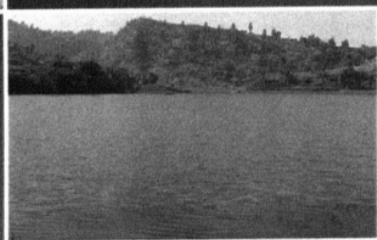


Ecology and Fisheries of Morni Tals, Haryana



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**Ecology and Fisheries of Morni Tals,
Haryana**

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Foreword

Reservoirs form the most important inland fishery resources of India with immense potential to enhance the country's inland fish production. Keeping this aspect in view and the demand of Department of Fisheries, Haryana, studies on the limnology and fish productivity of Momi tals in Haryana, were conducted by CIFRI in the year 2001-2002. I am glad that the investigations made with the cooperation of Department of Fisheries, Haryana, have brought important limnological features of Momi tals with useful recommendations for the development of fisheries therein.

I am hopeful that this document will greatly help in formulating guidelines for scientific management of said lakes in particular and for other similar small water bodies in the state.

**Director
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1. INTRODUCTION

The state of Haryana has large number of water bodies in the forms of rivers, canals, lakes and small ecotoper such as ponds and jauhars. The rivers, canals and drains approximately cover a length of 22400 km². The riverine water resources of the state are seasonal except the perennial river Yamuna having high potential for fisheries development. The reservoir fisheries resources of the state is meager (around 900 ha) and seems to be a neglected field of fisheries development since most of them lentic waters in the form of lakes, are under the control of Department of Tourism, whose main aim is to develop the tourism rather than the fisheries. Some small reservoirs, lakes have been constructed in Gurgaon, Faridabad and Mahendragarh district in Haryana for flood control. These are mainly Dhauj, Badkhal, Surajkund and Damdama. Morni Tals in PUNCHKULA district are known for good source of fish.

Morni Tals namely Bhim tal and Draupti tal were studied during the year 2001-02 with a major thrust on evaluation of production potential and to evolve the management plans capable of enhancing fish yield. Both the lakes have shown distinct characteristics. The present report portrays the significant findings of the ecological investigations of Bhim tal and Draupti tal.

2. SAMPLING PROCEDURE

Samples pertaining to limno-chemical parameters were collected once in post-monsoon (November, 01), winter (February, 02) and pre-monsoon (May, 02) seasons. The physico-chemical parameters of soil and water were determined following the standard methods prescribed in APHA (1985). The analyses in respect of biological parameters were done as described by Jhingran *et al.*, (1969).

3. BHIM TAL

Location and morphometry

Morni hills located 45 km away from Chandigarh are an off-shoot of the Shivaliks and run in two parallel ranges from south-east to north-west. Between them the ground is broken by projecting spurs. Among the spurs of the hills lie two natural lakes, the larger lake known as Bhim tal and smaller lake known as Draupti tal. A small hillock divides the two lakes. The upper crest of the hills are covered by pine trees.

Bhim tal, a small natural water body (16.8 ha) formed in ancient period is presently used for irrigation and drinking purposes. It is also put to water sports training by Department of Tourism, Haryana. The catchment area of the lake is hillock and terraced agricultural fields all around the lake wherein inflow mainly depend upon the local rains. Outflow flows into Tangri rivulet which joins the river

Ghaggar. The lake has gross capacity of 66.5 ha. m and a maximum depth of 4.0 m (Table 1).

Table : 1 : Location and morphometric features of Morni Tals, District Panchkula, Haryana

Lakes/Parameters	Bhim tal	Draupthi tal
Latitude N	28°-25'	28°-25'
Longitude E	76°-30'	76°-30'
Year of construction	Ancient lake	Ancient lake
Water spread area (ha)	16.8	7.08
Maximum Area (ha)	24.9	11.8
Gross capacity (ha.m.)	66.5	23.67
Maximum depth (m)	4.0	3.4

Limnology and productivity

Soil and water quality : Basin soil is sandy loam (sand 70.5%) and alkaline (pH 7.15). The increase in percentage of sand from 64.0 to 77.1 (Table 2) during post-monsoon may be due to influx of rains water loaded with more sand from the catchment. The available phosphorus and nitrogen was poor while the organic carbon (0.54%) was moderate.

