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Cultivation of Exotic Vegetables: Challenges and Future Prospects in India

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Abstract: -

Exotic vegetables, introduced from foreign regions, are increasingly gaining popularity in India due to their unique flavors, nutritional benefits, and high market value. With the exotic vegetable market growing at a rate of 15–20% annually, these crops present significant opportunities for farmers, particularly in regions with favorable agro-climatic conditions such as the Himalayas, Himachal Pradesh, Uttarakhand, and parts of Karnataka and Maharashtra. Key exotic vegetables cultivated include Broccoli, Asparagus, Lettuce, Cherry tomato, colored capsicum, and red cabbage, among others, which not only enhance dietary diversity but also offer substantial health benefits. Despite their potential, challenges such as pest and disease pressure, lack of efficient supply chains, and limited access to improved varieties hinder widespread adoption. Integrated Pest and Disease Management (IPDM), precision agriculture, and innovations in robotics and AI are emerging as promising strategies to overcome these constraints and improve sustainability. With their rich nutritional composition and profitability, exotic vegetables represent a valuable avenue for crop diversification, farmer income generation, and future-ready agriculture in India.

Introduction:

Exotic vegetables, locally known as English vegetables, are non-native vegetables

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and are originally from colder countries. Exotic vegetables are plant species that are introduced to a country or location, and which are not common in domestic crop production or in the traditional cuisine. Exotic Vegetable farming is a profitable venture and become source of livelihood to the farmers and is contributing significantly to food security in country (Badmus and Yekinni, 2011). Exotic vegetables market is growing at the rate of 15 to 20% per annum and is increasing day by day. India is importing more than 85 percent exotic vegetables. However, despite a naturally enabling environment for cultivating these high value veggies, the area unfortunately lacks proper export facilities and local marketing infrastructure. Due to huge supply chain, more demand and less supply these vegetables come very costly in the Indian market (Rao and Mrunalinisasanka, 2015). Growing of exotic vegetable & fruits is more profitable business than cultivation of traditional Indian vegetables.

There are very few areas in India which grow these vegetables such as Pune, Nasik, Mahabaleshwar, Banglore, Uttarkhand, Ooty, Himachal and Jammu Kashmir. (Dr. C Chandrasekhara Rao). Many private companies like Siddesh English Exotic Vegetables, W- Mumbai, PMS Agrotech trading company, Nagpur, Indogreen nature farm pvt. ltd, Bangalore involves in export of Exotic Vegetables. The cultivation of exotic vegetables has started picking up fast in Himachal Pradesh with farmers opting for diversification in agriculture. Having the most of climatic and soil conditions of the region conducive for exotic vegetables, farmers in Theog, Matyana, Narkanda, Sainj valley, Saproon valley in Solan, Nauradhar in Sirmaur, Katrain and Manali towns have taken to growing of exotic vegetables like asparagus, broccoli, lettuce, colored capsicum, celery, Chinese cabbage, Brussels sprouts, European carrots, parsley, leek and snowpeas (Janakiram and Reddy, 2016). The geographical area of exotic vegetables in different states shown **Fig.1.**

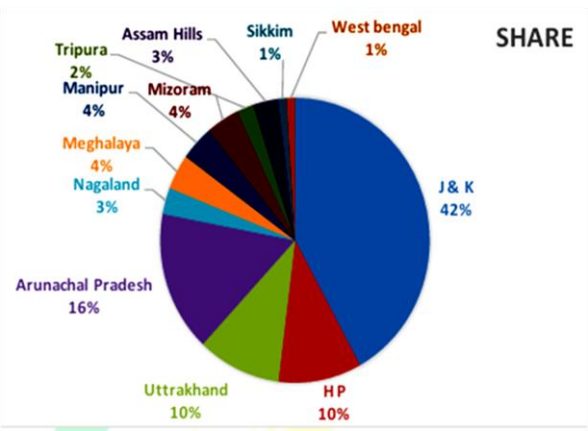

Fig.1 Share of geographical area of different states in Himalayan region (Pathania *et.al*, 2021)

The increasing demand for exotic vegetables in India has several reasons in which the most important reason is the changing food habits due to more health consciousness and availability of international

cuisines in Indian restaurants. The other reasons are the growth of organized food service sector, expansion in supply chain capabilities in Tier II cities, etc. The major states where exotic vegetables are in high demand are Goa, Maharashtra (Pune, Mumbai), Delhi and Gurgaon. These vegetables are now even demanded by the erstwhile non-consumers. As a result, the market for these vegetables is expected to grow in India.

