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Indigenous Uses and Value Addition of High-Valued Wild Legumes in Mandi, HP, India

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Abstract: Present study has been done in district Mandi, Himachal Pradesh, India to know the present status and potential of some high valued WEL in boosting health, sustainability and rural prosperity. Study is based on both primary and secondary data. Survey and sampling of WEL has been done from 2018 to 2022 between an altitudinal range of 500-4034 m. To calculate Use Value index (UV) 100 informants of study area were interviewed about diversity, distribution and utilization pattern of WEL through semi-structured questionnaires. A total 15 WEL (Herb = *Flamingiaproculumbens*, *Lathyrussativus*, *Medicagopolymorpha*, *Mucunapurriens*, *Phaneravahlii*, *Sennatoria*, *Trifolium repens*, *Vigna vexillate*; Shrub= *Abruscantoniensis*, *Indigoferaatrorepurea*, *Indigo feraheterantha*; Trees=*Bauhinia variegata*, *Buteamonosperma*, *Cassia fistula*, *Senna floribunda*) having more than 4 uses were selected for domestication, value addition and entrepreneurship development. Although WEL discussed in present study have tremendous potential of their wider adoption and commercial exploitation, but they were considered underutilized minor crops. Except a few of them their use is negligible in study area as a result their useful parts get wasted at resource level. Various constraints and opportunities for optimum use of WEL in study area has been worked out. To ensure sustainability and better outcome provision of storage facilities, processing units, lab testing, awareness for value addition, labelling, packaging, sustainable harvesting and domestication of WEL is strongly recommended.

Keywords: Legumes, Processing, Domestication, Rural prosperity, Sustainability)

INTRODUCTION:

Legume comes from family Fabaceae, which is the third largest family among the angiosperm, it represents more than 700 genera and about 19,000 species. (Christenhusz and Byng 2016). Being an essential source of food and feed proteins, they play an important role in the production system by supplying nitrogen to soil and proteins to the human diet (Kebede, 2021, Ram et al., 2023). However, with the advent of fertilizers since World War II, legumes have been sidelined causing a significant decline of soil health (Meena et al. 2018). So, their use is foremost in modern agriculture, which is characterized by reduced crop diversity, excessive use of fertilizers, agrochemical inputs and nutrient deficient food production. (Sanginga et al., 2003, Stagnariet al., 2017). In past farmers used to leave land barren for some time (From 3 to 6 months) to resume the cultivation cycle and rebuild the soil's productivity. But now with small landholdings and increased pressure to yield more

The gap between two cultivation cycle has reduced significantly (1 to 2 months) and most of the soils are now facing acceleration in soil erosion and nutrient depletion. Consequently, most of countries are now facing the challenge of providing quality food to their countrymen and a large number of people are facing serious health issues too. However, legumes are looked as a competitive crop due to

their environmental and socio-economic benefits. They are able to break diseases and pest's cycles and restore soil fertility through their nitrogen (N₂) fixing capabilities (Kebede, 2020a). So, legume-based rational cropping/soil management practices can support environmentally and economically sustainable agro-ecosystems. Exploiting legume as a nitrogen source for soil and sustainable protein rich food sources for man can thus help to keep soil alive, ensure soil fertility and provide high-quality food for ever increasing human population. Among legumes too the wild edible legumes (WELs) which are climate resilient and important sources of food and feed proteins in addition to medicine and other essential commodities can offer multiple benefits to people. However, with modernization, urbanization and westernization, there is a significant decline in both the diversity of food items we consume and diversity of agricultural crops we cultivate. So, sustained adoption of legumes in present agricultural systems is of utmost requirement for ensuring low-input crop. production and sustainable agriculture from an environmental, economic, and managerial standpoint (Ghosh et al., 2007, Stagnariet al., 2017, Kebede, 2020b). Previous studies had reported a rich wild crop diversity in different parts of Himachal Pradesh (Chauhan et al., 2016, Negi and Subramani, 2015, Samantand Dhar, 1997, Singhet al., 2014, Sen et al, 2013, Parmar and

Thakur, 2021, Tara 2021). But, focused study on legumes, particularly on underutilized WELs of Mandi district of HP has not been attempted so far. So, the present study has been undertaken in Mandi HP North Western Himalayas to know the diversity, distribution and indigenous uses of some high valued WELs in Mandi, their role in boosting health, sustainability and rural prosperity, work out the constraints and opportunities for justified use of WELs and mass awareness for sustainable harvesting and domestication of these crops.

