We are pleased to present this book entitled **"Modern Technology of Agriculture, Forestry, Biotechnology and Food Science"** Ratnesh Kumar Rao, Secretary, Mahima Research Foundation and Social Welfare are not new to Agriculture students. With his vast experience in Academic activities, he has dealt this complex subject and edited, with practical approach and simple language, to meet the requirement of the students and teachers of Agriculture.

The New Vision for Agriculture initiative, led by the Consumer Industries Community of the World Economic Forum, works to develop a shared agenda for action and foster multi-stakeholder collaboration to achieve sustainable agricultural growth through market-based solutions. The initiative has defined a vision that highlights agriculture's potential as a positive driver of food security, environmental sustainability and economic opportunity worldwide. The group believes that achieving this vision will require the leadership and capacity of all stakeholders—government, business, civil society, academia, farmers and consumers.

The large gap between potential and current crop yields makes increased food production attainable. India's low agricultural productivity has many causes, including scarce and scant knowledge of improved practices, low use of improved seed, low fertilizer use, inadequate irrigation, conflict, absence of strong institutions, ineffective policies, lack of incentives, and prevalence of diseases. Climate change could substantially reduce yields from rainfed agriculture in some countries. With scarcity of land, water, energy, and other natural resources, meeting the demands for food and fiber will require increases in productivity.

Though this book is mainly deals with the agriculture research and education, it will also be very handy for those who desire to start Agricultural Research in Food security.

We are sure this will be accepted very much by the students, teachers, scientists and Stakeholders of Agriculture all over the India. We solicit your encouragement in this endeavour

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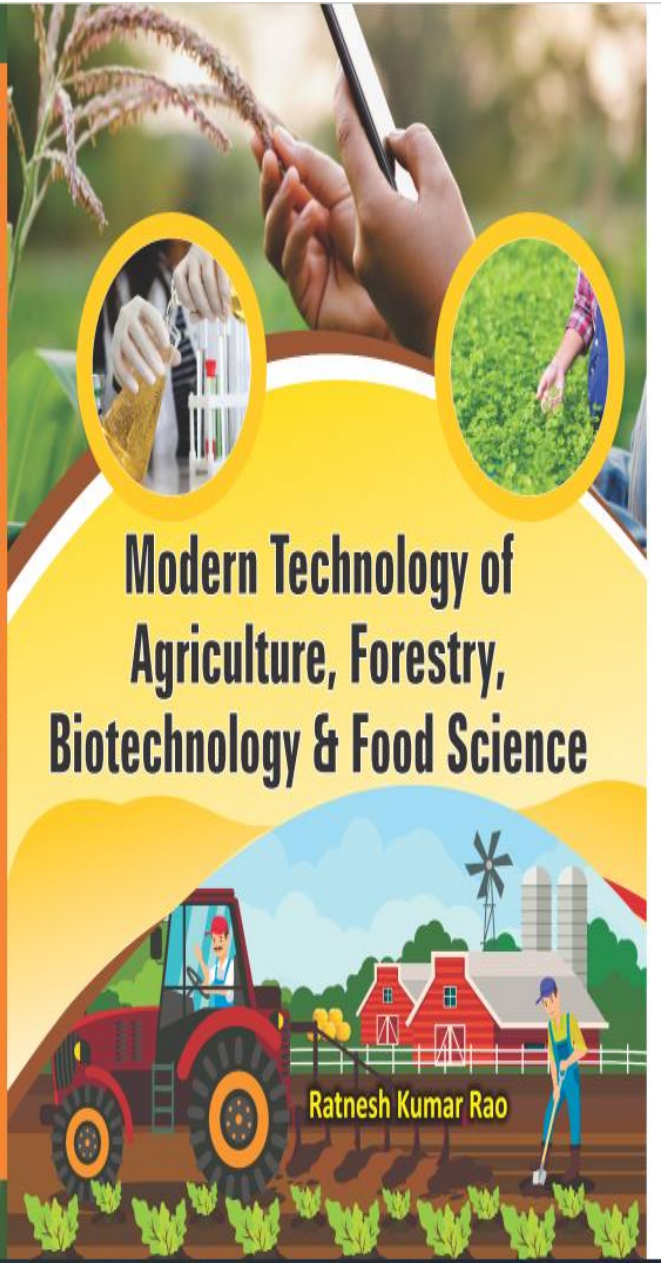

