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Watersheds in the Alaknanda Basin of Uttrakhand

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Abstract: We use satellite remote sensing and a DEM to determine the boundary of the Alaknanda basin. –watersheds are found in the Alaknanda Basin. Our detailed data on watershed areas over the area provide an important temporal assessment of water resource variability in this area. These data can be integrated into further studies to analyze morphometric analysis of the region and hence can be used for water resource management.

Key Words: DEM, Watershed, Basin, GIS, Remote Sensing.

I. INTRODUCTION

Land and water capital are narrow and their wide consumption is essential, especially for countries like India, where the inhabitants pressure is progressively more continuous.

Drainage basins, catchments and sub catchments are the primary units for organizational purposes to safeguard natural resources. The watershed management notion recognizes the interrelationships amid the linkages between uplands, low lands, land use, geomorphology, slope and soil. Soil and water management is the key issue in watershed management while demarcating watersheds.

However, while considering watershed preservation work, it is not realistic to take the whole area at once. Thus the whole basin is divided into several smaller units, as sub watersheds or micro watersheds, by considering its drainage system.

Digital Elevation Model (DEM) and Shuttle Radar Topography Mission (SRTM) widely used in drainage basin analysis.

A watershed is an ideal unit for the management of natural resources like land and water and for mitigation of the impact of natural disasters for achieving sustainable development (Nookaratnam et. al., 2005). The proper watershed management needs utilization of land, water and soil resources of a watershed for optimum production with minimum hazard to natural resources, and morphometric analysis could be used for prioritization of sub-watersheds by studying different linear, aerial and relief aspects of the watershed (Biswas et. al., 1999).

Watershed prioritization is the ranking of different sub-watersheds of a watershed according to the order in which they have to be taken for handling through water and soil preservation measures. The concepts of prioritization play a very important role in soil and water preservation for watershed development and planning.

II. STUDY AREA

The Alaknanda basin located 30.1333˚ N latitude and 78.6029˚ E longitude which can be mapped to the closest address of Alaknanda river.The Alaknanda is a Himalayan river in the Indian state of Uttarakhand, the major river of Northern India and the holy river of Hinduism.

The Alaknanda is considered to rise at the foot of the Satopanth glacier inUttarakhand, although the Saraswati River offshoot flowing from Mana Pass is longer; the two meet at Mana, India, 21 km fromTibet. Three km below Mana the Alaknanda flows past the Hindu pilgrimage centre of Badrinath. It meets the Bhagirathi River at Devprayag after flowing for approximately 190 km (118.1 mi) through the Alaknanda valley. Its main tributaries are the Mandakini, Nandakini, and Pindar rivers. The Alaknanda system drains parts of Chamoli, Tehri, and Pauri districts.

- Satopanth Glacier six km up from Alaknanda's origin at its snout, the triangular Lake Satopanth is found at a height of 4350 m.
- Nanda Devi is the highest point in the Alaknanda basin.

ALAKANANDA SYSTEM: The Alakananda rises in the glaciers to the north of the temple town of **Badrinath.** It washes past the feet of the holy Lord Badrivishal temple in a SW direction & along a V-shaped valley through the towns of Vishnuprayag, Nandprayag, Karanprayag, Rudraprayag and Srinagar. It has formed a broad valley at Gauchar. The main tributaries of Alakananda are:

- The river Mandakini .
- River Pindar.
- Nandakini river
- The Dhauliganga river.

THEORITICAL DEVELOPMENT:

