

Importance of weed endemic in subsistence agriculture in Ladakh region and their traditional management

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For sustainable agriculture and food security in Ladakh, it is the need of hour to intervene small-scale interventions by research institutes to draw the attention of farming community to adopt for sustainable hike in productivity by energy-oriented saving. In subsistence agriculture of Ladakh region, it is required to disseminate the selection of an efficient and socially acceptable weed control system which require a thorough understanding of the physical, economic, and social realities in Ladakh region like weed menace and its impact on crop yield amongst the farming community.

Key words: Mulching, Subsistence agriculture, Tools, Weeds, Weed Management

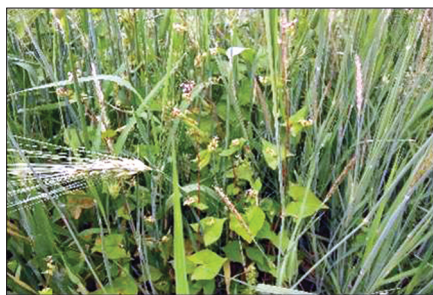
Ladakh, also known as ‘Little Tibet’, is a wildly beautiful desert region high in the western Himalayas, at an altitudes ranging from 10,000 to 14,000 feet (from 3,000 to 4,300 m). It is a place of limited resources with an extreme climate. The Himalayan mountain range has significant bearing on the climate of India, as its towering height created a vast rain-shadow zone in the north. Ladakh lies between 32° 15' - 36° N and 75° 15' - 80° 15' E, and is a high altitude cold arid region of India. Due to harsh winter, and medium to heavy snowfall, Ladakh remains cut off for almost seven months i.e. from October to May from rest of the world by surface transportation and experiences an extremely hard climate during winter (-30°C). Agriculture with harvesting glacier water in the lap of Himalayas has come-up as a small-scale farming system, well adapted to this unique and extreme environment. People, through the ages, have developed need-based and location-specific indigenous

technologies for enhancing productivity and the concept of quality seeds is well known, but the agronomic practices have not so far been standardized.

The Himalayan mountains and the Indus river system are two of the gigantic land features that limit the possibility of large-scale agricultural activities in Leh region. Its agriculture in the past rendered the region self-sufficient in food grains especially with small-land holdings. Families rely more essentially on subsistence agriculture based on principal crops like wheat, barley and potato on their stone-built terraces. Potato, being main vegetable, is a main cash crop grown between May and September in the region. The art of crop production which seems as old as civilization itself and its essential features have remained largely unchanged over the ages. Productivity in cold deserts, as elsewhere, is centered on crops and animal husbandry. Agriculture and livestock rearing are the two predominant sectors of Ladakh

economy, supports almost 80% of its population, having its own specific geo-climatic condition and determines the cropping pattern and productivity of the region.

In subsistence agriculture of Ladakh region, it is required to disseminate the selection of an efficient and socially acceptable weed control system which requires a thorough understanding of the physical, economic, and social realities in the particular region like weed menace and its impact on crop yield amongst the farming community. Warming in the Himalayas is predicted to increase plant upper distributional limits, vegetation cover and abundance of species adapted to warmer and this newer climate in which however, weeds are an integral part of cultivated lands which are regarded as fodder for livestock sacrificing productivity of crops and other damages by insects but on the other hand, CAZRI, Leh is successful to educate farmers first time in Ladakh region the importance and weed



Wheat crop under heavy weed pressure in valleys



Phragmites spp. infestation in wheat



Infestation of *Artemisia* spp. in alfalfa fodder

menace in agriculture and unpalatability and deterioration of desired fodder resources in cropped, non-cropped and pastoral systems. Weeds being big robbers not only compete for space and moisture, but also inviting undesirable insects, drastically and dramatically not only crops but orchards too beside quality of produce to a significant level. This belief of protecting weeds indirectly in crops has come as an important issue in a place where farmers are resource poor and own very small agricultural land.

Enriched weed menace

In Ladakh, solar radiation is as high as 6 to 7 kwh/m², which is among the highest in the world, accelerating plant growth at higher rate. Similarly weed growth and its occurrence increase the emergence and number of weeding to be performed in a piece of land, thereby, enjoying temperature and available soil nutrients, increasing the weedy growth at faster in colder northern regions under climate change, resulting 5 to 6 weedy flushes/emergence and on the other hand the cost of manual labour is high i.e. ₹ 500/day and farmers are resource poor, possessing very small land holding of 0.4 to 1.8 ha/household subsist more on natural resources and limited crops. Besides, higher seeding on adequate land preparation with negligible intercultural practices has led to the build-up of weed seed bank. Though organic farming is in practice for many decades, it is without using pesticides. In many crop fields, it was noted that crops are dominated by weeds and their density was more.

