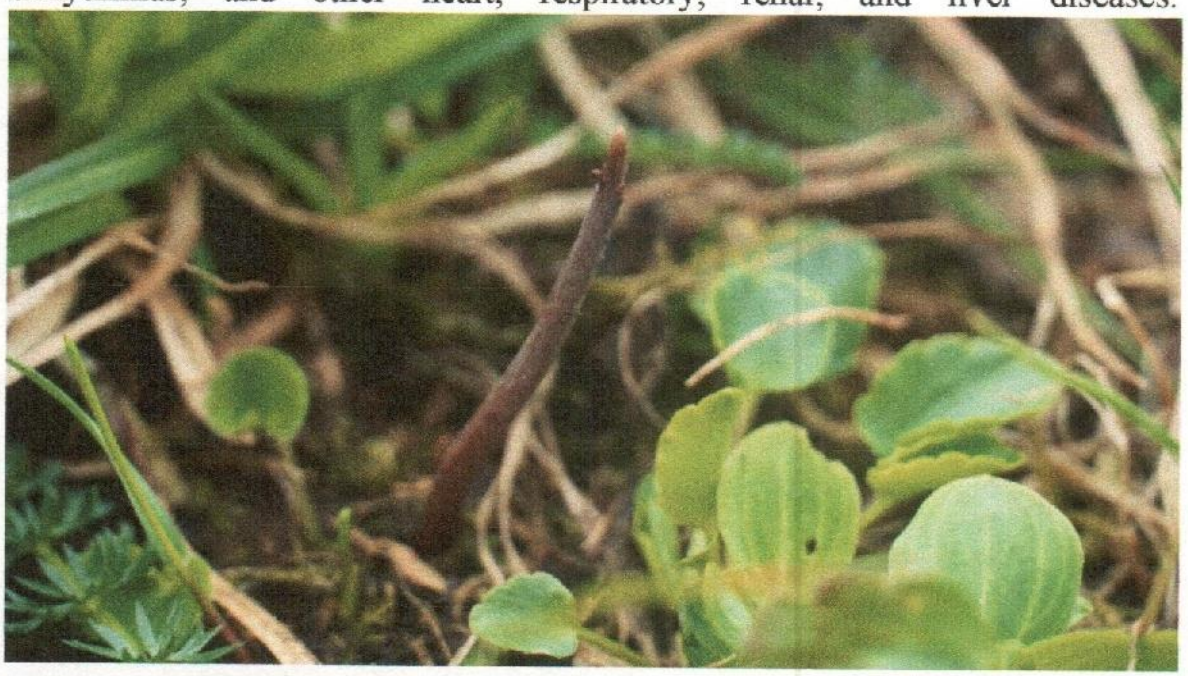
A report based on Study of Socioeconomic and Ecological impact of Keera jari/ Yartsagunbu(*Ophiocordyceps sinensis*) extraction & selling with respect of on-site people awareness program for scientifically sustainable harvesting in the upper catchment area of Sundardhunga and Pindari Glacier (Bageshwar) (2020-21)

Introduction- Forest Research Range Pithoragarh is working with multiple aspects of various research-oriented fields under the supervision of Forest Research Circle Haldwani. By continuing this process, a project entitled "Study of Socio-economic and ecological impact of Keera jari extraction" was started in the year 2018 with a time frame of three years. During the first year in 2019, the on-field study was conducted in Pithoragarh district basically in Dharchula Block. After gathering the data, two workshops were organized in both Munsyari and Dharchula block to sanitize the scientific harvesting of Keera jari to maintain sustainability and to make people aware of the benefit of ecological conservation. This year the on-site study is done by taking both objectives simultaneously in villages near to upper catchment area of Sundardhunga and Pindari glacier.

