ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 11, pp. 21580-21586, November, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

FUEL RESOURCE OF WATERSHED RISSA-KHAD IN H.P.INDIA, THEIR DIVERSITY, ASSESSMENT AND UTILIZATION PATTERNS FOR CONSERVATION AND MANAGEMENT

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DOI: http://dx.doi.org/10.24327/ijrsr.2017.0811.1099

ARTICLE INFO

Article History:

Received 17th August, 2017
Received in revised form 12th September, 2017
Accepted 04th October, 2017
Published online 28th November, 2017

Key Words:

Diversity, preference, conservation, utilization, Provability.

ABSTRACT

A general decrease in the abundance of wild plant species of fuel suggest that more detailed information is is urgentaly needed on species- level trend and their conservation. Such studies have not been carried out in India on water-shed basis and elsewhere; present study therefore quatified the species wise collection of fuel from watershed rissa khad. In all forty eight (48) species (38 Trees and 10 Shrubs) were extracted for fuel by the inhabitants. Out of these 11 were native to Himalaya while 2 species were native with extension to surrounding area while 6 species were near endemic. Utilization pattern, preference, distribution, probavility of use (PU), resource use indices (RUI), of these species were dertermined. Species such as *Albizzia chinensis, Quercus leucotrichophora*, *Pinus roxburghii, Grewia oppositifolia, Pyrus pashia, Bauhinia variegata, Berberis lysium*, *Celtis australis* and *Toona ciliata* were mostly prefered as fuel. Use pattern did not vary much with low altitude where as along the vertical (Elevation) gradient it varied consideravly. At high altitudinal villages like Kaas, Thankar, Gujar Gehra species such as *Quercus leucotricophora* A. Camus, *Cedrus deodar** (Roxb.) Loud., *Euonymus pendulus** Wall., *Myrica esculenta* Ham.ex Don, *Pinus roxburghii* *Sarg., *Lonicera quinqulocularis* * Royle, *Viburnum continifolium* Wall. ex CI. Contributed most to collection, while at low altitudinal villages Janjehal, Chail, Ropri, Rissa species such as *Terminalia arjuna* (Roxb.ex DC.) Wt.& Arn., *Terminalia tomentosa* (Roxb.) Wt. & Arn.) , *Mallotus philippensis* Muell. -Arg., *Carissa opaca* Stap. *Murraya koenigii* (L.) Spr. *Gymnosporia royleana* Wall, *Spondias pennata* Willd., *Acer oblongum* Wall. ex DC., *Albizzia lebbeck* (L.)Willd. Contributed most to collection and remaing species such as *Albizzia chinensis* Osbeck, *Grewia oppostifolia** Roxb. Ex Mast., *Bauhinia variegata* L*, Toona ciliata* Roem., *Prunus cerasoides* Don, *Cocculus laurifolius* DC Contributed most to collection at mid elevational villages Kalar Ropri, Bhalyan and Khadii. Overall, average collection of fuel species ranged from 38.4 - 946.2 kg household^{-1} year^{-1}, it was highest for *Albizzia chinensis* (946.2 kg household^{-1} year^{-1}), followed by *Pinus roxburghii* (773.6 kg household^{-1} year^{-1}), *Grewia oppositifolia* (686.4 kg household^{-1} year^{-1}), *Pyrus pashia* (525.1 kg household^{-1} year^{-1}) and *Quercus leucotrichophora* (409.2 kg household^{-1} year^{-1}). Overall, PU ranged from 0.01-0.7, it was highest for *Albizzia chinensis* (0.7), followed by *Grewia oppositifolia* (0.22), *Pyrus pashia* (0.17) *Bauhinia variegata* (0.17), *Quercus leucotrichophora* (0.12,) and *Toona ciliata* (0.11, each). The remaining species showed < 0.11 PU. Overall, RUI ranged from 4.56-280.04. It was highest for *Albizzia chinensis* (280.04.), followed by *Pinus roxburghii* (271.98), *Grewia oppositifolia* (192.94) and *Quercus leucotrichophora* (161.42). The remaining species showed < 161.42 RUI.

