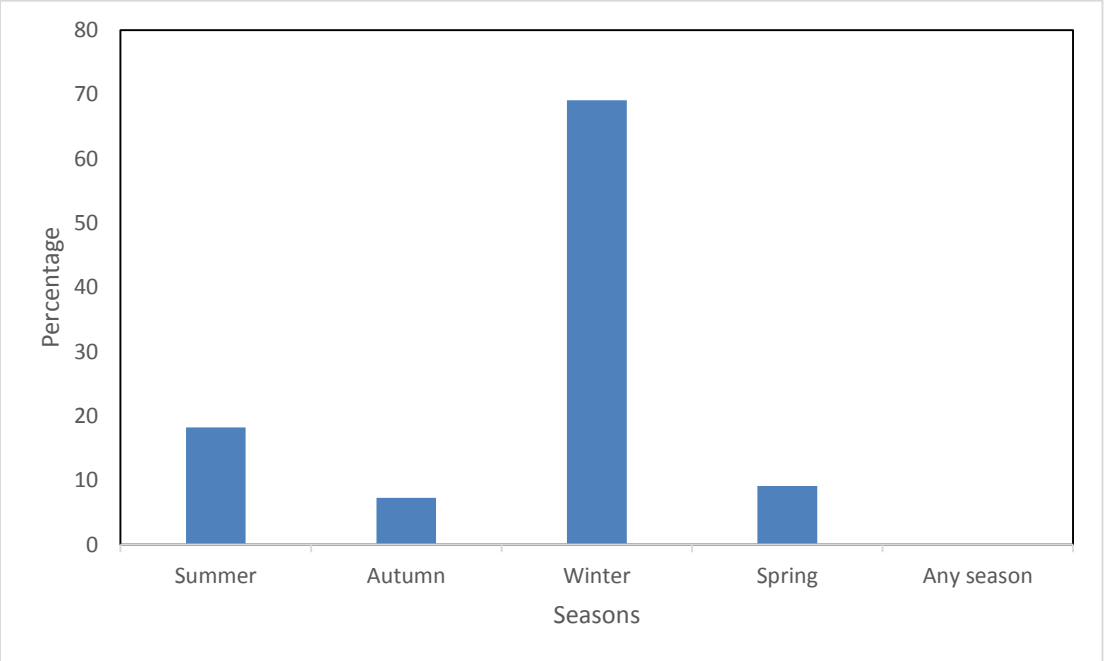

Figure 16: Preferences as regards the timing of PRA exercises

A total of 57 participants were asked to fill up questionnaires for finding out the most appropriate timing for carrying out PRA exercises in the future. It was found that 70 percent of respondents prefer the winter season (December to February), followed by 18 percent who would prefer the summer (June to August), 9 percent preferring spring (March to May) and 7 percent which would prefer the autumn season (September to November).

4.3.7 Participants' feedback on PRA exercises

Figure 17 inter alia shows the feedback of participants regarding learning experiences through PRA exercises. This shall provide some hints about whether the PRA exercises facilitated learning processes.

