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Protected Cultivation of Horticultural Crops and its status in Nepal

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Abstract

Protected cultivation is the process of growing crops under controlled settings by altering the natural environment with activities and buildings in order to attain maximum production. Vegetables and flowers are grown using protected horticulture methods. The greenhouse is the most feasible means of attaining the goals of protected horticulture. It allows for some control over wind velocity, moisture, temperature, mineral nutrients, light intensity, and atmospheric composition. However, some environmental parameters must be regulated, to what degree they must be controlled, and the expense of regulating them might go high. The primary interest of this paper is to convey increase understanding to the Nepalese about the concept of protected horticulture.

Keywords: protected cultivation; green house; environmental parameters; microclimate; precision agriculture.

Introduction:

Nepal is an agricultural country with a 28.89 percent contribution to the national gross domestic product (GDP) including the forestry and industry[1]. Nepalese citizens have a maximum landholding of 0.68 hectares per family[2]. According to V.K Singh n.d., Nepal's many agroecological zones allow for the cultivation of various fruits and vegetables[3]. The biggest sub-sector of work prospects for Nepalese people is vegetable cultivation[4]. Precision agriculture, according to Nabi et al., [5] is meant to optimize agricultural production via the use of crop information systems, innovative production technology, and enhanced crop management methods. Precision horticulture and protected horticulture are modern agriculture's tools, with protected horticulture being under precision horticulture[6]. Precision and protected horticulture are two new fields of technology that are helping Nepalese agriculture to modernize. Protected horticulture falls under precision horticulture, which is a complete system[7].

Precision farming, precision horticulture, Site Specific Farming (SSF), Site Specific Management (SSM), Site Specific Crop Management (SSCM), and Variable Rate Application (VRA) are all examples of precision agriculture[5]. With the development of the protected structure, many forms of protected structures appropriate for certain types of crops and agro-climatic conditions have arisen. Green houses, plastic houses, lath houses, cloth houses, net houses, shade houses, hot beds, and cold frames are among the agricultural technologies used in Nepal [6]. Its goal is to reduce environmental effect while enhancing productivity at a cheap cost [8]. It is a more efficient means of producing than an open field[9]. In Nepal, out of an estimated 1000 hectares of protected farmland, 70% of the land is used for vegetable production and 30% for fruit and flower cultivation[6].

Protected agriculture is the process of growing crops under controlled settings by altering the natural environment with activities and buildings in order to attain maximum production by boosting yields and enhancing quality[10]. The environmental elements that govern plant development, such as sunshine, air composition, and temperature, are uncontrollable in open field agricultural techniques. As a result, a large number of winter vegetables, flowers, and other horticultural crops, as well as their nursery, cannot be grown during the summer and must be transported from far away;

similarly, summer crops must be transported during the winter, and in such cases, protected cultivation, or cultivation under controlled conditions, comes to the rescue[11]. Vegetables and flowers are grown using protected horticulture methods. Many fruits are commercially cultivated as early-season sheltered cultivation, such as sweet cherry growing in a high tunnel, has resulted in less rain-induced cracking and enhanced yields[12].

The controlled environment in fruits is mostly utilized for nursery rearing in order to increase the success rate of crop multiplication like walnut where success rate is higher under zero energy polyhouse[13]. Protected crops have lately spread to certain Asian nations, including India, Korea, and, most notably, China[14].

The greenhouse is the most feasible means of attaining the goals of protected horticulture, in which the natural environment is altered via the use of solid engineering principles to ensure optimal plant development and yield (more output per unit area) while reducing input consumption[15]. By maximizing more and higher-quality produce per unit of land, they contribute significantly to food and nutrition security.

Materials and Methods:

The major sources of information for this article were secondary information from various publications and market hub information. Secondary data was gathered from various sources, and descriptive analysis was performed using the information provided.

Discussion:

General concept:

Protected cultivation, which allows for some control over wind velocity, moisture, temperature, mineral nutrients, light intensity, and atmospheric composition, has greatly contributed to a better understanding of growth factor requirements and inputs for improving crop productivity in open fields, and will continue to do so. Protected agriculture is a distinct and specialized type of farming. Windbreaks, irrigation, soil mulches, and greenhouses, tunnels, and row coverings are examples of devices or technologies that can be utilized with or without heat. The goal is to grow crops where they would otherwise perish by altering the natural environment to extend the harvest time, frequently with early maturity, in order to boost yields, improve quality, improve production stability, and provide commodities when there is no outside output. The main focus is on horticulture crops with great value (vegetables, fruit, flowers, woody ornamental, and bedding plants). The most often produced agricultural and ornamental crops in greenhouses to generate greater returns include tomato, bell pepper, cucumber, rose, carnation, and gerbera[16].