MATERIALS AND METHODS:

Study Area

Mandi (31°42' 29.4" N latitudes and 76° 55' 52.92" E longitudes) district of Himachal Pradesh is a part of North West Himalaya. It covers approximately 3,950 km² area and comprises 469 panchayats, 3374 villages and 2, 19, 145 households. The total human populations of study area is 9, 99,777 and livestock population is 67355. Altitudinal range of study area varies from 500-4034 m. It is known for diverse habitats, species, communities and ecosystems. (District Economic and Statistical Department, Mandi, H.P).

Survey and sampling:

Present study was based on both primary and secondary data. Survey and rapid sampling of WELs has been done between amsl 500-4034 m in Mandi Himachal Pradesh from July 2018 to June 2023. Identification of WFPs has been done with the help of local floras (Chowdhery,1984, Dhaliwal and Sharma,1999, Singh,1918). Information about altitudinal range, habit, habitat (s), method of harvesting, season of availability and current and past use of WELs. was gathered by interviewing the knowledgeable persons like traditional healers, priests, local sellers and agricultural, horticultural and forest officials working in study area through semi-structured questionnaires. Information was also collected from the People Biodiversity Register (PBR) managed by PBR managing committee at gram panchayat level. Market survey was done on different altitudinal range to know the local market value of WEL. Data collected on WELs was organized in a simple database using Microsoft Excel. Each row (elementary record) represents a citation, defined as a single use reported for a single plant by a single informant

(Signorini *et al.* 2009). Distinct citations based on available literature were considered for those differing from one another in at least one of the following data: species, informant and the category of use (i.e., Edible, medicinal, fodder etc.). Citations differing in minor aspects, such as the part of the plant used, were combined into a single citation. The number of uses was obtained by considering as distinct uses for each species those differing in category of use. In the columns of the table, the following attributes are reported for each citation: as botanical names, family, local name/s, informant name, category of use, used plant part and all the other information concerning plant use collected in the interviews.

Data Analysis: Use Value index (UV) was calculated using the formula $UV = \sum U_i/n$ proposed by (Rossato *et al.* 1999) to assess the relative importance of each WEL. where: U_i = the number of uses mentioned by each informant for a given species, n = the total number of informants.

Three types of UV were calculated based on citation of 100 informants: a Current Use Value (UV current), based only on the citations of plants reported by the informants for uses still practiced at the present time; a Past Use Value (UV past), based on the citations of plants reported by the informants as used only in the past; and a Potential Use Value (UV potential) based on personal experience of use plus uses known, but never practiced by informants

A total 25 WFPs were documented in this study. Out of these 15 high valued WEL which have 4 or more than 4 uses were selected for domestication and value addition. Detail description of all these plants were available in website www.himalyanwildfoodplants.com. 10 active Self-help groups, local seller and entrepreneur were selected at different altitudinal range for processing, value addition and marketing of WEL. They were given education, training and study material required for sustainable harvesting, value addition, marketing and domestication of WEL. Various constraints and opportunities for using WEL as a source of food, medicine and income were worked out and possible measures were taken. For ensuring sustainable harvesting and domestication mass awareness programs for Mahila-Mandal, Self-help groups and school children were organized. (Table.1).

Table.1 List of SHGs, local seller and entrepreneur selected to impart training for value addition and marketing of WEL.

S. No	Self Help Groups (SHGs) Name	Head of group	Members	Location Latitude/ Longitude	Occupation
1	BaglaMukhi SHGs	Sumitra Sen	07	Talyahar 31.68235N 76.91473E	Farming/ selling of local food items.