Table : 2 : Physico-chemical characteristics of Soil of Morni Tals, Haryana

Lakes /Parameters	Bhim tal			Draupthi tal		
	Pre-mon.	Post-mon.	Av.	Pre-mon.	Post-mon.	Av.
Sand (%)	64.0	77.1	70.55	59.0	75.0	67.0
Silt (%)	22.0	17.1	19.55	23.0	17.9	20.45
Clay (%)	14.0	5.8	9.9	18.0	7.1	12.55
pH	7.7	6.6	7.15	7.85	7.1	7.48
Org. carbon (%)	0.30	0.78	0.54	0.23	0.72	0.48
Cal. Carbonate %	5.25	9.5	7.38	2.75	5.0	3.88
Av. phosphorus (mg/100g)	0.80	0.32	0.56	1.80	0.40	1.10
Av. nitrog. (mg/100g)	4.76	7.0	5.88	2.24	8.4	5.32
El. Conductance μ mhos/cm	342	280	311	200	230	215

Water quality in terms of physical and chemical features is presented in table 3. The mean water temperature of the lake varied between 12 and 26.5°C in post-monsoon and pre-monsoon respectively. Similarly transparency

fluctuated from 41.5 cm in post-monsoon to 82.0 cm in pre-monsoon. Average pH (7.9) reflected alkaline water condition suitable for fish growth. Dissolved oxygen ranged between 4.8 in post-monsoon to 9.6 mg/l in pre-monsoon. Low oxygen value in post-monsoon may be ascribed to the abundance of organic detritus. Total alkalinity varied from 106 to 172 (av. 133) mg/l. The water bodies having total alkalinity above 100 mg/l are known to be conducive for high fish productivity.

Table : 3 : Physico-chemical characteristics of water in Morni Tals, Haryana

Lakes/ Parameters	Bhim tal	Draupthi tal
Water temp. (°C)	17.5 (12-26.5)	19.8 (14-27.0)
Transparency (cm)	62.5 (41.5-82.0)	35.0 (32-40)
pH	7.9 (7.62-8.3)	7.9 (7.63-8.35)
D.O. (mg/l)	6.9 (4.8-9.6)	8.7 (8.0-9.2)
Free CO ₂ (mg/l)	0.8 (Nil-2.4)	2.0 (Nil-6.0)
Total alkalinity (mg/l)	133 (106-172)	139 (126-160)
El. Conduct. (µmhos/cm)	388 (370-403)	344 (336-355)
Hardness (mg/l)	142 (120-182)	150 (120-187)
Calcium (mg/l)	28.4 (24.2-31.0)	30.9 (26.6-36.0)
Magnesium (mg/l)	11.7 (6.0-18.4)	13.8 (7.2-23.4)
DOM (mg/l)	2.5 (2.0-3.0)	2.5 (1.8-3.2)
Phosphate (mg/l)	0.13 (0.06-0.28)	0.14 (0.06-0.30)
Silicate (mg/l)	1.4 (1.2-1.5)	1.2 (0.8-1.7)
Chloride (mg/l)	6.7 (4.2-11.0)	7.1 (3.8-12.0)

Calcium concentration varying between 24.2 and 31.0 (av. 28.4 mg/l) was moderate. Magnesium content was of high order ranging from 6.0 to 18.4 (av. 11.7) mg/l. Total hardness fluctuated between 124 and 182 mg/l. Organic matter is an important parameter reflecting productive nature of water. Its value ranged

from 2.0 to 3.0 (av.2.5) mg/l. Values of organic matter thus reflects high production potential of the lake. Phosphates (0.06-0.28 mg/l) and silicates (1.2-1.5 mg/l) were in moderate range. High values of specific conductance ranging between 370 and 403 (av. 388) $\mu\text{mhos/cm}$ reflected the productive state of the lake.