Keera jari or Yartsa gunbu is a high-value medicinal caterpillar mushroom. It is scientifically known as *Cordyceps sinensis*. It is found to be growing in the higher hills in and around the altitude range 3700-4500 meters of the Himalayas including Nepal, China, Tibet, and India. It was first seen in the eighteenth century. In India, this fungus was first noticed from the high-altitude hills of Dharchula,in Pithoragarh district (Uttarakhand) along the Indo Nepal border area of central Himalayas. Cordyceps contain a broad range of compounds that are considered nutritional. It contains all the essential amino

acids, Vitamin E and K, and the water-soluble vitamins B1, B2, and B12. In addition to this, it contains sugar, including mono-, Di- and oligosaccharides, and many complex polysaccharides, proteins, sterols, nucleosides, and trace elements. The bioactive compound polysaccharides of fungus account for the anti-inflammatory, antioxidant, antitumor, immunomodulatory, hypoglycaemic, steroidogenic, and hypolipidemic effects, and Cordycepin contribute to the anti-tumor, insecticidal and antibacterial activity. It can be used to treat a condition such as a hypo sexuality, night sweats, hyperglycemia, hyperlipidemia, asthenia, arrhythmias, and other heart, respiratory, renal, and liver diseases.



Keera jari is the most important source of income for the local people. Due to its high medicinal value and higher price, it is facing the threat of overexploitation and reduction in yield.

Objective-

1. To gather information about the habitat of Keera jari along Sundardhunga and Pindari catchment areas.
2. Study of socio-economic status of linked communities with Keera Jari extraction.
3. Study of the on-site ecological impact of Keera jari extraction.
4. Average Measurement of the quantity extracted and its selling by local communities.
5. To Aware villagers about the harvesting of Keera jari by sustainable harvesting means.

Methodology-

Study of the Socioeconomic and ecological impact of the Keera jari extraction and scientific harvesting awareness program was conducted in June 2021. The overall work was done by the following method-

1. To study Socioeconomic status, a formal rapid questionnaire-based work in the villages has been done to get reliable information.
2. To study the ecological effect, an observational study was conducted on the Keerajari extraction site near Sundardhunga glacier.
3. To make people aware of the scientific harvesting of Keera jari yartsagunbu extraction for its sustainability, formal workshop and meetings were organized in various villages of both Khati Van panchayat and Wacham Van panchayat.

Study area-

The study was conducted along the catchment area of Sundaradhunga river and at the catchment of Pindar river in Khati village. These are two dominant van panchayat/Gram Panchayat which harvest Yartsagunbu from dominant alpine Bugyal parts of Sundardhunga and Pindari area. Apart from these two villages Sorag, Badiyakot and Jhuni are some other Van panchayat from where people come to harvest the Yartsa gunbu from the parts of Sundardhunga, Pindari, and Kafniglaciers. The villages are situated at 2000-2500meter altitudinal range, whereas harvesting sites are situated in between 3200- 4200 mt altitudinal range.

Demographic details of Villages-

The site area and its villages are very famous due to the presence of three well-known glaciers i.e. Kafni, Pindari, and Sundardhunga glacier. Most of the villages near these catchment areas are becoming tourist destinations. The study area falls under the Kapkot tehsil of Bageshwar district and the total population of this tehsil was around 64,894 as per the census 2011. The total literacy rate of this tehsil is 75.33%. However, the main study was conducted in two van panchayats. Population status of some other nearest villages which are involved in keedajari extraction work are as follows:

S.No.	Van panchayat/ Village Name	Total Number of Families	Population	Male	Female
1	Waccham	232	1244	625	619
2	Khati	66	314	150	164
3	Sorag	181	959	490	469
4	Jhuni	108	510	233	277

Literacy rate-

S.No.	Van panchayat/ Village Name	Total literacy	Male literacy	Female Literacy
1	Waccham	78.24%	91.76%	64.45%
2	Khati	70.97%	86.47%	56.85%
3	Sorag	79.51%	88.22%	70.30%
4	Jhuni	87.17%	92.70%	82.98%

