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India, Water Scarcity
Vertical Farming in India

Living in Iowa, in the heart of the Midwest, with an abundance of fertile soil, we often forget that the rest of the world does not look the same. We have readily available resources without concern for the space or sacrifices it took to produce them; however, other parts of the world cannot say the same. Countries like India do not have enough land or water to dedicate to farmland to support its large population of 1,425,900,000 (Britannica, 2026). India is classified as a developing country, which is connected to its food security and water scarcity issues.

India is a relatively large country. It is located in South Asia and shares borders with Pakistan, Nepal, China, Bhutan, Myanmar, and Bangladesh. India is made up of 28 states and 8 union territories, with the national capital being New Delhi. India is the 7th largest country by area and became the most populous country as of 2023 (Wikipedia 2026). The exact square footage of India is 1,269,219 sq mi. India has operated under a federal parliamentary republic form of government since 1950. In this type of government, there is an executive branch that is accountable to the legislature, and both are held by the more powerful parliament. The government in India is slightly similar to that of the United States, but there are also many differences. Here in the U.S., we have a presidential republic, which has a single head of government instead of a ceremonial president, like India has.

The culture in India is very diverse, consisting of thousands of ethnic groups and hundreds of languages that are a part of everyday life. There are also many religions in India, as a result of the very diverse culture. These include Islam, Hinduism, Christianity, Jainism, and Buddhism. According to the 2011 census, Hinduism is the most popular, which takes up about 80% of the population. India is a multiethnic country (Britannica, 2026). It is made up of many small ethnic and some tribal groups. The amount of different ethnic groups is a result of migration throughout the long history of India, dating all the way back to the Indus Valley Civilization in roughly 2500- 1700 B.C.E (Britannica, 2026). Aside from ethnic groups, there is also a large number of languages and dialects spoken in India. All of these variations of languages come from one of four families: Indo-European, Sino-Tibetan, Dravidian, and Austroasiatic. It is unclear exactly how many languages are spoken, but the number is believed to be somewhere in the hundreds. However, only 22 languages are scheduled, including Bengali, Nepali, Sindhi, Urdu, and many more. “The constitutionally designated official languages of the Indian central government are Hindi and English" (Britannica, 2026).

In India, family plays a very important role in people's lives. They rely heavily on family members, often giving them priority over themselves. Unlike the United States, families in India do not just live with immediate family members. Usually, multigenerational families live together in one house. “In many parts of India, it is common to find three or four generations living together” (Indian Culture, 2018). This is to provide economic security for an individual and the older members of the family. In India, there is a hierarchy with the father or eldest son being the head of the household (Indian Culture, 2018). There is a

very large gap between the status of men and women in Indian culture. Despite this gap, it has become more normal for boys and girls to receive the same education. “That being said, only about 50% of Indian children go to school at all: while registration is compulsory, attendance isn’t typically enforced” (Wise). A typical Indian diet consists of various types of rice, vegetables, and lentils. Less common foods are high-protein foods and fruits. This is a result of cultural and religious practices.

“India’s export portfolio is diverse—ranging from cereals, pulses, and spices to fruits, vegetables, and processed foods.” (Vertez, 2026). Although India exports agricultural products, it accounts for only about 12% of total merchandise exports. India benefits from these unique crops because of its diverse climate that is suitable for production, as well as the high prices of these goods. The number one export from India is basmati rice. This is often referred to as the signature grain in India, where India exported about 4.5 million tonnes in 2025. (Vertex, 2026). Goods from India end up all over the world. “Top importers like the UAE, Saudi Arabia, USA, Netherlands, and China rely on Indian produce for both bulk and specialty needs.” (Vertez, 2026).

India is a world leader in its economy. As of 2025, India’s economy ranks 5th in the world and is continuously growing. “By 2027 it is projected to become the world’s third largest economy, with a GDP exceeding $5 trillion, surpassing Germany and Japan and ranking behind only the United States and China.” (Britannica, 2025). Although India faces other severe issues, a failing economy is not one of them. However, there are still some challenges. “Growth has since been sluggish, driven by declining private investment despite the government’s pro-business stance. A key issue is rising inequality, which has surged since 2000, placing India among the world’s most unequal countries.” (Britannica, 2025).

The topic I have chosen to focus on is water scarcity. Water scarcity occurs when an area or region lacks sufficient water resources to meet the demand. This issue is very prevalent in India and hurts the everyday lives of millions. India is home to 16% of the world's population, but only has 4% of the world's fresh water supply. (SIWI, 2018). This means that there is not enough water to meet the demand, which is the exact definition of water scarcity. India is not the only country that faces this issue, but it has reached an alarming level in a country with such a high population.