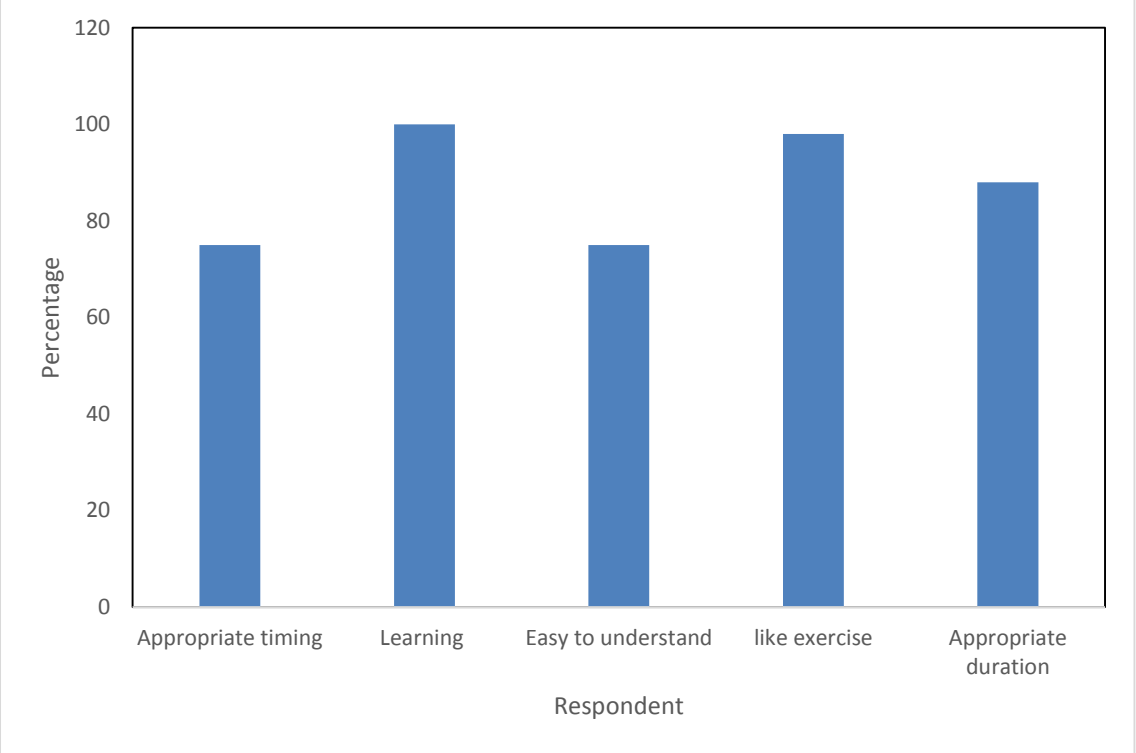

Figure 17: Participants' feedback on PRA exercises

As figure 17 also shows 75 percent of the respondents felt the timing to carry out the PRA exercise (conducted in July 2014) was appropriate. However, most of them would have preferred the winter season (see Figure 16) which is off season for agriculture and generally characterized by favourable weather conditions. All participants felt that the participatory approach helped them to learn and an equal percentage of respondents felt that the PRA methods were easy to understand. 88 percent of the participants stated that the duration of PRA exercises was neither to long nor to short.

5 Summary and discussion

Overall, the selected PRA methods were found adequately applicable to participatory land use planning processes. They efficiently generated useful information required for land use planning, which is one of the important components for watershed management planning. They furthermore allowed properly documenting the results of the participatory exercises. Further, the PRA methods provided the farmers with platform to express their views, to analyse their land use problems, plan the implementation activities and also encouraged their active participation.

5.1 Assessment of individual participatory methods

The drawing of team contracts is one important step to ensure smooth implementation of planned activities and to avoid unnecessary waste of time in managing the participants. The definition and announcement of the start and the end (timing) of the exercises helped the participants to plan their time for the start and end of the days' activities. This avoided a waste of time in waiting where people usually think, it is alright to go bit late in the absence of such team contract. The rules to switch off phones and to avoid gossiping and talking about other topics during group discussion also helped participants to concentrate in the discussion and to devote more time to group discussions.

The use of a matrix for identifying land use types, land use problems and interventions, made it easier to note down the results of discussion in a sequential manner. This method lead to good discussion within the group and facilitated participants to learn how to identify land use types, to analyse land use problems and potential interventions. Useful information covering a wide range of land use related issues were generated in a given time frame as the applied methods appeared easy to understand and facilitators did not have to spend too much time for explaining the methods. The only disadvantage was that there needs to be at least one literate participant as the exercise involves a bit of writing for transferring the result of group discussions to paper. This issue was echoed when one female participant remarked that she could have finished the job faster if she would be literate.

The participants found the pair wise ranking matrix simple and easy to use. A similar finding was reported by Hoang Fagerström et al. (2003). Since the comparison of only two land use types was as for at a time, this pair wise ranking matrix made it easier to decide about the importance of land use types and the participants could effectively come out with a land use ranking. The ranking process being faster than expected was also reported by Mukherjee

(1995). This exercise was so simple that even illiterate participants understood it without any difficulty. Participants were found enjoying the pair wise ranking process (ibid.).