INTRODUCTION

The cultural diversity of the society reflects the close relationship between the existence of human life and nature. The inhabitants all across the globe depend on biological resources in various ways. Like other parts of the globe, inhabitants of the IHR are largely dependent on the biodiversity. They used plant diversity in various forms *i.e.,* medicine, wild edible/food, fodder, fuel, timber, making agricultural tools and various other purposes (Samant & Dhar, 1997). In India fuel wood continue to be the primary source of domestic energy. The reckless felling of trees for timber and fuel, and unmanaged lopping of the fodder species has increased the rate of habitat degradation. Many shade loving species have been disappeared from degraded forests and hardy and spiny species with low value for the mankind are establishing rapidly (Dhar *et al.,* 1997, and Samant *et al*., 2000,). Such unmanaged activities are changing the whole

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forest ecosystems gradually (Singh & Singh, 1992). Such trends of biodiversity necessitate initiating studies on assessment and monitoring of biodiversity in Himachal Pradesh.

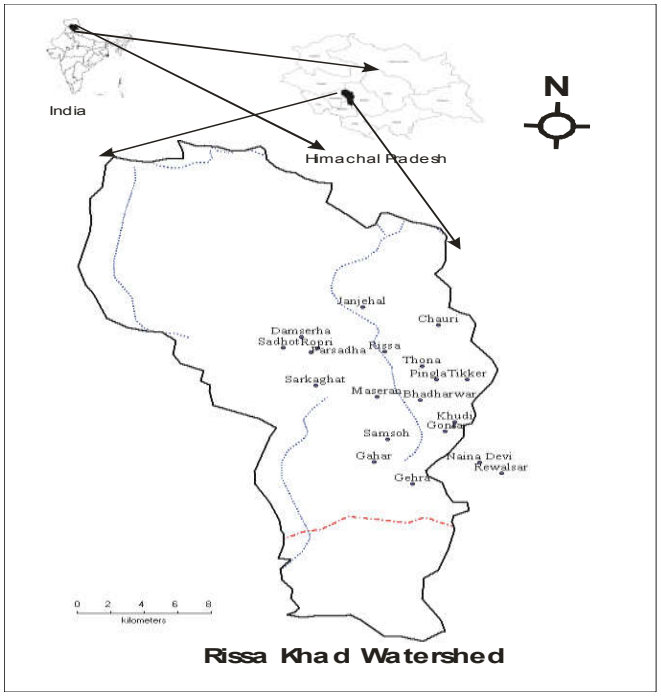
Inspite of latest available modern technology inhabitants of region are forced to rely on the woody species to fulfill their basic needs of fuel due to remoteness of the area and day by day increasing alternative fuel prises. Due to exploitation of huge quantities of fuel and fodder resources, there is a detrimental impact on the forests which results in deforestation, erratic rainfall, soil erosion, loss of habitat, loss of biodiversity etc. Due to increase in population and changing socio-economic conditions of the people, fuel, fodder, timber and other forest resources are becoming scarce. Thus, it is necessary to know the resource availability and resource utilization patterns which affect the fuel wood and fodder availability in a particular area.(Qureshi *et al*.,2015).

