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# Assessment of the Resource Potential of Sal Seeds, Existing Market Mechanism and its Role in Livelihood Generation of Rural Communities in Kumaun Himalaya

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## ABSTRACT

Sal seeds are an important Non Timber Forest Product (NTFP) and are an important livelihood resource for about 90,000 forest fringe villages with a combined population of 56 million. During the month of May and June, when there is almost no other source of income, rural people are engaged in seed collection which provides them with a crucial bridge income before the commencement of the agricultural season. Hence, a study was conducted at three sites in the mixed Sal forest of Nainital district of Uttarakhand (India) to assess the present and future resource potential of Sal seeds, existing market mechanism and its role in livelihood generation of rural communities in Kumaun Himalaya. Seed fall was more in June accounting for more than 50% of annual seed fall. The average dry weight of seed wings was 21.33%, kernel 64.83% and shell 13.83% at the study sites, and the average biomass of seed was 722 kg $ha^{-1}$ seed collection $year^{-1}$. Sal seed collection work in Kumaun is capable of generating about 146,025 man-days of employment in a collection season.

*Keywords:* Sal seed, Non Timber Forest Product, biomass, marketing, livelihood generation

## INTRODUCTION

The genus Shorea (family–Dipterocarpaceae) is a large genus of 103 species and, in India, the genus is represented by four species viz. *Shorea robusta, S. assaamica, S. talura* and *S. tumbuggaia* (Troup, 1921). *Shorea robusta* is a native species of India, Myanmar and Nepal. Sal seed is one of the important produce obtained from Sal (*Shorea robusta*, Gaertn. f.*)*. Sal forests are classified into two types i.e. dry and moist and occupy an area of 1,14,000$km^2$ in India. Sal forests extend into tropical and sub-tropical regions where precipitation ranges from 1000 to 2000mm and above, and the dry period does not

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exceed 4 months (Tewari, 1995). Sal seeds are collected in the Sal belt of central, eastern and northern India. The income from sale of the forest products for households living in and around forests constitutes about 40 to 60% of their total income (Sadashivappa et al. 2006; Bahuguna, 2000). In India, the estimated annual production of Sal seeds was 200,000 tons generating a revenue of Rs.100.20 million with 1.30 lakh man-days of employment (Anon, 1972). The economic importance of Sal seed is mainly due to its oil, which has tremendous potential for the export market due to its low price. Its thorough assessment and inventory is necessary in order to know the supply to fix the yield for sustained management (Gusiya, 1990). The International Tropical Timber Organisation (ITTO) has developed guidelines for the sustainable use of all natural resources. These guidelines specifically stress the need for estimation of the present and potential values of NTFPs (Arnetz, 1993).

Since Sal seeds are significant for the livelihood of millions of people and play a vital role in forest ecosystems, sustainable management of Sal seeds is essential. Hence, there is a need for comprehensive study of Sal seeds to assess production potential as well as current extraction level, current collection and management techniques for establishing the trade and its role in livelihood generation of rural communities in Kumaun Himalaya. Against this background, this study was taken up.

## MATERIALS AND METHODS

### *Study Sites*

Sal forests are distributed in 1110396.64ha (77.05% area of the total forest area) in Kumaun Himalaya (Table 1). The maximum area under Sal forests is in Ramnagar (74.75%) and the minimum in Almora (2.12%). These forests are dispersed in all forest divisions except in Bageshwar and Tarai Central divisions. Three study sites were selected in the mixed Sal Forest of Nainital District for the present study, which represents the major section of Sal forest, having high density in the foothills, subjected to minimal biotic disturbance in terms of grazing, lopping and easy approach (Table 2). Rural communities of the study area have experience in Sal seed collection and trading. The major villages of the areas involved in the extraction of Sal seed are Kaladungi, Choti Haldwani, Musabunger, Chorgaliya.

### *Sampling Procedure*

One plot of 0.22ha (110mx20m) area was demarcated at each study site and 30 permanent subplots of 1m² areas were laid out within each of these plots. The tree density in the area was estimated by placing 10 random quadrates of 10x10m² area (Saxena & Singh, 1982). The fallen Sal seed, from each permanent subplot, were collected fortnightly (represented on monthly basis) during May-June in the years 2008 and 2009. Fallen Sal seeds on the ground were collected carefully and were placed in polybags for further study. Fresh

weight of the collected seeds was taken at the site using an electronic balance and was oven dried at 60ºC for 48 hours till constant weight in the lab. Seasonally collected fallen Sal seed samples were weighted separately.