The preparation of village timelines gave light to the changes that occurred over the time in terms of population, agricultural practices, the income of famers, and the occurrence of natural calamities. The participants found it a bit difficult to understand the exercise in the beginning as they were not exposed to such an exercise before. The preparation of timelines took longer as expected as the participants could often not remember the dates and events of the past. The obvious reason was that participants were new settlers which migrated to the village under the re-settlement program initiated by Royal Government of Bhutan in the late 1990ies. Accordingly many among them had no idea about the dates and events that had occurred in the past. This was also the case with regards to members of the young generation of native settlers. However, older native settlers remembered some past events but could of the not remember the exact year of events as they never keep record.

The use of a 3-D model for resource mapping enabled the participants to learn about the detailed geographical features of their villages and helped to accurately point out the location for implementing interventions. The 3-D models have been user friendly and proved to be an efficient planning and management tool for farmers as also reported by DENRS (2000). The model lead to an increased intensity of interactions among participants as also reported by NAFRI (2012). However, the construction of a 3-D model was costly compared to using only simple maps that are drawn on a sheet of paper and on open ground.

The transact walks through the villages helped to visit the problem areas and to cross-check information that was provided during group discussions.

Semi-structured interviews enabled us to get the perspective of individuals and obtain additional useful information. For instance, few female interviewees mentioned that the earthworms and crabs also contribute to a shortage of irrigation water because of water seepage through the holes dug by the worms and crabs. Similarly, a male interviewee reported that open concrete irrigation channels are better as compared to installing pipes due to the simple reason that the open concrete irrigation channels can also collect surface flow water and thereby increase the quantity of water reaching the paddy fields. Further, semi-structured interviews helped to cross-check the information gathered from group discussions. These advantages of semi-structured interviews were also reported in other researches (Hoang Fagerström et al. 2003). The disadvantage of conducting semi-structured interviews randomly was that farmers were often out on their fields which made it hard to reach them and resulted in less interviews than originally envisaged (for a similar observation see Hoang Fagerström et al. (2003).

5.2 Land use types in the watershed area

Overall, agriculture is the main source of income for farmers of the Dagana district. The climatic conditions are suitable for growing crops such as paddy, maize, oranges, cardamom, vegetables and further fruit trees (Dagana 2010). The other types of land use reported were vegetables fields, pasture, community forests, government reserved forests, drinking water sources, and private forests.

Out of 10 different types of land use existing in the 9 villages, four land uses, viz. orange orchard, paddy field, dry land and cardamom orchard, were identified in group discussions as the most important ones in all nine villages, as also proven by the respondents of semi-structured interviews (Figure 3). The paddy fields and dry land are used for cultivating cereal crops like maize and paddy which are the staple food in addition to other agriculture crops for their own consumption. However, farmers of all nine villages widely cultivate orange and cardamom for cash income. These two land use types are their main sources of income. A similar finding was reported in the study by NSB (2014). There was one instance of a farmer cultivating cardamom in a paddy field in lower Goshi as cultivation of cardamom is more profitable than paddy. It has been reported that cardamom fetches a good price as compared to other cash crops in the region.

5.3 Land use related problems in the watershed area

All nine villages that were studied faced the problems of a shortage of irrigation water as well as insects and other pests on orange and cardamom crops. Crop depredation by wild animals like monkey, beer and wild boar was prevalent in seven villages and insufficient drinking water was reported in six villages. The shortage of irrigation water was attributed to erratic quantities and untimely rainfall, the need of irrigation water in all important land use types throughout the year, deforestation, over grazing and a lack of funds for constructing irrigation channels and procuring water pipes for transferring the water. Water sources are often far away from the settlements. Such findings were also reported in a study by NSB (2014). The analysis of rainfall data from 1996 to 2014 (Figure 5) also showed a trend of decreasing of rainfall quantities. Kusters and Wangdi (2013) also reported the decreasing rainfall quantities, untimely rainfall and an increasingly erratic nature of rainfall as causes of a shortage of irrigation water in the Punakha district.

All villages in the Dagana watershed have reported the presence of four important land use types (Figure 2). These land use types require the irrigation water in different seasons and this

may be another reason for the shortage of irrigation water. For instance the paddy field requires irrigation water in the months of June, July and August. Cardamom and oranges need irrigation water during the winter months. The farmers have started converting dry lands for growing cardamom and oranges, and recently they also started growing vegetables for commercial purposes. These activities resulted in an even increased need of irrigation water in different seasons. Currently farmers are using old irrigation water channels to meet the increasing needs for water. Kusters and Wangdi (2013) also reported the shortage of irrigation water faced by farmers of Punakha district.

