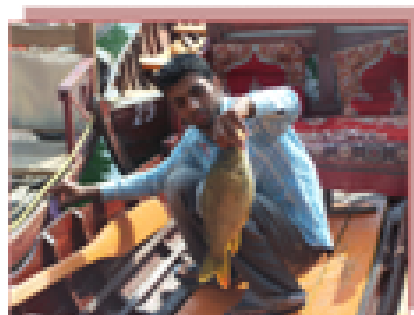


INTEGRATED ACTION PLAN (IAP)

UTTARAKHAND, INDIA



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EXECUTIVE SUMMARY

Highland Aquatic Resources Conservation and Sustainable Development or HighARCS encompassing five sites in Asia (Guangdong, China; Uttarakhand and West Bengal, India; and Northern and Central Vietnam) is a study with an aim to conserve the highland aquatic resources and improve livelihood strategies of the local people simultaneously, i.e., sustainable development without affecting the biodiversity of the concerned area. This study is focused on three most important highland water bodies (Nainital, Bhimtal and Naukuchiatal lakes) of the Nainital lake system situated in Nainital district of Uttarakhand. These three highland water bodies are important in terms of environment significance, tourist attraction as well as income and livelihood generation of the local people. The overall purpose of this study is to identify the needs and deficiencies of the different conservation, livelihood and policy issues in these communities, check the vigor of highland aquatic resources, build up and endorse wise-use, livelihoods diversification (where necessary), augment poor's livelihoods and conservation, amalgamate sustainable and wise-use, livelihoods diversification and conservation with watershed, facilitate the adjustment of management priorities throughout the area and then to develop an integrated action plan focusing on these aspects. The approach adopted for this study is based on facilitating the interactive participation of communities and stakeholders who utilize these resources and associated ecosystem services. With this broad aim in phase 1, a situation analysis study (Situation Analysis Report, Uttarakhand Site, India [Work package 1]) was conducted with an objective to identify the site and management issue. In phase 2, separate detailed study on biodiversity values and ecosystem services (Biodiversity and ecosystem service values of Nainital, Uttarakhand [Work package 3]); highland aquatic resources and livelihoods that depend upon them (Livelihood Report, Uttarakhand Site, India [Work package 4]); and legal and policy aspects regarding the various issue related to environment and protection of natural resources (Institutions, Policy and Conflict, Uttarakhand Site, India [Work package 5]) were undertaken. Then to collate the data on biodiversity, livelihood and institutions, policy & conflict, the integrated approach (toolkit) was pursued. This report is Integrated Action Plan (IAP) which aims to conserve and manage biodiversity along

with fulfilling and improving local community interests and livelihoods must combine biodiversity and ecosystem service values, livelihoods and institutions, policy and conflict issues and thereby take an integrated approach because the livelihoods of people are dependent on biodiversity and both biodiversity and livelihoods must be protected by a policy approach.

The proposed Action Plans in the IAP report have evolved as a result of swapping of facts and ideas within our research team and interactive participation on the part of stakeholders using PRA tools such as, Focused Group Discussion (FGDs), personal interview, data collection, workshop, case studies and Delphi method. Interactive participation of stakeholders in action planning and subsequent monitoring and evaluation is considered critical to ensure future development of aquatic resources in the region is sustainable and that aquatic biodiversity is conserved and enhanced.

Draft Integrated Action Plans were formulated on the basis of issues such as information and threats on aquatic biodiversity; its impact on livelihood of local people; socio-economic facts related to the situation and legal and policy aspects related to aquatic biodiversity, focused on mitigation and or improvement. The issues, mitigation and improvement plans will be verified through a process of joint assessment and decision-making with stakeholders. And on the basis of these verification discussions, the final Integrated Action Plan will be formulated and agreed.

The proposed actions from our team side, to solve the Management Issue(s) and the general aims of the project at our field site include 1) Monitoring on illegal fishing, 2) Fish release programmes, 3) Monitoring to prevent garbage and waste water disposal in and around the lakes, 4) Marketing of Handicrafts, 5) Marketing of Agricultural products, 6) Crop Protection, 7) Desiltation of Bhimtal lake.

In our Integrated Action Plan we have concentrated on realistic actions and identified their goals, timescale, main agencies in charge of implementation and/or finance, indicators for success, and difficulties which may be faced during implementation. The main focus of the proposed actions is to improve the management and conservation of aquatic resources in the

lakes as well as benefit the local people, which in other words, can also be termed as “Wise-Use of Wetlands”.

1. INTRODUCTION

1.1 PROJECT INTRODUCTION

Highland Aquatic Resources Conservation and Sustainable Development or HighARCS aims to develop an understanding of the importance of aquatic resources in highland areas of Asia. It is focused on the highland aquatic resources and their functionality, management, exploitation, and their conservation at five sites in Asia, that is, Guangdong, China; Uttarakhand and West Bengal, India; and Northern and Central Vietnam. This study is focused on the Nainital lake system in Nainital District of Uttarakhand, India (Figure 1).

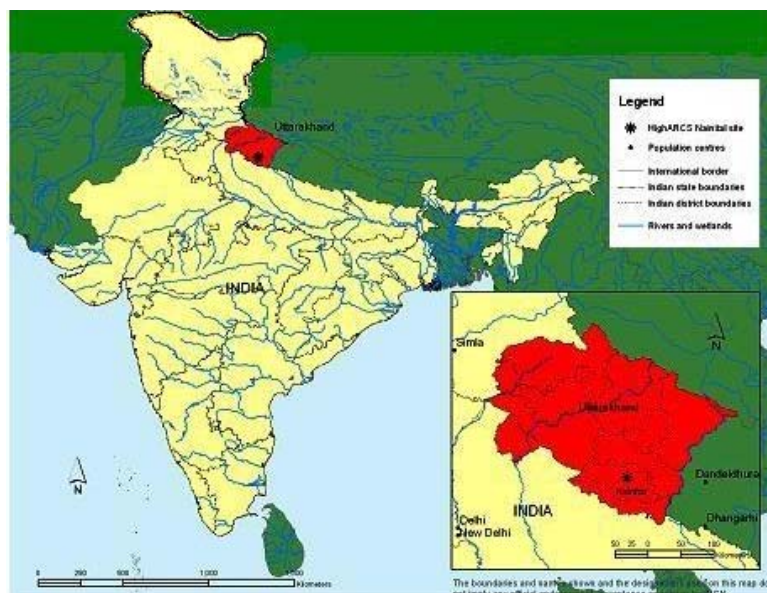


Figure 1. Location of the HighARCS project site in Nainital, Uttarakhand, India.

In phase 1, this study undertook a situation analysis to identify the site and management issue, then in phase 2 pursued the integrated approach (toolkit) to collate data on biodiversity, livelihood and institutions, policy & conflict. This document is the Integrated Action Plan (IAP) which aims to identify the needs and deficiencies of the different conservation, livelihood and policy issues in these communities and then to develop an integrated action plan focusing on these aspects.

1.2 NAINITAL LAKES SITUATION ANALYSIS AND THE MANAGEMENT ISSUE

Situated in the Kumaon foothills of the outer Himalayas and blessed with scenic natural splendor & varied natural resources, **Nainital** is ideally '*a glittering jewel in the Himalayan necklace*'. Nainital, the 'Lake District of India', possesses more than hundred of lakes amid them some are the exquisite beautiful lakes in India and attracts hundreds of domestic and foreign tourists every year. Although few among them are already dried up (we came to know this information by discussing with the local people). Few lakes attract tourists more than others due to their scenic beauty, easy accessibility and resource availability to becoming a tourist place. Nainital, Bhimtal, Naukuchiatal lakes are the three most important water bodies in Nainital in terms of environment importance, tourist attraction as well as income and livelihood generation of the local people. These lakes have its importance in the socio-economic and cultural life of the people in the region and have varied uses from tourism, potable water, irrigation, and to fisheries in some cases. The livelihood of the most of the people, specially marginalized people living in the villages adjacent to these lakes are mostly dependent on these lakes. In the past, this area had plentiful aquatic resources and these aquatic resources and associated ecosystem services used to provide great benefits to people living there but there is little information on the present situation. But no detailed and comprehensive study has been conducted to understand the present status of biodiversity in the lake system and the dependence of the local people on these resources for their livelihood activities. This is the main reason why a study was undertaken at the start of the HighARCS project which focuses on the aquatic resources and the livelihood of the people in these areas (see Work package 3 and Work package 4, for further details).

In HighARCS project, Action Planning is the nub. By means, Action Planning involves stakeholders in joint appraisal and decision-making with respect to highland aquatic resources planning and management. Three elements of action planning consist of conservation, livelihoods and policy issues, however instead of organizing action planning separately for conservation, livelihoods and policy concerns; it was decided to adopt an Integrated Action Planning approach because they (conservation, livelihoods and policy) are all inter-related

concerns (problems and solution) and it's impractical to hold separate planning activities (on conservation, livelihoods and policy) with the same group of stakeholders. This Integrated Action Planning approach seeks to point out apparent conservation, livelihoods and policy requirements and paucities; appraise anticipated actions with respect to possible depressing effects on conservation and livelihoods or conflicts with policy and existing management provision appraise; recognize suitable indicators applicable to conservation, livelihoods and policy for scientific and partaking supervision and assessment of impacts of Integrated Action Plans (IAPs); choose final action plans with regard to stakeholders' priority, viability and worth and wise-use of wetlands.

The three selected communities in our study are Pandeygaon village situated near Bhimtal lake, Chanoti village situated near Naukuchiatal lake, and Nainital proper (the area covering nearly 0.5 km radius surrounding the Nainital lake). Pandeygaon village is selected as it is the closest village to Bhimtal Lake and most of the people living there are engaged in agriculture and depend on the irrigated water of the lake for this, and they also collect water from the canal for different household purposes (to a limited extent). Chanoti village is selected being nearest village to Naukuchiatal Lake and most of the people living there are engaged in boat driving and tourism. Nainital proper area is selected because it is not only the heart of the city but a famous tourist place and the lakes being the centre of attraction of the tourists the livelihood of the local people mostly depends on these lakes, either directly or indirectly.

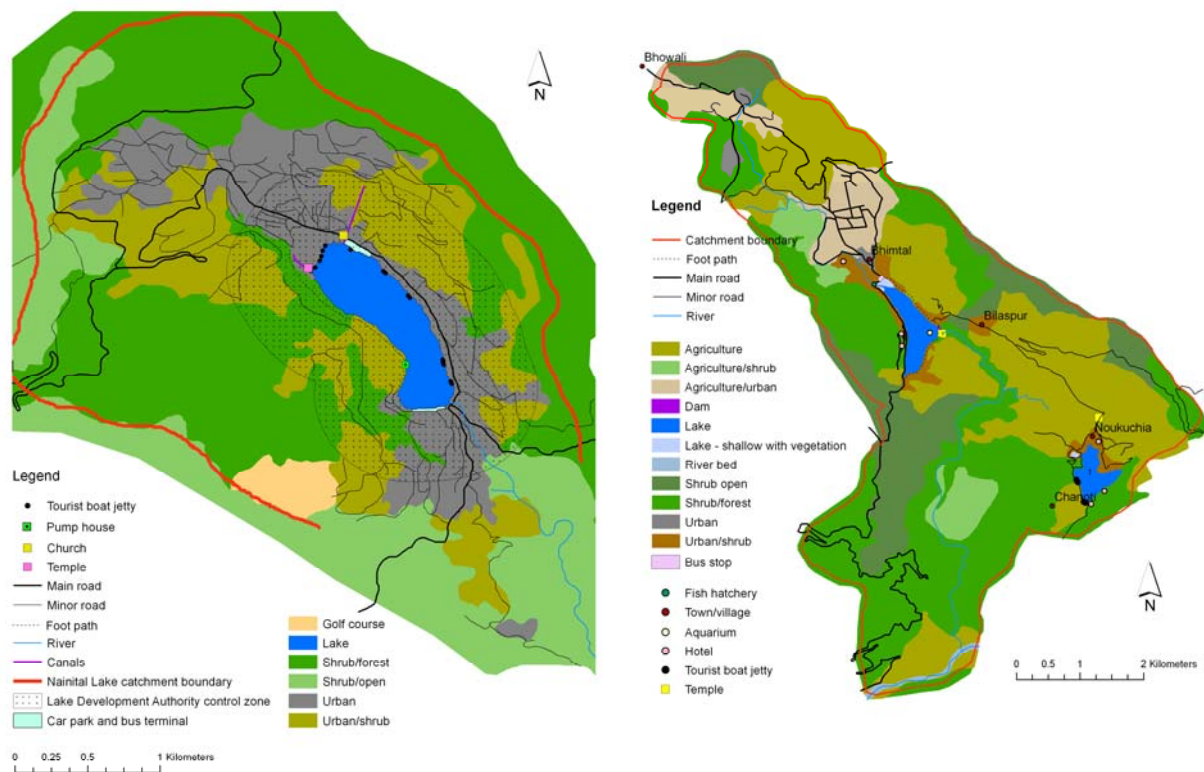


Figure 2. Maps of the lakes and surrounding land cover of Nainital (left) and Bhimtal and Naukuchiatal (right).

The approach adopted for this study is based on facilitating the interactive participation of communities and stakeholders who utilize these resources and associated ecosystem services. The different stakeholders such as the boat drivers, fishers, tourists, small shop and restaurant owners are dependent on these lakes' ecosystem and associated services and apart from this, there are various non-use values attached to the lakes. In our study, we have not included stakeholders related to spiritual interest and the reason behind this is that though Uttarakhand is commonly known as 'Dev Bhoomi' because of its religious significance but tourists generally visit our field sites i.e. Nainital, Bhimtal and Naukuchiatal to enjoy its natural scenic beauty. Though it is also true that there they do visit the places of religious interests but it is not generally the main reason behind their trip to HighARCS sites. The livelihood activities in this

region with respect to aquatic resource use and tourism industry, can be characterized into three types: *directly* dependent on aquatic resources (such as boating, fishing, agriculture etc), *indirectly* dependent on aquatic resources (such as hotels, resorts, restaurant owners etc), and *not* dependent on the lakes but are *dependent* on the tourism economy (such as travel agents, local site seeing services, tourist guides, photographers, car repairing, rickshaw pulling etc). These groups of people are dependent on the lakes (directly or indirectly) and the tourism industry to earn their living and make the most use of aquatic resources i.e. they are the ones who mostly influence the lakes (positively/negatively) and are affected by any changes in the lake. For example, tourists have both positive and negative impacts on biodiversity, supply of ecosystem services, as well as on the livelihoods of local communities. Positive effects associated with tourism development include: creation of job opportunities for unskilled, semiskilled and skilled workers; improvement in infrastructure, local arts and crafts, regional development and standard of living; encouragement of ecological awareness and conservation pollution control measures. Negative impacts attributed to tourism include pollution (throwaway mentality, congestion, hygiene problem, waste water from hotels or restaurants seeping into the lake water etc), destruction of forests for energy, eradication of fauna due to poaching and degradation of grazing lands due to camping activities.