Technologies used in precision and protected horticulture in Nepal:

1	Green house monitoring system
2	Farm Management System (Vegetable Crops Development Center, Khumaltar).
3	Mobile apps for technology dissemination on fruits, vegetables and flowers production.
4	Sensor based temperature and RH management by the use of mobile apps for greenhouses (VCDC, Khumaltar).
5	Quality sapling production of citrus fruits species under screen house at Warm Temperate Horticulture Center, Kirtipur.
6	Germplasm collection and conservation of citrus fruit species under glasshouse (WTHC, Kirtipur).
7	Tissue culture lab and screen houses in government farm and private sector for prebasic potato seed and banana sapling production
8	Soilless farming support grant (hydro and aeroponics).
9	Vegetable (tomato, capsicum, cucumber) and flower production under structures (roses, gerbera, carnation).
10	Vegetable seedling and flower seedling production using hi-tech structures
11	Use of drones for spraying micro-nutrients and pesticides.
12	Apps controlled hydroponics system (water flow, light and temperature control).

Needs of Protected Cultivation:

Protected cultivation, which allows for some control over wind velocity, moisture, temperature, mineral nutrients, light intensity, and atmospheric composition, has greatly contributed to a better understanding of growth factor requirements and inputs for improving crop productivity in open fields, and will continue to do so[10]. It is carried out because of the numerous advantages.
• When compared to open fields, greenhouse productivity is significantly higher.
• Higher-quality crops – pest and disease resistance
• Early maturity • Year-round cultivation
• Cultivation is feasible even in harsh environments.
• Create a microclimate for optimal plant performance by controlling temperature, humidity, and light levels according to the plant's needs.
• Crop cultivation during the off-season when open-field cultivation is not practicable.
• Cucurbits, capsicum, brinjal, okra, and other tropical vegetables are uncommon in mountainous areas, but they may be produced in a greenhouse.
• Producing high-quality crops for export is a breeze in the greenhouse.
• Using a greenhouse, it is feasible to raise the nursery sooner and advance the availability.
• The greenhouse allows for the preservation of important planting materials as well as their cultivation.
• The greenhouse may also be used to cultivate flower plants, strawberries, and grapes, as well as to propagate high-quality fruit

plants.

• Pest and weed control in the greenhouse are easier than in the open field.

• The greenhouse keeps moisture at bay. As a result, the frequency with which plants are watered is reduced.

• Adopting appropriate crop sequences can boost productivity per unit area and time.

Limitation:

• Manual or hand pollination of cross-pollinated crops such as cucurbits, as well as the generation of parthenocarpic hybrids/varieties.

• Cladding materials are expensive, have a short lifespan, and are in low supply.

• A lack of suitable tools and machinery.

• The cost of the structure appears to be prohibitively expensive at first glance.

Farmers who can afford it with zero risk do not embrace it.

Common Controlled Environments Used in Horticulture:

Which environmental parameters must be regulated, to what degree they must be controlled, and the expense of regulating them in relation to the value of the crop being produced will determine the structures and types of control system utilized? The goal is to create a controlled environment framework that allows for the precise control of those factors that must be managed. Hoop Houses, Cold Frames, Hot Beds, Shade Houses, Greenhouses, coolers, growth chambers, and other sorts of controlled habitats are common.

1. Hoop Houses

Hoop houses and polyethylene ("poly") tunnels are two types of propagation habitats that are both exceedingly adaptable and affordable. The semicircular frames of polyvinyl chloride (PVC) or metal tubing are often rather lengthy and are coated with a single layer of thick polyethylene. Solid material, such as water-resistant plywood, is used for the end walls. During the growing season, the cover of hoop houses is changed to give a new growth environment, removing the need to shift the crop from one building to another. During seed germination and seedling establishment in the early spring, a transparent plastic cover is usually utilized. On sunny days, the plastic cover may be pushed back to promote ventilation as the days become longer and warmer.