2	Shakti SHGs	Maya Devi	09	Sunder Nagar 31.53641N 76.89148E	Selling of local food items.
3	Prerna SHGs	Sneha Kumari	07	Gohar 31.58709N 76.99689E	Farming/ selling of local food items.
4	Hateshwari SHGs	Rukmani Devi	09	Sunder Nagar 31.49775N 76.88633E	Selling of local food items.
5	Ritik SHGs	Dolma Devi	07	Thunag 31.55267N 77.16196E	Seller
6	EktaMahilaEktaSan gthan	Ajita Devi	08	Dhuan Devi 31.67055N 77.01261E	Farming /Preparation of value-added food items.
7	MahilaMandal	Chetna Thakur	10	SumaduPaidi 31.63663N 76.89889E	Selling of
8	The Dietician Choice	Anamika	02	Mandi 31.70771N 76.93200E	Manager, Café incharge
9	Local Seller		4-5	Chohatta Bazar, Mandi 31.70863N 76.93188E	Vendors, seller
10	Siddu/ Siraa		5-6	Seri Market 31.70828N 76.93229E	SHGs Seller at Seri

Source: Author compilation.

RESULTS and DISCUSSION

Diversity, distribution and indigenous uses of WELs

Total 15 WEL (Herb=08; Shrub=03; Tree= 04) of family Fabaceae belonging to 13 genera have been discussed in present study. Among these Genus *Indigofera* and *Senna* were found dominant, represented by two species each, rest of WEL were represented by single species each. Nine WELs were found growing between an altitudinal range of 500 to 1500m; three of them were found above 1500m; and rest three were found growing equally well from lower to higher altitude (less than 1500 to above 1500m). All the WELs (15) discussed in this study were multipurpose types and have edible and medicinal

value. 14 WELs were used as fodder plant and nine of them have commercial value. On the basis of informant citation UV score for current use was highest for *Bauhinia variegata* (UV_{Ic} =0.94;) followed by *Phaneravahlii* (UV_{Ic}=0.8; UV_{Ip}=1) and minimum for *Abruscantoniensis* (UV_{Ic} =0.1) showing maximum use of *Bauhinia variegata* and least use of *Abruscantoniensis* in study area. UV for past use was highest (UV_p=1) for *Bauhinia variegata* & *Phaneravahlii* and least for *Abruscantoniensis* (UV_p=0.2). UV for potential use was highest (UV_p=1) for 3 WEL i.e., *Bauhinia variegata*, *Phaneravahlii* & *Sennatoria*. It was least for *Abruscantoniensis* (UV_p=0.5) (Fig. 1(a-o); Table.2&3)

Table.2. Diversity, distribution and utilization pattern of WEL in Mandi HP.

S. N	Botanical Name/ Common Name/ Local Name	Cuisine	Parts used (Ed)	Altitude/ Habitat	Food Value/ Phytochemicals	Medicinal Value (Md)	Indigenous uses	Season of Availability Market rate
1.	<i>Abrus c antonie nsis</i> / Liquorice root/ Safedra ti	Chilla, Pakoras, Paranthas Tea	Lf	1800 m (Sh)	Phytochemicals: Alkaloids, triterpenoids, flavonoids & saponins (Yang <i>et al.</i> , 2015.)	Powdered Lf (2-3 g) are given to cure chest infection, kidney disorders, constipation, tumors, pains; diabetes, liver problems and auto-immune diseases.	Ed, Md, Fd, Or	Lf -round the year. Fr or Fl from rainy to autumn period.
2.	<i>Bauhinia variegata</i> / Orchid tree/ Karyale, kachnar	Veg & pickle from Fl buds, Chilla & rayata from Fl.	Fl, Bud, Bk	1700 m (T)	Nutrients: Moisture, 78.9 g; ash, 1.3g; protein, 1.8 g; fat, 0.2g; fiber, 1.3; carbohydrates, 17.8; Minerals: Ca, 70.1 mg; P, 74.2 mg; Fe, 6.1mg. Phytochemicals: Quercetin, apigenin (Anonymous, 1988; Awasthi, & Verma, 2019)	Wp is considered useful to cure various ailments. Rt decoction is useful in dyspepsia & flatulency: Dried Fl & Fl buds are useful in treatment of piles and dysentery. Bk is mostly used against skin disease and Rt as antidote to snake poisoning.	Ed, Fd, Md, Ev, Fl	Late spring to mid- summer. Local market Bud Rs 30-40 for 150-200gm Other Dry Bk: Rs 1216/250gm
3.	<i>Butea monosperma</i> / Flame of Forest/ Plah, Palas	laddu from Gm. Tea from Fl.	Fl, Sd, Bk & Young Rt	1500 m (T)	Phytochemicals: Fl contains butrin, 1.5%; butein, 0.37%; butin 0.04%; flavonoids & steroids. Rt contain glucose, glycine, glucosides & aromatic compounds. (Huxley, 1992)	Wp is useful in treatment of wide spectrum of diseases. Bk is helpful in curing tumors, bleeding piles, ulcers, cold, cough, fever and menstrual disorders. Fl & Lf decoction is useful in diabetes. Powdered Fl is supposed to enhance fertility.	Ed, Md, Ev, Fl, RI, Dy, Fi, Gm, O	Fl and Fr from spring to early summers. Fl Powder- Rs 245/200gm Gm- Rs 185/100gm Lf (powder) – Rs 190/15gm
4.	<i>Cassia fistula</i> / Indian laburnum/ amaltash.	Tea, soup, Chilla.	Fl, Sd	1200 (T)	Nutrients: 100g Fr pulp contains energy, 18 kJ/g; aspartic acid, glutamic acid, and lysine, 15.3, 13.0, and 7.8% respectively. Pulp is rich in Fe, Mn, K & Ca. Phytochemicals: Proanthocyanidins, flavonoids; phenolics (Bahorunet <i>al.</i> , 2005)	Sd pulp given to young babies and pregnant women as laxative.	Ed, Fd, Ag, Dy, Gm, Ti, Or.	Fl can be collected in summer season