Panch prayag:
Several rivers in the Garhwal region merge with the

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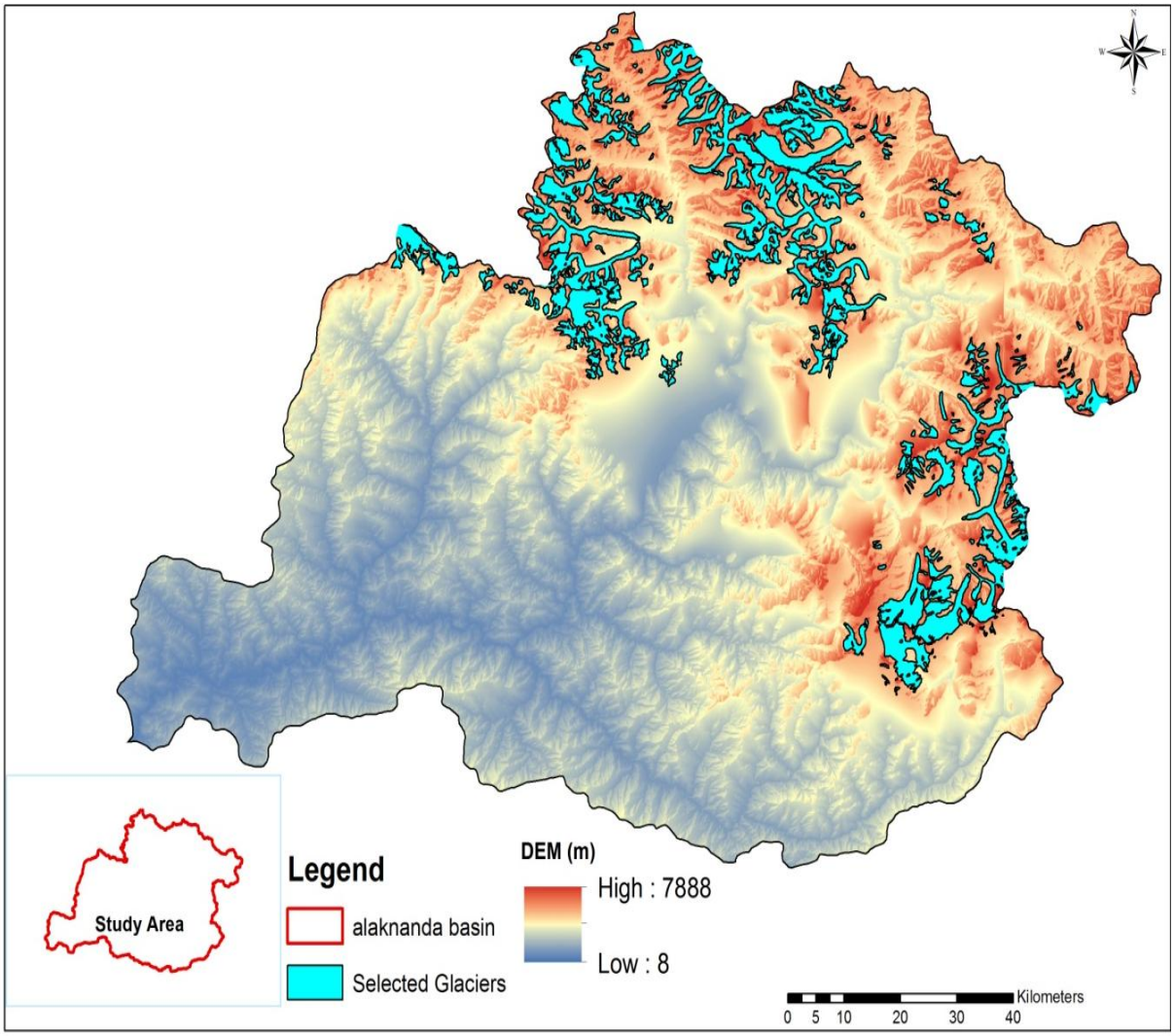
Alaknanda at Panch Prayag or 'holy confluence of rivers'. These are:[3]

1. Vishnuprayag, where the Alaknanda is met by the Dhauliganga River
2. Nandaprayag, where it is met by the Nandakini River
3. Karnaprayag, where it is met by the Pindar River
4. Rudraprayag, where it is met by the Mandakini River
5. Devprayag, where it meets the Bhagirathi River and officially becomes the Ganges.



III. DATA AND METHODS

A. DATA

Topographic maps at scales of 1:50,000 are utilised from the Survey of India. The main image sources were Landsat TM available from USGS (United State Geological Survey, and were orthorectified automatically using USGS Shuttle Radar Topography Mission (SRTM) DEM data. Elevation values (m) were derived from a SRTM-DEM.

B. METHODS

Data preprocessing

Geocorrections was conduct using Arc GIS software for all images. Clearly distinguishable terrain description from topographic maps was used as location to roll the other images.

All images and maps were presented in the Universal Transverse Mercator (UTM) system referenced to the World Geodetic System of 1984 (WGS84).

IV. RESULTS AND DISSCUSSIONS

A. Watersheds in Alaknanda Basin

There are a total of 247 Watersheds which fall into the boundaries of Alaknanda Basin. But some (i.e.,37 watersheds) are the part which only comes on the boundaries , so these were dropped as major part lies under some other area. And other minors are also merged to form bigger watersheds, so there are finally a total of 22 watersheds.