The exotic vegetables market in India was USD 2.4 Billion in 2024. It is expected to reach USD 6.7 Billion by 2033, at the average annual growth rate of 11.45% between 2025 and 2033. In 2021-22, the top exported countries in India were the UAE, Saudi Arabia, Qatar, Italy, the UK and the USA.

Important exotic vegetables grown in India

Mostly exotic vegetables are cultivated in small pockets in India for consumptions, marketing as well as for export. Some important exotic grown in India especially in Jammu and Kashmir are as follows: Lettuce, Broccoli, Brussels Sprouts, Chinese Cabbage, Celery, Parsley, Red Cabbage, Asparagus, Cherry Tomato, Coloured Capsicum

Broccoli: Broccoli is one of the most popular exotic vegetables that you can find in local Indian cuisines shown in **Fig.2**. It is mostly grown in Tamil Nadu and Gujarat. It is best grown in winters and in areas where there is less rainfall. They are excellent in improving overall immune system and is used in salads and garnishes.

Fig.2 Broccoli

Lettuce: Largely used as salads, in burgers and spring rolls, lettuce is hugely popular used as a digestive food shown in **Fig.3.** However, it is grown on a small scale in India usually in hydroponics system. The iceberg lettuce is majorly grown in the Nilgiri mountain of South India.

Fig.3 Lettuce

Red cabbage: This variety of cabbage comes with distinct purple-red pigmentation shown in **Fig.4.** They are known for their rich source of anthocyanin. It is rich source of natural colourants used in candies and chewing gums. It is also served as raw and cooked.

Fig.4 Red Cabbage

Asparagus: Asparagus is a cool season crop and is grown better in hills than plains shown in **Fig.5.** There are around 300 varieties of asparagus with only 20 as edible. It is rich in Vitamin A, K and C, Calcium and dietary fibre. It is a primary source of antioxidants.

Fig.5 Asparagus

Cherry Tomato: It is a small distinct tomato variety considered as a different vegetable shown **Fig.6.** The plant is weak and is harvested in bunches during harvesting season. It needs a support of a trellis. Punjab, Uttar Pradesh and Bihar are the major producer of cherry tomatoes in India.

Coloured Capsicum: It is a non-pungent variety of bell pepper and is available in red, yellow and orange colours shown **Fig.7**. Late monsoon sees the sowing of seeds so that it can be harvested in winters. It grows on a large scale in Karnataka, Himachal Pradesh, Uttar Pradesh and Goa.

Fig.6 Cherry Tomato

Fig.7 Colored Capsicum

Parsley: It is a popular medicinal and culinary herb known for its rich antioxidants and disease preventing properties. It is also used to garnish salads and sandwiches. It takes 6-8 weeks to be ready for market shown **Fig.8.** In India, it is grown in peri-urban areas. It is grown as a minor crop in Punjab, Himachal Pradesh and Uttar Pradesh and in Nilgiri hills and Ooty in southern region.

Fig.8 Parsley

Fig.9 Celery

Celery: Celery is not only used in soups and salads for consumption but also its oil is used in perfume industry. It takes 4 to 5 months from seed sowing to harvest shown in **Fig.9.** It is usually grown in Punjab, Himachal Pradesh, Tamil Nadu, Karnataka and Kerala as vegetable, condiment and medicines.