5.	<i>Flamin giaproc umbens / Kujje</i>	Veg,	Tu	1700 - 3000 (Hb)	Nutrients: Rich in Fe, P, starch. & proteins (Facciola., 1998) Phytochemicals: Alkaloids, glycosides and phenols. (Pandey <i>et al.</i> , 2019)	A decoction of Tu is used as a vermifuge, Tu is also useful in managing menopausal disorders.	Ed, Fd, Ev, Md	Fl rainy to autumn period.
6.	<i>Indigof eraatro purpure a/ Deep-Purple Indigo/ Kathi</i>	Chilla, Raya ta	Fl	300-1900 (Sh)	Phytochemicals: Terpenoids, flavonoids and steroids (Rahman <i>et al.</i> , 2018)	Fl decoction is effective against diarrhea& dysentery.	Ed, Fd, Md, Ev, He, Hu	Fl: spring - early summer Sd- Rs 400/250gm Lf (dried)- Rs500/kg Lf powder- Rs 350/kg
7.	<i>Indigof erahete rantha/ Indigo Bush/K allikathi</i>	Chilla, Raya ta& Pickle	Fl	1000 - 2800 m (Sh)	Phytochemicals: Terpenoids, flavonoids and steroids (Rahman <i>et al.</i> , 2018)	Powered Rt heals internal injuries, half teaspoon twice a day with cow milk for 5-8 days. Plant is also considered useful for cough, muscular pains and urinary disorders in animal. Aerial parts are anticancer.	Ed, Fd, Md, Ev, He	Fl from rainy to pre winter season Lf (dried)- Rs500/kg Lf powder- Rs 350/kg
8.	<i>Lathyrus sativus/ Chickling Pea/ Sudu, Khesari</i>	Veg, Daal, Saag (leafy vegetable)	Sd, Pd	800-1000 m (Hb)	Nutrients: Sd are rich in protein, 26-33%; starch, 40-55%; crude fiber 6%. Phytochemicals: leguminvicilin, legumelin, oleo-resin, alkaloids, flavonoids, terpenes, phenols, tannins, vitamin C, riboflavin, carotenoids, beta-carotene. (https://www.fedipedia.org/node/285).	The oil from the Sds is a powerful cathartic.	Ed, Fd, Md, Ag	Lf and tender St in spring while Sd Pd and Sd are summer to rainy season of the year.
9.	<i>Medicago poly morpha/ Bur clover/ Khokna</i>	Saag, Veg	Lf, Sh	1500 (Hb)	Nutrients: 100g of dry leaves contains dry matter, 20.8; protein, 5.1; fat, 1.7; fiber, 3.9; N-free extract, 7.8; and mineral matter, 2.3%. Vitamin A, C and E. (Anonymous, 1962)	Treat rheumatic pain, Dysentery	Ed, Md, Fd, Ag (Green manure or cover crop)	Lf & tender St spring to summer season of the year.
10.	<i>Mucuna pruriens/Velvet bean, Cowitch/ Drag</i>	Veg, Parantha, Missi-roti, Chill	Young Pd& Lf	1500 m (Hb)	Nutrients: 100g beans contains 42.79 and 64.88% crude carbohydrate, 4.1 and 14.39% crude lipid, 5.3 and 11.5% crude fiber,	Powdered Sd and Rt taken as tonic for diseases of nervous system, Lf and young pods eaten to manage diabetes.	Ed, Fd, Md, Or	Lf from rainy to pre-winters Young Pd can be collected in autumn and Sd in winters.