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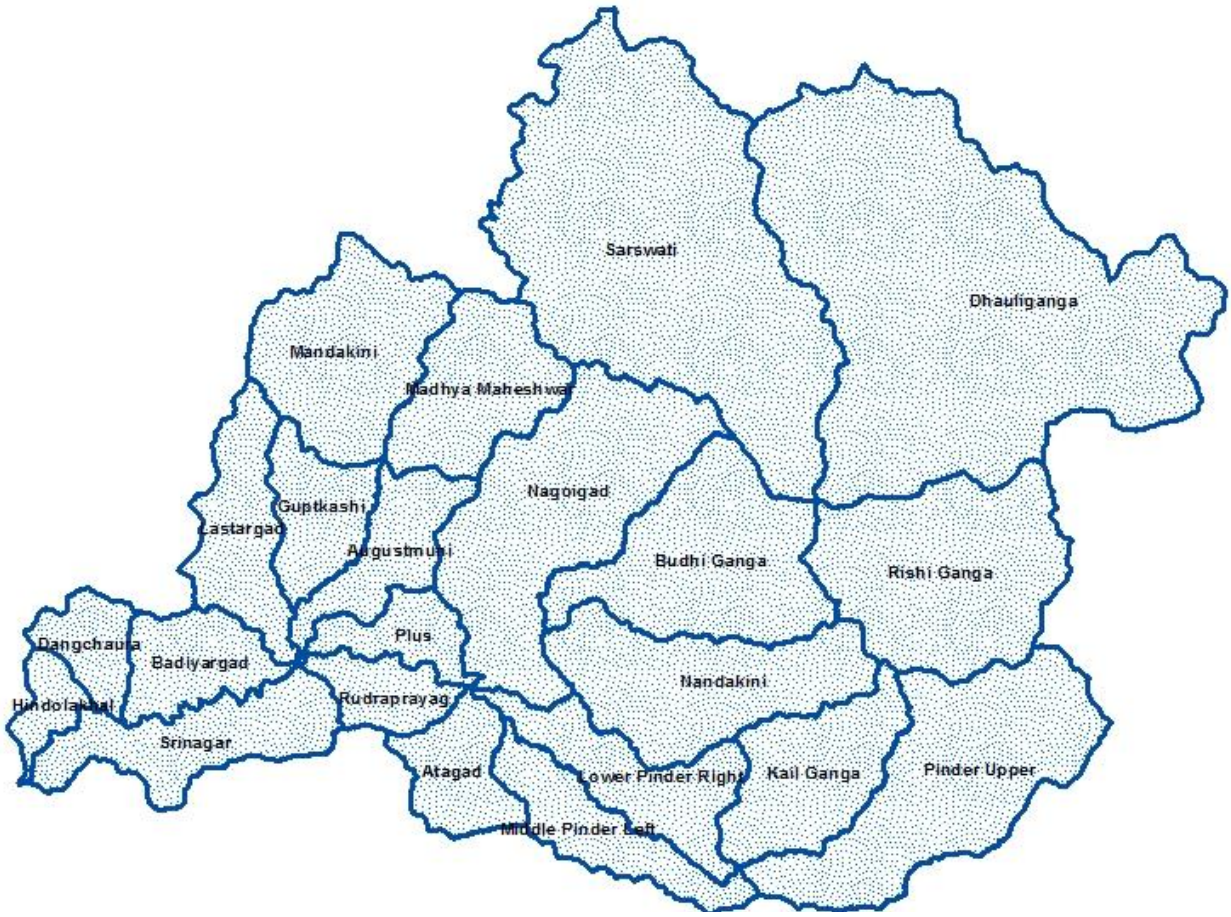

Figure 2.Watersheds of Alaknanda Basin (Merged into major ones)

1. Atagad
a. Karanprayag
b. Kotali
c. Bhatoli
d. Kakragad
e. Baret
f. Baragad
g. Adibadri
2. Augustmuni
a. Karkagad
b. Kyunjgad
c. Baniyari
d. Rampur
e. Surgad
3. Badiyargad
a. Bhardargad
b. Sera
c. Dhundsirgad
d. Utyasu
e. Namigad
f. Jakhni
g. Bhimpanisera
4. Budhi Ganga
a. Joshimath
b. Karmnasa
c. Sarnkola
d. Tapoban
e. Karchigaon
f. Garur Ganga
g. Puigadhera
h. Berihiganga
i. Batula
j. Lasi
k. Gauna
l. Taraktal
m. Guduyargadhera
5. Dangchaura
a. Dangri
b. Jakhi
c. Jakhand
d. Takoli
e. Maletha
f. Mundoli
6. Dhauliganga
a. Chemshala
b. Girthiganga
c. Dhauliganga
d. Jumagad
e. Malari
f. Jelam
g. Dunagiri
h. Wautigadhera
i. Gadigadhera
j. Gankhwigadhera
k. Tolmagadhera
l. Jonjgad