Each year hundreds of domestic and foreign tourists are attracted to the sites included in the HighARCS study due its salubrious climate, scenic beauty, diverse flora and fauna, and range of activities on offer. There is a danger, however, that if the unique features of the region are destroyed, irrespective of who/what factors are responsible, tourists will stop coming and that would result in a serious negative effect on prevailing economic conditions. Different government organizations including the National Lake Region Special Area Development Authority (NLRSDA); Uttarakhand (Bhimtal) Irrigation Department; Nainital Nagar Palika Parishad (NNPP); Uttarakhand Jal Sansthan (UJS); Department of Fisheries, Uttarakhand; Directorate of Cold Water Fisheries Research, Bhimtal; G.B. Pant Institute of Himalayan Environment Development; G.B. Pant Nagar University of Agriculture and Technology and non-government organizations [NGOs, Unions, Local people, Schools and Associations] are engaged

in the development of various environmental and associated socio-economic aspects thereby helping preserve the lakes and their biodiversity, and indirectly maintain the livelihoods of the vast majority of people that depend on these aquatic resources. The different organizations who are engaged in conservation and management of the lake ecosystem and its surrounding regions can be considered as advocates for wildlife and environment flows. The institutional situation at the sites is thus characterised by considerable complexity, making the issue of coordination of management responsibilities and practices one of the most important issues to address. In this respect, Water (Prevention and Control of Pollution) Act enacted in 1974 and Water (Prevention and Control of Pollution) Cess Act enacted in 1977 need special mention. The former act was endorsed to prevent and control water pollution as well as to maintain and restore the wholesomeness of water and lead to the establishment of the Boards for carrying out the aforesaid functions assigning power and functions relating thereto and for matters connected therewith. The Act was amended in 1988. The later act was endorsed to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003. The “Nainital Jheel Parikshetra Vishesh Kshetra Vikas Pradhikaran”, the Lake Development Authority notified under U.P. Special Area Development Act 1986 is a Special Purpose Vehicle (SPV) set up for implementing the restoration works. (See HighARCS 2011: Institutional, Policy and Conflicts Report, Uttarakhand site, India for further details). According to the study on policies and institutions in Nainital Lake District undertaken in HighARCS, the creation of the National Lake Region Special Area Development Authority, commonly known as *Lake Development Authority (NLRSDA)* has increased the efficiency of the coordination of the many types of planning and management activities necessary to conserve the state of the aquatic resources of the lakes, regulatory measures have been successfully introduced at the Lake Nainital itself. Yet, such measures have not been sufficiently organised for the two other lakes included in this HighARCS site and this therefore needs to be addressed. However, it appears that the more centralised administrative set-up has happened at the expense of the

participation of the local institutions and community groups, although some successful attempts of involving existing groups have been recorded (HighARCS 2011: Institutional, Policy and Conflicts Report Uttarakhand site, India).

In a nutshell, we can say that the key objective for the proposed action plan should be to monitor the health of highland aquatic resources as well as develop and promote wise-use. By “wise use of wetlands”, we mean, the maintenance of ecological character, sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem (For more details go to Pg.39). Such an approach is necessary for livelihood diversification and to enhance poor livelihoods, by integrating conservation and sustainable development. However, interactive participation of stakeholders in action planning and subsequent monitoring and evaluation is considered critical to ensure future development of aquatic resources in the region is sustainable and that aquatic biodiversity is conserved and enhanced.

1.3 Overall aims of the project at the site

The three sites of Nainital, Bhimtal and Naukuchiatal are based on three sets of aquatic resources that is, the three lakes. Due to population pressure, and dependence on these aquatic resources for livelihoods in the context of limited alternative employment opportunities, there is arguably a need to conserve these resources. The lakes should be managed and maintained well since it is not only an important site for natural attraction but also for its biodiversity. However, livelihoods of poor and vulnerable groups should also be protected. Hence, the purpose of this study is to identify the needs and deficiencies of the different conservation, livelihood and policy issues in these communities, check the vigor of highland aquatic resources, build up and endorse wise-use, livelihoods diversification (where necessary), augment poor's' livelihoods and conservation, amalgamate sustainable and wise-use, livelihoods diversification and conservation with watershed, facilitate the adjustment of management priorities throughout the area and then to develop an integrated action plan focusing on these aspects .

2 ASSESSMENT METHODOLOGY

If wetland assessment is to be functional to real-world wetland management planning and decision-making, it must espouse an integrated approach. An integrated approach entails evaluating the three major facets of the wetlands interaction with human society:

- assessment of the biodiversity and value of the ecosystem services wetlands provide.
- contemplation of wetlands' role in local people's well-being through a livelihood assessment.
- deliberation of institutions, policies and conflicts since the human management and use of wetlands involves a policy and governance context.

While biodiversity assessment offers the way to set up the associations between ecosystem vigor and the provision of particular goods and services, economic appraisal of ecosystem services conveys the economic connotation of these services for human welfare, livelihoods analysis depicts the elements of human well-being in relation to ecosystems and the economy and consideration of institutions, policies and conflicts expresses how human use of wetland is mediated. Jointly, an integrated approach to wetland evaluation which includes all these aspects enables the connections between wetland biodiversity and ecosystem services, livelihoods, and human well-being to be portrayed, and the various institutions, policies, and conflicts which temperate and outline these connections to be comprehended. Precisely, integrated approach includes appraisal of biological, ecological and socio-economic aspects of wetlands, along with their status, trends, and menaces. To be effectual, evenhanded and sustainable in performance, wetland management rejoinders must be enlightened by a perceptive of all of these facets, including their communal causality and interconnectivity. To assemble the information necessitated to enlighten the action plan for our project, we pursued an integrated assessment approach, which embraces determining the health of the aquatic resources as well as understanding the significance of the livelihoods reliant on it steered by a policy structure. It is the process of unfolding the status and individuality of a particular wetland including its traits, functions and the ecosystem services that it spawns and the measures that

could be taken for the preservation of these resources. Effectual management of these resources cannot happen devoid of proper policies to direct decision-making and resource allotment. Improved understanding pertaining to the character of policies need can only be attained in the course of an assessment of the aquatic resources and linked ecosystem services.

Previously as part of HighARCS activities in the Uttarakhand field site, a detailed study of biodiversity values and ecosystem services was undertaken (included under Work package 3 and see section 3 for a summary of this work package results). Conservation of aquatic resources in the field site is possible through information on biodiversity and on threats to that biodiversity. It also includes assessing the costs and benefits of investment and development activities. A study was also conducted regarding highland aquatic resources and livelihoods that depend upon them (included under Work package 4) because an analysis of the livelihood conditions of the local men, women, boys and girls, focusing on sustainable resource use promotion and poverty reduction, become necessary. Apart these studies, a study was also commenced to understand the legal and policy aspects regarding the various issue related to environment and protection of natural resources because that would facilitate in formulation and implementation of Action Plans useful for the conservation of the biodiversity of the lakes as well as for nourishing the livelihoods of the people (included under Work package 5). The rationale behind the study of institutions, policy and conflict is that livelihood assessments based on gender and age should not only focus on people's assets and capabilities, their strategies and opportunities for earning incomes, their level of dependence on aquatic resources for these activities but also on the policies which are aimed on enhancing these incomes. These policies include National Rural Employment Guarantee Bill (providing at least 100 days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work), Swarnajayanti Gram Swarozgar Yojana (Golden Jubilee Village Self-employment Scheme: organizes poor families above the poverty line in self-help groups by providing a mix of bank credit and government subsidies), Sampoorna Grameen Rozgar Yojana (Full Village Employment Scheme: aims to provide additional wage employment in all rural areas and thereby ensure food security and

improvement of nutritional levels), Rural Employment Generation Programme (creates self employment opportunities in rural areas and small towns), and Prime Minister's Rozgar Yojana (Prime Minister's Employment Scheme: provides self-employment opportunities to the educated unemployed youth by assisting them in setting up any economically viable activity). Findings from these assessments will be used to inform the development of the proposed integrated action plan to maintain the condition of these aquatic resources and establish sustainable and wise-use of these resources. [Please refer to Figure 3] Based on a number of site selection criteria, the field site in Uttarakhand encompassing Nainital, Bhimtal and Naukuchiatal Lakes and nearby villages was selected for inclusion in the HighARCS project and a series of studies undertaken. Firstly, informal focus groups were conducted separately with men, women, girls and boys around Naukuchiatal Lake who are engaged in different activities like boating or running restaurants. Combined with outcomes of other discussions this revealed that most boatmen or restaurant owners associated with Naukuchiatal Lake are from Chanoti village. From a general discussion with the local people around Bhimtal Lake and from the Irrigation Department in Bhimtal it was ascertained that lake water is channeled through canals to nearby villages. One such village near the lower side of Bhimtal Lake is Pandeygaon where lake water flowing under gravity reaches the village through a canal. People living in the part of the village receiving this water were selected for inclusion in the study and referred to subsequently as the Bilaspur community. Pandeygaon village is selected as it is the closest village to Bhimtal Lake and most of the people living there are engaged in agriculture and depend on the irrigation water of the lake for this, and they also collect water from the canal for different household purposes. Nainital town was selected for assessment as it is the heart of Nainital district as well as famous tourist place and the lakes being the centre of attraction of the tourists the livelihood of the local people mostly depends on this lake, either directly or indirectly. After gaining a general understanding of the livelihood situation, three communities were selected for a survey and more in depth study. After information was gathered from Focus Groups in Nainital, Bhimtal and Naukuchiatal about the livelihoods of men, women and young people and associated problems they encounter, a detailed household study was done in Nainital, Pandeygaon village (Bhimtal) and Chanoti village (Naukuchiatal). In this way, data has

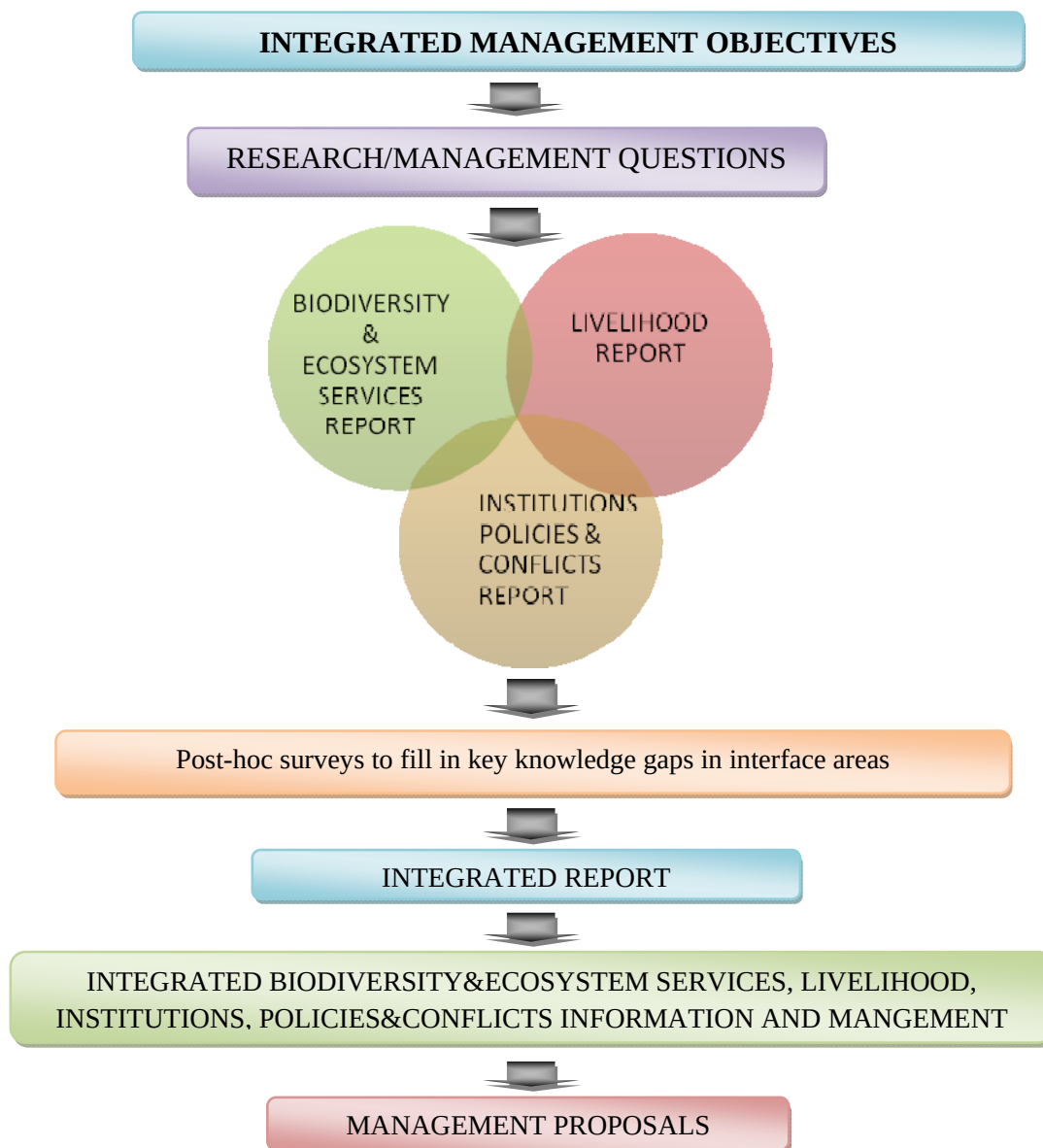


Figure 3: Development process of the proposed integrated action plan

been collected by moving from a general and broad overview of the livelihood strategies and aquatic resources to a more detailed and particular understanding (Figure 4).

