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Management of natural resources through integrated watershed management in Nana Kosi micro watershed, district Almora, India

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ABSTRACT

The watershed has been recognised as a unit for integrated resource management, where management is not merely limited to land, water and biomass; but also concerned with integration for self-reliance and holistic development of the rural population. The Uttarakhand Himalaya present an incomprehensible mixed risk prone ecosystem largely due to land degradation, hydrological discrepancies, low productivity, soil erosion and a pauperized subsistence economy. There is a need for sustainable strategy for redressal of the pressing natural and socio-economic problems. In an operational context, this would mean integrating different uses and management of resources through an inter-disciplinary approach, and towards alleviation of poverty. Keeping in this, this study has been focused on the analysis and management of natural resources through Integrated Watershed Management (IWM) in high altitude of Himalayan area of Nana Kosi river watershed. The present paper assesses the prevailing conditions in the Nana Kosi micro watershed and suggests strategies for the sustainable development.

Key words: *Land Degradation, IWM, Hydrological discrepancies, Soil erosion, Sustainable strategy, Natural resource.*

Introduction

The mighty Himalaya characterized as the most endangered eco-system of the world due to the faulty processes of development/ modernization, what the geographer's term as the 'dilemma of mountain development' (Ives and Messerli, 1989). Himalayan ecosystem is approaching a stage of disequilibrium and there are clearly visible negative changes in the resources and the environment. Step by step, nature is being destroyed and human, terrestrial, and aquatic life are being shortened by the effects of development in the form of landslides, sedimentation, and eutrophication of reservoirs, lakes and rivers, drying up of springs, and others (ESCAP Report, 1989). Natural resources in developing countries are under heavy pressure and degradation has increased since the economic growth period of the early 1970s. Proper management of available natural resources is a prerequisite for the development of any community (OECD, 2008). Studies across the globe have found that the health

of the world's mountains is in dire need of relief from modern anthropogenic activities that are causing lasting environmental damage and human insecurities (Ives and Pitt, 1988; Agenda 21, 1992; UNEP-WCMC, 2002; UNN, 2002)

The concept of integrated watershed management has established to ensure effective use of social, environmental and economic capitals (Yang *et al*., 2006; Van, 2014). The importance of watersheds as environmental units in the context of natural resource management and conservation cannot be overstated. They are hydrologic units that are often used as biophysical and socio-economic or political units for the planning and management of natural resources (Brooks *et al.*, 1991).

Integrated natural resource conservation and management encompasses all activities for the management of natural resources in an area or watershed. Common property resources include forest, pastureland, and water, which can be bifurcated into government and community management. Use and management of natural resources both in private and public lands are determined by numerous factors such as individual perceptions at household levels, population pressure, and resource pricing policy at the national level (Thapa and Weber, 1994). Watershed management approach encompasses the land use management, water management and biomass management and hence provides a viable option of people oriented and cantered development of any region (Katusiime and Schutt, 2020). As Eren stated (1977) that here is one common element in nearly every scheme of land development – an increased demand for water, if then a wise and effective integration of all efforts and activities towards the sustainability of quality water yield is attained, the objective of whole-scale development for prosperity without environmental degradation may be harmoniously fulfilled. The concept of integrated watershed management is not only an effective approach and practice within a small watershed, but also an integration of outcomes of small watersheds constituting a colourful mosaic in a large river basin. Watershed management is a holistic approach to address the problem of land degradation and to maintain ecological balance (Bhardwaj *et al.*, 2020). However, in the present context, watershed management is not only for managing or conserving natural resources in a holistic manner, but also to involve local people for betterment of their lives (Mountain, 2002).

Study Area

The Nana Kosi Micro Watershed lies between 29^{0}37′30′′ N - 29^{0}43′40′′ N Latitudes and 79^{0}31′ E - 79^{0}37′40′′ E Longitudes in Hawalbagh Block of Almora District (Fig.1). With an area of about 3336.47 hectares it supports 10,918 populations residing in 42 villages, consisting of 5,144 males and 5,774 females whereas the sex ratio is 1122 females/ 1000 males. Out of the total population 7681 peoples are literates and the male and female literacy is 81.06% and 60.80% respectively (Table 1).