Limnological investigations of Bhim tal thus exhibited productive state of the lake. This was evident from its limno-chemical parameters like total alkalinity (106-172 mg/l), dissolved organic matter (2.0-3.0 mg/l), calcium (24.4-31.0 mg/l) and specific conductance (370-403 $\mu\text{mhos/cm}$). The rich water quality reflects the transport of allochthonous dissolved nutrients and their leaching into trophic cycling system.

Primary productivity: The gross primary carbon production varied from 99.17 to 218.75, averaging 145.71 $\text{mgC/m}^2/\text{hr}$ while the net production ranged between 62.5 and 125.0 (av. 86.6) $\text{mgC/m}^2/\text{hr}$ (Table 4). The expected fish yield in terms of carbon production was 425 kg/ha exhibiting high productive potential of the lake. The energy assimilation efficiency (59%) also reflected productive nature of the lake.

Table : 4 : Primary production ($\text{mgC/m}^2/\text{hr}$) in Morni Tals , Haryana

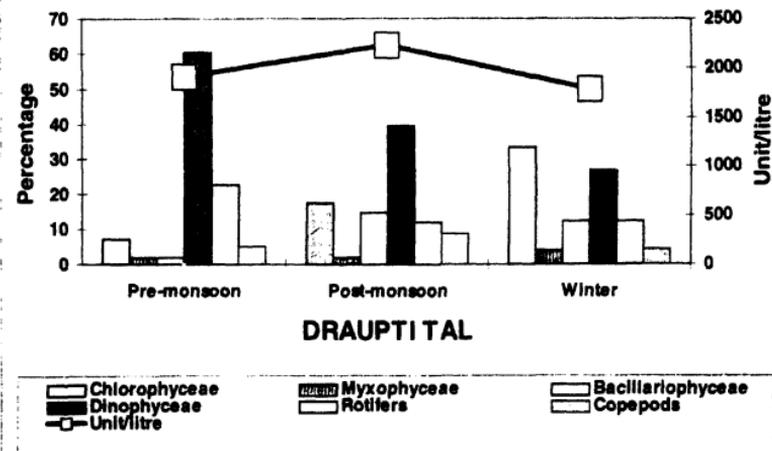
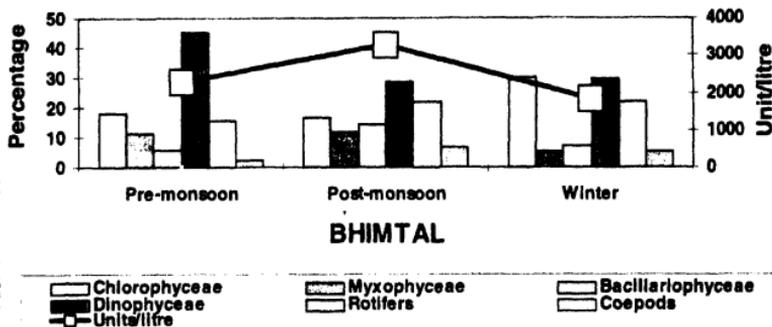
Reservoir/ Period	GP	NP	Respiration	Net/Gross
Bhim tal				
Post-monsoon	218.75	125.0	112.5	
Winter	99.17	62.5	50.0	
Pre-monsoon	119.21	72.3	55.9	
Av.	145.71	86.6	72.8	0.59
Draupti tal				
Post-monsoon	98.95	52.08	43.75	
Winter	135.40	118.75	20.00	
Pre-monsoon	118.45	74.21	53.75	
Av.	117.60	81.68	39.16	0.69