Photographs-

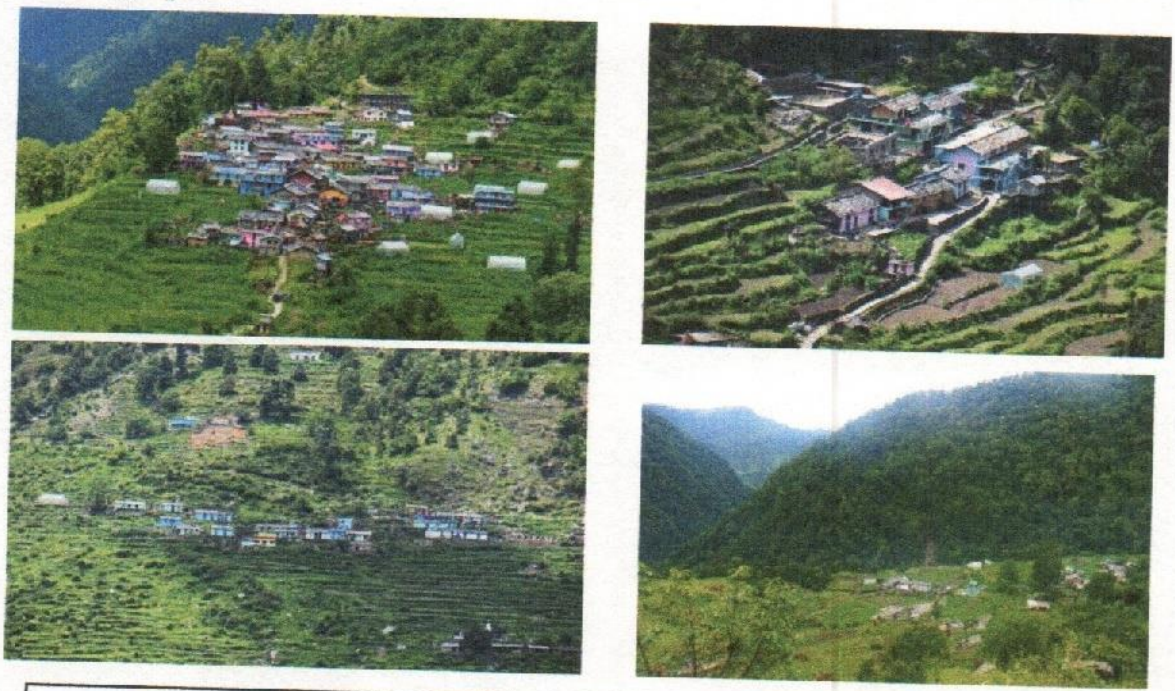


Fig1.Villages on study site- a) Khati village, b) Ritang village, c) Wachm village, D) Jatoli village

ECONOMIC AND SOCIAL ISSUES-

Yartsa gunbu is one of the major sources of the economy not only for the local surrounding villages but also for those villages which are situated far away from the extraction sites. The people of these areas are also dependent indirectly on Keerajari/Yartsa gunbu extraction. People of these villages lead a simple life. They live mostly in traditionally designed houses. Some of them are not cemented and are made of wood, ringal, and Salam grass. As this study area is also famous for various tourist destinations like the Pindari Glacier trekking route, Sundardhunga, and Kafni Glacier, etc so these villages are somewhat developed and mostly dependent on the tourists for their economic development. School facilities are available in Khati and the nearest villages. A govt degree college is also there at Bdiyakot Village. Wherever schools are available hardly one or two teachers are there for teaching jobs. A lot of work is still to be done for proper communication facilities, road networks, electricity and medical facility in most of these villages.

Primary source of economy	Secondary Source of economy
Tourism (for villages which are situated on the route of Pindari, Sundardhunga, and Kafni Glacier track); Agriculture; Goat, Sheep rearing; Shopkeeping; Porter, Labour work, etc.	Yartsa gunbu collection, collection of some other medicinal plant like Jungli Lahsoon, Hathajari, Jatamasi, Kutki, Gandrain, etc.

