

**Study of Socio economic & ecological effect of extraction of Yartsa gunbu/
Keerajari /Yartsa gunbu (*Ophiocordyceps sinensis*) and regulatory/ enforcement
issues**

Project Progress Report

1. INTRODUCTION

Yartsa gunbu (which is a Tibetan term meaning 'winter worm, summer grass') is a high value medicinal caterpillar mushroom. It is scientifically known as *Cordyceps sinensis*. The fungus germinates under ground inside living larvae, mummifies them during the winter, and then emerges through the head of the dead caterpillar, pushing up through the soil in the form of a stalk like mushroom. The fungus is a parasite, it infects ghost moth caterpillars. The caterpillars live underground in alpine grass and feed on roots underground and are more vulnerable to the fungus when they shed their skin in the late summer. This is also the time when the fungus release its spores. Once infected, the caterpillar, goes upward and lies perpendicular to the surface. The fungus digest the inside of the larvae and eventually kills it. In the spring, a stalked fluting body shoots out of the caterpillar's head and can be visible on the surface of the ground. The fungus survives by preying on ghost moth caterpillars and it eats the insides of caterpillar that burrows underground for winter and then fungus kills caterpillar and sprouts out of their heads, like a unicorn horn.



In Chinese, it is called *chong cao*(worm-grass) . The mixed morphology, a fungal head riding a caterpillar body, earns *Cordyceps* its Indian name, *Keeda Jadi*, or insects herbs.

This is most expensive fungus in the world and also priciest biological commodity on the planet, even surpassing tiger parts, elephant ivory and rhino horns. It is not the fungus itself that is prized, but the remains of its host; a species of caterpillar, that the cordyceps invades and kills at its larvae stage. Once harvested, the dried caterpillar carcasses are sold intact and made into various treatments.

The first known reference is reported in a 15th - century Tibetan text, titled as , "An Ocean of Aphrodisiacal Qualities" . By the 17th and 18th centuries, it was being imported into China for medical use. It is now widely used in traditional Chinese medicine as a natural remedy for a variety of ailments, including impotence, fatigue, pain and cancer to kidney diseases , inflammation and aging, and has earned the nick name of 'Himalayan Viagra' and 'Himalayan Gold'. Its profile got a major boost during the 1993 world athletic championships in Germany, when the record - setting performance of Chinese distance runners was popularly attributed to a cordyceps supplement. From 1997 to 2008, its price sky rocketed in China, as China's economy opened up and disposable income rose that fuelled popular demand for caterpillar fungus. In 2003, outbreak of SARS (Severe Acute Respiratory Syndrome), a deadly respiratory disease, gave this fungus a further publicity boost. Most of this product is still consumed in China, where in addition to its use as a medicine and supplement, the product is now flaunted as a sign of wealth and status.

It is found growing in the higher hills in and around the altitude range 3700-4800 meter of Himalayas including Tibet, Nepal, China and India. In India this fungus was first noticed from the high altitude hills of Dharchula in Pithoragarh (Uttarakhand) along the indo Nepal

border area of Central Himalayas. In Uttarakhand, this is found in Pithoragarh (Dharchula and Munsyari), Chamoli and Bageshwar Districts.

Cordyceps contains a broad range of compounds which are considered nutritional. It contains all of the essential amino acids, Vitamin E and K, and the water soluble vitamins B1, B2 and B12. In addition, it contains many type of sugars, including mono-, Di- and oligosaccharides, and many complex polysaccharides, proteins, sterols, nucleosides, and trace elements. The bioactive compound polysaccharides of fungus accounts for the anti-inflammatory, antioxidant, antitumor, ant metastatic and hypoglycaemic effects and Cordycepin contribute to the anti tumor, insecticidal and antibacterial activity. There have been no specific scientific studies in western countries to prove its effectiveness. Despite all the claims, no one has yet succeeded in producing commercially viable quantities of good quality *Yartsa gunbu*, in artificial conditions

As per a study published in *Nature*, global market for yartsa gunbu, ranges between \$5 billion to \$11 billion. *Keerajari/Yartsa gunbu* is one of most important way of income generation for the local people. Due to its high medicinal value and higher international demand and consequent price rise, it is facing threat of over exploitation and reduction in the yield.