Biotic communities

Observation on the plankton abundance and their composition is depicted in fig.1. It indicated richness of plankton (2461 μl) mainly dominated by dinophyceae (34.5%). *Ceratium* and *Peridinium* were the main plankters. The low water temperature in post-monsoon and winter ranging from 12 to 28°C could have favoured the proliferation of dinophyceae. Chlorophyceae (*Pediastrum*, *Botryococcus*, *Trochiscia*, *Scenedesmus*, *Rhizoclonium*, *Actinastrum*, *Cosmarium*, *Staurastrum*, *Characiopsis*, *Zygnema*) ranked second (21.6%) in order of preponderance. Rotifers (19.8%) represented by *Keratella*, *Brachionous*,

Hexarthra, *Trichocerca*, *Colurella*, *Asterionella* were abundant in winter. Presence of *Microcystis*, *Pediastrum*, *Scenedesmus* exhibited eutrophic tendency of the lake. Periphytic communities (2379 μcm^2 ; Fig.2) were dominated by bacillariophyceae (*Tabellaria*, *Synedra*, *Gyrosigma*, *Melosira*, *Diatoma*, *Fragilaria*, *Frustulia*, *Meridion*, *Stauroneis*, *Cymbella*, *Eucocconeis* and *Navicula*).

Fig.1- Composition of plankton in Morni Tals, Haryana



The standing crop of macrobenthos varied from 2150 in pre-monsoon to 7800 u/m^2 in winter (av. 4067 u/m^2 ; Table 5). This indicated richness of benthic community in the lake. Chironomids dominated with 72.9% followed by tubificids (16.4%), *Chaoborus* (8.2%) and molluscs (2.5%). Macrovegetation in the form of submerged, free floating and emarginating weeds were observed at an average of 0.8 kg/m^2 wet wt. (Table 6). The dominant forms were *Hydrilla*, *Vallisneria* and *Potamogeton*.

Table : 5 : Composition of macrobenthos in Morni Tals, Haryana

Bhim tal	Pre-monsoon		Post-monsoon		Winter		Average	
	Org/ m^2	g/ m^2	Org/ m^2	g/ m^2	Org/ m^2	g/ m^2	Org/ m^2	g/ m^2
Chironomids	1300	16.90	1300	16.90	6300	81.9	2967	38.56
Chaoborus	250	1.50	250	1.50	500	3.00	333	2.00
Tubificids	500	6.50	500	6.50	1000	13.00	667	8.67
Molluscs	100	Neg.	200	Neg.	-	-	100	Neg.
Total	2150	24.90	2250	24.90	7800	97.9	4067	49.23
Draupti tal								
Chironomids	200	2.60	200	2.60	500	6.5	300	3.90
Chaoborus	100	0.60	100	0.60	100	0.60	100	0.60
Total	300	3.20	300	3.20	600	7.10	400	4.50

Table : 6 : Distribution of macrophytes in Morni Tals, Haryana

Reservoir	Pre-monsoon		Post-monsoon		Winter		Average	
	Wet Wt. kg/m^2	Dry wt. kg/m^2						
Bhim tal	1.200	0.390	0.800	0.040	0.400	0.070	0.800	0.167
Draupti tal	Nil		Nil		Nil		Nil	

Fisheries

Morni tals are being exploited through an open auction initially for a period of three years, 2000-03. The auction amount for the two lakes was Rs. 50000/- for the year 2000-01. After three years there would be an increase of 25% of Rs.50000/-. On an average, the fish yield during 2001-02 has been estimated as 20 kg/ha . The fish spectrum of Bhim tal showed presence of *C. carpio*, *C. catla*, *L. rohita*, *H. molitrix*, *C. mrigala* and *P. sarana*. Species composition during the course of survey reveals dominance of *C. carpio* (83.2%) followed by *P. sarana* (9.9%), *L. rohita* (3.2%), *H. molitrix* (1.8%), *C. catla* (1.0%) and *C. mrigala* (0.2%) in the catches from Bhim tal. Common carp (*C. carpio*) thus seems to form a

mainstay of fishery forming bulk of the catch indicating that fish has become fully adapted and established in the lake due to its hardy nature, cold tolerance and prolific breeding.