Estimation of quantity and price of extraction of Keerajari/Yartsa gunbu From Sundardhunga and its surrounding area:-

As per information/data collated, in the year 2018 selling price of Keerajari/Yartsa gunbu was 7-10 lakh Rupee/Kilogram (1kg= 3800 pieces approx.) by villagers to selling agents which translate to around Rs 250 per piece. However, international prices vary from 20-30 lakh Rupees per Kg. This year people have apprehension of low prices due to last year's stock still lying with agents/contractors as Yartsa gunbu is supposed to remain viable for a period of almost one year if packaged properly. Covid-19 has also affected the extraction and selling of Yartsa gunbu.

1. Total no. of udiyaar covered with tents observed in Sundardhunga area- 100 approx.

2. Approximate no. of villages included in Keerajari/Yartsa gunbu extraction in and around Sundardhung site-2 broadly

3. On average around 3 people reside in a single tent, accordingly, the total no. of persons living in the extraction area is around= 100*3= 300 people

4. Approximate days of stay in the extraction site= 45 approx.

5. Average No. of pieces of Cordyceps sinensis extracted by a single person during a day= 5 pieces approx.

6. Total no. of pieces extracted in a day = 5*300=1500 piece approx.

7. Total no. of pieces extracted during the period of extraction= 1500*45=67,500 pieces approx.

8. Around 3800 pieces (roughly 3500-4000 pieces) weigh one Kg., so the total amount of extracted Cordyceps sinensis = 67,500/3800= 17.76 K.g, during the entire extraction period.

9. Based on informal interviews of various people this year, the prices at which they sell products to agents, are reportedly averaging around Rs 5 lakh per kg, though initially at the beginning of the season, they were expecting around Rs 7-8 lakh per Kg.

10. Thus, total earning from all villages which are involved in the extraction of Keerajari/Yartsa gunbu from Sundardhunga and its surrounding (as mentioned in the above table of villages) is expected to be around =17.76*500000=88,80,000 Rupee for the entire extraction period, which spans around 45 days.

11. As in most of the prior studied areas of keerajari extraction it was observed that there is also opportunity of income for pony owners and local small shops in the extraction site, but Sundardhunga site due to its hard boulder route, there is less use of porters.

12. Another major source of income is the collection of various other medicinal plants, which include Gandrayan, Satuwa, salam panja, jatamansi and jungli lahsoon. It is reported to have a price value of around 20000 rupees per kg. In the year 2018. However, the extraction is done by very limited families around (20 families).

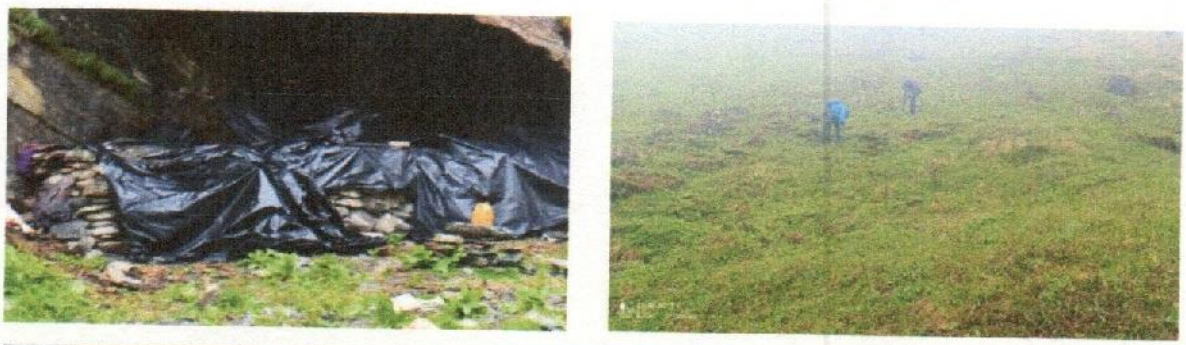


Fig A) An Residential tent placed under udiyaar. B) Searching of Keera jari sample with the help of an harvester.