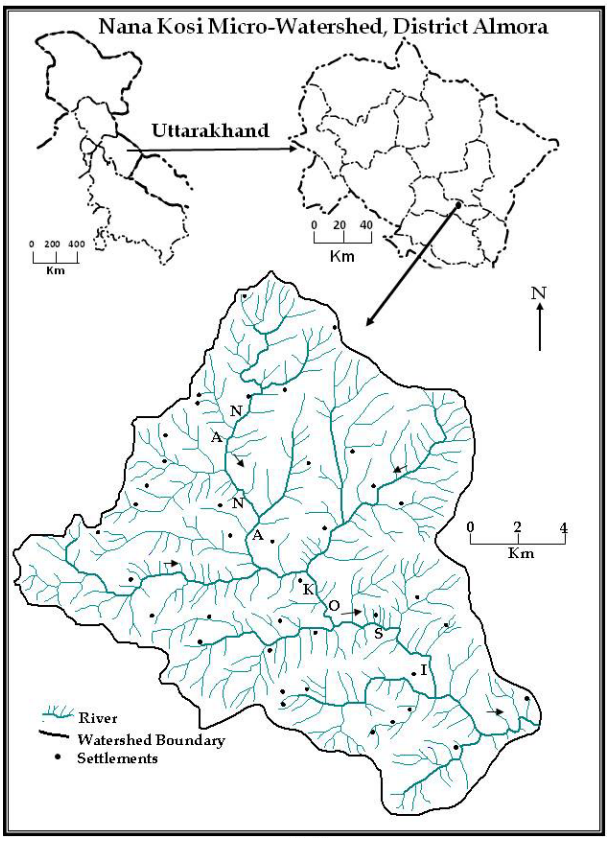

Fig. 1.

The land is the economic backbone of the region and uses of the land is determined by the geographical conditions, socio-economic structure, and availability of natural resources and determines the socio-economic conditions and land use pattern of the region (Lal *et al.*, 1987). More than 75 percent of regional population lives in rural areas and is solely dependent on this traditional agro-ecosystem even though the availability of arable land is severely limited and the productivity is considerably poor