2. OBJECTIVES-

1. Information gathering about the distribution/habitat of Keerajari/Yartsa gunbu, its medicinal value and commercial status.
2. Study of socio economic status of communities linked with Keerajari/Yartsa gunbu extraction, including impact on migration.

3. Study of the ecological impact of extraction of *Keerajari/Yartsa gunbu*.
4. Estimation of the quantity extracted and trade modalities by local communities.
5. Study of regulatory framework.
6. Suggest solutions for sustainable harvesting including study and mitigation of impact of climate change.

3. METHODOLOGY:-

The project is for a period of 3 years beginning from year 2018-19. Socio economic and ecological effect study of *Keerajari/Yartsa gunbu* was done during the month of May and June, 2019. The study was done by following measuring parameter i.e.-

1. To study Socio economic status, a formal rapid questionnaire based work in the villages was used to get the reliable information.
2. To study ecological impact of extraction, an Observation study was conducted on *Keerajari/Yartsa gunbu* extraction site.
3. To study issue of regulatory framework, information was obtained in written profirma from Pithoragarh Forest Divison.
4. To study issue of sustainable harvesting, information was collected from local villagers, Government officials and various Researchers.

4. STUDY AREA-

The study was conducted in various villages of Dharchula block covering the range from 30°04'35.87" N to 29°59'08.64"N and 80°36'49.14"E to 80°28'11.07"E. The questionnaire



based study was conducted in Villages Dar, Yawalgaon, Tjam, Vatan, Sumdum, Umchiya, gum, Talla panga, Malla panga, Karto, Khela, Garguwa, Karkigaon, Dhamigaon, Rauti, Dhura etc. and to observe the ecological impact, the study was conducted in Chhiplakot region. The study area covers the altitudinal range from 1000m to 4500m. The area studied belonged mainly to Sumdum, Syankuri Van panchayat of Pithoragarh Forest Divison.

Table 1.1-Studied villages and their Population (According to population census 2011):-

S.No.	Village Name	Population
1	Dar	560
2	Gargua	986
3	Jumma	3383
4	Kanar	1304

5	Khela	1764
6	Khet	504
7	Ranthi	4932
8	Syankuri	1232
9	Tejam	190
10	Umchiya	422
11	Watan	54

During the survey based study a lot of aspect were examined i.e. the facilities/public services in the villages, the agriculture crop status, the market distance, *Yartsa gunbu* collection, vegetations of the area, other source of income, other medicinal plants availability, and the ecological effect of the *Yartsa gunbu* extraction on the sites.

5- ECONOMIC AND SOCIAL ISSUES-

Yartsa gunbu is one of the major source of economy not only for the local surrounding villagers 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 mud houses, which are not cemented and made of wood, ringal and salam grass. Villages which are nearer to the town Dharchula are better developed then the villages which are far away from the Dharchula town. School facilities are inadequate in most of these villages. Wherever schools are available hardly one or two teachers are there for teaching job. Lot of work is still to be done for communication facility, road network, electricity, medical facility in most of these villages.

Table 1.2- Sources of income

Primary source of economy	Secondary Source of economy
Yartsa gunbu collection, collection of some other medicinal plant like Jungli Lahsoon, Hathajari, Kutki, Jumbu, Gandrain etc.	Agriculture, Goat, Sheep rearing, Shop keeping, Porter, Horses, Labour work etc.

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

As per information/data collated, in year 2018 the 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 25 per piece. However, as per local information and information collated from public domain, its current international price is around 20-30 lakh Rupees. This year people have apprehension of low prices due to last year's material still lying with agents/contractors as *Yartsa gunbu* is supposed to remain viable for a period of almost one, if packaged properly.

1. Total no. of Tents observed in Chhiplakot area- **1000 approx.**
2. Approximate no. of villages included in Keerajari/Yartsa gunbu extraction in and around Chhiplakot site-**6 broadly**
3. On an average around 3 people reside in a single tent, accordingly total no. of persons living in the extraction area are around= $1000*3=$ **3000 people**
4. Approximate days of stay in the extraction site= **60 approx.**