In general, a large number of studies pertaining to the medicinal, wild edibles, fodder, fuel, religious and other economically important plants have been carried out by various workers (Vitousek, 1986; Samant, 1998, 1999; Samant & Joshi, 2005; Samant *et al.,* 1996, 1998, 2000, 2003; Lal, 2007; Rana, 2007; Singh, 2007; Sharma, 2008; Sakshi, 2009; Uniyal &Singh 2012; Singh *et al,* 2017.*etc.*). But a very few studies on the fuel resource of Indian Himalaya (Shah,1982; Khoshoo 1987; Singh *et al,* 1998; Singh 1999, Jaiswal A, Bhattacharya P 2013: Qureshi *et al.*,2015,.) However, focused studies on the diversity, distribution and utilization pattern of the fuel plants of the watersheds and catchments have been poorly attempted (Dhanai *et al,* 2014; Kumar and Kumar, 2015.). It is well-established fact that the development at small unit areas like watersheds and catchments is easier than development at a larger scale like district, region, state and country, and being preferred for the development. Such studies are not available for the Rissa-Khad Watershed. Therefore, the present study has been conducted on the Rissa-Khad watershed to assess the dependence of inhabitants on fuel plant diversity.

METHOD

Study area and trend of collection

The Rissa khad watershed is located in Mandi district of the Himachal Pradesh. It covers approximately 123.07 Km2 area representing 20 panchyats and 132 villages. The altitude of the watershed ranges from 700-2051m. Climatically, the area faces three main seasons, i.e., winter, summer and rainy. The watershed represents the mid Himalayan zone. The study area supports diverse habitats, species, communities and Ecosystems. The vegetation mainly comprises of subtropical and temperate types mostly dominated by broad leaved deciduous, evergreen coniferous species. The watershed is inhabited by a large number of villages with 11,258 household and 33,458 human populations. The total livestock population is 11,214. The inhabitants are dependent on floristic diversity for their sustenance. They used plant diversity in various forms *i.e.,* medicine, wild edible/food, fodder, fuel, timber, making agricultural tools and various other purposes (Samant & Dhar, 1997). The increasing human and livestock population and decrease in floristic diversity have created imbalance in the ecosystem of the Watershed. Therefore, there is a need to assess and prioritise the floristic diversity of the watershed. Therefore, that adequate planning for the conservation of floristic diversity and sustainable development of the watershed could be done.



During the surveys, it was observed that fuel collection was usually done from mid September to March every year whereas fodder collection was done in mid December to March and August to October and stored for the lean period. Based on these observations, we assumed that the inhabitants collect fuel and fodder for about 120 and 70 days, respectively, and considered as total collection days (TCD). Interview with the local people in each village revealed that on an average two persons per day were involved in fuel and fodder collection from each household. They travel about 2-5 km to collect fuel and fodder resources from the village

Site sclection, sampling and species identification

In general, surveys and samplings of the fuel species were conducted throughout the study area.The representative villages namely Thankar, Kathogan, Kas, Khadi, Balh, Rissa, Ropri, Samsoh, Balyan, Chail, Janjehal, Gujar, Thauna, Pingla, Alayana etc., were selected at different elevations to generate information on the resource utilization pattern of the inhabitants. Surveys were conducted in the identified villages to identify and quantify the fuel resouces. The collection of fuel species brought in bundles (*bojha*) to the villages by the inhabitants were assessed and quantified; sixty bojhas, 20 Bojhas in one day, each for fuel species were sampled in each village for consecutive three days. The species collected in each sample were separated by local names, and weighed using a spring balance. Samples of each species were identified with the help of flora (Collett, 1902; Dhaliwal & Sharma, 1999; Aswal & Mehrotra, 1994, Singh & Rawat, 2000). The list of fuel and fodder species for each village was prepared.

Data Analysis

Suveys of the villages were conducted to identify and quantify the fue resources. The information generated from different samples was pooled for each village. For each species average quantum collection (kg sample^{-1}day^{-1}, kg household^{-1}day^{-1} and kg household^{-1} year $^{-1}$), Probability of Use (PU) and Resource Use Index (RUI) were calculated following Samant *et al*., 2000b, 2006 as below:

$$\text{Mean collection (kg) of the species (Cy)} = \frac{T}{N}$$

Where T= Total collection of the species in all the samples
N= Number of samples

$$\text{Mean Collection sample}^{-1}\text{ day}^{-1}\text{ (Cs)} = \frac{\sum_{i}^{n} ATPR_i}{\sum_{i}^{n} TPR_i}$$

