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Protected Cultivation: Indispensible for Cold Arid Ladakh

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Abstract: ***Cold arid Ladakh region experiences more than 300 cloud free sunny days. This solar energy is an asset that can meet all energy needs of Ladakh region. Protected cultivation is one sector that utilizes this natural resource for the benefit of small and marginal farming community of Ladakh. Protected cultivation in the form of greenhouse, trench and low tunnel together has the ability to provide a variety of fresh vegetables year round. These simple structures are economical and can add variety, taste and nutrition in one go.***
Keywords: Cold arid, Ladakh, protected cultivation, solar energy, nutrition, year round production

Introduction

A trans-Himalayan region cut by four ranges (the Great Himalaya, the Karakoram, the Zanskar and the Ladakh) and rivers fed by snow melt (Indus, Shyok and Suru), Ladakh lies at the western end of the Tibetan Plateau. At altitude mostly above 3000m, Ladakh is a cold arid desert. The great Himalayas act as a barrier to the moisture laden clouds from the south, creating a desert in the rain shadow, with most areas receiving only about 300mm annual precipitation. As it is so high and exposed to winds blasting down from Central Asia, the winters are long and bitterly cold. This restricts any agricultural activity in the open from October till April. The temperature often dips to -25oC during these months. As the region remains cut off from rest of the world due to blockage of passes during the harsh cold winter months, Ladakh faces acute shortage of fresh vegetables endangering nutritional security and availability. The prices of the meager Airlifted vegetables that arrive at the selected shops are usually beyond the pockets of common people.

Protected Cultivation and its Indispensability

Being a high altitude region Ladakh boasts of more than 300 sunny cloud free days. Solar energy can be best tapped to overcome energy shortages the region is so badly afflicted with. So unlike rest of India, the implementation of the passive solar greenhouse projects offer immense scope and possibilities, supporting small-scale farmers of this cold arid region and help improve their

nutritional and livelihood security. The greenhouses, heated entirely by sunlight to keep the inner temperature high enough to grow vegetables even when outside temperatures drop to -25°C, support the development of seasonal and off-seasonal vegetable production that improves: (i)variety, (ii) the dietary intake and nutrition (ii) the access to an increased amount of basic services through income generation.

Protected structures used in cold arid Ladakh:

For round the year availability of a variety of fresh vegetables three basic low-cost protected structures are used. These three basic structures are economical and can easily be established by the local farmers using local resources.

Table 1: Structures used for protected cultivation:

Structure	**Size (in ft.)**	**Material used**
Local Green house (Domestic use)	32x16*, 70x18**	Stone, Clay, Willow sticks, UV stabilized Polythene
Trench	10x6x1.5	Stone, Willow sticks, UV stabilized Polythene
Low Tunnel technology	30x3	Metal/wooden loops, rope, soil, stones, UV stabilized polythene

1. GREENHOUSES

These are most recommended for growing warm season crops like Tomato, Capsicum, Brinjal, Cucurbits (Cucumber, Bottle gourd, Long melon, Muskmelon, and Watermelon etc) during summer months and for growing cool season crops during autumn and winter (like cabbage, cauliflower, broccoli and all leafy vegetables). These structures are green round the year except for a brief period of 10-15 days' in between the harvest and before the next crop. These can also be used to lengthen the availability period of many short growing early vegetables.

Fig. 1: Greenhouse cultivation in November-December

2. TRENCHES

These are most suitable for raising healthy, stout and hardened seedlings (fig. 3). As the main season (open cultivation) seedlings in this cold arid region need to be ready by May, they must not be lanky and should have hardened before shifting them in the open where the seedling often are exposed to low temperature shocks which they must resist and is possible only if they had been adequately hardened. This hardening process is very easily accomplished under trenches better than other protected structures.

Trenches can also be used to grow cucurbits like watermelon and muskmelon (when allowed to trail on the ground) as they need higher temperature and in open they often fail to ripe and attain actual size. Soon after the seedlings are over the trenches can be used to force cole crops like cabbage, cauliflower, broccoli, knolkhol and kale etc to produce a month earlier than those in the open. This has been proved at the station and is a success story. After the cole crops are over, they can again be transplanted with the next set of cole crops and by ending November-December the crop is ready for harvest. This lengthens the cropping season and availability period as no green is seen in the open during this period of the year.

If the trenches are cultivated with cucurbits, then by ending September, they can be transplanted with leafy vegetables like beet root, spinach, lettuce, pakchoi and chinese-cabbage etc in which harvesting (cuttings) can be taken up from December onwards till March (around 8 cuttings) (fig. 5).