5. Average No. of pieces of *Cordyceps sinensis* extracted by a single person during a day= **3 piece**
6. Total no. of pieces extracted in a day = $3*3000=9000$ **piece**
7. Total no. of pieces extracted during the period of extraction= $9000*60=540000$ **pieces**
8. Around 3800 pieces (roughly 3500-4000 pieces) weigh one Kg., so the total amount of extracted *Cordyceps sinensis* = $540000/3800=142.10$ **K.g**, during entire extraction period.
9. On the basis of informal interviews of various people this year, the prices at which they sell product to agents, are reportedly averaging around Rs **5 lakh per kg**, though initially at the beginning of season, they were expecting around **Rs 10 lakh per Kg**.
10. Thus, total earning from all villages which are involved in the extraction of Keerajari/Yartsa gunbu from Chhiplakot and its surrounding (as mentioned in above table of villages) is expected to be around $=142.10*500000=71050000$ **Rupee i.e. around 7.1 crore**, for entire extraction period, which span around two months.
11. During the *Yartsa gunbu* extraction season, pony owners also gets earning of around 1500-2500 per horse for a single round from village to the *Keerajari/Yartsa gunbu* extraction areas. On an average if a single pony owner has min. 4 horses, he will earn around Rs 6000-10000 per day and during the extraction season, they get minimum of 4 rounds which generates income around Rs **24000-40000** during one week.
12. Another significant income generation activity during extraction period is opening of shops for grocery items along the extraction route in the alpine region. As per data collected/information gathered, average income during the entire time period of *Keerajari/Yartsa gunbu* extraction is around **one lakh rupee per shop owner**.

13. Another major source of income is the collection of various other medicinal plants, which includes Salam panja (*Dactylorhiza hatageria*), and Jungli lahsoon(*Allium* sp.). The later is reported to have a price value of around 20000 rupees per kg. in year 2018 . On an average, every family collects around 4 to 5 kg during the Keerajari/Yartsa gunbu extraction period which provides them additional income of around **1 lakh- 1.5 lakh rupees.**

Various Impacts including migration issue-

People mostly use the money obtained from *Keerajari/Yartsa gunbu* extraction for purposes like children's education, construction of houses, marriage expenses, purchasing vehicles etc. Most of the villages in study sites depend on the *Yartsa gunbu* for their economic needs, because it gives huge commercial return, to them without any investment, or prior qualification or training/skill development and money directly flows to people in cash form, which makes the entire business very lucrative . As mentioned above, the income of these eleven villages, for only two month extraction period, runs in crores of rupees, which includes income from extraction and sell of other rare medicinal herbs, which are in high demand in neighbouring areas. This income generated within a small period of just two months, without much physical efforts exceeds their income from other sources for entire year. Besides, in these two months, other economic activities are also triggered, including small scale business of grocery items and that of pony owners. This much amount generated in such a short period is very much higher than other normal villages of State, where people only depend on income from agriculture and allied activities. Overall, these economic activities have tremendous impact on migration pattern also. In fact the study indicates that this caterpillar fungus economy allows villagers to stay in

their pastoral livelihoods and make money. Caterpillar fungus collection has emerged as a way for people in these areas to make relatively easy money and to raise their standard of living.

The situation of shorter period of work and maximum income is working as a strong incentive for people to stay in the village. Normally if we go by the conditions of villages in terms of availability of general facilities, no one should stay under such conditions for a long period, but just because of the money obtained from *Yartsa gunbu* extraction and its high selling price, they are always happy to stay in the villages without adequate facilities like Hospitals, Schools, Electricity, Roads, and Communication system etc.

The effect of *Yartsa gunbu* extraction on migration can be easily understood by the example that in various villages, where only very few persons are working as Govt. Employee or outside the village in any other profession, even they come back to their villages for these two months extraction period of *Yartsa gunbu*. This can be termed as something like a 'reverse migration' where people are coming back towards their own villages just because of the money obtained from *Yartsa gunbu* extraction, though for a short period. Even in some cases school going children skip schools during this period, which may ironically spur dropouts as inform of *Keeda Jadi*, a more attractive option for livelihood exists.

However, there have been negative impacts also apart from environmental degradation and violence, as instances of drunkenness and gambling have increased. Recently, People of Bui and Pato villagers in Munsyari had differences over extraction areas from Ralam and Rajrambha meadows and finally when the differences could not be sorted out, District Administration was forced to impose section 145 of Cr.P.C(to prevent breach of peace over the dispute).