where A=mean collection of the species, and TPR_i =total population responsible for collection in the ith village;
Mean collection household^{-1} day^{-1}, Cd=2Cs
Mean collection household^{-1} year^{-1}, Cy=90Cd
Where 90 was the total collection days per year;

$$\text{Probability of Use (PU)} = \frac{\sum_{i}^{n} Fi\ Pi}{\sum_{i}^{n} Pi}$$

Where Fi= Frequency of collection of a species in the i^{th} village

Pi= Population of the i^{th} village
The collection (kg sample^{-1}day^{-1} and kg household^{-1}day^{-1}) and Probability of Use for different villages were pooled and mean values calculated.
Resource Use Index (RUI) = Cy PU
Where Cy = Mean collection household^{-1}year^{-1}and PU = Probability of Use

RESULT

Diversity distribution and utilization pattern

In all Forty eight (48) species (38 Trees and 10 Shrubs) were extracted for fuel by the inhabitants. Maximum species (21 spp.) were used in Rissa village, followed by Chail (20 spp.), Kaas (19 spp.) Ropr (18 spp.), Gujar Gehra and Janjehal (17 spp., each), Khadii (16 spp.), Kalar Ropri (15 spp.), Bhalyan (14 spp.), Thankar (13 spp.), (Table 1). Species such as *Albizzia chinensis, Quercus leucotrichophora*, *Pinus roxburghii, Grewia oppositifolia, Pyrus pashia, Bauhinia variegata, Berberis lysium*, *Celtis australis* and *Toona ciliata* were mostly used as fuel.

Result

Diversity, Distribution and utilization pattern

In all forty eight (48) species (38 Trees and 10 Shrubs) were extracted for fuel by the inhabitants. Out of these 11 were native to Himalaya while 2 species were native with extension to surrounding area while 6 species were near endemic (Table 2). Maximum No,(21) of species were collected in Rissa village while minimum No. of species (13) in village Thankar (Table 1)Utilization pattern, preference, distribution, probavility of use(PU), resource use indices(RUI),of these species were dertermined. Species such as *Albizzia chinensis, Quercus leucotrichophora*, *Pinus roxburghii, Grewia oppositifolia, Pyrus pashia, Bauhinia variegata, Berberis lysium*, *Celtis australis* and *Toona ciliata* were mostly prefered as fuel. Use pattern did not vary much with low altitude where as along the vertical (Elevation) gradient it varied consideravly. At high altitudinal villages like Kaas, Thankar, Gujar Gehra species such as *Quercus leucotricophora* A. Camus, *Cedrus deodar** (Roxb.) Loud., *Euonymus pendulus** Wall., *Myrica esculenta* Ham.ex Don, *Pinus roxburghii* *Sarg., *Lonicera quinqulocularis* * Royle, *Viburnum continifolium* Wall. ex CI. Contributed most to collection, while at low altitudinal villages Janjehal, Chail, Ropri, Rissa species such as *Terminalia arjuna* (Roxb.ex DC.) Wt.& Arn., *Terminalia tomentosa* (Roxb.) Wt. & Arn.) , *Mallotus philippensis* Muell. -Arg., *Carissa opaca* Stap. *Murraya koenigii* (L.) Spr. *Gymnosporia royleana* Wall, *Spondias pennata* Willd., *Acer oblongum* Wall. ex DC., *Albizzia lebbeck* (L.) Willd. Contributed most to collection and remaing species such as *Albizzia chinensis* Osbeck, *Grewia oppostifolia** Roxb. Ex Mast., *Bauhinia variegata* L, *Toona*

Table1 Human population statistics and number of fuel species (trees and shrubs) used in Water-Shed Rissa-Khad