The farmers of the Dagana watershed areas also keep livestock like cattle and goats, which are taken into nearby forests for grazing. These forests are also used for timber extraction. It was reported that trees were felled not only by resident famers but also by people from other villages. Overgrazing and deforestation may also contribute to the drying of streams which in turn also contributes to a shortage of irrigation and drinking water.

The washing away of existing irrigation channels by landslides and seepage of water through holes burrowed by earthworms and crabs along the irrigation channels were further factors identified as possibly contributing to a shortage of irrigation water. The analysis of village timelines (see Table 11) also shows that there was an increasing trend in human population in eight villages, that the forest cover has decreased, that a shift from subsistence to commercial agriculture hast taken place and that incident of landslides have occurred. The farmers have submitted a proposal to the concerned forest office to establish community forestry, which would guarantee their ownership of forest resources. The establishment of community forestry could address the problem of deforestation, of overgrazing and of a lack of water source protection. The development of forests by involving local communities is one of the objectives of establishing community forests (DoFPS 2012).

The construction of open concrete irrigation water channels, the installation of large water pipes over landslide prone areas, and the introduction of improved varieties of paddy plants, which require less water, were also proposed by farmers as possible interventions to ease the shortage of irrigation water.

A shortage of drinking water was reported as a priority problem by seven villages, viz. Lower Goshi, Upper Goshi, Middle Goshi, Khagochen, Pungzhi, Phunsumgang and Tashithang. These villages faced a shortage of drinking water as their existing water supply was not enough due to increased numbers of households (Figure 8). Another reported reason is that even though

the villages have water sources, a lack of funding prevented them from installing new drinking water supply pipes. A further problem related to drinking water is pertaining to the presence of debris and a lack of water taps. The construction of water reservoir tanks and the procurement of water pipes were some of the measures put forward by farmers to ease their drinking water problem.

The problem of insects and other pests to cardamom and orange has become serious since in the recent decade. This resulted in wide scale damages to cardamom plants affecting the farmers' income. In addition, premature dropping of orange fruits was reported which according to farmers was also due to insect attacks. There is a need to carry out more detailed studies on the cause of this disease that result in premature dropping of fruits and the drying of cardamom plants.

Crop depredation by wild animals was reported in seven villages. Monkeys are reported to cause the most damage to the crops as compared to other wild animals like wild boar, bears, deer, squirrels and rats. It was reported by farmers during the transect walks that more than 400 monkeys were counted in Dogag village. In contrast, a study carried out by Rao et al. (2002) in India found out that beer and wild boar were major agents of crop damage. Crop damage by small animals was not reported (ibid.).

The crop depredation by wild animals was most reported in the villages surrounded by dense forests. Wild animals living in the forests get attracted to agriculture crops as crops are easy source of food for them. Wang et al. (2006) also reported crop damages caused by wild animals in Jigme Singye Wangchuck National Park (JSWNP) and the availability of palatable and nutritious foods at the edge of forest was believed to be a main cause of that damages.

No reports of crop depredation were found in Middle Goshi and in Khagochen. The land use maps show, that the settlements of Middle Goshi and Khagochen are surrounded by other villages, and hence protected by the adjacent villages (Figure 10). The crop depredation was a most common problem faced by most of the farmers across the country, and farmers have applied various measures against it, for example: guarding the crops, barbed wire fencing, setting up scarecrows, and keeping dogs to protect the crops from wild animals. In a study carried out in Bardia National Park in Nepal Thapa (2010), found that most of the means used for preventing crop damage by wild animals were only temporarily effective. However, the introduction of electric fences by the Royal Government of Bhutan proved effective, and has hence been gaining popularity among farmers (WCD 2013; Rinzin 2015). The killing of wild

animals is prohibited by the Forest and Nature Conservation Rules 2012 and also violates the religious beliefs of villagers. Therefore, farmers see the installation of electric fences as the only effective solution to the human-wild life conflict. Thapa (2010) also reported about the success of electric fencing in stopping elephants but also noted that the high cost of installation and safety issues may make installation impossible.