Weeds are more prevalent in Indus fed cultivated areas than valley. There

has been an altitudinal variation in species diversity in crops like wheat-barley, pea and potato in a villages like Saboo, Umla, Stakmo, and Nang located in valley at an altitude of 3,200 msl, weeds like *Chenopodium album*, *C. carinatum* > *Agropyron repens* > *Convolvulus arvensis* > *Polygonum convolvulus* (wild buchweat) > *Malwa neglecta* > *Amaranthus* spp. > *Melilotus officinalis* > *Setaria viridis* > *Stellaria media* > *Avena sativa* > *Bidens biternata* > *Digitaria ischaemum*, > *Hardeum vulgare* > *Medicago* spp. and *Lolium* species dominated. In lower altitudinal parts of Leh region (Phey, Spituk and Thiksey) at an altitude of 2,900 msl on river side, weeds like *Phragmites australis* > *Chenopodium album* > *Chenopodium botrys* > *Malwa neglecta* > *Convolvulus arvensis* > *Setaria viridis* > *Cirsium arvense* > *Festuca* sp. In case of non-cultivated land, vegetation along river belt was dominated by *Phragmites australis* > *Cirsium arvense* > *Festuca* sp. (preferred pasture grass) > along with *Ambrosia artemisiifolia*, and *Clematis* sp. around sea buckthorn along with other native vegetation.

Although weed control is as old a practice as agriculture itself in any sphere of farming systems, limiting their infestations brings economic benefits. In traditional agriculture of Ladakh region, many weeds have much importance especially when Ladakh is cut off from all sides and these leafy weedy specie serve as a substitute of regular vegetables available in the plains. These are dried and are used in many Ladakhi dishes during winter. Besides indigenous weedy species, many invasive weed plant species accidentally infiltrated into the region and impact negatively the cropped and non-

cropped areas especially rangelands by displacing desirable native species (over which large-sized of livestock rely), altering ecological processes, reducing wildlife habitat, degrading systems, decreasing productivity and increase management and pasture renovation.

Weed management

In Ladakh region, weeds are although an integral part of the cultivated lands but still dominance of traditional methods in the crop production system has led to various traditional uses of weed species.

General perception of farmers at Thiksey revealed that use of tractor for ploughing encourages weed growth, while use of traditional bullock plough reduces the incidence of weeds like *Agropyron repens* (locally known as Rampa)- a problematic weed in valley-based agricultural lands. In Kargil, weeds are removed manually thrice from fields especially vegetable production areas. In Ladakh, a small wooden structure called the *tokhre* is used for digging the soil facilitating the horizontal spread of roots in cabbage and other vegetable crops thereby increasing production. This practice facilitates enhanced moisture/nutrient uptake along with the removal of weeds. In the West Himalayan region, during March/April, when snow melts and weather condition improves, the bunds and comers of the fields are dug-out and weeds and grasses are removed with the help of spade and clods. The grasses or weeds are beaten up and then soil is separated from these clods and collected in lower fields.

(i) This practice of removing weeds and grasses from bunds and corners by digging helps in weed



Invasion of *Cirsium arvense* in Changthang pastoral system and its allelopathic effect on native species