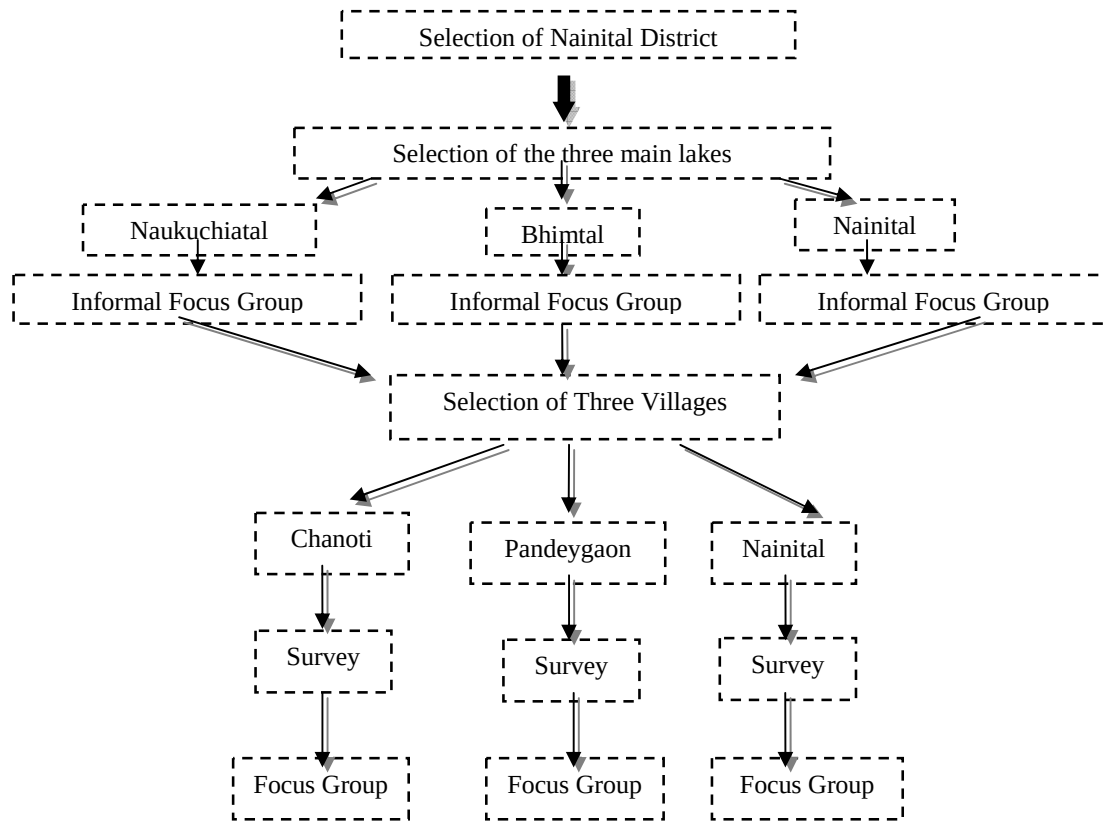


Figure 4: Process of Research

3. OVERVIEW OF BIODIVERSITY AND ECOSYSTEM SERVICE VALUES (WP3)

Following the methodology listed above (section 2) the freshwater biodiversity and ecosystem services present at the Nainital site was identified and valued. Below is a summary of the findings, but please see *Biodiversity and ecosystem service values of Nainital, Uttarakhand* for the full report that presents and discusses all the results.

The Central Himalayan lakes are mostly located at the Kumaon region. Although being at the sub-tropical part of the globe, the lakes are subject to prevailing sub-temperate climatic conditions owing to the altitude. The lakes under study include Nainital, Bhimtal, and

Naukuchiatal. These lakes contain not only a diverse array of aquatic biodiversity but as well as provide a number of different ecosystem services.

3.1 Biodiversity at the site

On the basis of resources(time and financial) availability, know-how and on hand data, the direct utilization of species by communities and the use of species as indicators to check probable actions put in place through the IAP, the taxonomic groups researched at the HighARCS sites had been selected. Accessible information on aquatic biodiversity at the sites is very good for fishes, but less for other groups. As indicators of water quality, which is one of the major threat to ecosystem services at the sites, the monitoring of noxious pollution, bio amassing and changeable populations and/or growth of certain species of fishes, molluscs, and plants were used. Therefore fishes, molluscs, and plants are the taxonomic groups selected for research in the HighARCS sites.

A total of 91 species of fish, 56 molluscs and 62 odonates had been identified and assessed for the wider catchment. Unfortunately due to the lack of reliable location data, it was not possible to identify the aquatic plant species from the wider catchment, however 186 species of aquatic plants from selected plant families had been assessed from the wider Ganges/Brahmaputra basins and the species that are found at the sites can be linked to these assessments but none of these species are globally threatened. An extract of the globally threatened animal species can be found in Table below but all four of these threatened species are fishes.

Table 1. Globally threatened species (those listed as Critically Endangered, Endangered and Vulnerable) found within the wider catchment of the site according to the IUCN Red List.

The IUCN Red List categories are EX – Extinct; EW Extinct in the Wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern; DD – Data Deficient; NA – Not assessed. The

categories CR, EN and VU are classed as the 'threatened' categories. '*' indicates a draft Red List assessment, that still needs to be peer reviewed.

Family	Binomial	IUCN Red List Category	IUCN Red List Criteria
CLARIIDAE	<i>Clarias magur</i>	EN	A3cde+4acde
CYPRINIDAE	<i>Puntius chelynoides</i>	VU	B2ab(i,ii,iii,iv,v)
CYPRINIDAE	<i>Schizothorax richardsonii</i>	VU	A2acd+3cde+4acde
CYPRINIDAE	<i>Tor putitora</i>	EN	A4acde

The results of the biodiversity assessment show that the lakes possess a wide variety of fauna and flora which includes 42 freshwater fish species, at least 9 mollusc species and 14 aquatic plants species. Of the fish species 37 are native while the remaining are non-native introduced species, namely, *Ctenopharyngodon idella* (grass carp), *Cyprinus caprio* (common carp), *Hypophthalmichthys molitrix* (silver carp) [helps to control algal blooms] and *Carassius carassius* (crusian carp) and mosquito fish (*Gambusia affinis*) [helps to control mosquito larvae] all of which can have negative impacts on native species and the ecosystem. In Nainital all five fish species (mentioned above) were introduced, but in Bhimtal and Naukuchiatal, except crusian carp (*Carassius carassius*), the other four fish species (mentioned above) in addition with grass carp (*Ctenopharyngodon idella*) were introduced. In Nainital, Bhimtal and Naukuchiatal the common indigenous species are the barbs (*Puntius* species), Rohu (*Labeo rohita*), Catla (*Gibelion catla*) but in case of Nainital one extra name is to be added, that of Barna Baril (*Barilius barna*) while in case of Bhimtal and Naukuchiatal Mrigala Carp (*Cirrhinus mrigala*) is common. In Nainital all the common indigenous fish species except the barbs have some economic importance while in Bhimtal and Naukuchiatal, mrigala carp is harvested for food. According to the IUCN RedList, two globally threatened species *Tor putitora* (Golden Mahseer)

and *Schizothorax richardsonii* (snow trout) assessed as Endangered and Vulnerable, respectively are present in the lakes. After eutrophication of the lakes, fish stocks severely declined with the mahseers (*Tor* spp.) and other species becoming extirpated. After conservation measures improved water quality Govind Ballabh Pantnagar University of Agriculture and Technology (for Nainital) and the Directorate of Coldwater Fisheries Research (DCRF) (in Bhimtal and Naukuchiatal) have released mahseer fish fingerlings (*Tor tor* and *Tor putitora*) and are continuing conservation stocking of the lakes.

Table 2. Economically important and threatened species found at the site

The IUCN Red List categories are EX – Extinct; EW Extinct in the Wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern; DD – Data Deficient; NA – Not assessed. The categories CR, EN and VU are classed as the ‘threatened’ categories. ‘*’ indicates a draft Red List assessment, that still needs to be peer reviewed.

Species binomial	Common name	Lakes present	IUCN Red List Category	Economic importance	Population trend at site
<i>Carassius carassius</i>	Crusian carp	Nainital	Introduced	Negligible	Occasionally found
<i>Chagunius chagunio</i>	Chaguni	Bhimtal; Naukuchiatal	LC	High	Occasionally found
<i>Cirrhinus mrigala</i>	Mrigala carp	Bhimtal; Naukuchiatal	LC	Food fish	Common
<i>Cyprinus caprio</i>	Common carp	Nainital; Bhimtal; Naukuchiatal	Introduced	Dominant in fish catches	Abundant
<i>Garra gotyla</i>	Sueku head	Nainital	LC	High	Occasionally found
<i>Labeo calbasu</i>	Orange fish labeo	Bhimtal; Naukuchiatal	LC	Food fish	Occasionally found

Species binomial	Common name	Lakes present	IUCN Red List Category	Economic importance	Population trend at site
<i>Labeo rohita</i>	Rohu	Nainital; Bhimtal; Naukuchiatal	LC	High value food fish	Abundant
<i>Mastacembelus armatus</i>	Spiny eel	Bhimtal; Naukuchiatal	LC	High value food fish	Occasionally found
<i>Schizothorax kumaonensis</i>		Nainital	DD	Important for angling	
<i>Schizothorax plagiosomus</i>	Hill trout	Nainital	Not assessed	Important for angling	
<i>Schizothorax richardsonii</i>	Snow trout	Nainital; Bhimtal; Naukuchiatal	VU	Important for angling	
<i>Tor putitora</i>	Golden Mahseer	Nainital; Bhimtal; Naukuchiatal	EN	Food fish and angling	Abundant
<i>Tor tor</i>	Mahseer	Nainital; Bhimtal; Naukuchiatal	NT	Food fish and angling	Abundant

Of the mollusc species identified *Lymnaea acuminata*, *L. luteola* ., *Gyraulus convexiusculus*, *Bellamya*(viviparous) *bengalensis* are the important species of molluscs in Nainital, whilst in Bhimtal and Naukuchiatal, mainly *Lymnaea* sp. are found. Populations of *Lymnaea acuminata* and *Gyraulus convexiusculus* are reportedly declining in the lakes as their eggs are being eaten by the introduced mosquito fish. However all of the molluscs species are assessed as Least Concern, according to IUCN **Red List Categorization**, and none of them were known to have any direct economic or livelihood value.

Fourteen aquatic plant species were identified at the site, of which *Potamogeton crispus*, *Hydrilla verticillata* and *Persicaria* sp are dominant. None of the plants are known to be of global conservation concern (all assessed as Least Concern) or having any notable use except *Nelumbo nucifera* (lotus flower) which is mainly used for decorative purposes.

Coldwater carps and freshwater bivalves have been identified as potential indicator species as both groups are sensitive to low oxygen levels and pollution.

3.2 Threats to biodiversity

Among the many threats that the lakes are facing the primary threats are pollution from urban waste, agricultural pollution, sedimentation and surface runoff which is causing nutrient levels in the lakes to increase (see Figure 3). Nainital is classed as a nutrient rich hyper-eutrophic lake, with very low water transparency, and suffers from frequent blue-green algae blooms (Gupta *et al.* 2007), with Bhimtal and Naukuchiatal lakes classed as being mesotrophic (Pangare *et al.* 2006). In Nainital during the winter months, low oxygen levels have led to major fish kills of coldwater carps. Another increasing problem in all the lakes is that of litter, particularly in Bhimtal, and the reason behind this is increasing tourist numbers. Overharvesting of fish has caused the declines of many fish species, but now fishing is banned in Nainital and restricted in Bhimtal and as a result of poor water quality as well as not much and appealing fish availability, fishing is not common in Naukuchiatal. Among the introduced fish species *Ctenopharyngodon idella* and *Cyprinus caprio* are known to completely eliminate aquatic plants in introduced habitats altering trophic structure, they also remove spawning substrate, disurb sediment and muddy waters; *Hypophthalmichthys molitrix* feed on plankton that is required by native species including larval fishes and bivalves; and *Gambusia affinis* are extremely aggressive and attack other fish, shredding fins and sometimes killing them, they are also increasing the nutrients in the lake due to their large population size and are eating the eggs of native gastropod species. However various programs have been run that help to improve the quality of lakes, such as, hypolimnetic aeration system, Mission Butterfly. National Lake Region Special Area Development Authority (NLRSDA) has taken up a programme to oxygenate the hypolimnic

layer of the lake through a hypolimnetic aeration system, with aim of increase fish growth and reducing winter kills. Also in 2007 the National Lake Region Special Area Development Authority (NLRSDA) set up a project called Mission Butterfly, which developed an Integrated Solid Waste Management (ISWM) system for 25 clusters (each consisting approximately 250 families) in Nainital town.

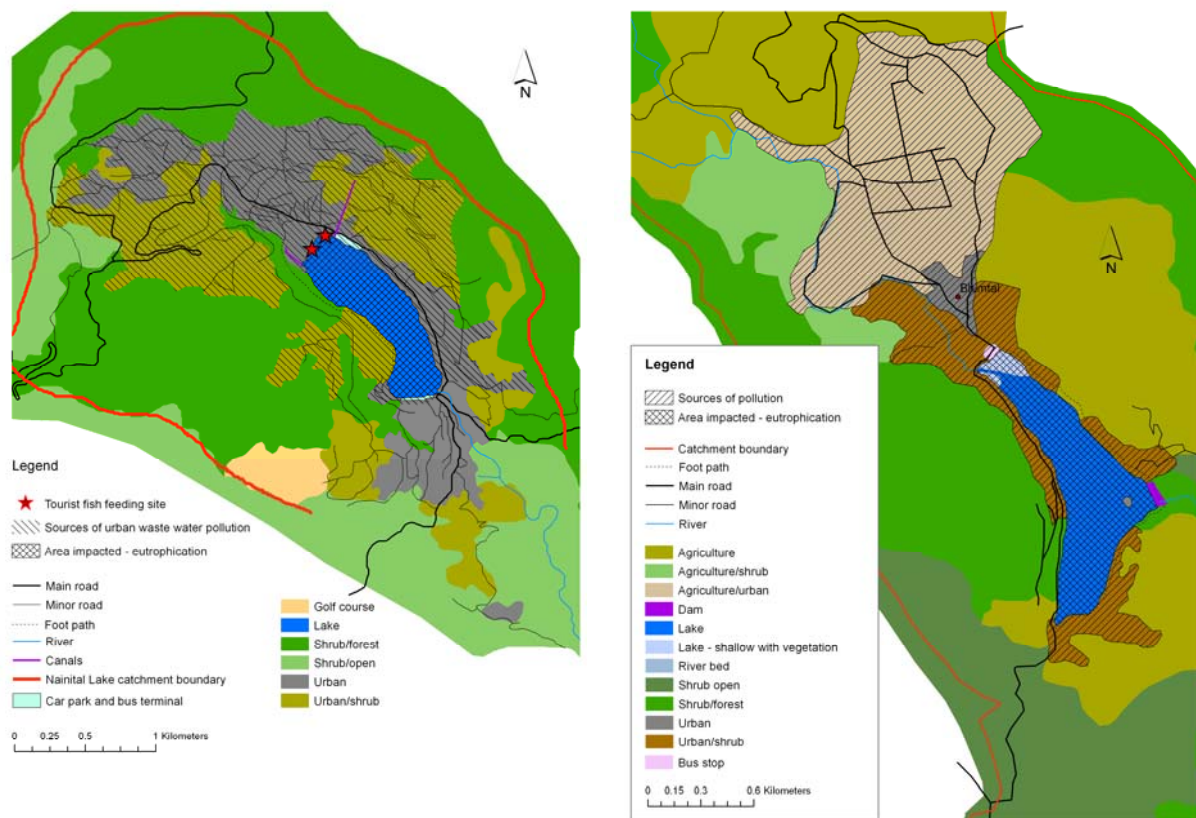


Figure 5. Maps of Nainital (left) and Bhimtal (right) showing major sources of pollution to the lakes.

3.3 Ecosystem service values

An ecosystem is a community of animals and plants (macro- as well as micro), continually interacting with one another and their physical environment. Ecosystem Services are the benefits that people obtain from these ecosystems (See Work package 3 for further details). The ecosystem provides various services or benefits to the people. These are provisioning, regulating, supporting and cultural services.

Ecosystem services that are valued most are tourism, water purification, recreation and water for drinking, with nutrient cycling, climate regulation and water regulation being the least valued. However, different stakeholder groups prioritized different services, with boatmen, fishermen, hotel owners, National Lake Region Special Area Development Authority, tourists, small shop owners and Nainital Nagar Palika Parishad all valuing tourism the highest, whereas the Irrigation Department and farmers valued water for agricultural use the highest, teachers valued water for drinking and fish harvesting the highest, the Directorate of Cold Water Fisheries Research, Bhimtal and National Lake Region Special Area Development Authority valued water purification, whereas the students valued the educational services provided by the lakes the highest. Thus, it can be said that the lakes serve as a lucrative source of varied ecosystem services, whilst biodiversity supported by the lakes must be protected as it helps maintain the balance and resilience of the ecosystem.