3. LOW TUNNELS

This is a very low cost portable structure and most suitable for forcing vegetables and extending availability period. In the lower belts of the region, this structure has proved quite useful for nursery raising. The farmers in this belt usually use floating row covers to raise nursery. During this period (spring), temperature at night often falls to subzero levels and therefore protection at night becomes imperative. Seedlings produced through this technique takes around 2-3 months as the farmers are forced to remove the cover during day time to prevent the seedlings from burning. This process slows their overall growth and development. This low tunnel technology has fastened seedling growth and is a success in this belt. Here it can also be used to force short vegetables like cole crops and for delaying harvest in late sown crops.

In the middle belt this technology is mainly used to protect cucurbit transplants (summer squash, muskmelon, watermelon) during late spring and to extend the short growing season of the region where late maturing crops (short stature) often fail to mature and size in the normal open conditions. In the late maturing crops when temperature starts dropping during September, the polythene coverings are again installed to provide congenial temperature conditions required for maturation and ripening.

In the upper belt, where harsh temperatures prevent growing vegetables in the open even during summer months, today with the help of this low cost technology farmers are successfully growing broccoli, cabbage, cauliflower and leafy vegetables making it a success story motivating other regions with similar topographical features.

Varieties and Hybrids tried and subsequently recommended for the region are:

Crop	**Variety/hybrid**
Cabbage	Golden Acre, POI, Pusa Drumhead. Champion, Mitra, Summer King
Cauliflower	Shenta, CFL-1522, Snow crown,Zimmi, NSC-102B, Himani
Broccoli	Lucky, Confident, Green Magic, NSC-105B
Onion	Liberty, Red Coral, NSC-AFLR, Brown Spanish, Local
Chinese cabbage	Spring Son, Palampur Green, Choko (Pakchoi), All Season
Kale	Khanyari, GM Dari
Knol khol	White Viena, Purple Viena, Early White Viena, Summer Special, King of North
Turnip	PTWG, olden Ball, Snow Ball
Radish	White Icicle, White Long, RRWT, Pusa Himani

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Brinjal	Janak Hybrid, Dev Kiran, Nav Kiran, PPL, PPC, Pusa Kranti, Pusa Hybrid-5, Pusa Hybrid-9, BR-112
Tomato	US-3380, US- 1080, Anand, Punjab Chuuara, Roma, Pusa Hybrid-2, Heem Sohna, Heemshikhar, Arka Rakshak
Capsicum	NSC-619B, Bharat, Swarna, Delisha, Natasha, CW, Orobella, Shalimar hybrid-1
Bottle gourd	PSPL, PSPR, Babu Gosha, NArvi, Vishwas
Cucumber	Aviva, Hilton, Kian, Priya, NSC-732B, Seedless, Claudia
Water melon	Kalia, Badsha, Madhubala, Rasdar, Swati, Hybrid Misthi, Aastha
Musk melon	Apsara, Madhuraja, Zoya, Meeta
Summer Squash	Australian Green, Pusa Alankar, Patty Pan, Orelia, Cora
Spinach/Beet	Delta, Virgenia Savvoy, All green
Carrot	Nantes group, chantney, New Karoda, Yamdagni

Manures and Fertilization:

Cole crops respond well to manures and fertilizers due to their heavy nutrient requirement. Fields should be well prepared by ploughing two to three times and incorporating 25 to 30 tonnes of well rotten farmyard manure. To obtain good yield, 120 kg nitrogen, 80 kg phosphorus and 75 kg potassium per hectare for cabbage and 100, 120, 80 kg nitrogen, phosphorus and potassium for cauliflower and broccoli are required.

Solanacious crops require an average of 20-25 tonnes well rotten FYM. As these crops are good feeder of macro nutrients, a general Average fertilizer dose of 100-125 kg N, 80kg P_2O_5 and 60-80 kg K_2O should be given for good quality yield.

Cucurbits (cucumber, bottle gourd, muskmelon and water melon) are basically warm season crops and they are not very heavy feeders. But musk melon responds well to manuring and fertilizer application. Add 15-20 tonnes of FYM along with the basal dose of fertilizers at the time of land preparation. A general fertilizer dose of 100kg N, 60kg P2O5 and 60kg K2O per hectare is recommended in cucumber, water melon and bottle gourd. In muskmelon a general fertilizer dose of 125kg N, 70kg P_2O_5 and 70 kg K_2O is recommended.

As leafy vegetables are good feeders, a basal dose of 25-30 tonnes of FYM should be applied per hectare at the time of land preparation, a general fertilizer dose of 100 kg N and 60 kg each of P_2O_5 and K_2O is recommended.

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Conclusion:

Protected cultivation is a sector that could make Ladakh self-sufficient in vegetables. Harnessing this sector could change general nutrition scenario of the region. Rather than using only one structure, the use of above three basic structures was found more economical and justified as along with year round production, these also enabled variety availability in vegetables. From nursery raising to growing summer vegetables and then cool season crops, these enabled cultivation of almost every vegetable year round. Further research and modifications in structures with enough access to resources and infrastructure can make production even easier and affordable.