6- ECOLOGICAL ISSUES-

Ecologically all sites are very rich in flora and fauna value. Various herbs, Shrubs, trees and agricultural 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 sites area. In most of the villages people know about



Rhododendron anthopogon flowering on extraction site

Picrorhizza urrooa(Kutki),*Salampanja/Hathajari*

(*Dactylorhiza hatagirea*),*Jatamasi* (*Nardostachys jatamansi*), *Chaerophyllum villosum*, *Van Satwa*(*Paris polyphylla*), *Jambu* (*Allium starachayei*), *kala jeera* (*Carum carvi*),*Atish* (*Aconitum heterophyllum*), *Kuth*(*Saussurea costus*) and medicinal value of these herbs.

Except these herbs, *Primula sp.*, *Rehum emodi*, *Bajardanti*(*Potentilla fulgens*),*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*), *Chir pine*(*Pinus roxburghii*), *Tansen*(*Tsuga dumosa*), *Fir*(*Abies pindrow*), *Burans*(*Rhododendron arboreum*,*Rhododendron barbatum*, *Rhododendron campanulatum*, *Rhododendron anthopogon*), *Thuner*(*Taxus baccata*), *Banj oak*(*Quercus leucotrichophora*), *Chook amesh*(*Hippophae salicifolia*) are found in high altitude areas while in lower altitude villages, species like *Cheyura*(*Diploknema beyuteracea*), *Mangifera indica*(*aam*), *Bamboo* (*Dandrocalamus strictus*), were found.

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

Many of the villages are under the threat of Landslide and continuous soil erosion e.g. the village Tijam was very much affected during the 2013 disaster and still the conditions are very fragile because most of the area of this village has sandy composition along the river and the continuous soil erosion is occurring in such areas, which is increasing the threat day by day for the local people. Similarly Dar village is also under the threat of land displacement and soil erosion.

Quantitative analysis of wood used by the villagers during their two month stay for fuel wood purpose-

On an average around 6 to 8 kg of wood is consumed for fuelwood purpose per tent (in which around three persons reside) which comes from around 50 to 70 wood logs of around 1 to 1.5 ft size, for a period of one week and accordingly total average wood weight used by a single tent members during two month stay come out $8 \times 9(\text{weeks}) = 72 \text{ kg}$.

There were around one thousand tents , and accordingly, on an average total amount of wood used by the extractors during the entire extraction period comes around= $72 \times 1000(\text{tents}) = 72000 \text{ k.g}$.

*As nowadays various people are using stoves due to difficulties in collection of wood from 2 to 3 km far from their staying sites so the estimated amount may slightly vary.

- ✓ Mostly affected species for fuel wood purposes are *Rhododendron barbatum*, *Rhododendron campanulatum*, *Betula utilis* etc.

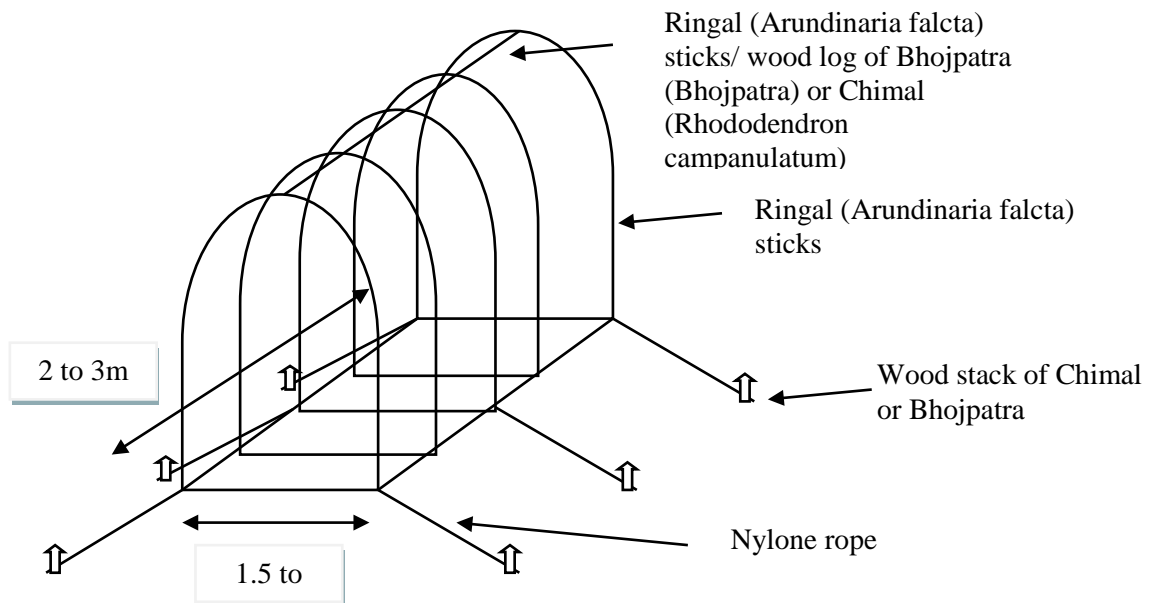
Estimation of top soil land area suppressed by A single tent during two month stay-