Hoop houses and polyethylene ("poly") tunnels are very versatile, inexpensive propagation environments. The semicircular frames of polyvinyl chloride (PVC) or metal pipe are covered with a single layer of heavy polyethylene and are typically quite long. The end walls are made of solid material such as water-resistant plywood. The cover on hoop houses is changed during the growing season to provide a different growing environment, eliminating the need to move the crop from one structure to another. Generally, in early spring, a clear plastic cover is used during seed germination and seedling establishment. As the days become longer and warmer, the plastic cover can be pulled back on sunny days to provide ventilation. After the danger of frost is past, the plastic cover is removed and replaced with shade cloth. Sometimes, a series of shade cloths, each with a lesser amount of shade, are used to gradually expose crops to full sun. During hardening, the shade cloth is completely removed to expose the plants to the ambient environment. When covered with white plastic sheeting, hoop houses can be used for overwintering. The plastic cover is removed and replaced with shade cloth after the threat of frost has passed. To progressively expose crops to full light, a sequence of shade cloths, each with a smaller quantity of shade, is often utilized. The shade cloth is removed entirely during hardening to expose the plants to the natural environment. Hoop homes may be utilized for overwintering when covered with white plastic sheeting.

2. Cold frames

Cold frames are low-to-the-ground constructions made out of a wood or metal frame and a clear covering. They rely only on the sun for heating, as the name implies. Cold frames are the most cost-effective propagation structure and are simple to construct and maintain. Because indoor temperatures can quickly rise, cold frames can be utilized to extend the growth season in the spring. Seeds and cuttings can be germinated and rooted weeks before they can be planted in an open compound. Cold frames are also used in late summer and fall to harden plants that have been taken out of greenhouses and can be utilized to overwinter harvests. Cold frames, on the other hand, are time-consuming to maintain since they must be opened and closed on a regular basis to maintain temperature and humidity conditions. A southern exposure with a modest slope is excellent for a cold frame to provide proper drainage and optimum sun absorption. A shaded place against a building's wall or in the greenhouse offers additional protection.

3. Shade houses

Shade houses are the most permanent and semi-controlled propagation settings, and they have a wide range of applications. Shade homes are used for hardening plants that have recently been withdrawn from the green house, as well as for overwintering (Jacobs et al. 2009). Shade homes (also known as Saran houses) are made of a fabric composed of polypropylene, cotton, plastic, or another material that is meant to block out some light. Some shading materials have been aluminized to deflect light away from the building. The cover material may be chosen to block out varied quantities of light, however shading materials that block out 20% to 60% of light are the most prevalent. These buildings are commonly utilized in subtropical (i.e., Florida) and tropical regions when light reduction and some forms of cooling (through shade) are sought. Shade Houses aren't usually equipped with heating or cooling equipment. Cut flowers, foliage plants, and nursery stock are all often grown in shade rooms.

4. Hot Frames or Hot Beds

Hot frames are similar to cold frames in structure, but they are heated with electric heating wires and are mostly used to root cuttings at a low cost. They're also great for overwintering non-hardy seedlings or cuttings that haven't yet rooted. Cold frames may be readily transformed into warm beds. Begin by removing soil to a depth of 8 to 9 inches (20 cm). On top of 2 in (5 cm) of sand, loop thermostatically regulated heating cables horizontally in loops. Make sure the cable loops are evenly spaced and do not intersect. Cover the cable with 2 in (5 cm) of sand and a piece of wire mesh on top of the sand (hardware cloth). Cuttings or seedling trays can be placed directly on the top of wire mesh.

5. Hotbed manure

The use of hotbed manure, a very different age-old means of heating the soil, is another very different age-old method of heating the soil. Microbial fermentation produces heat by heaping up new straw-rich manure and covering it with a layer of soil. As a result, the temperature of the soil's top surface rises, promoting root formation and crop growth. In addition, CO2 is emitted, stimulating photosynthesis. Fermentation can be accelerated by watering straw that has been treated with nitrogenous fertilizer. Straw bales can be utilized as well. After the straw has been fully wetted and saturated with a nitrogenous fertilizer, they should be covered with 15- 20 cm greenhouse soil. The temperature can reach 30°C or higher, depending on the volume of water utilized per meter.

Conclusion:

Protected production of high-value crops has become indispensable, both economically and environmentally. Recent advancements in automation and robots have the potential to boost production efficiency in protected settings even further[17]. It has various advantages, including the ability to grow high-value crops with increased quality even in poor or marginal conditions. However, greenhouse producers' high training demands and certain low-quality product with chemical residues have been a source of significant worry. These problems may be readily solved by combining diverse production and protection strategies, such as location-specific polyhouse design and construction for efficient input usage. Educating greenhouse producers on the proper use of pesticides for safe production will help them produce high-quality goods without damaging the environment.

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