Productivity Status

Assessment of the productivity based on total alkalinity (106-172 mg/l) placed the lake under productive category. Calcium and magnesium were also in optimal range. The potential fish production (kg/ha) on the basis of carbon assimilation has been estimated as 425 kg in Bhim tal. Thus the lake falls in highly productive category.

Management guidelines

Bhim tal is a small and shallow lake wherein common carp (*C. carpio*) contribute substantially in the catches. Indications are that the lake is quite productive with rich plankton density and fairly rich bottom fauna. Dinophyceae is dominant in plankton and chironomids in bottom fauna. Stocking policy is reported to the release of fries of Indian major carps, 8300 per hectare in 2001-02, without paying adequate attention to the biogenic capacity of the ecosystem. A sound management program based on yield potential and availability of food resources is needed and may be adopted as under.

- i) A stocking program, 500 fingerlings/ha with emphasis on common carp (3), rohu (3), mrigala (2) and catla (2) may be undertaken to realize the production potential.
- ii) Raising of the level of outflow channel would help in the increase of storage capacity as well as water spread area *vis-à-vis* the fish production.
- iii) Fish production can be enhanced further significantly by adopting judicious exploitation policy. The first step in this direction could be affected by preventing the use of small sized gill-nets (below 40 mm) that causes the mortality of fish at younger stage *vis-à-vis* limiting auto-stocking.
- iv) Eradication of weeds by implementing the biological control such as introduction of *C. idella* would also help in increasing the efficiency of gears besides optimum utilization of fish yield.
- v) Fish productivity levels can also be raised by adopting pen culture technology.
- vi) A note of caution is given not to allow entry of silver carp in the ecosystem as this may eliminate the indigenous fauna.

4. DRAUPTI TAL

Location and morphometry

Draupti tal, commonly known as Morni Tal formed in ancient days. It lies among the spurs of Shivalik hills. A small hillock divides it from the adjacent lake

Bhim tal. Draupiti tal (7.08 ha) has gross capacity of 23.67 ha m and is shallow in nature having a maximum depth of 3.4 m (Table 1). The catchment area is surrounded by hillocks. Outflow flows into river Ghaggar through Tangri rivulet.

Limnology and productivity

Soil and water quality : Basin soil is alkaline (pH 7.48) and sandy loam (Table 2). Available nitrogen (5.32 mg/100g) and phosphorus (1.10 mg/100g) were low and showed poor nutrient status of soil. Organic carbon (0.48%) was also deficient. The increase in percentage of organic carbon from 0.23 to 0.72% (Table 2) during post-monsoon may be due to influx of rain water loaded with organic debris from the catchment.

The physico-chemical characteristics of water are presented in table 3. The mean water temperature varied between 14.0 in winter and 27.0°C in pre-monsoon, averaging 19.8°C. Water transparency varied from 32.0 cm in winter to 44.0 cm in pre-monsoon. Water was alkaline (pH 7.9) and has no marked seasonal variation. This enable the normal ion exchange of fresh water fishes and is favourable for fish growth. Dissolved oxygen values ranged from 8.0 to 9.2 (av. 8.7) mg/l. Free CO₂ was absent in winter and pre-monsoon. The total alkalinity fluctuated from 126 to 160 mg/l. This showed the conduciveness of the lake for high fish productivity.