A questionnaire was prepared to collect the primary information on the traditional method of Sal seed collection, transportation, resource use pattern, socio-economic status of Sal seed collectors, ecological impacts of Sal seeds and to identify the marketing channels, price spread and prospective markets in order to know the quantum of trade of Sal seeds in Kumaun. The primary information was collected from the traditional collectors, store keepers, packers, transporter from forest to collection point/store house and the local contractors of Sal seed. There were a total of 60 randomly selected respondents who provided information during the interview. The information was collected through personal discussion and interview. The interview session was conducted in person by the author. Each respondent had a session of about 30 minutes. The interview was guided through a pre-structured open-ended questionnaire. Fortnightly information on climatic conditions of the area was also gathered. The data were

TABLE 1
Distribution of Sal forest in Kumaun Himalaya

| S. No. | Name of Forest Division | Total Area of forest Division (ha) | Area under Sal Forest (ha) |
|---|---|---|---|
| 1 | Ramnagar | 48736.90 | 36431.45 (74.75) |
| 2 | Almora | 61196.62 | 1297.00 (2.12) |
| 3 | Civil Almora | 11108.00 | 903.40 (8.13) |
| 4 | Pithoragarh | 75196.61 | 869.20 (1.16) |
| 5 | Champavat | 65980.12 | 20303.67 (30.77) |
| 6 | Nainital | 59552.50 | 2371.20 (3.98) |
| 7 | Haldwani | 59578.80 | 27745.70 (46.57) |
| 8 | Tarai East | 82429.92 | 15742.73 (19.10) |
| 9 | TaraiWest | 34806.63 | 4732.29 (13.59) |
| 10 | Bageshwar | 66236.20 | 0 |
| 11 | Tarai Central | 40496.97 | 0 |
| | Total | 143268.90 | 110396.64 (100) |

Note: Area under Sal forest in percentage is given in parentheses
Source: Uttarakhand Forest Statistics 2008-09 (UFD, 2009)

TABLE 2
Details of Sal Seed Collection Sites

| Name of sites | Elevation (m ) | Distance From road (km) |
|---|---|---|
| Kaladungi | 325 | 1.0 |
| Musabunger | 275 | 1.5 |
| Chorgaliya | 330 | 1.0 |

collected on various aspects viz. the visit of troop of monkeys, heavy rainfall, strong wind blowing, hails, human activities (such as harvesting of fodder, lopping of branches for fuel wood, timber) etc. by interacting with local people. In order to gather the information about the quantum of trade of Sal seeds in Kumaun and to identify the marketing channels, price range and prospective markets, primary collectors, contractors (middlemen), small and big traders and commission agents from two trading centres (Ramnagar and Tanakpur) were interviewed. The respondents from the area were selected randomly on the basis of their involvement in the Sal seed collection and trading. Secondary data was collected from Uttarakhand Forest department.

## RESULTS

### *Tree Composition at the Study Sites*

Across the study sites, the tree density varied between 852 and 1095 trees $ha^{-1}$ *Mallotus phillipensis* was dominant in the understory tree spp. in all the three sites. The other tree species viz. Cassia *fistula, Legersrtomia parviflora*, *Syzygium cumini, Bauhinia varigata* etc. had varying densities (Table 3).

### *Seed Fall Density and Production Potential of Sal Seed Fall Biomass*

Maximum collectors were of the view that flowering in *S. robusta* generally begins after about 15 years and a good seed-bearing year can be anticipated every 3-5 years. Production potential of Sal seed depends on the weather condition prevailing during flowering and fruiting. Profound flowering

TABLE 3
Tree Composition at the Three Study Sites

| S. No. | Species | Study sites | | |
|---|---|---|---|---|
| | | Chorgalia (tree $ha^{1}$) | Kaladungi (tree $ha^{1}$) | Musabunger (tree $ha^{1}$) |
| 1 | *Shorea robusta* | 495 | 691 | 131 |
| 2 | *Mallotus philippinsis* | 125 | 127 | 9 |
| 3 | *Cassia fistula* | 85 | 56 | 42 |
| 4 | *Legersrtomia parviflora* | 68 | 68 | 57 |
| 5 | *Syzygium cumini* | 26 | 27 | 34 |
| 6 | *Litsea polyantha* | 16 | - | 11 |
| 7 | *Pterocarpus marsupium* | 15 | - | - |
| 8 | *Bauhinia varigata* | 14 | 16 | 19 |
| 9 | *Butea monosperma* | 3 | - | - |
| 10 | *Terminalia bellirica* | 5 | - | - |
| 11 | *Bomax ceiba* | - | 2 | 3 |
| 12 | *Schlichera oleosa* | - | 4 | 6 |
| 13 | *Agle marmelos* | - | 9 | 2 |
| 14 | *Terminalia tomantosa* | - | 6 | - |
| | Total | 852 | 1006 | 1095 |