Table 1. Nana Kosi Watershed: Village wise Population Characteristics, 2011

Villages	Number of household	Total Population	Male	Female	Sex Ratio Females/ 1000 Males	Total Literacy	Male (in %)	Female (in %)
Syuna	37	160	63	97	1540	112	82.53	61.85
Panch Gaon	60	288	145	143	986	201	80.68	58.74
Bimola	260	703	423	280	662	531	89.36	54.64
Kwairali	32	131	59	72	1220	95	79.66	66.66
Maini	19	114	51	63	1235	82	82.35	63.49
Pathar Kot	65	250	122	128	1049	192	85.24	68.75
Gadhwali	49	213	90	123	1367	130	76.66	49.59
Kayala	63	346	180	166	922	269	86.11	68.67
Papoli	50	233	106	127	1198	160	83.01	56.69
Kotuli	69	292	126	166	1317	191	77.77	56.02
Takoli	30	114	49	65	1327	84	75.51	72.30
Ladhe Pahal	4	27	13	14	1077	15	61.53	50
Kataunia	13	51	25	26	1040	35	84	53.84
Chhana	15	74	36	38	1056	49	83.33	50
Bangsar	26	130	64	66	1031	98	82.81	68.18
Bhakara Dak	13	54	27	27	1000	42	81.48	74.07
Chauna	190	901	406	495	1219	629	78.57	62.62
Gurna	93	401	193	208	1078	304	82.90	69.23
Khori	87	421	213	208	977	257	69.48	52.40
Khakoli	23	97	41	56	1366	80	90.24	76.78
Kwairala	85	386	174	212	1218	249	75.86	55.18
Naugaon Gunth	10	25	11	14	1273	19	81.81	71.42
Rikhai	60	251	107	144	1346	171	80.37	59.02
Laxmipur	15	71	34	37	1088	56	91.17	67.56
Ramana	36	148	65	83	1277	108	83.07	65.06
Bhagoti	5	29	13	16	1231	28	100	93.75
Kakrat Maufi	12	66	29	37	1275.862	43	68.96	62.16
Dangi Khola	81	378	176	202	1148	262	81.25	58.91
Titar Muchi	18	116	62	54	871	83	80.64	61.11
Khai Kata	66	355	161	194	1205	234	80.12	54.12
Nakuta Mufi	35	153	68	85	1250	114	86.76	64.70
Patora	90	440	210	230	1095	271	73.80	50.43
Gaijole	2	15	9	6	667	6	44.44	33.33
Silari	67	300	138	162	1174	208	76.08	63.58
Kesta	80	345	141	204	1447	233	75.88	61.76
Nainoli	100	458	202	256	1267	351	88.61	67.18
Bajgal	48	206	88	118	1341	150	80.68	66.94
Raisal	2	7	2	5	2500	5	100	60
Vadla	77	348	149	199	1336	264	85.90	68.34
Rankhila	80	432	218	214	982	316	81.65	64.48
Gali Basyur	141	740	358	382	1067	517	81.84	58.63
Chinona	137	649	297	352	1185	437	79.79	56.81
Total	**2445**	**10918**	**5144**	**5774**	**1122**	**7681**	**81.06**	**60.80**

Source: Calculated from census 2011

(Tiwari and Joshi, 2005). The whole area is overwhelmed by fragile land conditions, water mismanagement, lack of off farm activities and heavy male out migration and family out migration in search of better life. The agricultural land accounts only for 33.52 % of the total area (Rawat, 2011). Table 2 presents the current picture of the land use in the area; the total area of the watershed is 3336.47 hectares, wherein the forests occupy 531.07 hectares, irrigated area covers only 19.38 hectares, Unirrigated area

Table 2. Nana Kosi Watershed: Land use Pattern (In Hectares)

Villages	Total Area	Forest	Irrigated Area	Unirrigated Area	Uncultivable Waste Land	Area NA for Cultivation
Syuna	139.61	82.83	0	47.72	9.06	0
Panch Gaon	206.96	0	0	86.94	108.58	11.44
Bimola	46.77	7.59	0	25.02	7.08	7.08
Kwairali	200.8	47.8	0	89.4	63.6	0
Maini	64	13	0	28	23	0
Pathar Kot	99.76	12.02	0	44.26	43.48	0
Gadhwali	120.32	25.52	10.8	44.7	39.3	0
Kayala	54.98	15.74	0	30.74	8.5	0
Papoli	141.48	34.48	0	76.54	30.46	0
Kotuli	30.32	0	0	9.48	19.84	1
Takoli	18.46	0	0	2.2	7.1	9.16
Ladhe Pahal	8.2	0	0	4	4	0.2
Kataunia	31.22	0	0	15.96	14.06	1.2
Chhana	36.18	0	5.6	27	3.34	0.24
Bangsar	12.24	0	0	1.76	10.48	0
Bhakara Dak	339.91	137.87	0	174.32	16.88	10.84
Chauna	99.83	0	0	60.17	31.86	7.8
Gurna	88.32	0	0	47.28	41.04	0
Khori	47.64	0	0	13.34	31.84	2.46
Khakoli	137.36	0	0	66.52	59.8	11.04
Kwairala	10.55	5.3	0	4.25	0.05	0.95
Naugaon Gunth	43.28	15.6	0	17.1	2.74	7.84
Rikhai	46.54	0	0	12.8	0.9	32.84
Laxmipur	130	0	0	52.08	10.92	67
Ramana	14.42	0	0	6.22	0.9	7.3
Bhagoti	24.6	1.9	0.6	3	19.1	0
Kakrat Maufi	122	0	0	72.38	0	49.62
Dangi Khola	58.44	0	0	22.18	0	36.26
Titar Muchi	21.08	0	0	11.14	0	9.94
Khai Kata	29.88	3	0	19.33	7.55	0
Nakuta Mufi	171.46	0	0	72.46	5.18	93.82
Patora	37	0	0	14.57	20.62	1.81
Gaijole	33.48	0	0	22.56	8.92	2
Silari	114.22	50.04	0	36.68	16.66	10.84
Kesta	180.59	20	0	40	80.2	40.39
Nainoli	77	0	0	16	27	34
Bajgal	12.1	3.1	0	0	4	5
Raisal	82.56	0	0.88	63.78	4.56	13.34
Vadla	24.08	0	1.34	10.54	10.45	1.75
Rankhila	77.44	25.28	0	23.36	13.6	15.2
Gali Basyur	101.39	30	0.16	36.85	4.38	30
Total	**3336.47**	**531.07**	**19.38**	**1452.63**	**811.03**	**522.36**