S.N.	Name of Village	A.R. (m)	Latitude	Longitude	Total Population	No. of Household	Population Responsible for Collection	No. of Fuel Species
1.	Janjehal	790	31°45‘14.07"N	76°44‘47.06"E	575	132	200	17
2.	Chail	900	31°43‘33.01"N	76°43‘51.02"E	277	48	98	20
3.	Ropri	1013	31°44‘24.02"N	76°44‘30.04"E	152	24	30	18
4.	Rissa	1150	31°45‘33.06"N	77°47‘26.02"E	323	75	121	21
5.	Kalar Ropri	1230	31°38‘27.06"N	76°45‘54.07"E	142	27	40	15
6.	Bhalyan	1285	31°41‘30.07"N	76°46‘00.07"E	176	39	80	14
7.	Khadii	1340	31°39‘30.07"N	76°46‘20.00"E	499	102	152	16
8.	Gujar Gehra	1400	31°42‘54.04"N	76°44‘47.06"E	330	32	48	17
9	Thankar	1448	31°41‘42.09"N	76°49‘02.09"E	150	30	60	13
10	Kaas	1551	31°37‘27.00"N	76°47‘07.05"E	118	25	42	19

Source: District Statistical Department, Mandi, Himachal Pradesh, India.

ciliata Roem., *Prunus cerasoides* Don, *Cocculus laurifolius* DC Contributed most to collection at mid elevational villages Kalar Ropri, Bhalyan and Khadii. Overall, average collection of fuel species ranged from 38.4 - 946.2 kg household^{-1} year^{-1}, it was highest for *Albizzia chinensis* (946.2 kg household^{-1} year^{-1}), followed by *Pinus roxburghii* (773.6 kg household^{-1} year^{-1}), *Grewia oppositifolia* (686.4 kg household^{-1} year^{-1}), *Pyrus pashia* (525.1 kg household^{-1} year^{-1}), *Quercus leucotrichophora* (409.2 kg household^{-1} year^{-1}).

Table 2 Mean collection rate, Provability of use and Resourse Use Index value for fuel species in Water-shed Rissa-Khad