is usually associated with the preceding drought time. Therefore, its production varies from year to year. Results obtained from the analysis of data collected from the three different study sites suggest that seed fall density of Sal seeds varies between 238 seeds $ha^{-1}$ (Chorgaliya) and 276 seeds $ha^{-1}$ (Musabunger). The annual seed fall was minimum (500 seeds $ha^{-1}$) and maximum (741.13 seeds $ha^{-1}$) during May and June, 2008. The average weight of the Sal seed was 1.31g. at Chorgaliya, 1.30g at Kaladungi and 1.36g at Musabunger. Seed fall density in May-June for 2009 was maximum 317 seeds $ha^{-1}$ and minimum 247 seeds $ha^{-1}$ at Chorgaliya site among all the three sites. The annual seed fall was minimum (562 seeds $ha^{-1}$) at Chorgaliya and maximum (567 $ha^{-1}$) at Musabunger (Table 4). The average weight of the Sal seed was 1.29g at Chorgaliya, 1.36g at Kaladungi and 1.35g at Musabunger.

The total annual seed fall biomass from trees varied between 654.10 kg $ha^{-1}$ at Chorgaliya and 766.01 kg $ha^{-1}$ at Kaladungi. Sal seed fall was highest in the month of June, which accounted for an average of more than 50% annual Sal seed fall. During the interview, respondents informed that monkey troops often visit the Sal forest but there was no menace from them nor were conflicts with humans noticed.

*Ratio of Dry Weight of Seed Wings, Seed Kernel and Seed Shell*

The study indicated that the average dry weight of seed wings was 21.33%, the dry weight of seed kernel was 64.83% and the dry weight of seed shell was 13.83 at the study sites (Table 5).

*Process for Decortications of Sal Seeds*

From the winged Sal fruit, seed is processed in the following two continuing stages:

- *De-winging:* This process is done after the fruit is completely dried either by beating on plain hard ground with a wooden stick so that the wings break and the round seed pods with shell and little covers get separated, or by spreading the seed on dry, hard ground and putting a light fire to the fruit so that the wings can burn.

TABLE 4
Seed Fall Density (No. of seeds / ha) and Biomass of Seeds (kg/ha) in Sal Forest

| Year | Month | Chorgaliya | | Kaladungi | | Musabunger | |
|---|---|---|---|---|---|---|---|
| | | Seed fall density | Dry weight of seed | Seed fall density | Dry weight of seed | Seed fall density | Dry weight of seed |
| 2008 | May | 238 | 306.90 | 275 | 349.06 | 269 | 368.53 |
| | June | 262 | 347.20 | 265 | 353.40 | 276 | 372.60 |
| | Total | 500 | 654.10 | 540 | 702.46 | 545 | 741.13 |
| 2009 | May | 247 | 335.92 | 265 | 371.00 | 280 | 378.20 |
| | June | 317 | 389.91 | 297 | 395.01 | 287 | 384.58 |
| | Total | 564 | 725.83 | 562 | 766.01 | 567 | 762.78 |

- *Separation of shell and pods:* When the wings are broken, the round seed enclosed with shells and pods remain behind and these are collected by picking up manually or by blowing. These seeds are spread on hard ground. The shells are rolled under pressure by a roller and the pods break and the kernels come out. Then by blowing the kernels or Sal seed are collected, and after being dried for some time they are ready for sale.

### *Trend of Market Price Change of Sal Seeds in Kumaun Himalaya*

In Kumaun, trading (auction and collection) of Sal seed was approved only from 2001-02 to 2003 in Ramnagar and the Tarai east forest division of the Uttarakhand Forest Department. The data regarding quantity of Sal seed collected and sale price obtained is presented in Table 6. After 2004-05, the trading of Sal seed was stopped due to conservation measures for regeneration of Sal forests.