	<i>al</i>	a			and 2.9 and 5.5% ash content. Minerals in mg are K, 806–2790; M,85–477; Ca,104–900, Fe,1.3–15; Na,4–70, P,98–498 ; Cu, 0.33–4.34, Zn, 1–15 and Mn,0.56–9.26mg, (Ravindran 1988; Siddhuraju <i>et al.</i> ,1996)			
1	<i>Phaneravahlii/ Maloo creeper/ / Taur</i>	Veg, Pulse s,	Sd, Pd, Lf	1500 (Hb)	Phytochemicals: Flavonoid and phenols (Lohani& Sharma, 2023)	A pinch of powered Fl with common salt and white pepper snuffed to relieve headache. External application of Lf &Fl paste with some hair oil is useful to check hair fall.	Ed, Fd, Md, Ev, Fl, Fi, Rl, Hu	Pd in summer to rainy season and Sd from rainy in pre-winter season of the year. Local Market Leaf plate -Rs 300/50 pc
1	<i>Sennatara/ Sicklesenna/Yelo</i>	Chutney, Veg	Sd, Sd Pd	1550 m (Hb)	Nutrients: Dry Sd contains; Gross energy,18.6 MJ/kg; Dry matter, 41.3;Crude protein, 18.2 %; Crude fiber, 4.6%; Ether extract, 7.4%; Ash,9.1%; Ca, 7.2 g/kg; P,2.0 g/kg.(Grant, et al., 1991) Phytochemicals: Tannins, gum, saponins, reducing sugar, alkaloids. & steroids (Murshid, <i>et al.</i> , 2007)	Sd useful to relieve headache, heat from the liver, cure kidney stone and boost eyesight.	Ed, Md, Fd, Ev, Dy	Pd and Sd from mid-September to January Local Market Sd (chutney)- Rs 100/250gm Other Sd- Rs 530/100gm
13.	<i>Senna floribunda/ Allon</i>	Veg, Chutney	Fl, Lf, Fr	Up to 1000 m (T)	Nutrients: Crude protein,19.9–21.7%; crude lipid 2.1–3.1%; total dietary fiber, 11.7–13.8%; ash, 3.4–5.6% & carbohydrates, 58.0–60.5%. Phytochemicals:: Phenolics, chymotrypsin ,tannins, &L-DOPA (3,4-dihydroxyphenylalanin., (Vadivel&Janardhanan, 2001)	Sd improve digestion and helpful in treating piles.	Ed, Fd, Md, Fl, Or	Fl and Fr from summer to autumn season of the year.
1	<i>Trifolium</i>	Saag	Wp	900-	Nutrients: lipids, 4.2 to	An infusion of Fls has been	Ed, Md,	Lf Spring to

4.	<i>m repens/ White Clover/ Jangali parseen</i>	(Leafy Veg) & Chillia		3000m (Hb)	8.6%: proteins,35.1 to 45.4% & carbohydrates, 26.7 to 47.0%. (Goundenet. al., 2018)	used as an eyewash & also helpful in treatment of leucorrhoea, colds, coughs and fevers.	Fd, Ag	autumn Fl rainy to pre winters.
1 5.	<i>Vigna vexillate/ Zombie pea, Wild Mung/ Junglee mung</i>	Chillia, Siddu, Parantha, Veg	Tu, Sd	900-1500m (Hb)	Nutrients: Rt Tu contains; Protein, 9.93%; Starch, 13.21%; Fat, 0.97%; Sugar, 2.05%; Moisture, 71.77 % ; Ash, 2.14%; Dietary fibre3.93% (Tripathi et. al., 2021)	Wp is effective against joint disorders, arthritis & to checks hemorrhaging in individuals which suffer from internal bleeding.	Ed, Md, Fd, Ev, Ag	Lf -round the year, Green Pd -winters while Sd -late winters.