Source: Field survey, 2016

covers 1452.63 hectares, uncultivable waste land occupies 811.03 hectares and area not available for cultivation covers 522.36 hectares. Gadhwali village has the highest irrigated area but most of the villages don't have the irrigated area due to rough topography and lack of irrigational facilities. The agricultural activity in the region is totally depends on rain god.

Objective

The main objective of this study is to assess the role of community dynamics in natural resource man-

agement and development so as to seek empirical evidences for suggesting eco-development strategies on the platform of integrated watershed management. More specifically, the study attempts to

- Study the role of socio-economic factors and community dynamics in natural resource management.

Data Used and Methodology

The current study is based on primary as well as secondary data collection. Primary data have collected through rigorous field survey, such as Focused Group Discussions, Organized field observations etc. The population data was taken from census report 2011.

The secondary data is collected through different sources, more decisively from the Survey of India, District Statistical Handbooks, and lots of published/unpublished research works on mountain development etc.

Results

Watershed as a Unit of Planning

The concept of ecosystem conservation as a broad theme emerged during the 1970s under the Man and Biosphere Programme (MAB) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The Indian Government followed this approach and chose the method to segregate the landscape for conservation of the ecosystem as well as development of the local economy and its people. A specific focus has been on how the landscape is changing in the mountains of the Indian Himalayan region where about 10% of the total geographical area is converted into segregated landscape. Human effects on ecosystems are a big concern all over the world and it is particularly important to understand human influences on the rural landscape where sustainability of the rural people is dependent on the surrounding natural resources. The study of various aspects of the interactions between human and local ecosystems/ landscapes is key to understanding the development process and hence provides the basis for designing and developing the strategies for future sustainable landscape. Sustainable landscape development is a crucial issue world-wide. In the mountains in particular, this issue requires additional attention as it has an additional effect on the sustainable landscape development in the plains. Unsustainable land use development in mountains accelerates erosion, which contributes to devastating floods in the plains (Ives and Messerli, 1989). The effectiveness of natural resource management requires a detailed understanding of the patterns and processes that exist within both the natural system itself and the human institutions associated with the use of the resource (Diwan, 2003). Therefore, to understand the complexity of the system and its behaviour under different socio-economic conditions, a detailed knowledge of the system is necessary. As an example of the region where nature protection areas (NPA) were established we focused on such a landscape for the area of study. In the Himalayas of India there are several NPAs that are being implemented for natural resource conservation and management. A Sanctuary, National Park and Biosphere Reserve together cover about 10% of the total geographic area of the Himalayan Mountains. In the Central Himalayas, where the current study was conducted, about 18.69% of the area is protected for ecosystem conservation (Govt. of Uttarakhand 2007– 2008). Land degradation is a serious and increasing ecological problem, particularly in rural areas where people secure their livelihoods from agriculture (Sanchez *et al.*, 1997). Therefore, this is an interesting opportunity to analyze the change in land use management in the region that started with a non-segregated to segregated approach towards ecosystem conservation and management. Land use Pattern of Nana Kosi is given in the Table 2.