### *Availability of Sal Seed for Collection and Generation of Employment*

Most of the 60 respondents who were interviewed were of the view that flowering of the *S. robusta* and the intensity of fruiting is affected by the seasonal condition at the time of flowering and fruiting. Children, men and women from poor or marginalised households in the study area are engaged in collecting Sal fruits. The socio-economic profile of the respondents is presented in Table 7. *S. robusta* bears fruit regularly from 15 to 16 years of age. In successive years, the intensity of fruiting also varies. The Sal seed collection season lasts for two months in a year, mainly May and June, after which

TABLE 5
Ratio of Dry Weight of Seed Wings, Seed Kernel and Seed Shell in Collected Seeds

| Name of the study Site | Ratio of Different Parts Dry Weight (%) | | |
|---|---|---|---|
| | Seed Wings | Seed Kernel | Seed Shell |
| Chorgaliya | 23.00 | 62.00 | 15.00 |
| Kaladungi | 23.00 | 63.00 | 14.00 |
| Musabangar | 18.00 | 69.50 | 12.50 |
| *Average weight* | *21.33* | *64.83* | *13.83* |

Table 6
Sal Seed Collection and Sale Price in Kumaun Himalaya

| S. No. | Year | Ramnager Division | | Tarai Division | |
|---|---|---|---|---|---|
| | | Quantity (qtl.) | Sale rate (Rs./qtl.) | Quantity (qtl.) | Sale rate (Rs./qtl.) |
| 1 | 2002 | 0 | 0 | 420.75 | 242.42 |
| 2 | 2003 | 627 | 242.42 | 454.75 | 226.50 |
| 3 | 2004 | 671 | 226.50 | 0 | 0 |
| 4 | 2005 | 359 | 111.42 | 0 | 0 |

Source: Forest Department Uttarakhand (UFD, 2009)

collection of Sal seed is not possible due to the monsoon season.

It was found that one person could collect around 8-10kg of Sal seeds in an 8-hour working day. Thus, a primary collector can collect a maximum of about 549kg of Sal seed in one collection season (in a 61-day collection season). The collection rate for Sal seed was about Rs.2.50 per kg in the study area. Thus, a collector / villager can earn a maximum of Rs.22.50 per day or Rs.4941 in a collection season from Sal seed collection, which was found to be very low compared with the minimum wages fixed by the Central Government for NREGA in 2009 (Rs.100 per day for unskilled workers). The sale rate for Sal seed in the market is about Rs.1000 per quintal. The annual production of Sal seeds has been estimated to be about 80168 t $yr^{-1}$. Thus, in Kumaun, Sal seed collection work, at present, can generate about 146,025 man-days' employment in a Sal seed collection season year. For primary collectors, Sal seed selling has been an important resource of livelihood generation in the agricultural lean seasons of May and June. However, due to low returns, workers were not interested in Sal seed collection work.

## DISCUSSION

Beating on plain hard ground is the best recommended process for manual collection of Sal seed as the quality and nature of the kernels remain unaffected. Though spreading the Sal fruit on dry hard ground and setting fire to it is an easy method of de-winging, it is an unsafe process as sometimes fire affects the quality of the seed as this process leads to the oil content of the seed being reduced. Burnt seeds often mixed with sand or stones are rejected by the local agent at collection centres. Now, mechanical decorticators are available in the market that are able to decorticate about 1-2 tons of Sal seed per hour. However, a collector friendly de-winging facility is yet to be developed. The collectors require training and infrastructure for decortication and storage of kernels, which may be provided either by the trading agencies or concerned government agencies. The daily collection is not more than 6-8kg per day (Saxena, 2003; Saigal, 2008), which is much closer to the observations of the study i.e. one villager can collect 8-10kg of Sal seeds in a working day. The variation may be due to seed production which varies from year to year and from tree to tree (Tewari, 1995).

TABLE 7
Socio-economic Profile of the Respondents

| Name of the Village | No. of Respondents | Male | Female | Occupation | | | |
|---|---|---|---|---|---|---|---|
| | | | | Agriculture | Livestock | Self-employed | Business |
| Chorgaliya | 20 | 12 | 8 | 15 | 3 | 1 | 1 |
| Kaladungi | 15 | 10 | 5 | 10 | 1 | 2 | 2 |
| Musabangar | 25 | 17 | 8 | 14 | 2 | 6 | 3 |
| Total | 60 | 39 | 21 | 39 | 6 | 9 | 6 |

Due to low returns, primary collectors were not interested in Sal seed collection work as collectors can earn only a meagre amount of Rs.22.50 per day. Therefore, most people collect Sal seed for sale or barter simply because of lack of alternative employment opportunities, especially during the lean agriculture season. NTFPs were regarded as poverty avoidance, filling gaps during periods of low income and functioning as a safety net and natural insurance (Pattanayak & Sills, 2001, Paumgarten, 2005). Unless the issue of low collection rates is not solved, it will be difficult to address the issue of poverty alleviation through the Sal seed collection.