Table 1. Weeds their families and uses

Family	Name of weeds	Vernacular name	Recorded-in	Possible traditional uses*
Poaceae	<i>Digitaria sanguinalis</i>	-	Crop fields	Fodder resource
	<i>Digitaria ishcaemum</i>	rTsa	Crop fields	Fodder resource
	<i>Avena fatua</i>	Kasam (Nubra)	Crop fields	Grains are grinded for making <i>roti</i> when not harvested makes a good fodder
	<i>Cenchrus ciliaris</i>	-	Pasture and wetlands	Fodder resource
	<i>Festuca rubra</i>	Lchipkyang	Crop fields	Fodder resource
	<i>Poa annua</i>	-	Crop fields, pasture and wetlands	Fodder resource
	<i>Poa pratensis</i>	Lchipkyang	Pasture	Fodder resource
	<i>Festuca gaulca</i>	Chipkyang	Crop fields	Fodder resource and straw basket for carrying vegetables to Market
	<i>Phragmites australis</i>	Dambu	Crop fields, pasture, sea buckthorn area, forest	Fodder resource
	<i>Bromus</i> spp.	-	Pasture, road sides	-
	<i>Trisetum spicatum</i>	Spang	Irrigation channels, around pond and water-bodies	To reduce seepage losses, collected for fodder or grazed by cattle
	<i>Setaria viridis</i>	Ljamak	Crops, irrigation channels, culvars	Collected for fodder or grazed by cattle
	<i>Setaria glauca</i>	Norbo-rtsey	Crop field, irrigation channels, culvars	Collected for fodder or grazed by cattle
	<i>Agropyron repens</i>	Rampa	Crop fields	
	<i>Medicago sativa</i>	Yarkhan Oal	Crop fields, orchards, agroforestry systems	Fodder purpose
Leguminosae	<i>Medicago falcata</i>	Oal		
	<i>Medicago media</i>	Oal		
	<i>Medicago lupulina</i>	-	Crop fields and water-logged condition	
	<i>Vicia monantha</i>	-	Crop fields and vegetable garden	
	<i>Melilotus officinalis</i>	-	Crop fields and water-logged condition	
	<i>Trifolium repens</i>	Oal chun	-	
	<i>Lotus corniculatus</i>	-	Crop fields and water-logged condition	
	<i>Astragalus</i> spp.	Landekaon	Pasture	
Cyperaceae	<i>Lathyrus aphaca</i>	rSanma, Shiche	Crop fields	Collected for fodder or grazed by cattle
	<i>Lathyrus humilis</i>	rSanma		
	<i>Carex</i> spp.	-	Pasture	Collected for fodder or the animals are left around to graze.
	<i>Cyperus</i> spp.	-	-	
Polygonaceae	<i>Kobresia</i> spp.	Spoto	Pasture	
	<i>Rumex patientia</i>	Shoma	Culverts and irrigation channel	
	<i>Fagopyrum tataricum</i> Tayat		Crop fields	
	<i>Polygonum convolvulus</i>		Crop fields	

Contd.

Table 1. (Continued from pre-page)

Family	Name of weeds	Vernacular name	Recorded-in	Possible traditional uses*
	<i>Fagopyrum esculentum</i>	Tao	Crop fields	Leaves are boiled with grinded barley prepared as stew, also mixed in buttermilk served with <i>paba</i> . Leaves with fried with onion and served with rice and <i>roti</i> , leaves are cooked as vegetables
Chenopodiaceae	<i>Chenopodium album</i> <i>Chenopodium botrys</i>	Nynue, Negue	Crop fields, vegetable garden, bunds	Leaves are cleaned and then boiled for 10 to 15 min. with grinded barley; stew is prepared and taken with Paba. It is fried in hot oil for 10 to 15 min and is taken along with rice or <i>roti</i> .
	<i>Chenopodium carinata</i> <i>Chenopodium glaucum</i>			Collected for fodder or for grazing
Convolvulaceae	<i>Convolvulus arvensis</i>	Tuk-tuk	Crop fields and bunds	Seeds are eaten raw or fried with onion or boiled and taken.
	<i>Capsella bursa-pastoris</i>	Shepherds purse	Vegetable garden	
Brassicaceae	<i>Lepidium latifolium</i> Shang-rtso	Payak rTsawa,	Vegetable garden	Leaves are collected to remove bitterness it is boiled for 10 min and then fried with onion or tomato served with rice, <i>paba</i> or <i>roti</i>
	<i>Artemisia</i> spp	Burtse, Khamppa	Alfalfa fodder fields, wetland	Leaves are boiled and taken as anti-microbial and intestinal worm. Leaf decoction is given during stomach or intestinal complaints.
	<i>Cichorium intybus</i>	Khala	Highland area	-
	<i>Sonchus oleraceus</i>	-	Fodder area	-
Astraceae	<i>Stephanomeria paniciflora</i>	-	Crop fields, pasture	-
	<i>Cirsium arvense</i>	Ljangtser	Crop fields, pasture, culverts, roadside	-
	<i>Cirsium verutum</i>	Ljangtser nakpo		-
	<i>Galinsoga ciliate</i>	-	Vegetable garden	-
	<i>Conyza canadensis</i>	-	-	-
	<i>Bidens pilosa</i>	Chaja, Saja, Soljaa	Vegetable garden	Freshly harvested leaves are used in preparation of 'Ladakhi tea'
	<i>Lactuca dissecta</i>	-	-	Leaf paste is used for skin diseases.
	<i>Picris hieracioides</i>	-	Wetland and irrigation channel	-
	<i>Taraxacum</i> spp.	-	Pasture	-
	<i>Ambrosia artemisiifolia</i>	Khamchu	Crop fields, fodder areas	-
	<i>Echinops</i> spp.	Jangtser nakpo	Barren lands	Medicinal uses
Rosaceae	<i>Potentilla fruticosa</i>	Toma	Pasture	Roots have both medicinal and edible properties. Roots are uprooted washed and eaten raw or fried with oil for taste. Roots are given to diarrhoea patients and are consider as good astringent.
	<i>Potentilla anserina</i>			
Solanaceae	<i>Datura stramonium</i>	-	Road sides	-
	<i>Physochlaina praealta</i>	Langtang	Pasture and highlands	-
Malvaceae	<i>Malva neglecta</i>	Halo	Crop fields and irrigation channel	-
Onagraceae	<i>Cuscuta approximata</i>	-	Alfalfa crop	-
Papaveraceae	<i>Corydalis flabellata</i>	-	Highlands	-
Lamiaceae	<i>Nepata laevigata</i>	Jatukpa	Non-cropped and bunds	Used as medicine (leaves decoction) during pneumonia
Fabaceae	<i>Vicia sativa</i>	Yughpo	Crop fields, leguminous (nitrogen-fixing) locals	Collected for fodder or grazed by cattle, consider to increase soil fertility
Caryophyllaceae	<i>Stellaria monosperma</i>	Sinche	Pea and other crop fields	Collected for fodder or grazed by cattle
Paperveraceae	<i>Corydalis sp</i>	Highlands	Ralchat-nakpo	Purple/ blue flowers are collected for decoration
Amaranthaceae	<i>Axyris hybrida</i>	highlands	-	-