Watershed management has become a new national strategy and approach to development of rural areas in India. The aim of the strategy is augmentation and stabilisation of production and productivity to minimize ecological degradation, reducing regional disparity and also opening up of greater opportunities for employment of the rural poor in the rain fed areas. To this end a common approach and participatory action for empowerment of the community has been suggested. Therefore, for successful implementation of integrated watershed management plan a high level collective action required, without local public participation any plan cannot be victorious. The role of each department, i.e. Forestry, Agriculture, Horticulture, Soil conservation, minor irrigation Animal husbandry, Energy conservation and Miscellaneous work for the community have been identified to be undertaken as part of watershed management programme (Bhan, 2013).

Discussion

Start with what people have, build on what they know

It is clear that conservation can be achieved by a combination of wise use of environmental resources and protection of ecosystems with the interests of people whose support is crucial to the resource management (Jhonson, 1993). However, the exclusively top down developmental approaches have proved to be ineffective in reaching the people and have also failed the conservation objectives. These approaches alienate local resource users and are perceived as a drain on the scarce resources of many countries while it became fashionable during the early seventies (Wells, 1992). Consequently, the way of development has led to the cause of environmental degradation and felt to change. It is pertinent to note here that local communities are more likely than governmental line departments to pay attention to the long-term consequences of resource use precisely because they depend upon the sustainable harvesting of resources for their livelihoods. So, ultimately it becomes livelihoods v/s environment.

Poverty forms a vicious cycle of environmental degradation especially in the Himalayan region of the country. The protection of environment cannot be isolated from poverty because for a starving person, the protection of environment is his remote concern (Shafi, 2003). The decline of natural resources is commonly equated with environmental degradation (Swanson, 1996). It reveals that environmental issues are directly interconnected with human needs and actions. Palo (1990) has given the five Ps i.e. principal of environmental resources degradation from a chain of process, events and agents namely, Property, Policies, Population, Prices and Poverty. Environmental degradation, the worldwide issue is basically an outcome of faulty methods of planning and policy formulation, besides ignorance of the ecological base and local interests for development. The implication of the above becomes more visible and aggravated in the Himalayan region. Years of centralized planning and keeping people at bay have also accentuated the problem. Natural resource conservation is an opportunity for the proper delimitation of eco resource base and eco development planning and for this peoples' involvement becomes important in stemming environmental degradation. However, in practice developmental agencies have not been successful in involving a precise model of peoples' participation in desirable scale (Bajpai, 1998). These grass root efforts have given impetus to a shift in the approach to development from top-down to bottom-up, from modern to appropriate technology, from specialized to integrated and from lecturing to dialogue. Start with what people have, build on what they know for achieving the goals of sustainable development (Burkey, 1993).

Peoples Participation and Natural Resource Management

Natural resources are means to satisfy human wants which exist in natural environment and which are available without any type of human endeavour. The degradation of natural resources such as land, water, forest etc. may have an adverse impact on livelihood of rural people (Singh and Dixit, 2020). The Nana Kosi Watershed exhibits excessive pressure on natural resources and years of borrowed planning mechanism and people's ignorance in the planning, calls for watersheds as a naturally defined planning unit. Changing land use is noticeable in forest and agricultural lands. The biological qualities of water are continuously depleting, and the growing numbers of population have aggravated the problem of food, fuel, fodder and water. Lack of ecological understanding is an important factor of environmental degradation in the area. It is apparent that the traditional top down approach of development has failed to resolve the enormous problem of environmental deterioration and evolving mechanism for the generation of off farm activities to save the hilly areas from the exodus of human population. Planning at watershed levels creates maximum synergy for the overall development of land, water and biomass. Therefore, any strategy of watershed management ought to involve people in its very conception wherein governmental and non-governmental organizations must attain the role of providers. It is important to understand the conditions when people participate in watershed management programmes: (i) making people aware of potential benefits of collective action in conserving and managing natural resources; (ii) including demand driven activities in the watershed program; (iii) empowering people in planning, implementing and managing watershed programs; and (iv) expecting high private economic benefits (Joshi *et al.*, 2000).