In the study, a mean biomass of Sal seed was found to be 722.38kg $ha^{-1}$ seed collection $year^{-1}$. Seed production varies (up to 500kg $ha^{-1}$ was recorded during the early 1980s) from year to year and from tree to tree (Tewari, 1995). The seed yield is up to 500kg $ha^{-1}$ (Gautam & Devoe, 2006). The average seed production $ha^{-1}$ is estimated to be 720kg $ha^{-1}$ in a good seed year (banjata. org). Contribution of seed wings was 21.33%, seed shell 13.83% and seed kernel 64.83% in a Sal seed at study sites. It is reported that in a Sal seed, the wings contribute to about 20.8%, shell 12.8% and kernel 66.4% (Pant, 2011). Tewari (1994) has reported 47% contribution of kernels (by weight) and 23% of wings. In the study sites, trading of Sal seed was carried out only up to 2005. The major reasons for no collection and a consequent reduction in the production are a result of the procurement policies of the state government, which forced traditional Sal seed collectors to opt for other more remunerative occupations.

There is a vast potential for Sal oil and fat in Kumaun Himalaya because of large Sal forest areas and the presence of thousands of collectors. The Sal kernels yield 10.5-17.1% of oil (Anon, 1998) and about 84% of de-oiled cake is obtained from Sal seed (Rai & Nath, 2006), which is used in boiling plants, as a sizing material in textile industries and as cattle feed after standardisation. Sal seed oil is customarily organic and free from pollutants and fertilisers. Sal fat is economically viable in the export market due to its low price. The superiority of Sal fat depends on how the kernels have been stored. Primary collectors and local traders are unaware about the end-use and quality requirements of Sal seed that they collect and trade. Due to this reason, they do not follow correct collection and storage methods and consequently, the marketability of their harvest suffers badly. Thus, the training of primary collectors can play an important role in enhancing oil quality such as for timely collection of dry kernel, avoiding burning of the seed (this affects the quality of the kernel and enhances the free fatty acid content, making it highly uncompetitive in the export market), moisture content (high moisture content in the kernel increases the free fatty acid quantity, making it unhealthy for use in the food sector), collection and crushing time (the oil quality is high if the gap between collection and crushing is kept to a minimum). Domestic legislations like the Prevention of Food Adulteration (PFA) Rules, 1954 prohibit use of Sal fat

in a number of prospective industries like chocolates, ice creams etc. The fluctuations in Sal oil export due to the accessibility of cheaper substitutes and the indifference of governments has created an impression that Sal seed is losing demand.

The annual production of Sal seed is estimated to be about 80168 t $yr^{-1}$, which generates about 146,025 man-days of employment in a Sal seed collection season year. The prevailing market rate is about Rs.10 per kg. This information may be helpful for the policy makers to fix the minimum price of Sal seed and in encouraging the Sal seed processing activities in the region to make it a viable livelihood option for rural communities of the Terai region of Kumaun, Himalayas.

Namdeo and Pant (1994) has concluded that Sal seeds have the potential to provide employment to 4.5 million persons for a period of 40 days and regular employment of 300 days per year for 0.436 million persons in processing of Sal seed. Hence, there is an urgent need for intervention with regard to legislation and trade of Sal seed for ensuring not only greater returns to the primary collectors but also employment in the processing and end use industries development in the Kumaun Himalaya.

## CONCLUSION

Collection of Sal seed is an important activity for the livelihood of people in Kumaun Himalaya. There is an urgent need to attract villagers to Sal seed collection work, fix the procurement rates at a level that allows at least a minimum wage to be collected by the collectors (this price should be revised every season to adjust for inflation and other market changes), assess the sustainable harvesting levels and practices to ensure timely processing of the seeds to preserve their quality and to increase awareness among the collectors to avoid the use of unhygienic sacks and pesticides for storing kernels. There should be clear-cut guidelines for the estimation of collection quantities of Sal seed so that planning for collection and marketing can be prepared accordingly. The government should review the decision to ban Sal seed collection in Kumaun and allow the use of Sal fat in food items such as chocolates and ice creams along with enhanced opportunities for domestic and international trade of Sal seed for ensuring greater returns to the primary collectors for livelihood generation in Kumaun Himalaya. However, prior to any large-scale increase in Sal seed procurement, its ecological impact, especially on regeneration, should be cautiously considered.

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