Table 3. Results of the ecosystem service prioritisation survey

Types of Ecosystem		Stakeholder Group (10= high value, 1 = low value)												
Service		Red square = Each stakeholder group highest ranked service Blue square = Stakeholder group lowest ranked service												
		Boat drivers	Fishers	Hotel owner	Irrigation Dp.	DCFR	NIRSADA	Jal Sansthan	Tourists	Small shop owner	Teacher	Student	Farmer	NNPP
Cultural	Tourism	10	10	10	9	4	9	9	10	10	3	6	7	10
	Spiritual sites and areas	9	5	8	7	2	4	4	8	8	5	5	5	7
	Recreation	8	7	8	7	2	7	7	9	9	3	7	7	8
	Education	7	3	8	1	7	1	1	2	8	6	9	1	3
Provisioning services	Water use for human	6	5	6	7	3	7	10	6	5	7	6	7	7
	Water use for agriculture water	7	7	6	10	2	3	3	3	3	5	5	10	3
	Fishes for own consumption	6	7	5	3	3	2	2	8	7	7	8	8	6
Regulating Services	Climate regulation	2	2	4	3	6	4	4	4	2	2	1	2	3
	Water regulation	2	3	2	5	7	3	3	3	2	2	2	2	5
	Water purification	7	8	7	8	8	9	9	9	7	5	6	7	9
Supporting services	Nutrient cycling	1	1	1	1	3	2	1	1	1	2	1	1	1

Figure 6 (below) shows the average score given by each stakeholder group, it indicates how much value each group placed on the ecosystem services provided as a whole. All groups

scored between 4 and 6, with hotel owners and boat drivers giving the highest average score of 5.9, closely followed by tourists (5.7) and NNPP and small shop owner (5.6). Teachers and the DCFR gave the lowest average score of 4.3.

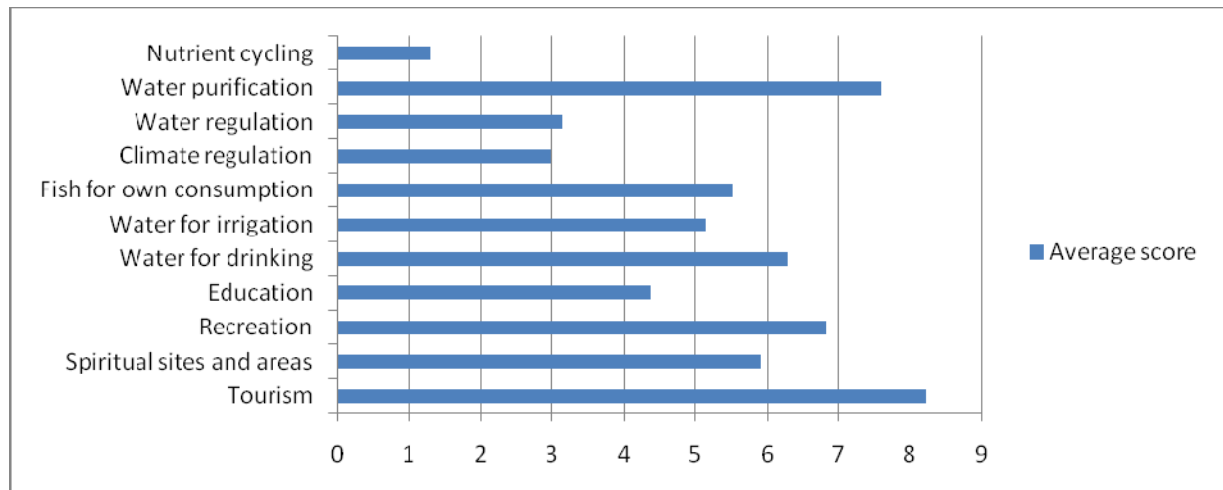


Figure 6. Average score given to each ecosystem service

Tourism is the key industry of the Nainital district, providing income for many of the local populace and is also the most valued ecosystem service provided by the lakes. Tourism is the only cultural ecosystem service to receive the highest value score of 10, it receives this from NNPP(issue licenses for boating, impose toll taxes, and collect tax for keeping clean adjacent areas of Nainital Lake and this revenue is highly linked with the tourists generating a larger revenue during tourist season), small shop owner, hotel owner, boat drivers (these three groups depend directly upon tourism for their livelihood), tourists and fishers (even though commercial fishing is not legally undertaken in the three lakes, illegal fishing does exist and is marketed to locals as well as tourists). Tourism receives a score of 8 or more from all the stakeholder groups apart from the farmers (7), students (6), DCFR (4) and teachers (3). Figure 7 illustrates that the entire upper catchment that include the 3 lakes create the natural visual significance that magnetizes tourists to the region. The figure also demonstrates that the areas gaining are much broader as the whole of Nainital District is benefiting because people from distant travel to the lakes to get employment in the tourism industry, also the tourists

themselves who benefit come to Nainital from all across India as well as abroad. However it should be noted that tourism itself, as a cultural ecosystem service, depends significantly on other ecosystem services such as climate regulation (lakes cooling the surrounding area making it more hospitable) and water purification (if the system can no longer clean itself due excessive loads of pollution it will lose some of its aesthetic value).

Water for human use depends a lot upon water purification. Water use for human consumption & water purification are perhaps the second most decidedly assessed ecosystem service given by the lakes. Water use for drinking is given highest score 10 by Jal Sansthan (responsible for supplying drinking water to households) whereas NLRSDA, NNPP (both aim to improve water quality in the lakes for human use), tourists, shop owners, teachers, farmers and students (they require lakes' water for their personal and household uses rather than livelihood purposes) all of them assessed this ecosystem service with value 7. DCFR and NNPP (responsible for monitoring quality and purity of the water in the lakes so that their biodiversity are maintained) gave water purification nearly the same score 8 and 9 respectively, whereas NLRSDA (LDA) and Jal Sansthan (both playing key roles in the management and conservation of the lakes) scored it 9 and again fishers also gave it a high score of 9 (logic behind it is that cleaner water will help them to catch larger amounts of good quality fish) and remaining stakeholder groups have scored this service slightly less but still all above 5, possibly conceding the significance of this service to many of the other services (tourism, fish harvesting, drinking water etc). Figure 7, illustrates that the remaining naturally vegetated areas within the catchments of Bhimtal and Naukuchiatal are means to the creation of these services, even though the lakes are not purely nourished by surface water but by underground springs etc. If these areas were to be degraded or lost completely these important ecosystem services would be significantly spoiled. It also shows the benefitted areas, the urban areas that get drinking water (Bhimtal, Bilaspur, and Chanoti) and also the town of Haldwani that receives drinking water from Bhimtal lake.

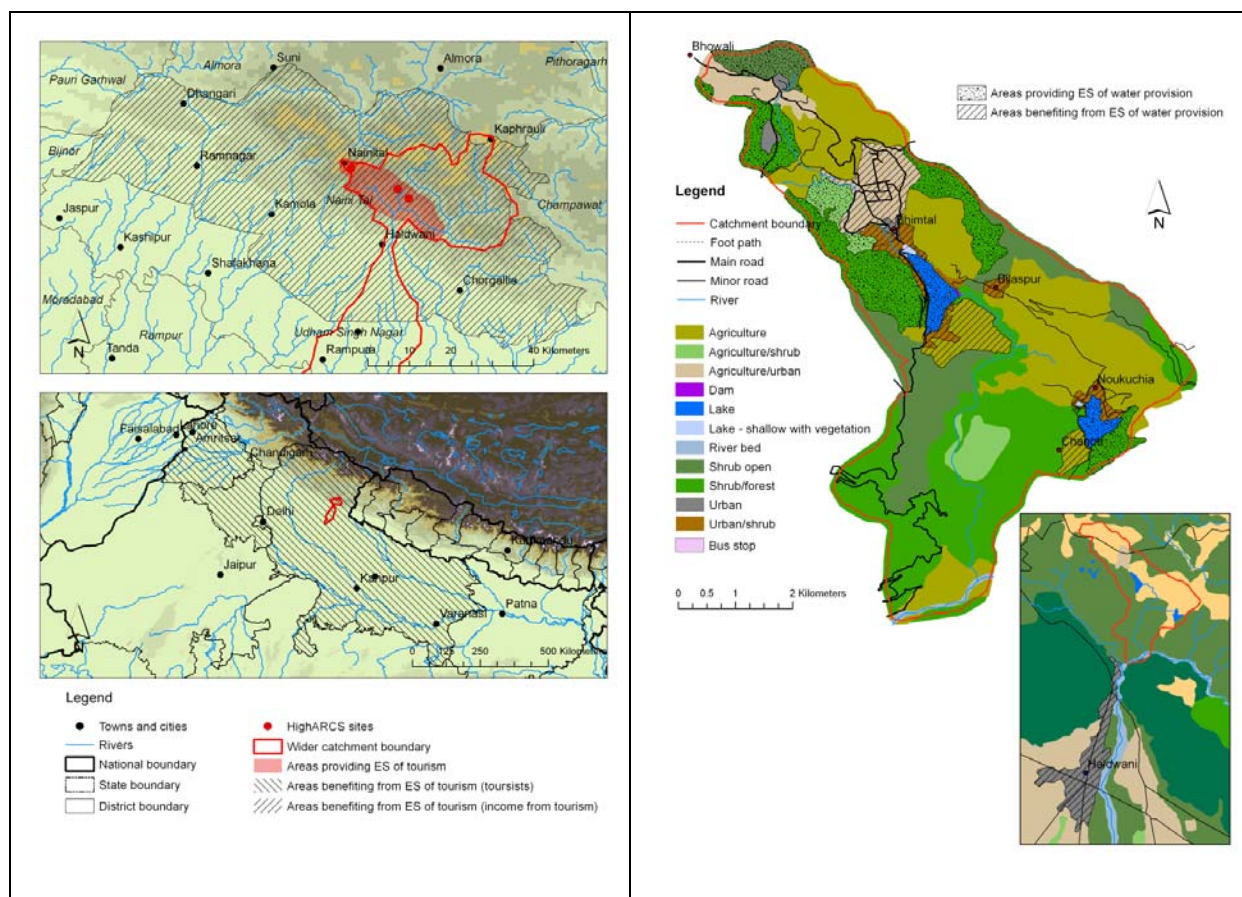


Figure 7. Areas generating and benefiting from the ecosystem services tourism (left) and water provision (right)

4. OVERVIEW OF LIVELIHOODS (WP4)

Following the methodology listed above (section 2) the livelihood activities of people residing in HighARCS site was identified and assessed. Below is a summary of the findings, but please see *Livelihood Report, Uttarakhand Site, India* for the full report that presents and discusses all the findings.

The magnificent beauty of the lakes and the surrounding hilly region attracts tourists from different places of India as well from outside India to come and visit. This makes tourism the most important industry of these areas providing various livelihood earning options such as

boating, agriculture, fishing (though restricted to some sites), hotels, restaurants, operation of small shops, labouring, photography, rickshaw pulling etc to the different stakeholders for the purpose of fulfilling their livelihood objectives. Activities such as boating, fishing, agriculture etc are directly dependent on aquatic resources, whereas hotels, resorts, restaurant owners etc are indirectly dependent. Again activities such as travel agents, local site seeing services, tourist guides, photographers, car repairing, rickshaw pulling etc are not directly dependent on the lakes but are dependent on the tourism economy. However, a large segment of people also work as labourers on others' land or as fish labourers who are hired by the Pant Nagar University for the catching of fishes. Tourism is a seasonal activity as a result of which there occurs a huge fluctuation in the earnings of the lake related livelihoods. Their earning depends on the arrival of the tourists during peak seasons and during the off seasons they have to pursue other types of livelihood activity. The lake is also an important site of recreation for the local people. Again, due to the seasonality of lake related livelihood activities, in this region seasonal migration of people (out-migration) occurs. During summer, people from the surrounding regions migrate seasonally from Nepal, Uttar Pradesh, Bihar and other areas to Nainital to enhance their livelihood whereas during winter as there are fewer tourists and so with the necessity for alternative source of livelihood, people of this region often migrate to different places in and around Nainital. With reference to the above part, we can say that there is a huge seasonal fluctuation in the livelihood activities of people residing in HighARCS site.

In concordance with the agreed terminology for all the sites in the HighARCS project, the households here are classified into three different categories: accumulating, subsistence and coping households with respect to their degree of dependence on aquatic resources, the different ways of utilization of aquatic resources and the benefits acquired from these resources. There is no absolute dependence of one household on the other as the people here are engaged in multiple activities and not just on one livelihood option. Richer households may employ labourers for agriculture, boating or fishing purposes and thus can 'accumulate' through utilizing the lake resources. For poorer households however, there are few sources of accumulation, although access to the lakeside economy for boating, labouring or small scale

trade is essential for their subsistence. The limited numbers of accumulating households are earning from different types of businesses and are directly dependent on the tourism economy. On the other hand, some of the subsistence income families and most of the coping households are dependent on the lakes directly through irrigated agriculture, boating, fish labour and indirectly through labouring in the tourism economy surrounding the lakes. They are more dependent on aquatic resources for their livelihood. Moreover most of the households possess some land for cultivation to produce vegetables for household consumption.

In terms of gender relations, the roles played by men and women in carrying out the various activities of everyday life and livelihood are different. Women generally do not take part in fishing and boating activities. However women run shops, restaurants and also they perform household activities like cleaning utensils, washing clothes and childcare.

Regarding age, young boys and girls generally concentrate on studies and they help their parents only before and after school in doing household work like fetching water, looking after younger siblings, collecting firewood and livestock rearing. When the boys do not go to school or college they do part time boating and fishing work, whilst girls tend to participate more in domestic labour.

But the negative side of tourism is that it is creating pressure on the land as well as on environmental conditions and it is also leading to an increase in construction activities. Different respondents identified different problems, according to women the unstable climate, erratic rainfall, shortage of drinking water during summer compelling them to travel long distances, fluctuating agricultural yields are the issues of major concern. They also complained about the absence of suitable marketing channels for selling handicrafts and other commodities, stating that the Nainital Nagar Palika is not cooperative and it is difficult to secure a trading permit. According to men only the downstream areas of the lake receive irrigation water from the lakes so a proper irrigation system should be developed for the upstream areas. According to boatmen and fishermen the key problem is the seasonality of livelihoods as during December and January it is very difficult to meet their subsistence needs. For the young boys and girls

transportation is a major problem in their lives as they have to travel to distant places for studying or to find reputed schools and colleges. The transport facility in Bhimtal or Naukuchiatal is not so developed and also fluctuates a lot as a result of which the traveling expenses become high.

Almost everyone, from school-college teachers to agricultural workers and even small school going boys and girls are aware of the importance of the environment and the need to protect and conserve the biodiversity. The people in these areas are concerned about the preservation of the lakes. They are aware about the problems of the environment and also the importance of the lakes in their lives. So, necessary action plans should be undertaken so that the aquatic resources are protected and preserved from destruction and at the same time the livelihood of those who are dependent on these resources are retained.