Calcium concentration was moderate varying between 26.6 and 36.0 mg/l. Magnesium content ranged from 7.2 to 23.4 mg/l. Chloride values fluctuated between 3.8 and 12.0 mg/l. The values of dissolved organic matter ranged from 1.8 to 3.2 mg/l indicating fairly high content of dissolved organic matter *vis-à-vis* productive state of the reservoir. Phosphates (0.06-0.30 mg/l) and silicates (0.8-1.7 mg/l) were moderate. Specific conductance fluctuated from 336 to 355 µmhos/cm. Values of 344 µmhos/cm of specific conductance supported the eutrophic character of the lake. The hydrological parameters of the lake thus clearly suggest the productive state of the lake.

Primary productivity

Studies on primary productivity exhibited an average gross carbon production of 117.6 mgC/m²/hr. The average net production was 81.68 mgC/m²/hr (Table 4). The expected fish yield in terms of carbon production is 340 kg/ha, indicating the productive nature of the lake. The energy assimilation efficiency (69%) also supported the productive character of the water body.

Biotic Communities

Studies on plankton abundance and their composition revealed richness of plankton (1970 u/l) dominated by dinophyceae (42.4%) mainly by *Ceratium* and *Pendinium*. The low water temperature during post-monsoon and winter, varying between 14.0-18.5°C respectively, could have favoured the proliferation in dinoflagellates (Fig 1). Chlorophyceae (*Pediastrum*, *Scenedesmus*, *Cosmarium*, *Characiopsis*, *Trochiscia*, *Rhizoclonium*, *Zygnema*) ranked second (19.6%) in order of predominance. Rotifers represented by *Keratella*, *Brachionus*, *Trochocerca*, *Polyarthra*, *Asplanchna*, *Notholca* were abundant in summer. Presence of *Microcystis*, *Pediastrum* and *Scenedesmus* exhibited eutrophic tendency of the lake. Copepods (*Diaptomus*, *Cyclops*) formed 8.5% of the total plankton. Periphytic communities were also rich (2532 u/cm², Fig 2) and were dominated by bacillariophyceae (69.4%). *Synedra*, *Fragilaria*, *Eucocconeis*, *Tabellaria*, *Melosira*, *Navicula* and *Cymbella* were the main periphytic forms observed.

The standing crop of macrobenthos ranged between 300 and 600 (average 400) u/m². This showed the lake was deficient with regards to benthic fauna. Chironomids were abundant (75%) followed by *Chaoborus* (25%). Molluscs and tubificids were absent (Table 5). Macrovegetation was altogether absent.

Fisheries

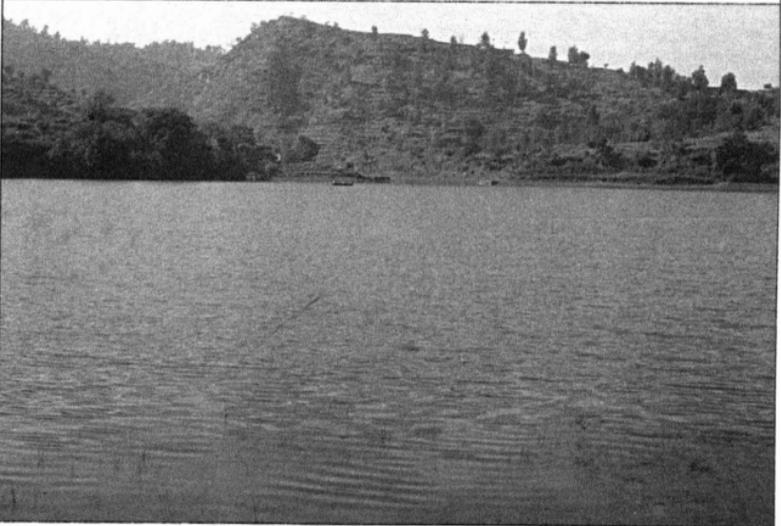
Morni tals, both Bhim tal and Draupti tal are being exploited through an open auction initially for an amount of Rs.50000/- for a period of three years, 2001-02. After three years, there would be an increase of 25% of Rs.50000/-. The fish spectrum in Draupti tal showed presence of *L. rohita*, *C. mrigala*, *P. sarana* and *C. carpio*. *H. molitrix* recorded from Bhim tal was absent in Draupti tal during the course of survey. The catch data revealed estimated fish yield around 60 kg/ha (2001-02).