Aquatic weeds: *Rumex crispus*, *zannichellia-palustris*, *Polygonum affine*, *Troglochin* sp, *Catabrosa aquatica*, *Pedicularis longiflora*, *Hippuris-vulgaris*, *Puccinellia maritima*.



control in the cultivated fields. (ii) Area under crops remains the same as that of previous crop i.e. area is not wasted for weeds and grasses.

(iii) The soil added in lower fields from the bunds of upper field is rich in nutrients and it improves the soil fertility.

Under this context, survey was carried out in identified TSP villages and the following weed endemics were noted along with their traditional uses:

- *Application of higher seed rate:* Broadcasting is practised with higher amount of crop-seed for attaining desired plant-population in higher crop yield and fodder for livestock. Simultaneously with the help of either plough or tractor, the broadcast seeds are brought up into the line. But it results in differential crop plant emergence, and weeds take advantage before crop emergence. This practice put the 30 to 40% broadcast seeds

into deeper layers which allow late emergence and weeds get the opportunity to find a suitable place and fight crops easily. Broadcasting is practised keeping in view the higher labour cost and short season.

- *Hand weeding/pulling:* this is followed only in vegetable grown land as most of the vegetables are dried and stored for harsh winter when Ladakh is completely cut-off from rest of India. Three to four flushes of weeds are removed from vegetable-garden.
- Before sowing, fields are irrigated to soften the hard crust soil and cultivated when soil completely becomes cultivable. Simultaneously, emerged weeds are also incorporated during ploughing and weeds are controlled. Immediately after ploughing, the crop seeds are broadcasted. It is very unique technique which allows weeds to

Table 2. Critical period of crop-weed competition in major crops of Ladakh

Crop	Critical period (DAS)
Wheat, barley, peas, cauliflower, cabbage and tomato	25-45
Potato, Lentil, Onion	30-60
Leafy and cole vegetables	15-30

emerge and is killed when ploughed.

- *Crop rotation:* Is followed for controlling weeds in Ladakh.

SUMMARY

Subsistence agriculture in Ladakh region requires a thorough understanding of its physical, economical and social realities before recommendation of any weed management technologies in the region. There is a need to make farming community aware of the weed menace and its impact on crop yields. Weeds in the region are used as fodder for animals, also for various medicinal purposes. Cultural methods of weed management like use of higher seed rate, weeding tools, mulching etc., may be accepted by the farmers of the region.



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