Abbreviation: Hb= Herb, Sh=Shrub, T=Tree, Sd= Seed, Lf= Leaf, Br= Bark, Rt= Root, Fr= Fruit, Sh= Shoot, Pd= Pods, Ten Sh= Tender shoot, Wp= Whole Plant, Fl= Flower, Fl Bd= Flower bud, Tu= Tuber, Bu= Bulb, Ed= Edible, Md= Medicinal, Ev= Economic value, Fd= Fodder, Fl= Fuel, Rl= Religious, T= Timber, Hu= Household items, Or= Ornamental, He= Hedge, O= Oil Source: Author compilation.

Table. 3. Use value index of WEL in Mandi HP

S. No.	Plant Name	Informants mentioning the plant use in past	No. of citation by informants for current use	Total no. of Citation	U _i (Used Value past)	U _c (Used Value current)	U _p (Used Value potential)
	<i>Abucentronum</i>	20	10	100	0.2	0.1	0.5
	<i>Bauhinia variegata</i>	100	94	100	1	0.94	1
	<i>Buteamonosperma</i>	70	35	100	0.7	0.55	0.8
	<i>Cassia fistula</i>	80	50	100	0.8	0.5	0.9
	<i>Flamingiaprocombens</i>	90	70	100	0.9	0.7	0.9
	<i>Indigoferatrogurucera</i>	80	76	100	0.8	0.76	0.8
	<i>Indigoferaveterantha</i>	70	45	100	0.7	0.45	0.8
	<i>Lathyrus sativus</i>	88	77	100	0.88	0.77	0.9
	<i>Medicago polymorpha</i>	77	40	100	0.77	0.4	0.8
	<i>Mucuna pruriens</i>	80	60	100	0.8	0.6	0.9
	<i>Phanera bhili</i>	100	80	100	1	0.8	1
	<i>Sennatori</i>	94	78	100	0.94	0.78	1
	<i>Senna floribunda</i>	90	68	100	0.9	0.68	0.9
	<i>Trifolium repens</i>	40	19	100	0.4	0.19	0.6
	<i>Vigna vexillate</i>	50	30	100	0.5	0.3	0.7

Source: Author compilation.

Role of WEL in boosting health, sustainability and rural prosperity

All the WEL discussed in present study are considered underutilized minor crops. Although they have tremendous potential of their wider adoption and commercial exploitation, but except a few their use is negligible in studyarea. As a result, their useful parts, which can be utilized for commercialization and value addition of popular food items get wasted at resource level. However, the use of some WEL like *Bauhinia variegata* and *Sennatori* has increased significantly from the last few years in view of their market demand, food and medicinal value. Even many farmers and Self-help groups have started their cultivation in private land. They sell dried seeds of *Sennator* both fresh and pickled round the year. Similarly fresh flowers and buds plus pickled buds

of *Bauhinia variegata* are sold in local markets. Among other uses leaves of *Phaneravahlia* are heavily utilized in preparing leaf plates and bowls. It is a good source of earning for people as both fresh leaf plates and machine-made dehydrated plates can be sold round the year. *Phaneravahlia* can also be grown as ornamental, soil binder and wind break, so it offers multiple uses along with its uses as source of nitrogen to soil and food and feed protein to man and animals. Rest of WEL specially *Buteamonosperma*, *Flamingiaprocombens*, *Mucuna pruriens*, *Senna floribunda*, *Vigna vexillate*, *Cassia fistula* is not of much use for local community in spite of their rich food, medicinal and commercial value. WEL like *Buteamonosperma*, *Mucunapuriens* and *Cassia fistula* show luxuriant growth and have high pharmaceutical demand. So, their sustainable harvesting, cultivation and marketing can play an important role in rural prosperity and entrepreneurship development. Their use and domestication need to be popularized in study areas. They even can be grown as multipurpose ornamental tree along roadside and pathways. The supplementation of wheat and other cereal products like noodles (Locally semiyam), pasta etc. and other traditional food items *siddu*, *kachuri*, *badiyan* with processed WELs too will increase concentration and diversity of proteins in food. Studies have shown that it may contribute to a high nutritional quality in plant-based diets (Margier,2018, Patil, 2016, Devi and Sen, 2020).