7. Guptkashi
a. Damargad
b. Rawanganga
c. Dangi
d. Naini
e. Utrasu
f. Jakhnoli
8. Hindolakhal
a. Chandrabhagagad
b. Jakher
c. Gharkotgad
d. Bhetyan
9. Kail Ganga
a. Khobina Ganga
b. Bedni Ganga
c. Halkan gad
d. Kuman gad
e. Bagri gad
f. Pinnu
g. Ghes
h. Sarmata
i. Kandai
j. Timli
k. Guram Toli
l. Sawar
m. Ichholi
10. Lastargad
a. Lastargad Upper
b. Khalyan
c. Chopra
d. Bhatwari
e. Mayali
f. Chirbatiyakhal
g. Barsari
h. Kwila(plus)
11. Lower Pinder Right
a. Nakot
b. Bhatiyawa
c. Bansoli
d. Chopta gad
e. Kichgad
f. Simligad
g. Chorgad
h. Tetuna
i. Khalyun
j. Tharali
k. Nandikesri
12. Madhya Maheshwar
a. Markanda Ganga
b. Madhya Maheshwar
c. Anphalgad
d. Setgad
e. Kyargad
13. Mandakini
a. Kedargad
b. Kaliganga
c. Mandani Ganga
d. Satanagad
e. Jhakuri
f. Patigad
g. Kaldunga Nala
h. Gobindgad
i. Byumggad
14. Middle Pinder Left
a. Chulakot
b. Chulakot
c. Nalgaon
d. Bedula
e. Panthi
f. Ming gadhera
g. Baramgad
h. Naunagad
i. Rakoli
j. Thala
k. Gwaldam
l. Talwari
15. Nagoigad
a. Kalpagad
b. Menagad
c. Vishnugad
d. Aroshigad
e. Barki
f. Balasuit
g. Bangina
h. Tapon
i. Kalsir
j. Gopeshwar
k. Diwar
l. Jaisal
m. Guram
n. Rarwa
o. Trishula
p. Gersal
q. Pokhri
r. Ratagad
s. Kujasu
t. Jilasu
16. Nandakini
a. Jatha Gad
b. Tomingad
c. Molagad
d. Nand Prayag
e. Gondeyagad
f. Ramni
g. Padairgaon
h. Sik
i. Bhadragad
j. Palri
k. Ala
l. Bhoriyagadhera
m. Suwalgad
n. Gulari
o. Goligadhera
p. Mokhgad
q. Mainigadhera
r. Roopganga
s. Puneragad
t. Ghat
17. Pinder Upper
a. Kaphnigad

b. Sunderdhonga
c. Bauragad
d. Surag
e. Ghatiyagad
f. Saurgad
g. Talkori
h. Maunagwar
i. Pheli
j. Chaur
k. Makhauli
l. Milotha
m. Kaligad

18. Plus
a. Pogtagad
b. Chamak
c. Chhinka
d. Dungri
e. Sarmola
f. Khurar

19. Rishi Ganga
a. Ramani
b. Paing
c. Raunthi gadhera
d. Dudh Ganga
e. Trishul Nadi

20. Rudraprayag
a. Ratura
b. Gholtir
c. Siwali
d. Sindrawani

21. Sarswati
a. Saraswati Nadi
b. Mana
c. Neelganga
d. Badrinath
e. Laxamanganga
f. Khirganga
g. Pandukeshar
h. Kagbhusand Nadi
i. Homegadhera
j. Jawagwar

22. Srinagar
a. Bargad
b. Rudraprayag
c. Gostugad
d. Bachangad
e. Srinagar
f. Devalgad
g. Chilgarh
h. Nakotgad
i. Gadurgad
j. Nadalgad
k. Dewanigad

V. CONCLUSION

- These watersheds further can be used for prioritization of watersheds.
- Natural watershed management can be achieved by calculating various parameters like flow direction, flow length, flow accumulation, etc.
- All parameters (i.e., linear, aerial &shape) can be calculated through these watersheds and their DEM.

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