- ✓ On the basis of the structure of the tent designed above a total land area suppressed by a single tent is around(assuming a rectangular shape)= length*width

$$= 2*3=6\text{m}^2$$

Accordingly total land area suppressed by all 1000 tents = $6000\text{m}^2=0.6 \text{ hac.}$

Tent placed near the extraction site in alpine area of Chhiplakot





Burning of wood on such a large scale over a very small period may prove very harmful for such a fragile ecology and leaves significant carbon foot print. These are very high altitude sites ranging from 12000 ft. to 16000 ft., close to glaciers and therefore burning of large quantities of wood at such sensitive locations, and subsequent release of green house gases in atmosphere may have many unintended consequences for overall ecology of area, local climate and temperature and particularly on glaciers of the area, which are already feeling impact of climate change and global warming. It may result in increase of temperature in the Upper Himalaya and may ultimately impact glaciers of this area, in an adverse manner and also very yield of *Keeda Jadi* in long term.

Various Ecological Factors and their Impact -

Unscientific harvesting affects vegetation cover and plants on which host caterpillar survives and hence this is resulting in decline of host caterpillar population. Another inimical practice is digging out infected caterpillars before the fungus begins producing spores which are necessary for reproduction. As a result its life cycle is not allowed to be completed, which is affecting reproduction and as fewer spores will infect fewer caterpillars which will reduce yield. It may also result in explosion of population of moth in future as there are no other predator species available. There is no ethnic barrier nor any limit on number of persons having access for extraction, which is ironically resulting in over exploitation of this precious herbs. Over harvesting may lead to degradation of Bugyals.

Digging process may lead to soil compaction. Disturbing fragile soils, cutting swaths of shrubs and trees for fuel and leaving trash and human waste around camps. People trample grassland and leave the trash behind. One of the major factors which is adversely affecting the condition of soil of alpine meadows is the dumped waste material like plastic waste, Nylon ropes, Old thrown boot or shoes, old clothes etc. These materials are non degradable and causing harm to the soil quality and adversely affecting a number of other valuable floras, which will be surveyed in detail in next years. During extraction period, near by water streams are also getting polluted.

There were around 300 to 400 cows and buffalo and around 1000 goats found roaming around the alpine zone of Chhiplakot region in areas of around 2



to 3 km from the extraction site. As in a wide range the fertile soil is removed by the cattle but



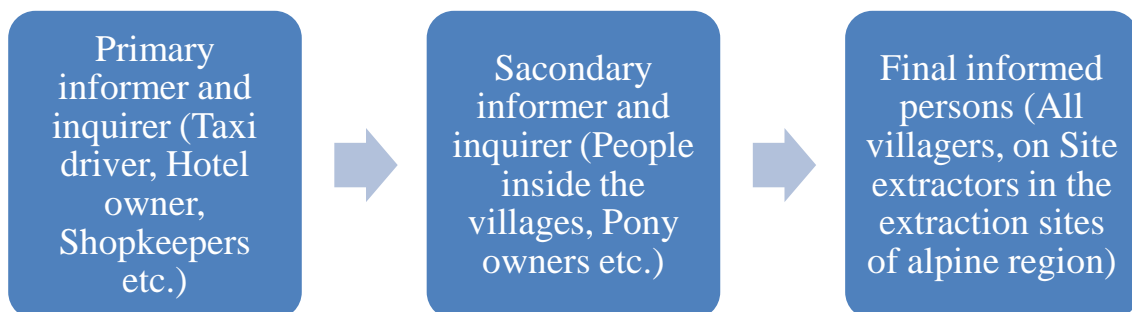
at the same time dung from these animals may help to make the soil fertile in the alpine zones and on an average every day the rainfall occurs on these sites, hence in view of all these factors, presence of livestock

may have both positive and negative impacts. Displacement of top fertile soil from the land and loss of vegetation on one side and spreading of dung manure making the soil fertile is a complex phenomenon, which has to be studied in detail in coming years.