Spiritual value of Jatamansi- Jatamansi (*Nardostachys jatamasi)* is the plant which is widely extracted from the Keera jari extraction site due to its ritual importance. Jatmansi is used by villagers in all kind of ritual ceremony along with the plant species like *Rhododendron anthopogon, Skimmia anquitella* and *Juniperus communies.* However, these plant species are not extracted for commercial purpose but their uncontrolled extraction can enhance ecological unstability or can reduce future yield of these plants, which may also affects the food availability for *Larvas* of *Cordyceps host.*

Per family income-

However not all families are involved in Keera jari extraction in these extraction areas. Overall around 150 to 180 families from both Waccham and Khati village were found to be involved in Keerajari extraction from both the extraction sites i.e. alpines of Pindari and Sundardhunga Glacier catchment respectively. On average each family goes with 2 to 3 family members. The income from keerajari extraction per family can be estimated as follows:-

No. of individual per family involved in keera jari extraction- 2 approx.

No. of Yartsagunbu samples collected by each member- 5 in a day approx.

Total no. of samples collected by one person during the harvesting season- 5X 45= 225 samples approx.

Total no. of samples collected by one family during harvesting season- 2 X 225= 450 samples approx.

So, the average earning for each family- 450 X 170 rupees (average cost of a single piece) = 76,500 rupees approx. (however, this amount can fluctuate from family to family as some of them didn't get the sufficient amount of samples and some get more samples).

Note- It was reported that if individual harvesters sell their collected material they may get higher prices (around 250 rupees per piece) but this is practically not possible, so when they sell their material in bulk they get lower prices (around 170 rupees per pieces) but this is the only way for selling to the contractor.

Ecological impact of Keerajari extraction- As yartsagunbu extraction is a short duration beneficial source of income for villagers it also affects the ecological conditions of alpine ecosystem by continuous use of fuelwood and unscientific harvesting of keerajari and other medicinal plants. Major fuelwood species which are widely used by the harvesters are *Rhododendron campanulatum* and *Betula utilis.* However, the intensity of use of fuelwood by cutting trees is not too much high and it is just because of that most of the harvesters placed their temporary residence along the riverside and most of the

wood is used for fuelwood obtained from the river which comes by floating with the river streams. However, continuous grazing by cattle, uncontrolled harvesting of medicinal plants, can pose serious threat for future yield. Use of fuelwood may also have effect of carbon emmision and temperature increase of these extraction sites and may have adverse impact on nearby glaciers like Sundardhunga, Pindari, and Kafni, in future.

Forest guideline for Keerajari extraction and people response

Uttarakhand Govt with association of Uttarakhand forest department, State medicinal plant board and some other departments had taken various step time to time to protect and conserve the upper Himalayan region by making various rules and regulation. In 2017-18 Government approved a new fresh guideline for extraction of Keerajari for its controlled harvesting and legalized collection and selling procedure.

However during field observation basis it was found that most of the peoples are still not aware about these guidelines. For this purpose there is a need to organize awareness camps about these govt guideline by including various departments on a single Platform including Forest Department, Revenue Department, Local administrative bodies, Teaching Staff and local village level administrative bodies. These kind of awareness workshop should be organized near the harvesting villages so that harvesters can understand these rules. These rules itself provide for organizing such scientific workshops to promote scientific and sustainable harvesting of Keerajari.

During this study, onsite formal awareness camp and workshop were organized to make people aware about these rules.

Awareness building workshop for villages- During the study of the various socio-economic and ecological impacts of keerajari harvesting, short onsite awareness camps/meetings were also organized to educate about scientific harvesting of keera jari yartsa gunbu. The awareness workshop was organized both in villages and along the route to make people aware of future hazards and sustainable development.