5. OVERVIEW OF INSTITUTIONS, POLICY AND CONFLICT (WP5)

From *Institution, Policy and Conflict Report, Uttarakhand Site, India* we get a compact perception of the legal and policy structure of India and that of the very state, Uttarakhand where the HighARCS site is located. Below is a summary of such understandings, but please see *Institution, Policy and Conflict Report, Uttarakhand Site, India* for the full report that presents and discusses all the perceptions.

As mentioned earlier, the majority of the population in the HighARCS site is dependent on the lakes directly or indirectly to earn their living. This has created a heavy pressure on the aquatic resources and a situation of high competition for access and control over these resources amongst the users and the authorities. In this situation, appropriate institutional arrangements for effective environmental management of the lakes are needed.

For pursuing all the different livelihood activities like fishing, boating, hotels, restaurants, shops it is necessary to take license. There are certain rules and regulations for pursuing these activities. Respective government departments make the rules. However, general people do not have any influence on the rule making process. Moreover there are also cases of conflict of

interests between the rule making organizations and the people for whom the rules are being made. The lakes constitute the most important factor for tourist attraction and hence most of the effort has been directed towards the conservation and the preservation of the lakes. The different agencies have undertaken different policies and programme to directly preserve the lakes and indirectly to maintain the livelihood of the vast majority of the people who are dependent on these aquatic resources. Both government and non government organizations are involved in this task. In this context, it should be mentioned that the Environment Protection Act is the umbrella legislation for environment protection and improvement through regulation of developmental activities. The Biodiversity Act of 2002 is the most important policy dealing with environmental protection and provides for conservation of biological diversity and sustainable use of its components and permits fair and equitable sharing of benefits arising out of the use of biological resources. The Uttarakhand Environment Protection and Pollution Control Board (UEPPCB) is a statutory Organization constituted under the section 4 of Water (Prevention and Control of Pollution) Act, 1974 to implement Environmental laws and rules within the jurisdiction of Uttarakhand. The Board has been entrusted with the powers and functions under the Water (Prevention and Control of Pollution) Act 1974. Subsequently the implementation of Water (Prevention and Control of Pollution) Cess Act, 1977; Air (Prevention and Control Of Pollution) Act, 1981; Environment Protection Act (1986) and the Public Liability Insurance Act, 1991 was also entrusted to the State Board. The primary objective of all these Acts is for maintaining, restoring and reserving the wholesomeness of quality of environment and prevention of hazards to human beings, terrestrial and aquatic flora and fauna. The involvement of the State Board is right from planning comprehensive programmes for the prevention, control or abatement of pollution, advising state Govt. relating to environmental aspects, collecting or disseminating information related to Environment protection and enforcing various provisions of the above Acts to keep the state's environment in a healthy condition.(For further details see D5.1 report).

The government organizations who are engaged in the development of various environmental and associated socio-economic aspects thereby help in preservation of the lakes and indirectly

maintaining the livelihood of the vast majority of the people who are dependent on these aquatic resources. Important institutions operating in the HighARCS site are National Lake Region Special Area Development Authority (NLRSDA), Uttarakhand (Bhimtal) Irrigation Department, Nainital Nagar Palika Parishad (NNPP), Uttarakhand Jal Sansthan (UJS), Uttaranchal Pey Jal Nigam (UPJN), Department of Fisheries, Uttarakhand, Directorate of Cold Water Fisheries Research, Bhimtal, G.B. Pant Institute of Himalayan Environment Development, G.B. Pant Nagar University of Agriculture and Technology, National Institute of Hydrology (NIH), Mahseer Conservancy forum, Kisan Bank, Brajendra Sahay Committee, Power Corporation, Forest Department, Forest Research Centre, Indo Dutch Horticulture, SIDCUL Florist Park, Kumaon Mandal Vikas Nigam (KMVN) and Garhwal Mandal Vikas Nigam (GMVN), Statutory Uttaranchal Tourism Board etc.

Local authorities such as National Lake Region Special Area Development Authority (NLRSDA), Nainital Nagar Palika Parishad (NNPP) and Uttarakhand (Bhimtal) Irrigation Department are instrumental in management and conservation of aquatic resources and for carrying out various conservation and improvement projects. Again, local governing bodies such as NNPP, UJS, Uttarakhand (Bhimtal) Irrigation Department are embodied with the authority of collecting water taxes and water charges from the respective villages. Kisan Bank has been set up by the Central Government to cater to the needs of farmers by helping them to buy inputs like seeds, fertilizers and farm equipments. For poverty alleviation and employment generation the most important step was taken by the Indian Government to remove poverty and ensure employment by implementing the *National Rural Employment Guarantee Bill* which would provide at least 100 days of guaranteed wage employment in every financial year. Also other Government schemes such as *Indira Awas Yojana*, *Pradhan Mantri Gramodaya Yojana* are applicable. In the HighARCS field sites, 90 households were interviewed and it was found from the interview that some of the houses were built under the Indira Awas Yojana Scheme. The non-government associations who are connected in the advancement of diverse environmental and related socio-economic facets, in that way aid in conservation of the lakes and indirectly sustaining the livelihood of huge mass of people who are reliant on these aquatic resources, in

the HighARCS site are NGOs, Unions (Boat drivers union, Car owners and Drivers union etc), Local people, Schools and Associations (e.g. Maitri Women Organisation). A number of NGO's such as Chirag, Chea, Gawal Sena have been operating in the area for the benefit of the people. These NGOs and local organizations are trying their best to conserve the lakes and the adjoining areas. Mission Butterfly for solid waste management and the Lake Warden Scheme for control and minimization of lake pollution are two of the conservation plans undertaken to protect the biodiversity of the lakes. Fishing is restricted in Bhimtal and Naukuchiyatal and it is strictly prohibited in Nainital. Conflicts between Jal Sansthan and the Irrigation department, Fishermen and Government organizations and Rickshaw Pullers and Nainital Nagar Palika are the few examples of conflict of interests between the rule making organizations and the people for whom the rules are being made.

In Nainital, overexploitation of resources by local people has led to conflict between the ecosystem and the socio-economic system. Threats facing Nainital Lake are as follows:

- a) lower level of oxygen in the *hypolimnetic layer* than is required to sustain fish
- b) decreasing levels of dissolved oxygen throughout the water column and at the sediment-water interface
- c) erosion of forests away from the villages leading to scarcity of fuel, fodder and fruit as well as extinction of medicinal herbs
- d) watershed management failure leading to drought and flood conditions, soil erosion, landslides, changes in the microclimate, increase in the silting rate, loss of wildlife, drying up of natural springs
- e) deterioration of forest ecology due to the large-scale replacement of natural forests as well as fire

To tackle the problems government has taken various managerial steps, such as, several underground high pressure jets supplied with highly pressurized air were laid near the lake bed

at various places throughout the lake to improve the quality of the lake water; a number fish species were introduced among which a number of plankton and algae eating fishes along with mosquito larvae eating mosquito fish were introduced in the lakes but though they were introduced with good thought such as speeding up the cleaning process, controlling algal bloom and mosquito larvae yet a number of introduced species are impacting the native species and the ecosystem; replacements of trees etc.

6. SYNTHESIS CHAPTER

In the HighARCS project, the biodiversity and ecosystem services provided by freshwater systems at the HighARCS site, which may contribute to the assessment of the ecological characteristics of the wetlands, that is the lakes, was identified and valued ,i.e., studied intently. Since these wetlands constitute an important source of livelihood for the people, a study has been conducted on the basis of the perceived need to conserve these wetlands. This however has to be done in a way which will balance the livelihood of the people as well as the lake biodiversity. The different Government and Non-Government institutions which are at work and the policies formulated by them for the conservation of the lakes have been reviewed as the management and conservation of the lakes cannot take place without any policy issue guiding it. This includes both policies on biodiversity conservation and livelihood enhancement.

Relation between biodiversity and ecosystem services, livelihoods and institutions, policy and conflict: The HighARCS sites i.e. Nainital, Bhimtal and Naukuchiatal are based on three aquatic resources that is, the three lakes and their aquatic ecosystems. Due to population pressure, and dependence on these aquatic resources for livelihoods in the context of limited alternative employment opportunities, improper development and over exploitation of these resources, there is arguably a need to conserve these resources. The lakes should be managed and maintained well not only because of its natural attraction but also for preserving its biodiversity. However, livelihoods of poor and vulnerable groups should also be protected. In other words, the balance between the livelihoods of the people and the lake biodiversity should

be supported. Different Government and Non-Government institutions are at work and formulated policies for the conservation of the lakes as the management and conservation of the lakes cannot take place without any policy issue guiding it. The different stakeholders such as the boatmen, fishermen, tourists, small shops and restaurant owners are dependent on these lakes ecosystem and the services they sustain. These groups of people, who are directly and indirectly dependent on the lakes and utilize the aquatic resources, are the ones who influence the lakes mostly and are affected by any changes in the lake. Since, the livelihoods of the people are dependent on the biodiversity and both biodiversity and livelihoods has to be protected by a policy approach thus we can say there exists relationship between biodiversity and ecosystem services, livelihoods and institutions, policy and conflict. The relationship between biodiversity and ecosystem services, livelihoods and institutions, policy and conflict can be explained with the help of many examples, some of them are:

i) the aquatic regions of HighARCS sites are bestowed with large population of both indigenous and exotic cultivable and non-cultivable fish species, including the globally threatened Golden Mahseer (*Tor putitora*) and Snow Trout (*Schizothorax richardsonii*). The presence of such diverse range of aquatic fauna makes fishing an occupation which is pursued by many people to maintain their livelihoods. But the overharvesting of fish along with eutrophication of the lakes has caused the declines of many fish species with the mahseers (*Tor* spp.) and other species becoming extirpated and thereby hampering the biodiversity of the lakes. The National Lake Region Special Area Development Authority (NLRSDA) has been authorized by the Govind Ballabh Pantnagar University of Agriculture and Technology to formulate decisions regarding the cultivation and catching of fish. To restrict the overharvesting of fish, the way that was taken initially was the introduction of fishing licenses. These licenses are to be issued by the Department of Fisheries, Uttarakhand and in case of Nainital, Nainital Nagar Palika Parishad (NNPP) also do the job. But to maintain the biodiversity of the lakes fishing license was not enough so it was decided to ban fishing in in Nainital Lake, and in Bhimtal and Naukuchiatal to regulate it (i.e., there is a limit as to how many fish can actually be caught). The relevant authorities; Govind Ballabh Pantnagar University of Agriculture and Technology (for Nainital)

and the Directorate of Coldwater Fisheries Research (DCRF) (in Bhimtal and Naukuchiatal) who are involved in monitoring lakes' water quality and maintaining and stocking fish stock levels in the lakes have released mahseer fish fingerlings (*Tor tor* and *Tor putitora*) and are continuing conservation stocking of the lakes.

ii) Boating for tourists is an important occupation of the people surrounding the lakes in all three sites. But it is exerting negative impact on the biodiversity of the lakes. The tourists who enjoy boating in the lake throw left over edibles, plastic packets and polythene-bags in to the lakes without any consideration, even though some bins are present on the lakes' side. This kind of waste is reportedly obstructing the free flow of the fresh water in the lakes and thus it can be said that this throw away mentality of the tourists is responsible for environmental pollution and thereby hampering the biodiversity of the lakes. So to maintain the biodiversity of the lakes and to reduce environmental pollution, district administration authorities (local authorities) have prohibited polythene bags in Nainital and there are also proposals to ban them in Bhimtal.

Briefly, by providing licenses and making some rules the state government tries to rationalize the use of the lakes, i.e. restricting its exploitation after a certain level. Thus in this way the government restricts fishing and the number of boats and thereby try to maintain a balance between biodiversity of the lakes and livelihoods associated with the lakes.

7. Action Planning Process and Methodology

Any Action Plan which aims to conserve and manage biodiversity along with fulfilling and improving local community interests and livelihoods must combine biodiversity and ecosystem service values, livelihoods and institutions, policy and conflict issues and thereby take an integrated approach. For meeting this requirement a detailed study of the relevant reports, i.e. Biodiversity and ecosystem service values of Nainital, Uttarakhand; Livelihood Report, Uttarakhand Site, India; Institutions, Policy and Conflict, Uttarakhand Site, India; was done and this helped us to understand the issues of aquatic resources conservation and the conflicts for sustainable development more deeply.

In the HighARCS project, the freshwater biodiversity and ecosystem services at the HighARCS site, which may aid in evaluation of the ecological attributes of the wetlands, that is the lakes, were recognized and valued ,i.e., studied closely. Since these wetlands comprise a vital source of livelihood for the people, a study has been carried out on the basis of the apparent necessity to preserve these wetlands. This however has to be done in a way which will balance the livelihood of the people as well as the lakes' biodiversity. The different Governmental Institutions which are at work and the policies formulated by them for the conservation of the lakes have been evaluated. This includes both policies on biodiversity conservation and livelihood enhancement. On the basis of these three reports the Integrated Action Plan report has to be done which includes notable aspects of needs and deficiencies, conflicts of biodiversity conservation, livelihood development within an integrated policy framework.

The need for an integrated assessment and planning approach was highlighted in Figure 8 which shows the amalgamation of conservation, livelihoods and policy-based approaches. These three strands have been combined because the livelihoods of people are dependent on biodiversity and both biodiversity and livelihoods must be protected by a policy approach. Hence with this integrated view an Integrated Action Plan has to be formulated where the three interdependent issues of needs and deficiencies, conflicts or negative impacts and indicators have been combined together (Figure 8).

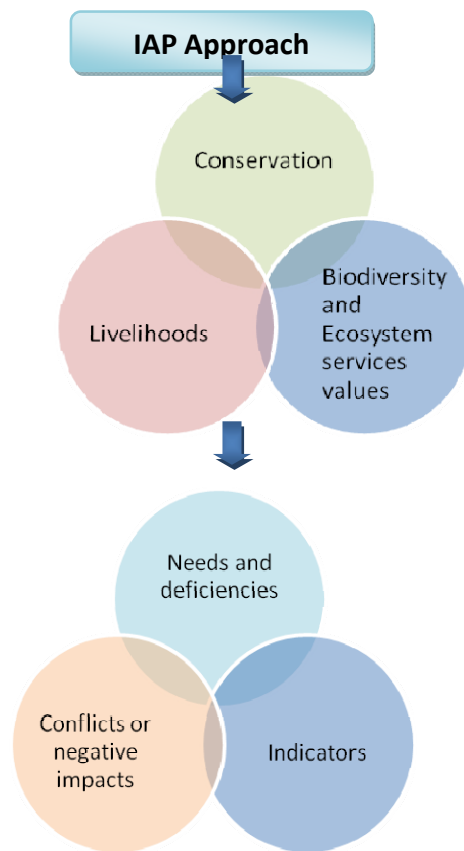


Figure 8. Flow Chart showing IAP approach

The HighARCS survey began on the 17th of April 2010 in the three primary field sites, namely, Chanoti village near Naukuchiatal, Pandeygaon village near Bhimtal and Nainital proper (the area covering nearly 0.5 km radius surrounding the Nainital Lake) (figure 2). Before working on formulating the Integrated Action Plan we identified highland wetlands by considering ecological importance and livelihood potentials in Uttarakhand. Selected wetlands for our project, conducted field visits, collected data, gathered information about these wetland related livelihoods and biological resources from secondary sources. Listed out direct and indirect stakeholders through the analysis of focus group interview and wetland sites, selected sample villages, i.e. Nainital, Chanoti and Pandeygaon on the basis of the place of residence of the families engaged in different types of activities associated with these wetlands. Arranged

meetings and workshop with the stakeholders to discuss situation and management issues and adopted the stakeholder Delphi method to structure the joint identification and assessment of problems and management issues affecting the full range of stakeholders associated with the lakes in the study site.