During *Keerajari/Yartsa gunbu* extraction period, people also collect various other important medicinal plants also from the extraction site which is increasing the threat to these important medicinal plants.

7- TRADE PATTERN/ NETWORK

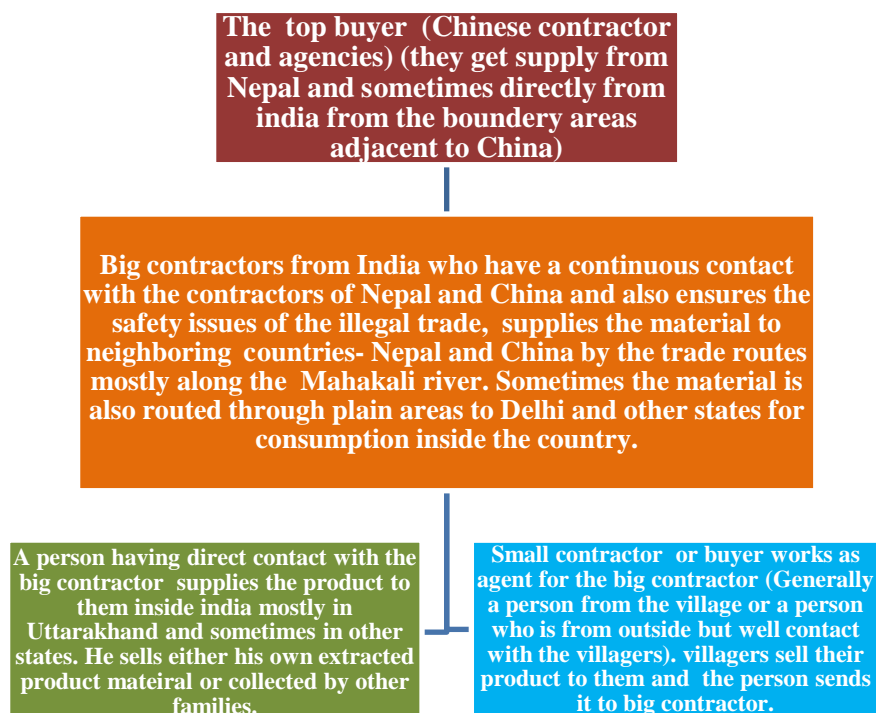
The information network of local people is very strong and every single villager acts as an source of information to inform other villagers if they get any sign of entrance of any outsider. They are not very open about discussions on issues about the *Keerajari/Yartsa gunbu*, and very reluctant to share any information about the trade route of the *Yartsa gunbu*. If any outsider



enters into the village they thoroughly inquire about their purpose to enter into the village and its surrounding and this is done at all the villages falling enroute.

As per prevailing practice, *Yartsa gunbu* is traded through a wide network in a systematic manner.

- Last year in 2018 Govt. of Uttarkhand and Forest Department Uttarkhand issued new policy to regulate *Yartsa gunbu* collection and its trade. After this, some villagers are getting pass issued by Gram pradhan or Sarpanch of concerned Van panchayat.
- Still not all the villagers are following this policy, however, They expressed their intent to follow it after completion of the *Yartsa gunbu* extraction period. According to information obtained from Forest Range office Dharchula, till 15 June 2019, only 907 persons got pass for Keerajari/*Yartsa gunbu* extraction which is apparently a low number compared to actual number of extractors in the region.



8- SUSTAINABILITY AND POLICY ISSUES -

As the local people have no other major source of income generation due to lack of basic facilities, they only rely on the *Keera jari* or *Yartsa gunbu* extraction for their survival. However, over the years, serious issues are emerging because of over exploitation and, habitat destruction. Some of the local villagers are interested in cultivation of medicinal plants under the guidance of govt agencies or forest department, particularly for technical knowledge support and better price. The livestock - cow, goat, sheep, horses, pony etc. are found almost in all villages though the number of sheep is very high.