Finally, landslides and erosion are further problems which farmers face, although, according to farmers, these are not severe problems. However, incidents were reported in Dogag, Balaygaon, Khagochen, Upper Goshi and Phunsumgang villages. Balaygaon was found to be the most affected by landslides. Most of the landslides occurred along the riverine. Soil erosions mostly occurs at steep slopes during the rainy seasons. In the villages affected by landslides and soil erosion most of the area is dominated by steep slopes (Figure 12). This results in washing away of irrigation channels and causes the farmers to change the land use from paddy fields to other land use types. Farmers listed various interventions to address these problems and to secure or even improve the fertility of soils, such as the stabilization of land slide areas by plantations and the construction of retention walls and hedge row plantations on steep agriculture land (Table 10).

5.4 Participation in the application of different in PRA methods

The participatory methods used for group discussion encouraged active participation and drew the attention of almost all the participants and facilitated learning. Most participants remarked that they were learning through the participatory approaches (Figure 17). The exercises of identifying land use types, problems and potential interventions in an opportunity matrix , of pair-wise ranking of land use types, of drawing action plans and resource mapping were perceived to be easy to understand (Figure 17) and to be completed in the given time. However the preparation of village timelines took longer and farmers found it difficult to understand the task. Most participants only recently settled in the researched villages and older people could often not remember damaging events and the years of their occurrence.

The application of semi-structured interviews helped to cross-check information gathered during group discussions and to gather individual opinions as well as additional information (for similar results see Fagerström et al. (2003)). The use of 3-D models helped framers to learn about the geographical features of their villages and also assisted in the planning of activities.

The participatory rural appraisal methods employed at various stages of participatory land use planning have led to quite active participation during group discussions. Fagerström et al.

(2003) also found out that the PRA methods can be quite effective in terms of facilitating free expression of opinion by farmers and their involvement in problem definition, analysis and decision making. PRA methods kept the participants engaged in the discussions. Although most of them took part in active participation, others were only attentively listening to the discussions of others. The analysis of the level of participation (Figure 12, Figure 13 and Figure 14) generally showed slight changes, thereby indicating that the PRA methods more or less led to enduring participation up to the end of the exercises. However, a significant decrease was observed in some PRA methods (Figure 12, Figure 13 and Figure 14). This may be attributed to the timing of observation towards the end of each exercise. It was made at a certain point time and it is possible that the respective participants were not active at only this specific time.

In the beginning of the exercises, some female participants kept silent. But as the exercises progressed they often started taking more actively part in the discussions and also started encouraging some male participants to raise their concerns more actively. A study carried out by Bagdi and Kurothe (2014) made similar observations by observing participants encouraging each other to become active. Men participated relatively more active as compared to women (Table 12). This may be due to males' higher awareness about the general situation of the village as mostly male are working outside the homes whereas female are often confined to working in their own and in the neighbours' fields.

More active participation was observed when the specific issues under discussion directly affected the respective individuals. For instance, few males and females participants who remained silent most of the time started raising their concerns when discussion were about the installation of tap stands and electric fences because they were badly affected by human-wildlife conflicts and could not construct drinking water tap stands due to a lack of resources. Sometimes participants chose to remain silent when they found that their concerns were raised by other participants anyway.

The educational background of participants also influenced the level of participation. The analysis (Table 13) shows that literate participants were found more actively participating compared to illiterate ones. This may be probably due to illiterate people feeling that literate people are more knowledgeable about the topics being discussed. Furthermore, group work was compiled in charts and hence some writing was required. However, an average of 68 percent of illiterate participants still actively involved themselves. This stands in contrast to the

results of Lestrelin et al. (2011) who found that non-elite participants were largely excluded from a processes of zoning and planning of village land uses.

The transect walks also facilitated active involvement of the participants. Some of those who remained silent during the focus group discussions freely interacted and more easily raised their concerns there, e.g. about land use problems. It seems that participants felt very comfortable and confident in their respective villages. Another reason may be that each participant wanted to make sure that his/her land use problems were noticed in the field so that they could more likely receive assistance in the form of funds or expertise from the concerned agencies. Last but not least, data collected by the transect walks also helped to cross-check information gathered in the focus group discussions.