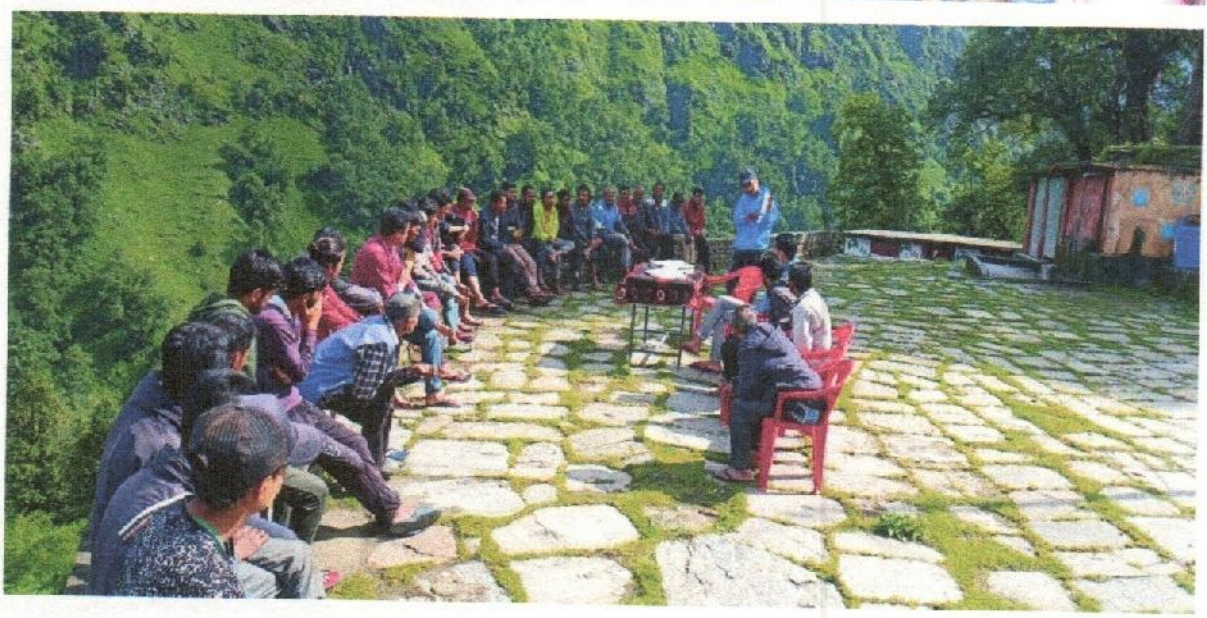
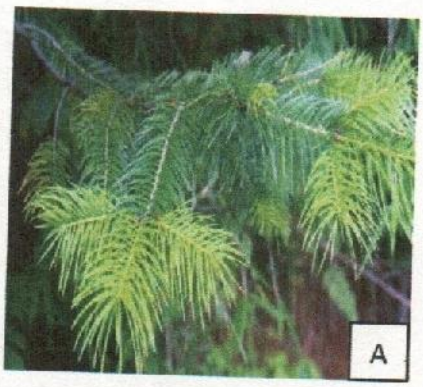


Fig. Awareness generating meetings on various villages.

Floral diversity- Ecologically all sites are very rich in flora and fauna value. Various herbs, Shrubs, trees, and crops were found under the whole study area. Many of these species have very important medicinal value, and various endangered species are also found in these study site areas. In most of the villages, people know about *Picrorhizza urrooa(Kutki), Salampanja/Hathajari (Dactylorhiza hatagirea), Jatamasi (Nardostachys jatamansi), Chaerophyllum villosum, Gandrayan (Angelica glauca), Van Satwa(Paris polyphylla), Atish (Aconitum heterophyllum), Kuth(Saussurea costus)* and medicinal value of these herbs. Except for these herbs, *Primula sp., Rehum emodi, Bajardanti(Potentillafulgens), Mahameda(Polygonatum sp.)* are also found in higher alpine regions. Various tree species like *Kharsu oak(Quercus semicarpifolia), Chimshu oak(Quercus floribunda), Devdar(Cedrus deodara), Pangar(Aesculus indica), Fir(Abies pindrow), Burans(Rhododendron arboreum, Rhododendron barbatum, Rhododendron campanulatum, Rhododendron anthopogon), Thuner (Taxus baccata), Bhojpatra (Betula utilis), Sorbus lanata, Juniperus communis, Banj oak(Quercus leucotrichophora), Chook/amesh (Hippophae salicifolia)* are found in high altitude areas.