This year many villages were found to be aware about the new policy regarding Keerajari/Yartsa gunbu extraction and some of them have got themselves registered for extraction of Keerajari/Yartsa gunbu before the extraction period and many are planning to do it after extraction period according to their collected amount.

A comprehensive approach needs to be adopted taking into account various aspects like development of local people, ecological issues, developing proper network system and continuous patrolling.. As *Keerajari/Yartsa gunbu* is one of the major sources of economy for the local people, any decision will be directly affecting the life of these people and their survival. It has also been reported by local people during the research work that the habitat of *Keerajari/Yartsa gunbu* is shifting upwards which may be due to excessive anthropogenic pressure, unsustainable harvesting practices or climatic factors, which will be studied in detail in next years of the project.

Local people need to be educated about sustainable harvesting practices, including reduction in number of days for extraction, proper extraction methods and locating the camping sites away from meadows. They have to be impressed that if they want fungal gold to last in future, they should harvest it sustainably and leave behind some fungi to release their spores. Any resource of such immense value and key relevance to rural livelihoods as the main cash source runs the risk of being over exploited. In fact, sustainable harvesting is still a big issue which is yet to be effectively addressed. Education is the key element to promote sustainable resource conservation, including knowledge of fungal reproduction. Conservation efforts may require cooperation between leaders at village, district and State level. Establishing an end date to the collection season may allow for sufficient spore dispersal to ensure sustainability and similarly, only one member may be allowed from each family for harvesting.

In this regard, different countries are experimenting with different models. In Nepal, number of days for extraction has been reduced and it has been ensured that camping sites are at least 3-4 Km away from extraction site. Bhutan has restricted number of members per family, for extraction. They have also developed a proper system of auctions, which brings revenue to Government. In Tibet, certain village leaders set a date for the start of the harvest. In the weeks prior, residents must check in at the community meetinghouse four times daily. The roll call is designed to thwart attempts by any individual to begin collecting earlier than others. Since the trek to the nearest gathering ground is several hours away, it's nearly impossible to sneak off and dig for *yartsa gunbu*. There's also a heavy fine for those who don't check in. While all residents in village have a right to collect *yartsa gunbu*, each household is required to register any collectors and pay a corresponding tax. The tax money funds repairs and services, from fixing the hydroelectric system to

hiring a lama to perform an empowerment ritual. Local rituals and certain Buddhist beliefs have also helped keep the harvest under control. Religious decrees prohibit harvesting on certain sacred mountain slopes. This creates a natural sanctuary, ensuring that part of the landscape will remain undisturbed and allowing fungal spores to spread for the next season.

In Uttarakhand, efforts to involve Van Panchayats, cooperatives, and Forest Corporation, in sale has not been much successful as the gap between these prices and amount offered by agents, is still very high. Middlemen use far-flung hill routes to smuggle the keeda jadi across the border to Nepal and china. In year 2003, the State Government empowered Van Panchayats to grant licence to local residents for collection of the herbs. Over 12000 Van Panchayats issued permits to local residents to collect keeda jadi, but it was found that local residents often by pass Van Panchayats as it is more lucrative for them to sell it to middlemen. In 2014, it was proposed that a single body would be setup to regulate all activities related to keeda jadi from its collection to sale, however, it could not materialize. Further, upto 2017, not a single auction had taken place. While in extraction areas falling under Van Panchayats, there are still some supervision and checks, however, the situation of other extraction areas falling under control of Revenue/Forest Department, need better monitoring and focus during extraction period to prevent any pilferage. Another peculiar feature is that there is not much demand and hence no markets for this product in our country, and therefore, even for above mentioned organizations, there are no forward linkages. The main market of this product is China and therefore more creative strategies need to be made, to involve international players in this chain, within four corners of law and national interest, so as to bring maximum benefit to local people, and to eliminate middlemen.

At a time when upto one third of the planet's parasite species could go extinct within a few decade, there is increasing need to protect parasite as well as their hosts. So far not much research has been carried out on host caterpillar and the same needs to be carried out at the earliest covering all its biological aspects.