Most of the participants found the month of July, in which the study was undertaken in the field, to be "ok" for conducting PRA exercises (Figure 16). However, they would have generally preferred the winter season (Figure. 16). While most agricultural activities usually are done by June the summer heat and heavy rainfall with frequent blockage of roads by landslides often cause problems to take part in activities outside the villages. Hence, the winter season would have been preferred. Also, all agricultural activities would be over then and the weather conditions are usually good most of the time. Furthermore, the schools remain closed during winter months and school children help their parents and relatives in carrying out household chores. This also allows elder household members more easily to attend to various activities outside their homes and villages.

The assessment of the level of participation by village also showed the high levels of participation, ranging from an average of 57.9 percent in Khagochen village to 92.5 percent in Upper Goshi. The lowest levels of participation were recorded in Khagochen and Pungzhi with an average of 57.9 percent and 61.1 percent respectively (Table 14). These comparatively low levels may be due to the higher number of illiterate participants in these villages, most of them being women. The highest average levels of participation were observed in Upper Goshi and Phunsumgang (92.5 and 91.5 percent). The group members in these villages were mostly literate and local community leaders. This indicates that the participation level can be strongly influenced by gender, educational background and the positions in the society.

6 Conclusions and recommendations

The selected PRA methods were user friendly and very applicable to participatory land use planning processes. The use of participatory approaches for land use planning in the course of this study encouraged active participation of farmers in group discussion and facilitated learning. The PRA methods used were easy to understand for farmers and also helped the research team in gathering required and useful information for watershed management planning. The use of semi-structured interviews and transect walks was also useful in gathering additional information and in validating information obtained in group discussions. The results of participatory land use planning processes were obtained systematically and documented clearly. The required information on land use types, the importance of land use types to farmers, land use related problems and potential interventions was generated efficiently on time. The implementation planning was accurately carried out with the use of 3-D models. The preparation of village timelines was bit difficult for farmers as they could not remember the past events and dates. This can be replaced by simply asking them to write down whether they noticed any changes as regards certain categories of events and changes. The level of participation in all the selected PRA methods was high and socio-economic background factors like gender, the education background and the position in the society as well as the economic conditions of addressees influenced the level of participation.

We can conclude that paddy fields, dry land, cardamom orchards and orange orchards are the four most important land use types practiced in the Dagana critical watershed areas. Dry land and paddy fields are the two important land use types on which farmers depend for their livelihood. The other two land use types (cardamom and orange orchards) provide the major sources of cash income. Vegetable fields are also likely to become important sources of cash income for most of the farmers as the Royal Government of Bhutan is encouraging them to go for the commercial cultivation of vegetables as a measure to curb imports from India.

Amongst the many land use problems that have been identified, the shortage of irrigation and drinking water were reported as most severe ones in all the nine villages which were researched. Other land use problems which directly affect the farm-families' livelihood are insect and pest diseases that damage cardamom and orange plantations, landslides and crop depredation by wild animals.

However, for even better encouraging farmers to become involved future participatory studies or land use planning processes should better be carried out in the winter months (but not in the

middle of summer). During the winter climatic conditions are usually favourable and farmers are less occupied with agricultural work.

The method of observing the level of participation at only a few points in time during the group work entails the risk of unreliable results as some participants who may have actually taken been part in discussions may be found inactive at the time of observation (and others who may have been largely inactive may have been active at that point in time). The observation can be improved by increasing the frequency of observations.

Furthermore, this study revealed a need for more research on insect pests and other pest diseases that seriously affect the cardamom and orange plants in the region. There is a lack of knowledge and respective advice for farmers about how to mitigate such pest and hence to avoid significant economic loss.

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Acronyms

3-D	Three Dimensional
BC-CAP	Bhutan Climate Change and Adaptation Potentials of Forests of Bhutan
DzFO	Dzongkhag Forestry Officer
GIS	Geographic Information System
PLUP	Participatory Land Use Planning
PRA	Participatory Rural Appraisal
RNR	Renewable Natural Resources
WMD	Watershed Management Division
DAO	Distict Agriculture Officer
Tshogpa	Village leader
Geog	Block (Administartive block below district)
Dzongkhag	District