Various constraints and opportunities for justified use of WELs

WEL in spite of their luxuriant growth cannot be utilized optimally in study areas due to various social, geographical,

economic and environmental constraints. Most prominent argument behind their little use is ignorance of young generation about their rich food, medicinal and commercial value followed by distinct geographical and economic barriers. Advancement in technology and better health care facilities as a result of modernization, urbanization, and westernization has also significantly declined the use of WEL. Various social constraints for limited use of WEL are disintegration of joint families, involvement of people in MNRREGA, increased rural migration and poor labour availability. Various geographical constraints are small landholdings per family, frangibility, inaccessibility and poor road connectivity resulting in higher cost of production also listed by earlier worker too (Sen et al., 2013, Samant and Dhar, 1997). Studies have shown that various economic constraints are lack of marketing opportunities, poor financial resources and infrastructure viz storage and processing units, food testing lab and irrigation facilities (Kumar, et al., 2021). Various environmental stresses people are facing at present are environmental pollution, land fragmentation, disease outbreak, soil erosion, climate change and uncertainties of weather (Heal and Millner, (2014a). As Mandi district of HP India is bestowed with opportunities which are unique to these agro-ecosystems, organic agriculture and several agriculture-based subsidiary occupations can be initiated to boost the rural economy here. But till now optimum resource utilization has not been achieved due to various constraints mentioned in present study. Out of fifteen WEL, eight WEL being herbaceous annual or perennial can be used as green manure along with main crop and rest of seven, being either shrub or tree can be grown along field margins as source of nitrogen due to their ability to fix atmospheric nitrogen. Studies have shown that they are very useful in maintaining soil health and food quality through decreasing soil pH, increasing soil organic matter, recycling nutrients, diversifying the soil microscopic life, breaking disease build-up and weed problems, improving soil porosity and structure (Sanjappa, 1990).

Awareness for sustainable harvesting, optimum utilization and domestication.

WEL discussed in present study being organic and rich in food value are essential sources of vitamins, micronutrients and protein. They are a valuable component to attain nutritional security, uplift the socio-economic status of the local community and restore soil sustainability. Since ages WEL used to be an important constituent of traditional food but their use has significantly declined in modern food culture. To bring WEL in mainstream following areas of action are strongly recommended:

1. Mass awareness for rich medicinal, food and commercial value of WEL.

2. Imparting education and inputs to farmers and SHGs for sustainable harvesting, processing and value addition of useful parts of WEL.

3. Nutrient analysis of value-added food items.

4. Training for labelling and packaging of value-added products to meet the market standards and have a produce of international quality.

5. Motivating farmers to cultivate and domesticate WEL for maintaining soil fertility and supply chain of produce.

To achieve these goals in study area interaction with school children, SHGs, Mahila Mandals, local sellers, owners of restaurants etc. has been initiated. Some of SHGs were also trained to use WEL as a food supplement in addition to popular traditional food items like dried flowers of *Bauhinia variegata*, *Buteamonosperma* and *Cassia fistula* were used in pakoras, badiyan, kachuri, missi roti and parantha etc.

Agriculture is under constant pressure to produce greater quantities of food, feed and biofuel with shrinking of land for the projected nine billion people on mother earth by 2050 (Godfray, et al., 2010). For this use of chemical fertilizers and pesticides is a common practice in modern agriculture deteriorating soil, water and human health. So, scientist, policy makers and farmers round the world are now looking for organic food and fertilizers (Kumar, et al., 2023). For this domestication of multipurpose WELs specially *Bauhinia variegata*, *Buteamonosperma*, *Cassia fistula* *Mucunapruriens*, *Phaneravahlii* and *Senna floribunda* etc. can play an important role to support soil, human health, environment and rural prosperity. All the WELs listed in present study are not only climate resilient but also show immense potential to provide nutrient to soil and food system, for this herbaceous WELs recommended to be incorporated on sequential and intercropping basis in modern agriculture and trees, shrubby and woody vines recommended to be grown on field margins and waste land around agricultural land to restore soil fertility and environmental substantiality. Thus, including WEL in modern cropping systems is very important to advance towards nutritional security and soil sustainability without compromising soil quality and production potential.



Fig.1 (a -o). Source: Author compilation.

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