Productivity Status

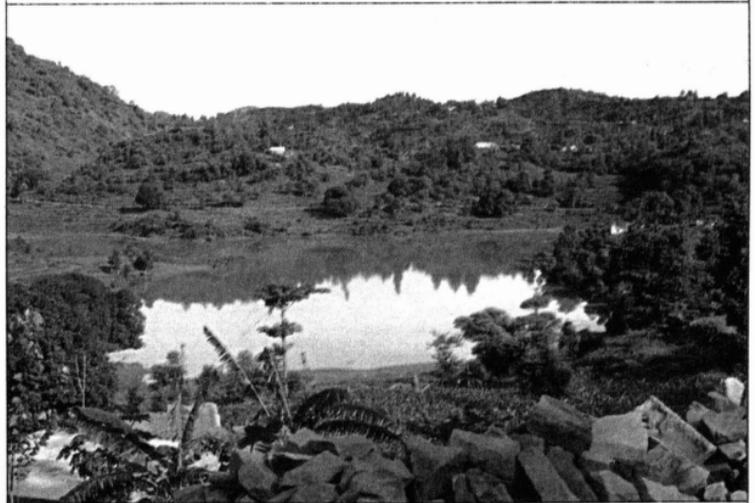
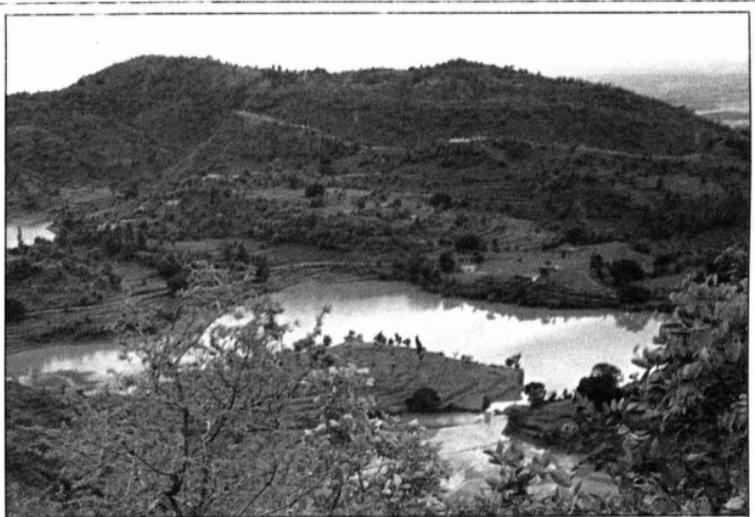
Assessment of total alkalinity (126-160 mg/l) placed the lake under productive category. Calcium and magnesium were also in optimal range. The potential fish production (kg/ha) on the basis of carbon assimilation in Draupti tal was 340 kg. Thus, the lake falls in highly productive category.

Management guidelines

In Draupti tal and Bhim tal, stocking, rearing and fishing is being managed by a private contractor. Major carps account for the commercial catch. The natural recruitment of major carps seems to be absent due to non-availability of suitable breeding ground. Stocking of the lake has so far been arbitrary. A sound management program based on yield potential is therefore needed. Stocking of IMC fries at high stocking rate, 8300/ha in 2001-02 may not prove beneficial. A stocking program, 500 fingerlings/ha with emphasis on common carp (3), rohu (3), mrigal (2) and catla (2) may be undertaken to realize the production potential. Gill-nets of mesh bar 40, 50 and 60 mm may be used for fishing. Since the lake is shallow, the depth of nets need to be adjusted according to water level. Conservation may be given highest priority especially to check the use of under sized nets etc. during breeding season. Close season be observed unflinchingly.



View of Bhim Tal



View of Draupti Tal