Nutritional Composition

Vegetables are well represented in the composition of antioxidants, vitamins and

Health Benefits of Exotic Vegetables: (Pathania *et.al*, 2021)	
Vegetable	**Benefits**
Cherry tomato	Rich source of lycopene, vitamin C and antioxidants
Zuccini	Source of iron, calcium, zinc, and several vitamins like Vit-A,
Baby corn	Low in carbs and high in fibers
Celery	Prevents inflammation and cancer, regulates blood pressure, and controls liver diseases, gout, asthma, psoriasis, and fever
Lettuce	Packed with Vitamin A, Vitamin K, and folate
Asparagus	Is low in calories, neutralized stomach acids and packed with essential vitamins, minerals, and antioxidants
Broccoli	Good source of fibre and protein, and contains iron, potassium, calcium, selenium and magnesium as well as the vitamins A, C, E, K and a good array of B vitamins including folic acid.
Parsley	Helps prevent diabetes, prevent and treat kidney stones and is a proven all-natural anti-cancer remedy
Chinese Cabbage	Contains several vitamins such as vitamin B, C, and K, folic acid, antioxidants, and dietary fibers
Red Cabbage	Lowers inflammation and protects against various kinds of cancers
Pak choy	Rich in vitamin C, Magnesium, beta carotene, folic acid, calcium, and many essential minerals
Coloured Capsicum	Rich in vitamins, help in the formation of collagen, and improves skin health

numerous minerals such as those of Ca, Fe, Cu, P, Zn, Cl, Na and others. The dominant basic elements in plants and vegetables are Ca, K, Mg, Fe, Na. These provide alkalizing effects, neutralizing the acidity produced by other foods, especially those of animal origin (Gupta *et al.* 2005). Leafy vegetables grown in soilless culture require careful management of fertilizers (Soundy *et.al.*, 2001) because of limited root substrate; high density of seedlings, also the concentrations of essential plant nutrients in the media are frequently insufficient to sustain plant growth. Therefore, optimizing the nutrient solution concentration is required by farmers in order to maximize yield and quality. The total nutrient concentration of the solutions used in soilless culture is one of the most important aspects for a successful vegetable production. Too high levels of nutrients induce osmotic stress, ion toxicity and nutrient imbalance, while too low values are mostly accompanied by nutrient deficiencies (Savvas *et al*., 1999).

Cultivation practices

Cultivation practices for exotic vegetables (like broccoli, lettuce, zucchini, asparagus, red cabbage, bell peppers, celery, etc.), which are increasingly grown under open-field and protected cultivation systems:

Cultivation practices under open-field:

Site & Soil: Grown on fertile, well-drained loamy soils with neutral to slightly acidic pH (6.0–7.0). Climate: Most prefer cool to moderate climates; some (like capsicum, zucchini) tolerate warmer conditions. Land Preparation: Fine tilth with raised beds or ridges; incorporation of FYM/compost. Planting Material: High-quality hybrid seeds/seedlings raised in nurseries or protected structures. Planting/Spacing: Transplanted at 3-4 weeks; spacing varies with crop (30-60cm). Nutrient Management: High nutrient demand; apply FYM + balanced NPK + micronutrient sprays. Irrigation: Frequent, light irrigations; drip with fertigation is ideal; avoid waterlogging. Intercultural Practices: Weeding, mulching, staking/trellising for support, pruning when required. Pest & Disease Management: Adopt IPM (resistant varieties, biological control, safe pesticide use). Harvesting: Hand-picked at optimum stage (tender, fresh, compact produce). Post-Harvest Handling: Grading, washing, packaging, and cold storage to maintain freshness and extend shelf life.

Cultivation practices in hydroponics:

System Selection: Common systems, NFT (Nutrient Film Technique), DWC (Deep Water Culture), Cocopeat/Perlite Substrates, Drip Irrigation in Grow Bags. Growing Medium: Soilless substrates like cocopeat, perlite, vermiculite, rockwool, clay pebbles. Provides root support and aeration. Nutrient Solution: Balanced NPK with micronutrients

(Ca, Mg, Fe, Zn, B, Mn, Cu). pH maintained at 5.5-6.5, EC 1.5-2.5 mS/cm depending on crop stage. Nutrient solution supplied through automated fertigation. Water & Environment Management: Clean water is essential. Temperature: 18-25°C (cool-season crops), 22-28°C (warm-season crops). Relative humidity: 60-70%. Adequate light (natural sunlight or artificial LED grow lights in controlled systems). Planting & Spacing: Seedlings raised in plug trays, transplanted at 2-3 weeks. Spacing varies: Lettuce (20 × 20 cm), Capsicum/Tomato (40-50 cm apart). Crop Care: Continuous monitoring of pH, EC, water temperature. Pruning, training, and trellising in crops like capsicum, tomato, cucumber. Preventive measures against pests (aphids, thrips, whiteflies) using IPM. Harvesting & Yield: Lettuce: 30-40 days after transplanting. Broccoli: 60-70 days. Capsicum/Tomato: 80–100 days. Higher yield and better quality compared to soil cultivation. Advantages: Year-round production. Water saving (up to 80-90%). Faster growth, uniform quality, pesticide-free produce.