Taxa	Pre	L.N.	L.F	A.R. (m)	Nativity	Uses	Mean collection(Kg/HH/ Year)	PU	RUI
Albizzia chinensis Osbeck	1	Oyee	T	700-1500	As Trop Austr	Md,Fd,H,T	946.2	0.7	280.04
Pinus roxburghii *Sarg.	2	Chil	T	700-2000	Reg Himal	Md,R,T	773.6	0.02	271.86
*Grewia oppostifolia** Roxb. Ex Mast.	3	Beul	T	700-1700	Reg Himal	Fd,Fib,Ag- T,R	686.4	0.22	192.94
Pyrus pashia Buch. -Ham.ex Don	4	Kenth,Segal	T	700-1800	Reg Himal	Md,Ed,R	497.9	0.155	107.22
Quercus leucotricophora A. Camus	5	Ban	T	1400-2100	Reg Himal	Md,Fd,H	409.2	0.12	161.42
Bauhinia variegata L.	6	Kachnar	T	700-1400	Ind Or Burma China	Md,Ed, F,R.	302.4	0.095	30.9
Toona ciliata Roem.	7	Tuni	T	700-1400	Malaya	Md,Fd ,T,	267.2	0.095	67.38
Terminalia tomentosa (Roxb.) Wt. & Arn.)	8	Alshahan	T	700-1200	Bras	Fd	266.4	0.105	49.44
Ficus roxburghii Wall.	9	Trayambalu	T	700-1500	As Trop	Md,Ed,R,Fd,	254.4	0.085	59.1
Bombax ceiba L.	10	Sembal	T	700-1500	Amer Austr	Md,Ed,R	229.2	0.065	39
Ficus hispida L.	11	Dhaebri	T	700-1400	As et Austr Trop	Md,Ed	204	0.09	32.4
Mallotus philippensis Muell. -Arg.	12	Kambhal	T	700-1200	As et Austr Trop	Md,H,Dye,Fib	180	0.085	31.74
Indigofera atropurpurea DC.	13	Kathi	Sh	700-1600	Afr Trop	Fd,Ed	154.8	0.08	34.14
Carissa opaca Stap.	14	Garnu	Sh	700-1200	Ins Molucc	Md,Ed, Fd	153.6	0.01	27
R. parvifolia L.	15	Tunga	Sh	700-1700	As et Austr Trop	Md.Ed.	148.8	0.04	20.34
Celtis australis DC.	16	Kharik	T	700-1700	Europe As Temp Ind Or	Md,Ed,Fd	136	0.07	29.88
Prunus cerasoides Don	17	Pajja	T	700-1700	Reg Himal	Md.R.Ed	135.6	0.025	12.06
Melia azedaracht L.	18	Dreak	T	700-1500	Reg Himal	Md,Fd,R,H,Ag, T	123.6	0.06	27.12
Vitex nirgundo L.	19	Banae, Suraei	Sh	700-1700	As Trop et Subtrop	Md,R,H	118.8	0.09	19.5
Myrica esculenta Ham.ex Don	20	Kaphal	T	1500-2100	As Trop et Sub Trop	Md,Ed	114	0.06	19.98
*Berberis lyceum** Royle	21	Kasmale	Sh	700-1800	Reg Himal	Md,Ed, Fd	112.6	0.08	24.12
Grewia elastica L	22	Pharsa	T	700-1700	Ind Or	Fd,T	109.2	0.055	21.6
Litsea monopetala (Roxb.)Pers.	23	Gwanyu	T	700-1400	Ind Or Malaya	Md,Ed, Fd	107.2	0.03	18.849
Albizzia lebbeck (L.) Willd.	24	Siris	T	700-1200	Geront Trop	Md,Fd,T,H,R	99.6	0.06	20.46
*Cedrus deodar** (Roxb.) Loud.	25	Devdar	T	1700-2150	Reg Himal	Md,R,T,Fd	92.4	0.045	21.4
Debregeasia longifolia Wedd.	26	Shyaaru	T	700-1400	Ind Or	Md,Ed,Fd	92.2	0.03	9.24
Bauhinia vahlii (Wt. & Arn.) Benth.	27	Tour	Sh	700-1300	Ind Or	Md,Ed, Fd,R,H	90	0.05	26.46
Elaeagnus conferta Roxb.	28	Ghaiyeen	T	700-1500	Japon	Md,Ed	86	0.035	15.24
Murraya koenigii (L.) Spr.	29	Gandhelu	Sh	700-1200	Ind Or	Md,Ed	81.6	0.05	13.3
Acer oblongum Wall. ex DC.	30	Parange	T	900-1100	Reg Himal	Fd,Ag,T	79.2	0.05	19.92
Dalbergia sissoo Roxb.	31	Sihn	T	700-1400	Ind Or Afghan	Md,Fd,T,H	78.8	0.045	21.42
Shorea robusta Gaertn.f.	32	Sal	T	700-1700	Ind Or	H,R,Ed		0.03	15.6
Cocculus laurifolius DC.	33	Paroda	T	700-1700	Reg Himal Japan	Md,Fd	66	0.025	7.98
Pistacia integerrima Bin.	34	Kakarsingi	T	700-1400	Reg Himal Aegypt Persia	Md.Fd.H	66	0.025	8.1
Glochidion velutinum Juss	35	Sama	T	700-1600	Ind Or Malaya	Md	63.6	0.035	11.16
Spondias pennata Willd.	36	Ambara	T	700-1200	As Trop	Md,E, Fd	61.2	0.026	15.3
Dendrocalamus strictus Nees	37	Bans	T	700-1400	Ind Or	Md,Ed,H,R	57.6	0.03	8.64
Terminalia arjuna (Roxb.ex DC.) Wt.& Arn.	38	Haryan	T	700-1000	Ind Or	Md,Fd	56.4	0.04	8.28
Euonymus pendulus Wall.*	39	Charmadae	T	1700-2100	Reg Himal	T ,Fd	55.2	0.015	8.24
Acacia catechu (L.f.) Willd.	40	Khair	T	700-1700	Ind Or	Md.Fd	54.8	0.035	8.52
Justicia adhatoda L.	41	Vasuti	Sh	700-1300	As Trop	Md,Ed	54	0.04	7.32
Salix tetrasperma L.	42	Gad-bhains	T	700-1400	Ind Malaya	Md,H,Fd,Ag.	54	0.025	7.68
Rhododendron arboreum Sm.	43	Burans	T	1500-2100	Reg Himal India Or Zeylan	Md,Ed,R,Fd	52.8	0.045	21.12
Ficus. palmata Forsk.	44	Phaegda	T	700-1700	Afr Trop Arab Ind Or	Md,Ed	46.8	0.03	7.08
Viburnum continifolium Wall. ex CI.	45	Ghenu	T	1600-2100	Ind Or	Md,Ed, Fd	46.5	0.02	4.56
*Lonicera quinqulocularis * Royle*	46	Bhatkukra	Sh	1500-2100	Reg Himal	Ed,Fd	45.6	0.025	5.82
Gymnosporia royleana Wall	47	Kangu	Sh	700-1200	Ind Or		38.4	0.025	4.92
Butea monosperma (Lamk.) Taub.	48	Palas Dhak	T	700-1400	Ind Or Burma	Md,Ed,R,H	22.8	0.015	3.42