Most of the village people use *Banj oak, Kharshu oak, Chimsu oak, Burans, Uteesh,* and *Thuner* for their fuelwood purpose. In higher altitude areas of Bugyals they widely use *Rhododendron barbatum, Rhododendron anthopogon, Rhododendron campanulatum, Betula utilis* and *Juniper.* for fuelwood purpose and temporary tent house making purposes.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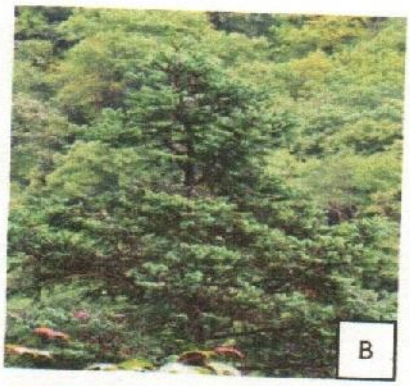
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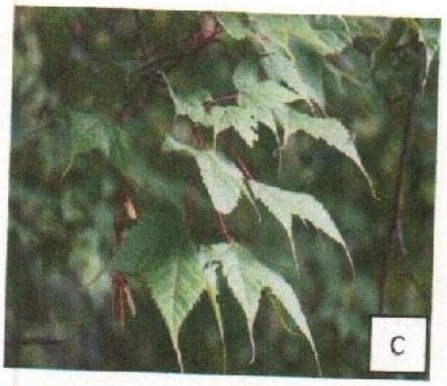
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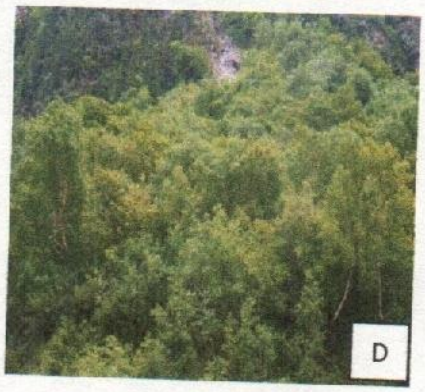
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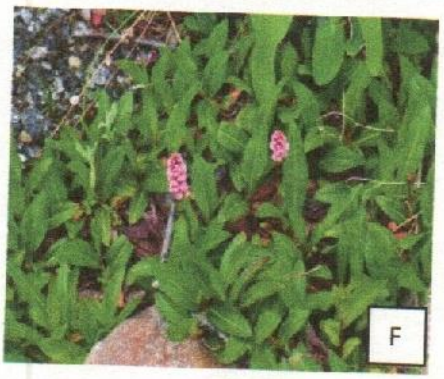
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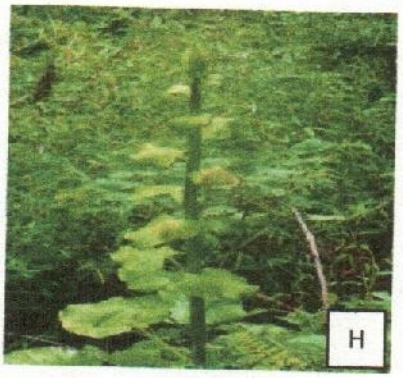