In the selected locations chosen as field sites, the informal focus group interviews were conducted in the villages situated near to the lakes. On the basis of these informal focus group interviews, a detailed discussion with the stakeholders was carried out. For more in depth study, a detailed household survey was carried out in a minimum of thirty households in each village. These included fishers, boat drivers, rickshaw pullers, school going girls and boys and all those men, women and young boys and girls whose livelihoods are in some way related to and dependent on the lakes in this region. Informal interviews were also carried out in villages nearby to each of these sites such as Siloti, Sanguri, Karkotak, Shongaon, Pangot and Pali. Further analyses were made on the issues mentioned by the stakeholders during the interviews. Draft Integrated Action Plans were then formulated on the basis of these issues, focused on mitigation and or improvement. The issues, mitigation and improvement plans will be verified through a process of joint assessment and decision-making with stakeholders. And on the basis of these verification discussions, the final Integrated Action Plan will be formulated and agreed. The process is summarized in Figure 9.

In our Integrated Action Plan we have concentrated on realistic actions and identified their goals, timescale, main agencies in charge of implementation and/or finance, their capacity and commitment and/or incentives they have for undertaking the action, indicators for success, and difficulties which may be faced during implementation.

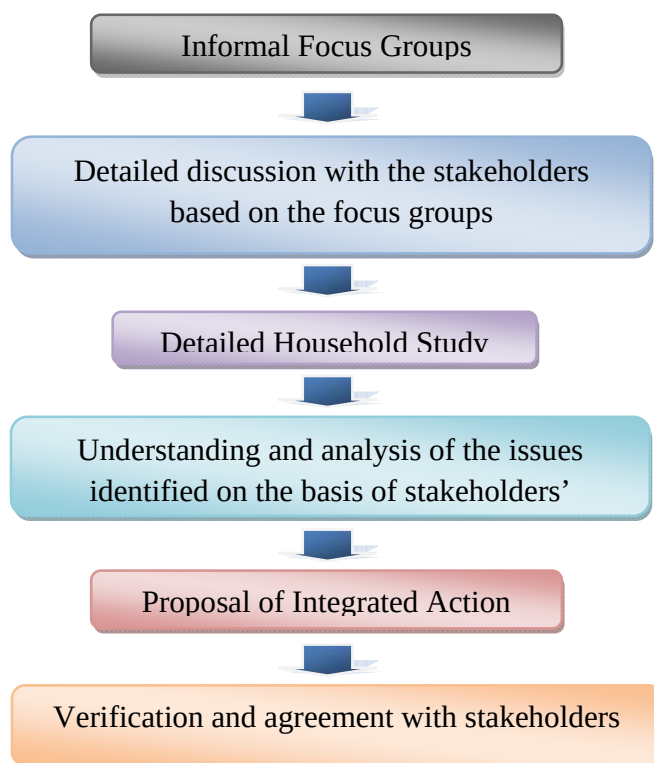


Fig 9: Formulation Process of final Integrated Action Plan

The field site areas being the lakes and the immediate surroundings, the stakeholders are chosen in accordance to the site, being directly or indirectly associated with the lakes. Here association means any kind of interaction with the chosen lakes. IAP report here covers a diverse range of stakeholders which can broadly be classified into

- 1) National Lake Region Special Area Development Authority (NLRSDA) and G.B. Pant Nagar University of Agriculture and Technology via NLRSDA.
- 2) Department of Fisheries, Uttarakhand.
- 3) Directorate of Cold Water Fisheries Research, Bhimtal.
- 4) Nainital Nagar Palika Parishad (NNPP).
- 5) Bhimtal Municipality and Naukuchiatal Panchayat.
- 6) Uttarakhand (Bhimtal) Irrigation Department.
- 7) Interested local schools, colleges, NGOs and local people.

- 8) Department of Agriculture, Govt. of Uttarakhand.
- 9) Kisan Bank.
- 10) Boat drivers.
- 11) Fishers.
- 12) Tourists.
- 13) HighARCS team.

The rationale behind the involvement these above mentioned stakeholders in the proposed action plans is given in each action plan accordingly.

8. Management Proposals

The main focus of the proposed actions is to improve the management and conservation of aquatic resources in the lakes as well as benefit the local people, which in other words, can also be termed as “Wise-Use of Wetlands”. With reference to Ramsar Convention, “Wise Use of Wetlands” is the maintenance of ecological character, sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem. That is, the ‘Wise Use of Wetlands’ mainly comprises of three components:

- 1) Maintenance of biological, chemical and physical components of wetlands.
- 2) Maintenance of ecological balance between the components of wetlands.
- 3) Protect the livelihood of the local people who are directly or indirectly dependent on wetlands.

Fishing, integrated farming, agriculture, forestry, aquaculture, transportation and nature tourism may be consisted with wise use within certain limits, but can damage wetlands and become unwise uses if they exceed the carrying capacity of the concerned wetland systems.

The recommended actions from our team to solve the Management Issue(s) and the general aims of the project at our field site are as follows:

- 1) **Monitoring on illegal fishing**
- 2) **Fish release programmes**

- 3) **Monitoring to prevent garbage and waste water disposal in and around the lakes**
- 4) **Marketing of Handicrafts**
- 5) **Marketing of Agricultural products**
- 6) **Crop Protection**
- 7) **Desiltation of Bhimtal lake**

1) Monitoring on illegal fishing

Objectives

0 Activities to be carried out

- 1) Hold stakeholder meetings with local authorities and local stakeholders to discuss the options of how to effectively resist illegal fishing.
- 2) Expanding the Group/Committee who will be responsible for monitoring the lakes.
- 3) There should be strict rules/laws which would prevent the fishers, boat drivers, tourists and local people from illegal fishing. But again it should be kept in mind that these rules/laws should be developed with the concern of related authorities and stakeholders jointly because in that way, awareness, legitimacy, and commitment to rules/laws is more likely to emerge.
- 4) It can be suggested from HighARCS team that the Department of Fisheries, Uttarakhand should have a rule of catch-and-release for fish species of conservation concern. For implementation of this catch-and-release rule, identification of fish species of conservation concern and expertise on the part of the people involved in fish catches so that they can recognize conservation concern fish species and release them when they are caught are required. Identification of fish species of conservation concern can be done with the help of Directorate of Cold Water Fisheries Research, Bhimtal and G.B. Pant Nagar University of Agriculture and Technology in association with Department of Fisheries, Uttarakhand (if they agree to do so). Expertise on the part of the people involved in fish catches can be achieved

through a training programme for the fishers with the help of Department of Fisheries, Uttarakhand (if the department agrees to do so).

5) Poster campaign for fishers and local people to spread awareness about the disadvantages of illegal fishing, involving schools, colleges, local NGOs and interested local people. And also asking fishers, boat drivers, tourist offices and maybe some of the temples to do their bit for successful implementation of this action.

6) Seeking local government assistance to implement this action.

o *Reasons for Prioritization*

1) Though consuming fish is not a traditional practice in Nainital region, the harvesting of fishes in Nainital had increased dramatically mostly to supply the tourist industry, leading to the decline of existing fish stock in the lakes. As a result of which legally fishing is strictly prohibited in Nainital and regulated in Bhimtal and Naukuchiatal. However, enforcement of this ban leads to the common problem of illegal fishing activities.

1) Fishing is strictly prohibited in Nainital, but still it occurs legally by fishermen, boatmen, tourists and local people (we came to know this information by discussing with the local people).

2) In Bhimtal and Naukuchiatal fishing is limited to 4 kg/person per day throughout the year. But whether it is followed or not, cannot be said with certainty.

o *Potential issues*

1) The unprofessional fishermen who are not much conversant with the right methods of fishing are adversely affecting the biodiversity of these lakes.

2) Fishermen, boatmen and local people may not be cooperative as some are less aware about the ecological issues.

o *Geographical Scale*

The focus should be on Bhimtal lake, Naukuchiatal lake and Nainital lake.

Gender and age mainstreaming

Men are directly involved in fishing and boating, while women and girls do not as a livelihood option participate in fishing and boating in our field sites. Both of these activities are mainly dominated by men. So this will benefit them directly but women and girls indirectly as part of overall household livelihood strategies.

Improved income from tourism due to enhanced environmental quality will be beneficial not only to men, but to male youth who take up a lot of tourism related work in jobs such as boating. Improved income for this group is important given the difficulties finding employment at school leaving age. Women and girls unfortunately have less involvement in the tourism economy in Bhimtal and Naukuchiatal so it will not benefit them directly. However, many women have stalls alongside Nainital Lake, so they may benefit from increased tourist numbers.

Implementer

o *Who will take a lead in implementing the action?*

- 1) HighARCS team.
- 2) Department of Fisheries, Uttarakhand.
- 3) Directorate of Cold Water Fisheries Research, Bhimtal.
- 4) G.B. Pant Nagar University of Agriculture and Technology.
- 5) National Lake Region Special Area Development Authority (NLRSDA).
- 6) Interested local people (taking part in adjusting the rules of access and control and in lake monitoring for prohibiting illegal fishing).

7) Schools, colleges, NGOs and interested local people (taking part in poster campaigns and awareness spreading).

o *How will they do it?*

1) HighARCS team will take a lead in initiating stakeholder meetings.

2) Fishing licenses are issued by the Department of Fisheries, Uttarakhand. The fisheries department along with Nainital Nagar Palika makes rules on how much quantities and what species of fish can be collected. It prevents over fishing. To maintain the biodiversity of the lake there are restrictions put on by the fisheries department, each fisherman can withdraw 4 kg of fish per day and only the people having the fishing license are permitted to catch fish in these lakes by the method of angling. As per HighARCS team suggestion, the Department of Fisheries, Uttarakhand should have a rule of catch-and-release for fish species of conservation concern and should look after its proper implementation (if the department agree with HighARCS team suggestion and is willing for its implementation). So, Department of Fisheries, Uttarakhand can be approached to take a leading part in implementing this action.

3) Directorate of Cold Water Fisheries Research (DCFR), Bhimtal has the accountability to maintain the biodiversity of the Bhimtal Lake. Being involved in research work related to fishes, Directorate of Cold Water Fisheries Research, Bhimtal can play a role in identification of fish species of conservation concern. So, it can also be approached to take part in implementing this action.

4) G.B. Pant Nagar University of Agriculture and Technology collects the fishes from the lakes when they grow large in number, and instead they plant fish seeds for culture. A large segment of people who also work as labourers in others' land or as fish labourers are hired by the Pant Nagar University for the catching of fishes thereby providing them a source of livelihood as well as controlling the fish catches. It can be recommended from HighARCS team that apart from hiring fish labourers, G.B. Pant Nagar University of Agriculture and Technology can involve its

committed students in this work as part of their project work. Being involved in research work, G.B. Pant Nagar University of Agriculture and Technology can also play a role in identification of fish species of conservation concern. So, it can be approached to take an active part in implementing this action.

5) National Lake Region Special Area Development Authority (NLRSDA) can be approached for implementing this action as they possess the authority to finance this action.

6) HighARCS team in association with Department of Fisheries, Uttarakhand can take the lead in initiating the process of organizing group/committee that will be responsible for monitoring the lakes for prohibiting illegal fishing involving interested local people. In spite of the fact that this project is a time limited project and HighARCS team live far away from the site, the said group/committee must be socially self-sustaining after the end of HighARCS so the responsibility of it can be given to GB Pant Nagar University or some local NGO with due permission from Department of Fisheries, Uttarakhand.

7) HighARCS team can take part in arranging poster campaigns involving schools, colleges, NGOs and interested local people.

o *Who will finance the action?*

National Lake Region Special Area Development Authority (NLRSDA) comprises of five planning zones Nainital, Bhowali, Mehraon (khas), Bhimtal (including Sattal) and Naukuchiatal. This authority shoulders the responsibility of preparing and enforcing the development plans for lake conservation. NLRSDA is the nodal agency for Nainital Lake Conservation Project (NLCP). It is commonly known as Lake Development Authority (LDA). So, National Lake Region Special Area Development Authority (NLRSDA) could be approached to finance this action. Along with NLRSDA, Department of Fisheries, Uttarakhand could also be approached to finance this action as it has the accountability to maintain the fish biodiversity of the lakes in Uttarakhand.

o *Over what timescale?*

To check whether this action is a success or failure, the minimum time period required is 6 months to 1 year. But this action is proposed keeping in mind that it would be a continuing process and should continue even after the end of HighARCS project for maintaining the fish biodiversity in the concerned lakes.

Indicator

O Indicators of success

If illegal fishing is stopped in the concerned lakes then generally we can say that this proposed action is successful. Along with that the annual assessment of fish stock in the three lakes can also be taken as indicator of success of this action.

O Who will do the monitoring and evaluation

Whether illegal fishing has stopped or not this information can be obtained from local people and supervising team who will supervise the work of the group/committee responsible for monitoring lakes to prevent illegal fishing. NLRSDA in association with Department of Fisheries, Uttarakhand can be approached for assessment of annual fish stock in Nainital while in case of Bhimtal and Naukuchiatal, DCFR in association with Department of Fisheries, Uttarakhand, can be approached for this assessment.

2) Fish release programmes

Objectives

O *Activities to be carried out*

1) There can be fish release programmes in the lakes which may engage local people as laborers. This fish release programme will be conducted on the basis of current stock management practices which was developed by the concerned department focusing on threatened or decline fish species of the area to maintain the fish biodiversity of the lakes. Fish release programmes should be such that would enhance surveillance and also new introductions of

invasive or non-native species programs should be prevented to eradicate or reduce non-native species populations.

2) The fish release programmes in the lakes can also involve school and college students because in that way they would be aware about conservation concern fish species of their area and that would help in spreading awareness which is required for future conservation of the lakes.

3) Hold stakeholder meetings with local authorities to discuss the progress of existing fish programmes and the other alternative processes through which these fish release programmes could be conducted.

4) This could be done by tourists whereby they will pay to release the fish, as was observed in Shaoguan, China. If the tourists are willing to release the fish they have to buy them.

5) Directorate of Cold Water Fisheries Research, Bhimtal and G.B. Pant Nagar University of Agriculture and Technology in association with Department of Fisheries, Uttarakhand Department of Fisheries, Uttarakhand can play a role in deciding which fish to release according to present ecological interests. Another fact is that risks from disease and parasite introductions must be considered and managed even when fish species selection is good. These organizations can be approached to initiate proper research work to identify present threatened or decline fish species of the area so that fish biodiversity of the lakes can be maintained.