Constraints and Challenges

Exotic vegetables require specific temperature (15-28°C depending on crop) and humidity (60-70%) for optimum growth. Any deviation leads to poor yield, quality loss, and higher disease incidence. Along with climate sensitivity, water quality, nutrient management, high investment, perishability, and skilled management are major challenges. Exotic vegetables require polyhouses for strict climate control and shade nets for partial protection, both ensuring year-round, high-quality production in Indian conditions.

Vegetable crops play a vital role in global food security and nutrition, but their production is frequently threatened by a wide range of pests and diseases. Insect pests such as aphids, whiteflies, thrips, and caterpillars, along with fungal, bacterial, and viral pathogens, can cause severe yield losses and degrade crop quality. Traditionally, farmers have relied on chemical pesticides as the primary means of pest control. However, excessive pesticide use has led to serious environmental and human health concerns, including soil and water contamination, pesticide resistance, and adverse effects on beneficial organisms. Integrated Pest and Disease Management (IPDM) is an ecologically sound alternative that combines various pest control strategies to ensure sustainable vegetable production. This approach integrates cultural, biological, mechanical, and chemical control methods while prioritizing environmentally friendly solutions. By adopting practices such as crop rotation, use of resistant varieties, biological control agents, and targeted pesticide application, IPDM minimizes chemical

dependency and enhances long term pest management. Moreover, advancements in biotechnology, precision agriculture, and nanotechnology further improve the effectiveness of IPDM. This review explores the principles, strategies, and emerging innovations in IPDM for vegetable crops, emphasizing its role in improving crop productivity, reducing environmental risks, and ensuring food safety and sustainability (Rai and Chandra).

The marketing of exotic vegetables suffers due to low awareness, high perishability, weak supply chains, absence of cold storage, and lack of organized retail support. Strengthening consumer education, cold-chain logistics, direct farmer-market linkages, and value addition can improve the marketing scenario.

Future prospects in exotic plant production

The future of exotic plant production holds promises and potential, with innovative technologies and sustainable practices poised to reshape the landscape of the industry.

The future of exotic vegetable cultivation lies in sustainable, resource-efficient, and technology-driven systems. Among them, hydroponics is the best alternative to overcome climatic constraints, increase productivity, and ensure year-round supply of high-quality exotic vegetables for both domestic and international markets.

As technology continues to advance, the integration of artificial intelligence (AI) in agriculture is expected to play a pivotal role. AI applications can optimize cultivation processes, from monitoring plant health to predicting and preventing diseases, ultimately enhancing the efficiency and precision of exotic plant production.

Robotics and automation are set to revolutionize the way exotic plants are cultivated. Autonomous machines equipped with precision tools can streamline tasks such as planting, harvesting, and even intricate processes like selective pruning (Eviner *et al.*, 2010; Martin *et al.*, 2009; Zalba *et al.*, 2000; Adomako *et al.*, 2019; Allen *et al.*, 2021; Diallo *et al.*, 2006). This not only reduces labor-intensive efforts but also contributes to the overall precision and productivity of exotic plant cultivation. The incorporation of robotics aligns with the growing demand for sustainable and resource-efficient farming practices.

Conclusions

Exotic vegetables are highly nutritious. Exotic vegetables are an important source of cash income for farmers. The public and private sectors seeds to farmers at a reasonable price. Only an old variety of exotic vegetables are available locally in India. the major exotic vegetables available in India are Broccoli, Asparagus, Cherry Tomato, Bell Pepper, and

Zucchini. Future research should focus on developing and refining cultivation techniques that specifically address the challenges posed by climate change. Investigating how exotic plant species respond to changing climate conditions and exploring innovative methods for adapting cultivation practices will be essential for ensuring the sustainability of the industry.

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