In the long term, if income from caterpillar fungus can be sustained, it can provide an important financial cushion for those whose livelihoods on high altitude grasslands face mounting threat from climate change. Local Resident in higher reaches have to be permitted its extraction as they have limited means of income. These are regions which contain few natural resources and where agricultural productivity is low, making the fungus their primary source of income. This will help curb migration as well. Any depletion of the fungus would severely impact the economy and culture of the people who rely on it.

9- IMPACT OF CLIMATE CHANGE-

According to a much publicised study, last year, which was led by researchers from Stanford University and published in the *Proceedings of the National Academy of Sciences* (PNAS), caterpillar fungus production has decreased due to habitat degradation, climate change and specially over exploitation. The researchers interviewed four dozen harvesters, collectors and traders of the fungus and analyzed weather patterns, geographic factors and environmental conditions to create a map of yartsa gunbu production in the region. They concluded that climate change is contributing to decline. "With significant warming already underway throughout much of its range, we conclude that caterpillar fungus populations have been negatively affected by a combination of overexploitation and climate change. Our results underscore that harvesting is not the sole threat to economically valuable species, and that a

collapse of the caterpillar fungus system under ongoing warming and high collection pressure would have serious implications throughout the Himalayan region,” the study says.

From interview with local people who have been involved in extraction, for years, it was gathered that in initial years of extraction, less people were reportedly involved and they used to collect around 50 to 250 pieces per day, however, with price rise, more people joined and now, daily collection per day hardly reaches maximum 5 pieces per person. In Nepal also, it has been pointed out in various studies that production dropped from 210-260 pieces per persons in 2006 to 97-126 in 2010 while China also reported a decline of around 70% from 1978 to 2001. Reduction in amount of snowfall and warm winters may be two important parameters affecting production. Future of the harvest is contingent on many factors - collection intensity, rainfall and climate change among them.

This year due to heavy snowfall people were expecting high yield of Yartsa gunbu, however as per information collated from local sources, actual yield was somewhat lower than previous years. Again this involves a complex interplay of climatic factors as well as extraction practices which may be further studied in detail in coming years. This year they could get less time for the extraction of Keerajari/Yartsa gunbu, because of extended period of snowfall and hence. number of people was high for a short period of time in the extraction site and the site has been adversely affected by various harmful factors as the Bugyal are very fragile and sensitive for any anthropogenic factors like cutting of trees, cattle grazing pressure, high pressure on land surface, top soil erosion, non degradable waste, which are posing threat to these areas resulting in loss of vegetation and habitat, soil erosion and chances of landslide.

These practices if not controlled, may adversely impact nearby glaciers, by releasing heat into atmosphere, particularly loss of tree cover.

10- INTERNATIONAL SCENARIO-

Since 2001, Nepal Government, legalised harvesting of fungus after which mountains have been flooded with thousands of harvesters in extraction season. Nepal is second biggest supplier of this product. Though number of harvesters has increased, yet overall yield has reportedly decreased over the years. The official royalty rate is around 10000 Nepali Rupees (fixed since year 2001). Around year 2006, community leaders decided in Nepal to place a taxation system on harvester to control numbers and to spend the revenue for environment protection measures and to subsidize food for villagers. However, it was found later that this made harvesting seem even more valuable and as a result more people were drawn. In Nepal, Dolpa District, is a major centre where tens of thousands of people gather every year for harvest.

Various studies suggest that with boom in Chinese economy, global market for this product reached around 11 billions dollars per year. However, there has been various reports of fall upto 20% in its market price in China in recent years, because of sustained campaign against corruption by Chinese Government as it was once supposed to be a common practice to bribe officials with expensive gifts which included caterpillar fungus.

More than 90 % of supply of *Keeda Jadi* come from Tibet. It is reported that prices sky rocketed between 1997 to 2008. Over the years, this has become backbone of rural cash economy of Tibet and there is no other economic segment that generates as much income. In

fact it has become their economic life line. It has been reported in various research studies that around 40-100% of total income of villagers come only from *Yartsa gunbu* extraction

This activity has led to violence and social tension also in these countries. In 2009, seven harvesters from another region were killed by villagers in Nepal and similarly 8 persons were reported to be killed in China's yushu province in 2007. In 2014, a dispute between the local community and a park management committee about the right to collect fees for access to *yartsa gunbu* led to two deaths. In 2013, two people had died in fight between Tibetan groups near Rebgong, China.