Participatory watershed management is a complex issue, embracing the technical complexities of the resource itself, socio economic complexities of the different livelihoods of local households and of political complexities regarding the collective action necessary for effective and equitable planning, implementation, maintenance and benefit sharing (Reddy *et al.,* 2010). Collective action is a prerequisite if local priorities are to be served by the watershed management activities. Participatory watershed management is certainly found to be more effective when compared to the watersheds where's people participation is either passive or absent. A widely held and endorsed view is that people's participation is more widespread in the watershed implemented and managed by NGOs. But such instances are small in scale, and can only be expanded by repeating the same slow, costly, in depth techniques (Farrington and Lobo, 1997). In most of the cases the existing property rights that are imbedded in political economy systems are biased against poor. Hence, collective action social mobilisation is an important channel for asserting the right of poor. Most importantly, full participation is necessary from the initial stage of watershed selection through the selection of crops, systems, and varieties, to the monitoring and evaluation of watershed activities (Rehman, 1993). Collective action could lead to poverty alleviation not only through asserting or changing rights over natural resources like land water etc., but also through asserting their right to information, share in the development programmes, etc. (Reddy *et al.,* 2010).

Peoples Participation for Integrated Watershed Management Planning in Nana Kosi Watershed, there is good example of Community based activities particularly in *Bimola* village, where many water tanks on the riverside is made by the local community. In dry season, with the help of water tanks the problem of irrigation is solved as well as they are doing pisiculture. To solve the problem of erosion Community based efforts are made by the villagers of *Bimola* on the hill slope by plantation. Further, rehabilitation of these structures will not only enhance community participation, but also acted towards integrated resource management as well.

Conclusion

There is an immense potentiality in the study area for self-reliant development. It is thus, the need of the hour to make environmental issues as a part of the local plans and call for watershed management which is an integration of technology within the natural boundaries of a drainage area for optimum development of land, water and forest resources. Integration of many scattered programmes of soil conservation, afforestation, minor irrigation and other development activities into well prepared micro-watershed projects based on a micro level study of climate, land, water and forest resources on one hand, and human and animal resources on the other, offers scope for bringing about sustained natural resources development. Two decades of operational research and development in watershed management have also given a ray of hope on ecodevelopment strategy (Grewal *et al.,* 2001). So, it is high time that the ultimate stakeholders' need to be incorporated into the entire mechanism of planning, monitoring and implementation but off course keeping their aspirations and needs in mind. The participation of the local community i.e., farmers, is essential if watershed management is to have a successful impact. To promote community participation in the watershed for site selection, implementation and assessment of activities, various committees/groups ought to be formed so as to recognize a shift in the community participation from contractual to a consultative and collegiate mode which is necessary to provide tangible private economic benefits to individuals. Such benefits could come from in situ rainwater conservation leading to increased farm productivity through the application of the Integrated Genetic and Natural Resources Management (IGNRM) approach. Most importantly, full participation is necessary from the initial stage of watershed selection through the selection of crops, systems, and varieties, to the monitoring and evaluation of watershed activities (Rehman, 1993). The principle should be that 'users pay'. Once individuals are able to realize the benefits of soil and water conservation they come forward to participate in other community activities in the watershed by becoming members of various organized groups like Watershed Associations, Watershed Committees, Self-help groups (SHG), User groups and Women self-help groups (Singh and Singh, 2011).

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