My solution for India is vertical farming. This is perfect because of its limited agricultural land use due to the large cities and population, combined with the water scarcity that it is facing. India has very polluted water, which is in large part due to pollution from the Ganges River throughout history. The world is covered in 71% water, but only 3% of that is suitable for human use. (World Economic Forum, 2023). Agriculture alone uses about 70% of global water reserves. Using this much water on crops significantly increases soil salinity, decreasing the overall quality of crops. “Vertical farming can use up to 98% less water” (World Economic Forum, 2023). Vertical farming is stacking crops in layers. “Unlike traditional agriculture, which relies on vast expanses of land, vertical farms make efficient use of available space by going upward.” (Pure Greens). Meaning India would benefit greatly from vertical farming.

There are many advantages to vertical farming. It can be entirely climate-controlled, meaning crops can be grown more efficiently all year long, and artificial sunlight is used, allowing the plants to get sunlight 24 hours a day, boosting growth. Vertical farming uses precision agriculture techniques, and many of these methods of farming are seen as the future of agriculture. Alongside these significant advantages,

pest control is another big topic; because vertical farming is done indoors, there is much less concern for pests and pest invasions. “This minimizes crop loss due to pests and eliminates the need for chemical pesticides. As a result, the produce from vertical farms is healthier and safer for consumption. Additionally, the risk of disease spread is lower, further enhancing crop protection.” (The Essential Pros and Cons of Vertical Farming). Meaning not only does this cut down the cost of vertical farming, but it also provides people with healthier food. All of these things are very beneficial, but the most important for India is the amount of land and water that vertical farming uses. This kind of farming stacks crops upward, not outward. This maximizes what little ground space is dedicated to farming. Vertical farming uses up to 90% less water than traditional farming. This would directly help fix the water scarcity issue in India. All of these advantages of vertical farming would positively impact and help meet the agricultural demand of India.

Unfortunately, there are also a few challenges of vertical farming. The cost of starting up and operating vertical farms is the biggest drawback. This type of farming requires a lot of energy, which can be expensive. “As a result of vertical farming’s highly efficient production, involving grow lights and electronic components, these systems require large amounts of electricity to operate.”(The Essential Pros and Cons of Vertical Farming). There is also the cost that comes with trying to start vertical farming. “In addition to typical farming expenses like property, labor, and packaging materials, vertical farms also cost the price of the facility, lighting, hydroponic system, and electricity to power it” (The essential pros and Cons of Vertical Farming). These challenges are real concerns, but I believe India's economy can handle this solution. As stated previously, India has the 5th-largest economy and is considered a world leader. They are projected to continue to grow in the upcoming years. The standing they are in right now and the growth that is expected put them in an adequate place to take vertical farming to a larger scale.

I am proposing large-scale vertical farming in India. The first step is to find a location that is suitable, sustainable and functional. I decided that Delhi is the best place to start vertical farming. Several factors influenced this decision, including population density, city size, and proximity to major rivers. Delhi is one of the most populous cities, consisting of 34 million people, and is located near the Ganga and Yamuna rivers. Delhi is also in a region of India that receives the lowest amount of rainfall annually, making it not ideal for traditional farming. The second step is to figure out what kind of structure will house the vertical farms. There are two options: new buildings can be built, or old buildings can be repurposed. I believe that old buildings should be reused for vertical farming. I propose using old shipping containers; vertical farming shelves can then be built into the containers. It is not only cheaper to do, but also faster. Water scarcity is already a severe issue and is only going to get worse in the future, meaning we need to start the solution now. The next step is to decide on a method for the crops to grow. Vertical farming does not use soil; instead, either hydroponics, aeroponics, or aquaponics. I recommend using the aeroponics system. Aeroponics is a system that does not use soil; instead, the roots are exposed in the air. Then a nutrient-dense mix is sprayed onto the roots. Aeroponics uses 99% less water than traditional farming, making it a much more efficient option for India. To make sure all of the plants have equal exposure to light, LED lights are placed over the plants. Although this is expensive, advances in LED technology allow LED lights to be more affordable and use less energy. This vertical farming solution would apply to leafy plants, such as lettuce, spinach, tomatoes, and herbs. These are plants that can be picked and then will regrow on the plant.

India will benefit immensely from my solution. The population of India is extremely large, and the citizens of India need fresh water and food to eat. Vertical farming allows for efficient use of water as well as increased food production per square foot. It is essential to increase crop production as well as conserve the accessible fresh water that is available. Vertical farming is growing in popularity across the globe. If it is implemented in India, it could eventually get to a point where they are not concerned with the sacrifices they make for agriculture.

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