0 *Reasons for prioritization*

1) Fishermen depend largely on the lakes for their main source of livelihood.

2) Maintenance of fish population in the lakes, thereby protecting biodiversity of the lakes.

3) Better resource availability to the fishermen.

4) Fish release programmes in the lakes which may engage local people as laborers, can increase employment opportunities locally.

o *Potential issues*

1) If fish release programmes are not conducted taking into consideration the ecological interests that may exert negative impact on biological diversity.

2) There is always a risk factor involved with the restocking of fishes, as the restocking of fishes may not suite the current ecological condition of the lakes or wrong fishes may be restocked. Risks from disease and parasite introductions are always there even when fish species selection is good.

3) Fishermen, boatmen, tourists and local people may not be cooperative as some are less aware about the ecological issues.

o *Geographical Scale*

The focus should be on Bhimtal lake, Naukuchiatal lake and Nainital lake.

Gender and age mainstreaming

This will primarily benefit men and older boys who are engaged in boating and fishing (boating and fishing both are male dominant occupation). Again, enhanced tourism income due to improvement in lakes' biodiversity and scenic beauty would benefit men, boys, women and girls in the field sites, but men and boys would be directly benefited while women and girls would be benefited indirectly.

Implementation

o *Who will take a lead in implementing the action?*

- 1) HighARCS team.
- 2) Department of Fisheries, Uttarakhand.
- 3) Directorate of Cold Water Fisheries Research, Bhimtal.
- 4) G.B. Pant Nagar University of Agriculture and Technology.
- 6) National Lake Region Special Area Development Authority (NLRSDA).
- 7) School and college students (taking part in fish release programmes).

o *How will they do it?*

- 1) HighARCS team will take a lead in initiating stakeholder meetings.
- 2) Any decision and step regarding fish species in Uttarakhand cannot be taken without the concern of Department of Fisheries, Uttarakhand. It also has the power to approve and implement any action related to these species. Hence, it can be approached to take part in implementation of this action as well as identify different organizations that can help in proper implementation of this action.
- 3) Directorate of Cold Water Fisheries Research, Bhimtal has the accountability to maintain the biodiversity of Bhimtal and Naukuchiatal lakes. The fish culture and study is conducted by them. Hence, it can be approached to take up more fish release programmes, under the Central and State Government projects and it can also hire few local fish laborers and thereby can become a leading organization behind the implementation of this action. Being involved in research work related to fishes, Directorate of Cold Water Fisheries Research, Bhimtal can be approached to play a role in identification of present threatened or decline fish species of the concerned area.

4) G.B. Pant Nagar University of Agriculture and Technology collects the fishes from the lakes when they grow large in number, and instead they plant fish seeds for culture. A large segment of people who also work as labourers in others' land or as fish labourers are hired by the Pant Nagar University for the catching of fishes thereby providing them a source of livelihood as well as controlling the fish catches. Being involved in research oriented work, G.B. Pant Nagar University of Agriculture and Technology can also play a role in identification of present threatened or decline fish species of the concerned area. Hence, it can also be approached to take an active part in implementing this action.

5) National Lake Region Special Area Development Authority (NLRSDA) can be approached for implementing this action as they possess the authority to finance this action.

6) HighARCS team can recommend to the concerned department that school and college students can be involved in the fish release programmes.

O *Who will finance the action?*

NLRSDA is in charge for maintaining all the lakes in the Kumaon Region. It is the planning and development authority for Nainital lake region area. It comprises of five planning zones Nainital, Bhowali, Mehragaon (khas), Bhimtal (including Sattal) and Naukuchiatal. This authority shoulders the responsibility of preparing and enforcing the development plans for lake conservation. NLRSDA is the nodal agency for Nainital Lake Conservation Project (NLCP). It is commonly known as Lake Development Authority (LDA). National Lake Region Special Area Development Authority (NLRSDA) could be approach to finance this action. Along with NLRSDA, Department of Fisheries, Uttarakhand could also be approached to finance this action as it has the accountability to maintain the fish biodiversity of the lakes in Uttarakhand.

o *Over what timescale?*

To check whether this undertaken action is a success or failure, the minimum time period require is 6 months to 1 year.

Indicator

o *Indicators of success*

After releasing figure lings in the lakes, the evaluation of survival/mortality rate of the species and their impact on fish biodiversity. Along with that annual assessment of fish stock in the three lakes to find out whether there is any positive/negative/ no change in the enhancement of the fish stock and to check where the fish population according to ecological interests is balanced or not can also be an indicator of success for this action.

o *Who will do the monitoring and evaluation*

For evaluating the survival/mortality rate of the species, their impact on fish biodiversity and annual assessment of fish stock, NLRSDA in association with Department of Fisheries, Uttarakhand can be approached in case of Nainital while DCFR in association with Department of Fisheries, Uttarakhand can be approached in case of Bhimtal and Naukuchiatal

3) Monitoring to prevent garbage and waste water (nutrients) disposal in and around the lakes

Objectives

o *Activities to be carried out*

1) Hold stakeholder meetings with local authorities to discuss the possible options to prevent garbage disposal in and around the lakes.

2) A strict regular monitoring around the lake to look out and prevent the disposal of garbage and waste water in the lakes of Bhimtal and Naukuchiatal. Local people can be employed for the look after of the lakes and can be paid on daily/monthly basis. This system is already present in Nainital. Around 6 to 7 people can be hired for regular monitoring around Nainital lake, around 8 to 9 people required for Bhimtal lake and 6 to 7 people for Naukuchiatal lake.[Length of shoreline: Nainital-3630m; Bhimtal- 4023m; Naukuchiatal- 3560m. We have assumed that, for monitoring 1 Km, approximately 2 persons are required.]

3) Building awareness of cultural heritage of lakes and need for environmental protection amongst tourists and local people may also help. This could include giving training to guides and boatmen to warn tourists against disposing of garbage in the lakes. This could take more the form of a meeting, and the team could also learn from the guides/boatmen's own ecological knowledge. The aim would be to gain a commitment from them to inform tourists about environmental issues and encourage 'ecological' behavior.

4) Put emphasis on the matter of prohibition of disposal of waste water (nutrients) in and around the lakes, collection of plastics in definite vats and time to time cleaning of vats in the front concerned department in the stakeholder meeting.

5) Visual tools such as posters could be presented next to ticket counters for tourists with an aim to reduce their throw away mentality and imposition of fine if anyone tries to pollute the lake and adjacent areas.

6) Seeking local government assistance to implement this action.

0 *Reasons for Prioritization*

1) Throwing away of plastic bottles and polythene by the tourists and local people is degrading the environment day by day.

2) Vats present adjacent to the lakes are found not to be cleaned time to time.

3) Absence of proper sewage system.

4) The protection of the water quality will also help to protect biodiversity of aquatic species.

5) If the visual appearance of the lakes improves, then that will increase the length of tourists stay time and thereby will increase its value as a tourist attraction. As a result, the income of those people whose livelihood depend on tourism industry will enhance and thereby their standard of living.

6) This, alongside the mobilization of local people to assist with monitoring, can increase employment opportunities locally.

o *Potential issues*

1) Waste water (nutrients) from houses adjacent to the lakes, often usually gets disposed in the lakes. The matter more alarming in case of Nainital lake compared to others because it is situated in proper city.

2) Hotels and restaurants situated nearby the lakes, often usually throw their garbage in the lakes.

3) Some tourists while boating have a tendency to throw food packets, plastic packets etc in the lakes.

4) Hotel or restaurants' owners and local people may not be cooperative as most of them are profit maximizer and some are less aware about the ecological issues.

o *Geographical Scale*

The focus should be on Bhimtal lake, Naukuchiatal lake and Nainital lake.

Gender and age mainstreaming

Once again improved income from tourism due to enhanced environmental quality will benefit men and older boys (youth). However, it will not directly benefit women or girls given that they have limited involvement in the tourism economy in Bhimtal and Naukuchiatal.

Nevertheless, women and girls can be involved more directly in the actual implementation of the project. For example, women could be employed on the monitoring teams if they agree. Similarly, school children (both boys and girls) could be involved in disseminating and producing publicity materials, such as a school poster competition. This would help give them some ownership of the project, and would also spread environmental awareness amongst the new generation.

Implementer

o *Who will take a lead in implementing the action?*

- 1) HighARCS team.
- 2) National Lake Region Special Area Development Authority (NLRSDA).
- 3) Nainital Nagar Palika Parishad (NNPP).
- 4) Bhimtal Municipality and Naukuchiatal Panchayat.
- 5) Schools, colleges, NGOs and interested local people (taking part in lake monitoring for preventing garbage disposal as well as taking part in poster campaigns and awareness spreading).

o *How will they do it?*

- 1) HighARCS team will take a lead in initiating stakeholder meetings as well as publicity and awareness raising activities.

Regarding Lake monitoring, a meeting will need to be held with the NLRSDA to decide on the next stage.

Regarding Publicity materials/group meeting or training for guides and boatmen

- A first stage would be to agree on the key environmental issues where changed behavior could have an impact. (e.g. disposal of litter in the lake, unnecessary use of plastic bags).
- A second stage would be to develop publicity materials, perhaps in collaboration with local school children, college students, local NGOs and interested local people.
- A third stage would be to arrange the meeting for guides and boat drivers.

2) National Lake Region Special Area Development Authority (NLRSDA) can hire people for the regular monitoring of the lakes. There is already a project in Nainital named Lake Warden Scheme, where the local people are engaged to supervise the lake like in the lakeside there are volunteers to look after the lake. Frequently they investigate about the litter floating in the lake collected by them on boats. This can be developed in Bhimtal and Naukuchiatal also. Thus it can be said that NLRSDA can be approached to take a lead for implementing this action and it also possesses the authority to finance this action.

3) Nainital Nagar Palika Parishad is the Municipality of Nainital town. NNPP is chiefly liable for maintenance for the roads and lakeside roads. So, it can be approached to take an active part in implementing this action.

4) Like NNPP in Nainital, Bhimtal Municipality and Naukuchiatal Panchayat is chiefly liable for maintenance for the roads and lakeside roads in Bhimtal and Naukuchiatal respectively. So, they can be approached to take an active part in implementing this action.

5) HighARCS team in association with NLRSDA can take a part in organizing group/committee that will be responsible for monitoring the lakes for preventing garbage disposal in and around the lakes involving interested local people. The team can also take the lead in arranging publicity and awareness raising activities such as poster campaigns, school poster competition etc involving schools, colleges, NGOs and interested local people.

o *Who will finance the action?*

The three lakes (Nainital, Bhimtal and Naukuchiatal) are located in three different administrative jurisdictions of Nainital Nagar Palika Parishad (NNPP), Bhimtal Municipality and Naukuchiatal Panchayat respectively. They are chiefly liable for maintenance for the roads and lakeside roads of their concerned area. Hence, they could be approached to finance this action.

Regarding the lake monitoring teams, there are no taxes as such which is imposed on the tourists. However, there are some local taxes imposed on vehicles, such as, in Bhimtal, there is a tax of Government which is required to be paid by the vehicles at some entry point which is Rs 20 for cars. This is done through tender. Some amount of money from this could potentially pay for the person who will do the monitoring.

Publicity materials and awareness raising activities will not involve significant expenses because it can be done through poster campaigns, school-college poster competition, school-college essay competition regarding effects of garbage and waste water disposal etc involving schools, colleges, NGOs and interested local people.

However, if we want to offer training to guides and boat drivers about environmental issues, National Lake Region Special Area Development Authority (NLRSA) could be approached to finance this action as this authority shoulders the responsibility of preparing and enforcing the development plans for lake conservation and is the nodal agency for Nainital Lake Conservation Project (NLCP).

o *Over what timescale?*

To check whether this undertaken action is a success or failure, the minimum time period require is 6months to 1 year. But this action is proposed keeping in mind that it would be a

continuing process and should continue even after the end of HighARCS project for maintaining the biodiversity in the concerned lakes.

Indicator

o Indicators of success

Half yearly to annually assessment of frequency / amount of litter, garbage or waste water disposal found in and around the lakes along with that half yearly to annually assessment of water transparency of the lakes can be taken as indicators of success for this action.

o Who will do the monitoring and evaluation

Half yearly to annually assessment of frequency / amount of litter, garbage or waste water disposal found in and around the lakes along with half yearly to annually assessment of water transparency of the lakes can be done by NLR SADA in involving the group/committee responsible for monitoring to prevent garbage and waste water disposal in and around the lakes.

4) Marketing of Handicrafts

Objectives

o Activities to be carried out

1) Hold stakeholder meetings to encourage production and marketing of handicrafts which are generally made by women and girls.

2) Try to find a place where women have a permanent market to sell their handicrafts.

3) Consider exemption from licenses for selling in Nainital bazaar. If this is not possible, we could facilitate the development of a user group, whereby they apply for a license for a stall to sell all the handicrafts, and the profit could be shared- a marketing cooperative.

4) Try to seek concerning authority's assistance in making the process of getting trading license for handicrafts simplified and easy available for the deserving candidate.

5) Try to convince NNPP to be more cooperative while issuing trading license for handicrafts.

6) Seeking local government assistance to implement this action.

7) Seeking local NGOs assistance to implement this action.

o *Reasons for prioritization*

1) Less direct involvement of women and girls in the tourism economy.

2) Lack of proper marketing channels for handicrafts.

3) Lack of proper coordination on the part of concerning authority regarding the issue of trade license for handicrafts.

4) Enhance the involvement of women and girls and provide them with a standard livelihood earning option.

o *Potential issues*

1) NNPP is less cooperative in providing trade license to women for selling handicrafts.

2) No proper marketing channels for selling handicrafts.

o *Geographical Scale*

The focus should be on Pandeygaon, Chanoti and Nainital.

Gender and age mainstreaming

This activity is mainly done by women and girls in their homes. Men and young boys are mainly engaged in other earning activities. So it is hoped this will directly benefit women and girls. And

would provide support to women who specifically complained about the lack of proper marketing channels and in cooperation on the part of NNPP.

Implementer

o *Who will take a lead in implementing the action?*

1) HighARCS team.

2) Nainital Nagar Palika Parishad or NNPP.

3) Local NGOs.

o *How will they do it?*

1) HighARCS team will take a lead in initiating stakeholder meetings and in finding permanent market to sell the handicrafts.

2) Nainital Nagar Palika Parishad (NNPP) is an important local governing body of Nainital as it not only provides licenses to the boatmen of Nainital but also for various other activities like fishing, rickshaw driving, photography, restaurants, hotels, shops etc. Thus, NNPP can be approached to be a leading organization in implementing this action.

3) Local NGOs can also be approached to take an active part in implementing this action either by organizing training programmes for women and girls regarding the production and selling of handicrafts or can try to convince NNPP to be more cooperative while issuing trading license for handicrafts.

o *Who will finance the action?*

NNPP (Nainital Nagar Palika Parishad) can be approached to finance this action. It is an urban local authority for the famous hill town of Nainital. NNPP is one of the most important agency responsible for the urban finance in Lake Region.

o *Over what timescale?*

To check whether this undertaken action is a success or failure, the minimum time period require is 1 year. But this action is proposed keeping in mind that it would be a continuing process and should continue even after the end of HighARCS project for providing livelihood support specially to women and girls in the field sites.