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Ratnesh Kumar Rao

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Content

VERTICAL GARDENING: A MODERN CONCEPT OF URBAN GARDENING

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In the recent times, greenery aspect has spread extensively as a component to design various buildings as well as to combat the deleterious effects of pollution. The quality of human life will be directly affected if there is lack of vegetation in urban areas. Though not a new concept, greenery aspects in the building has augmented the percentage of greenery in urban built-up area and bring back the vanishing urban green space (Wong *et al.* 2003). One of the greenery systems that is gaining increasing popularity in the recent era is vertical gardening. Vertical gardening is a relatively new concept of urban gardening which are suitable for small spaces, mostly for adorning the walls and roofs in various styles. This is a distinctive method of gardening by expanding the possibility of growing ornamental plants in a vertical space wherever space is a constraint. In the present era of rapid urbanization, the horizontal space left for outdoor gardens is very limited. Here comes the importance of vertical landscaping.

The use of vegetation and its benefits were the subject of study for researchers, since 1970's. In the late 1980's, Patrick Blanc is credited as having developed and commercialized the concept of Green walls. Stanley Hart White, a Professor of Landscape Architecture at the University of Illinois is the actual inventor of Green walls or Modern Vertical Gardens who patented a green wall system in 1938 (Richard, 2012). The patent was for "Vegetation-Bearing Architectonic Structure and System".

The creation of vertical gardens is recommended both in interiors as well as exteriors of buildings. Vertical gardens can be freestanding or attached to an existing wall, and it comes in a wide variety of designs and sizes. Vertical green walls are aesthetically appealing, refresh the ambiance and improves the air quality. By application of Green wall technology, any empty areas can be utilised to its maximum capacity for obtaining aesthetic appeal which is further beneficial for environment and human health. One of the important plus point of vertical gardening is its possibility of reducing heat transfer through the building envelope. Plant layer on the building façades can effectively reduce interior surface temperature on the façade (Ratih et al., 2016). Even if the price of constructing and maintaining the vertical gardens is higher than a classical landscape it's compensated by the environmental benefits, raising the vegetation surfaces, with impact for reducing the pollution effect (TNAU, Agritech Portal).

Vertical Gardening is a special kind of urban gardening suitable to small spaces, particularly for decorating the walls and roofs in various styles. They are particularly popular for small-space gardening where ground is at a premium, or as decoration for patios, verandas and outdoor rooms. Intensive urbanization has left hardly any horizontal space for outdoor gardens. Hence Living walls or Green walls are particularly suitable for cities, as they allow efficient use of available vertical surface areas. Green walls are not only spectacularly beautiful, but also helpful in enlivening the ambiance. Growing plants vertically in the buildings can also help to filter air particulates and air pollutants thereby improving air quality. Green walls can absorb heated gas in the air, lower both indoor and outdoor temperature, providing a healthier indoor air quality as well as a more beautiful space.

Need of Vertical Gardening: Poor air quality has been associated with health problems throughout the world due to rapid urbanization and industrialization. Urban air pollution is a matter of global health concern. Neglecting the air pollution results in acute health risks like frequent illness, allergies, asthma, strokes, heart attacks, bronchial infection, dry eyes, sore throat, sinus, headache, cancer, cardiovascular emergencies, loss of concentration, nausea, dizziness, fatigue, skin and eye irritation, and many other ailments.

Swatch Bharat Abhiyaan the flagship programme of the Government of India envisages on the mission 'Green India - Clean India' as part of the unique initiative. Vertical gardens allow plants to grow on walls and other nonhorizontal surfaces. Plants in the vertical green walls can remove toxicants and obnoxious compounds from air, in addition to the basic photosynthesis. Air quality can be improved exponentially by use of vertical green walls. It reduces dust levels, stabilize humidity and