Abbreviations used: Pre=Preference, L.N.=Local name, L.F.= Life form, A.R.= altitudinal range,PU= probavility of use, RUI =resource use indices, T=Tree; Sh=Shrub; Reg Himal= Himalayan region; As=Asia; Trop= Tropical; Ind Or=Indian Oriental; Amer= America; Trop=Tropical. Md=Medicinal, Fd=Fodder, Ed=Edible =Religious, H=Household, T=Timber, Fib=Fibre, Ag= Agricultural Tool

Bauhinia variegata L.(302.41 kg household^{-1} year^{-1}) and *Toona ciliata* Roem. (267.2kg household^{-1} year$^{-1)}$ The remaining species showed<267.2kg household^{-1} year^{-1} average collection. Diversity in species preperence, Altitudinal range and uses of fuel resources for the entire area are given (Table 2).

Probability of Use (PU)

Overall, PU ranged from 0.01-0.7, it was highest for *Albizzia chinensis* (0.7), followed by *Grewia oppositifolia* (0.22), *Pyrus pashia* (0.17) *Bauhinia variegata* (0.17), *Quercus leucotrichophora* (0.12,) and *Toona ciliata* (0.11, each). The remaining species showed < 0.11 PU (Table 2).High values of PU reflected increased fressure on the species and low value reflected low preference or low availability in the wild

Resource Use Index (RUI)

Overall, RUI ranged from 4.56-280.04. It was highest for *Albizzia chinensis* (280.04.), followed by *Pinus roxburghii* (271.98), *Grewia oppositifolia* (192.94) and *Quercus leucotrichophora* (161.42). The remaining species showed < 161.42 RUI (Table 2).. The RUI was very low for *Lonicera quinqulocularis* (5.82), *Viburnum continifolium (*4.56), *Gymnosporia royleana*(4.92), *Butea monosperma*(3.42) suggesting their low acceptability as a fuel