Indicator

o *Indicators of success*

Evaluation of the market for handicrafts, i.e., whether the market for handicrafts has developed or not thereby its impact on income, standard of living and livelihood improvement of the people engage in production and sell of handicrafts, along with that increment in the number of households and members of household engage in this business can be taken as indicators of success for this action.

o *Who will do the monitoring and evaluation*

Nainital Nagar Palika Parishad (NNPP) and some local NGOs can be approached for monitoring and evaluation of the indicators of success of this action.

5) Marketing of Agricultural products

Objectives

o *Activities to be carried out*

1) Agriculture is not commercially practiced in our field sites so hold stakeholder meetings to encourage the farmers for marketing the agricultural products that they produce for their household consumption.

2) In Nainital there is no agricultural land as it is totally an urban area. However, in Bhimtal and Naukuchiatal people have some amount of agricultural land. These agricultural lands are mainly

for producing vegetables, fruits and other crops by the families for self consumption. So there is little or no marketing of the agricultural goods. Main crops produced in this region are wheat, maize and rice. Thus, if agriculture could be enhanced by producing more output using organic fertilizer or pesticides then the surplus beyond the consumption could be marketed. Moreover, vegetables mainly come from Haldwani and the local markets are expensive. So if vegetables are produced locally and marketed then that problem could be solved.

3) Seeking local government assistance to implement this action.

o Reasons for Prioritization

1) Since the vegetables come from Haldwani they become more expensive.

2) There is lack of earning opportunities for the local people.

3) Vegetables mainly come from Haldwani and then sell in the local market. Hence because of poor weather conditions, if the transport-communication system of the area get hampered which is a common phenomenon in hilly region, the availability of vegetables might be affected.

o Potential issues

1) Agricultural land is scarce and all the agricultural produce is used for self consumption.

2) Terrace farming prevents much agriculture.

3) Decreasing interests of younger generations to take part in agricultural activities or taking agriculture as one of their future livelihood options.

o Geographical Scale

The focus should be on Pandeygaon, Chanoti and Bilaspur where people depend more on agriculture.

Gender and age mainstreaming

A key problem with many of the interventions targeted at improving the environment of the lake and tourist revenue was that women have less direct involvement in the tourism economy, particularly in Bhimtal and Naukuchiatal. With regards to the latter two lakeside communities however, women and girls play a very important role in agriculture, so it is hoped this will directly benefit them. By trying to involving girls also, this will enhance agro-ecological knowledge amongst the younger generation, something which is crucial when many young people devote less time to agriculture and more time to their education.

Implementer

o *Who will take a lead in implementing the action?*

1) HighARCS team.

2) Department of Agriculture, Govt. of Uttarakhand.

o *How will they do it?*

1) HighARCS team will take a lead in initiating stakeholder meetings.

2) Department of Agriculture, Govt. of Uttarakhand is responsible for the formulation and implementation of policies and programmes aimed at achieving rapid agricultural growth through optimum utilization of the state's land, water, soil and plant resources. So, it can be approached to be the leading organization in implementing this action.

3) Farmers in Uttarakhand are benefiting from a unique financial institution named Kisan Bank, mooted by the Central Government. Kisan Bank can be termed as a single window institution catering to the needs of farmers. It helps the tillers to buy various inputs like quality seeds, fertilizers and farm equipments. A remarkable aspect of the bank is that the financial support

advanced to the farmers is recovered not monetarily, but in the form the farm produce. The Kisan Bank channelizes the sale of the farmers' produce, counsels the farmers about the technical aspects in agriculture which is environmentally approving too. Thus, it can be approached to take an active part in implementing this action.

o *Who will finance the action?*

1) Department of Agriculture, Govt. of Uttarakhand provides agricultural credit, crop insurance and ensures remunerative returns to the farmers for his agricultural produce. Thus we can say that it possess the authority to finance this action. So it can be approached to finance this action.

2) Kisan Bank provides financial support to the farmers in form of loan and the interesting part of this advance is that it is recovered not monetarily, but in the form of farm produce. Thus, Kisan Bank can also be approached to finance this action.

o *Over what timescale?*

To check whether this undertaken action is a success or failure, the minimum time period require is 1 year. But this action is proposed keeping in mind that it would be a continuing process and should continue even after the end of HighARCS project for livelihood improvement of the people in the field sites.

Indicator

o *Indicators of success*

Evaluation of the market for agricultural products, i.e., whether the market for agricultural products developed or not, thereby its impact on income, standard of living and livelihood improvement of the people engage in production and sell of agricultural products can be taken as indicators of success for this action.

o *Who will do the monitoring and evaluation*

Department of Agriculture, Govt. of Uttarakhand can be approached for taking necessary steps required to monitor and evaluate the indicators of success of this action.

6) Crop Protection

o *Activities to be carried out*

- 1) Hold stakeholder meetings to discuss various possible options of crop protection.
- 2) The fact of often damage of crops by the wild animals (particularly pigs) should be put forward in the stakeholder meeting and local people(farmers) must be encouraged to form groups for monitoring the agricultural fields so that fields could be protected from wild animals (particularly pigs).
- 3) Opening of more shops where organic (environmentally friendly) fertilizers, insecticides and pesticides and other products which are required for farming are easily assessable.
- 4) Making the farmers aware of the fact that the fertilizers, insecticides and pesticides they are using must be organic (environmentally friendly), i.e., awareness generation among people.
- 5) Seeking local government assistance to implement this action.
- 6) Training and extension in Integrated Pest Management or environmental stewardship

o *Reasons for Prioritization*

- 1) Lack of easy access to organic (environmentally friendly) fertilizers, insecticides and pesticides etc in local markets of Pandeygaon, Bhimtal, Chanoti and Naukuchiatal.

2) If fertilizers, insecticides and pesticides local people are using are not organic (environmentally friendly), then they may lead to environmental degradation.

3) Damage of crops by wild animals often lead to discouragement of practicing agricultural activities by the farmers.

o Potential issues

1) Crops are often damaged by the wild animals (particularly pigs).

2) Nowadays farmers have reduced maize production because it faces high risk of being eaten by the wild animals.

3) Decreasing interests of younger generations to take part in agricultural activities or taking agriculture as one of their future livelihood options.

o Geographical Scale

The focus should be on Pandeygaon, Chanoti and Bilaspur where people depend more on agriculture.

Gender and age mainstreaming

A key problem with many of the interventions targeted at improving the environment of the lake and tourist revenue was that women have less direct involvement in the tourism economy, particularly in Bhimtal and Naukuchiatal. With regards to the latter two lakeside communities however, women and girls play a very important role in agriculture, so it is hoped this will directly benefit them. By trying to involving girls also, this will enhance agro-ecological knowledge amongst the younger generation, something which is crucial when many young people devote less time to agriculture and more time to their education.

Implementer

o *Who will take a lead in implementing the action?*

1) HighARCS team.

2) Department of Agriculture, Govt. of Uttarakhand.

3) Kisan Bank.

o *How will they do it?*

1) HighARCS team will take a lead in initiating stakeholder meetings. HighARCS team can also encourage local people (farmers) to form groups for monitoring the agricultural fields so that fields could be protected from wild animals (particularly pigs).

2) Department of Agriculture, Govt. of Uttarakhand is responsible for the formulation and implementation of policies and programmes aimed at achieving rapid agricultural growth through optimum utilization of the state's land, water, soil and plant resources. The Department undertakes all possible measures to ensure timely and adequate supply of inputs and services such as fertilizers, seeds, pesticides, agricultural implements and also to provide agricultural credit, crop insurance and ensure remunerative returns to the farmers for his agricultural produce. So, it can be approached to be the leading organization in implementing this action.

3) Farmers in Uttarakhand are benefiting from a unique financial institution named Kisan Bank, mooted by the Central Government. Kisan Bank can be termed as a single window institution catering to the needs of farmers. It helps the tillers to buy various inputs like quality seeds, fertilizers and farm equipments. A remarkable aspect of the bank is that the financial support advanced to the farmers is recovered not monetarily, but in the form the farm produce. The Kisan Bank channelizes the sale of the farmers' produce, counsels the farmers about the

technical aspects in agriculture which is environmentally approving too. Thus, it can be approached to take an active part in implementing this action.

o *Who will finance the action?*

1) Department of Agriculture, Govt. of Uttarakhand provides agricultural credit, crop insurance and ensures remunerative returns to the farmers for his agricultural produce. Thus we can say that it possess the authority to finance this action. So Department of Agriculture, Govt. of Uttarakhand, can be approached to finance this action.

2) Kisan Bank provides financial support to the farmers in form of loan and the interesting part of this advance is that it is recovered not monetarily, but in the form of farm produce. Thus, Kisan Bank can also be approached to finance this action.

o *Over what timescale?*

To check whether this undertaken action is a success or failure, the minimum time period require is 1 year. But this action is proposed keeping in mind that it would be a continuing process and should continue even after the end of HighARCS project for livelihood improvement of the farmers in the field sites.

Indicator

o *Indicators of success*

Evaluation of annual agricultural productivity, i.e., whether agricultural productivity has improved or not, per unit yield has improved or not thereby overall income and percentage of income of the farmers derived from agricultural activities have enhanced or not, this can be taken as the indicators of success for the said action.

o *Who will do the monitoring and evaluation*

Department of Agriculture, Govt. of Uttarakhand can be approached for taking necessary steps required to monitor and evaluate the indicators of success of this action.

7) Desiltation of Bhimtal lake

Objectives

o *Activities to be carried out*

1) Hold stakeholder meetings to encourage the concerned departments to implement better catchment management to help reduce silt loads – appropriate engineering intervention to trap silt and sustainable means of maintaining and renovating this.

2) The HighARCS team can suggest the concerned department to analyze the chemical composition of the silt to characterize it for disposal, the silt may contain heavy metal contamination or hydrocarbons from road runoff that make it hazardous and so cannot be spread to land without remediation. When the quantity and quality of the silt have been established then a disposal plan can be formulated.

3) If the silt is enriched with soil nutrients and there is no presence of heavy metal contamination or hydrocarbons, then farmers to the adjacent areas can be involved to use this silt.

4) Uttarakhand (Bhimtal) Irrigation Department itself has some lake desiltation programmes. HighARCS team can recommend the concerned to take into consideration the above mentioned issues while preparing their future lake desiltation programme plans.

4) Seeking local government assistance to implement this action.

o *Reasons for prioritization*

- 1) Bhimtal lake is the source of water for irrigation in case of farmers of Chanoti and Pandeygaon.
- 2) As agricultural practices are common in Bhimtal, so water for irrigation is very essential there. Thus if high siltation result in reduction of lake's depth, then it may lead to scarcity of water needed for irrigation in case of farmers of Chanoti and Pandeygaon.
- 3) Bhimtal water is now classified as unfit for human drinking.

o *Potential issues*

- 1) High siltation resulting in reduction of lake depth.
- 2) Less absorption of heavy metals, leading to their depletion in the bed sediments of the lake.
- 3) Human and organic pollution.
- 4) Open bazaar drains and uncontrollable garbage and waste from the roadside mushrooming slums or colonies.
- 5) In spite of installing sewer lines to prevent sewage entering the lake still some effluents from drains, leakage and open defecation add to the eutrophication.
- 6) Clogging of water channels (drains) in the surrounding hills because of encroachment, leading to poor drainage.

o *Geographical Scale*

The focus should be on Bhimtal lake.

Gender and age mainstreaming

In Bhimtal, women and girls play a very important role in agriculture. Men and young boys are mainly engaged in other earning activities. So it is hoped availability of irrigation water will directly benefit women and girls. Women and girls also utilize lakes' water for washing and cleaning but that too is from the water channeled from the lakes. So, this will benefit the entire household but will benefit women and girls directly and men and boys indirectly.

Implementer

o *Who will take a lead in implementing the action?*

- 1) HighARCS team.
- 2) Uttarakhand (Bhimtal) Irrigation Department.
- 3) National Lake Region Special Area Development Authority (NLRSDA).
- 4) Kisan Bank.

o *How will they do it?*

- 1) HighARCS team will take a lead in initiating stakeholder meetings to discuss various techniques to remove the silt and transport it to a disposal area (if possible).
- 2) Uttarakhand (Bhimtal) Irrigation Department does not derive any services from the lake but it is the protector of the lake. It has the responsibility to take care of the Bhimtal lake and to provide water for irrigation to the farmers of Chanoti and Pandeygaon. Thus, since Irrigation Department of Bhimtal possesses both the responsibility of taking care of the lake as well as providing irrigation water to the farmers and again high siltation resulting in reduction of lake's depth may lead to scarcity of irrigation water in case of farmers of Chanoti and Pandeygaon. So,

Irrigation Department of Bhimtal can be approached for taking an active part in implementing this action.

3) National Lake Region Special Area Development Authority (NLRSDA) is in charge for maintaining all the lakes in the Kumaon Region. It is the planning and development authority for Nainital lake region area. It comprises of five planning zones Nainital, Bhowali, Mehragaon (khas), Bhimtal (including Sattal) and Naukuchiatal. This authority shoulders the responsibility of preparing and enforcing the development plans for lake conservation. NLRSDA is the nodal agency for Nainital Lake Conservation Project (NLCP). It is commonly known as Lake Development Authority (LDA). So, it can also be approached for implementing this action.

4) Kisan Bank can take a part in implementing this action as it possesses the right to financially help the farmers.

o *Who will finance the action?*

1) Uttarakhand (Bhimtal) Irrigation Department can be approached to finance this action as it possesses both the responsibility of taking care of the lake as well as providing irrigation water to the farmers of Chanoti and Pandeygaon.

2) National Lake Region Special Area Development Authority (NLRSDA) is in charge for maintaining all the lakes in the Kumaon Region which includes Bhimtal lake. It is also the nodal agency for Nainital Lake Conservation Project (NLCP). So, it can also be approached for financing this action.

3) Farmers in Uttarakhand are benefitted from a unique financial institution named Kisan Bank, mooted by the Central Government. Kisan Bank can be termed as a single window institution catering to the needs of farmers. Thus since high siltation resulting in reduction of lake's depth may lead to scarcity of irrigation water in case of farmers of Chanoti and Pandeygaon and may affect their agricultural produce. So, Kisan Bank can also be approached to implement this action by giving financial help.

o *Over what timescale?*

To check whether this undertaken action is a success or failure, the minimum time period require is 1 year. But this action is proposed keeping in mind that it would be a continuing process and should continue even after the end of HighARCS project so that the lake remain siltation free.

Indicator

o *Indicators of success*

Annual evaluation of the depth of lake, i.e., whether the depth of lake has increased or not, along with that whether Uttarakhand (Bhimtal) Irrigation Department has included the HighARCS team recommended actions in their lake desiltation programme or not can be considered as indicators of success for this action.

o *Who will do the monitoring and evaluation*

Uttarakhand (Bhimtal) Irrigation Department can be approached for monitoring and evaluation of the indicators of success of this action.

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