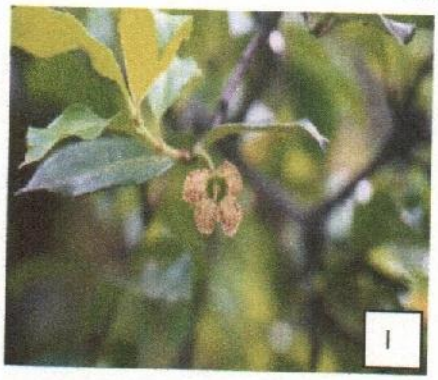
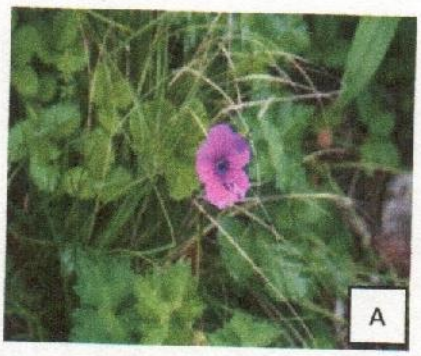
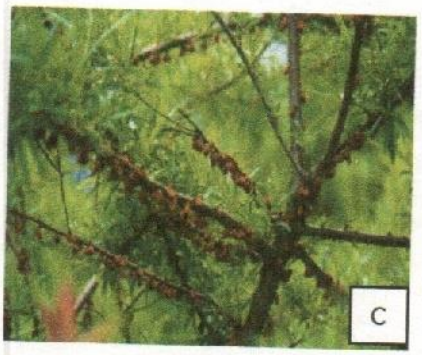
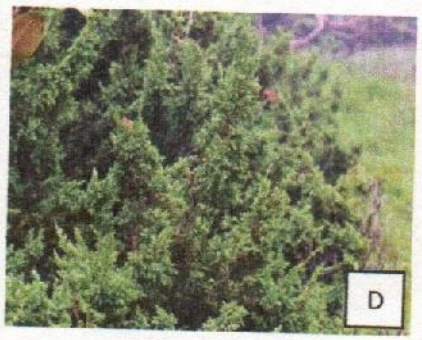


Fig.- Plants Photograhs ***A) Abies pindrow, B) Abies spectabilis, C) Acer acuminatum, D) Betula utilis, E) Angelica archengelica, F) Bistorta affinis, G) Calanthe tricarinata, H) Cardiocrinum giganteum, I) Eunonymus tingens, J) Fragaria daltoniana, K) Epilobium latifolium, L) Danthonia cachmeriana.***







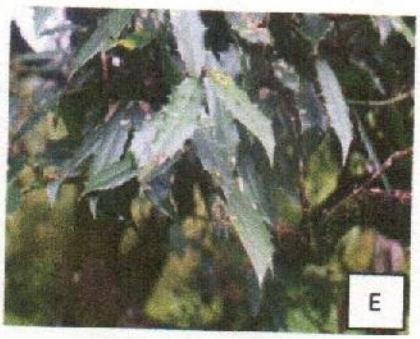


Fig.- Plants Photograhs ***A) Geranium wallichianum, B) Goodyera repens, C) Hippophae rhamnoides, D) Juniperus communis, E) Ilex dipyrena, F) Viola biflora, G) Magacarpea polyandara , H) Oneorchis micrantha, I) Rheum moorcroftianum, J) Skimmia anquetillia, K) Roscoea alpina, L) Rhododendron anthopogon, M) Paris polyphylla, N) Picrorhizza kurooa, O) Oxyria digyna.***

Ritual ceremony during the end of harvesting site

In accordance with spiritual traditions of Himalayan region, at the end of the harvesting season harvesters organise a ritual ceremony as a mark of respect and regard to their local deities. They also pray for the future availability of various income generating resources. By this short ritual ceremony, they thank to their deities for providing shelter and protection from various natural and climatic hazards. Most of the time this ceremony is organised by the senior most shepherd or the head of the extractor families.

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