DISSCUSION

Fuelwood in the Himalayan regions is considered one of the important sources of energy, where majority of the villagers collect fuelwood from different sources such as forest, agro forestry, pastureland, community land etc. (Kumar and Kumar, 2015) In present study High PU of *Albizia chinensis*, *Grewia oppositifolia*, *Pyrus pashia*, *Bauhinia variegata*, *Quercus leucotrichophora* and *Toona ciliate* and RUI of *Albizia chinensis*, *Pinus roxburghii*, *Grewia oppositifolia* and *Quercua leucotrichophora* among fuel species species showed high demand and pressures. Population assessment of these species is essentially required for developing appropriate strategy for conservation. The broad-leaved species of the watershed were mostly lopped for fodder and felled for fuel and timber. This has caused the loss of forest area (Singh, 1998). It has been observed that due to unplanned collection of the resources, ecology of the forests has been seriously affected. Also, it can influence vegetation by altering its composition and structure.. Similar problems are also prevalent in the Rissakhad Watershed. Therefore, adequate conservation measures have to be taken to maintain current status of the habitats of economically important floristic diversity for effective management of the Rissakhad Watershed. Awareness among the villagers need to be created for the collection techniques so that sustainable utilization of the economically important floristic diversity could be done by the inhabitants. Further, the degraded forests may be re-established through plantations of the seedlings of multipupose tree species particularly species preferred for fuel, fodder, and timber with the participation of local inhabitants.

Conservation and management perspective

The study area as such support a high proportion of non native (77.08%) and proliferation of several non native taxa is a consequence of deliberate introduction and promotion by inhabitants (Dhar *et al*, 1997; Samant *et al*,1998).The inhabitants are utilizing > 70% non native as a fuel but the extraction intensities on these in most cases are consideravly lower than on non native species. This practice indirectly contribute to relative protection of non native taxa. This phenomenon over the course of time lead to long term changes in the ecosystem processes (Vitousek 1986). Rapidity with which the environmental damage, loss of floristic and cultural diversity, occur today, a necessity is felt for the recording and documentation of traditional knowledge about the utilization of plant. (Pangtey *et al*, 2017). Fuelwood is necessary to satisfy the basic household requirements for cooking and space heating in the watershed Rissakhad, Inspite of considering the remoteness of area and inflammation in the conventional fuel prices inhabitants have to rely on the woody species to meet their fuel demands. Fuel resource are easily available in the watershed both in private land as well as in surrounding forest so their fuel consumption habit remain wastefull or faulty. As a result the many resource species are under heavy pressure. Considering that in reality the existing resource base is finite, inhabitant knowingly or unknowingly have unsustainable fuel use practice. The use and management of plant resources promote environmental conservation and are in situ management methods (Rankoana,S.A.). Fuel plant harvested in their habitat and direct conservation methods are applied to sustain the resources.

The following measure seems appropriate to sustain the fuel resource for prosperity.

1. Enforcement of strict protected area rule for intensive management in identified site, especially those project to high pressure
2. Diversification of choice of fuel speciesfrom frequently used to less frequently used and from native to non native species.
3. Practically feasible propagation for the most preferred and their dessimination to local inhabitants.
4. Greater awearness among the inhabitants of the available stock, accompanied by the conservation programe such as agroforestery and community forestery.
5. Education of inhabitants about less wasteful habit of fuel consumption (Singh *et al,* 1988)
6. Afforestation programmes through plantations of the multipurpose tree species should be encouraged.

Acknowledgement

I am thankful to the villagers of the study area to provide valuable knowledge and information fuel species and their utilization pattern. I am also thankful to my Ph,d guide Dr S.S. Samant for guidance and support, official of forest department and district statistical department for their cooperation in data collection. Dr. Aman Sharma and Dr. Manohar lal are acknowledged for their help during data compilation.

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How to cite this article:

Tara Devi.2017, Fuel Resource of Watershed Rissa-Khad In H.P. India, Their Diversity, Assessment And Utilization Patterns For Conservation And Management. *Int J Recent Sci Res.* 8(11), pp. 21580-21586.
DOI: http://dx.doi.org/10.24327/ijrsr.2017.0811.1099

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