LCB FERTILIZERS

LCB FERTILIZERS PRIVATE LIMITED

Proposal for Establishing Apple Farming in Jammu & Kashmir

1. Executive summary:

Apple farming is a vital part of Jammu & Kashmir's economy, yet farmers continue to face challenges such as high input costs, poor soil health, irregular irrigation, and climate variability. To address these issues and support sustainable horticulture in the region, LCB Fertilizers Private Limited has developed innovative, single-use, crop-specific biofertilizers derived from agricultural biomass such as cow dung, and other organic waste. These advanced inputs are designed specifically for apple cultivation and are created using a unique blend of Biotechnology, Nanotechnology, and Chemical engineering. By utilizing six specialized microbial strains and eight optimized microbial-nano combinations, we have successfully increased the levels of essential nutrients like nitrogen, phosphorus, and potassium through the fermentation process under controlled environmental conditions.

These biofertilizers provide a wide range of benefits for apple Farmers in Jammu & Kashmir. Field trials have shown up to a 21% reduction in overall farming expenses and a 15% to 35% increase in fruit yield, depending on seasonal and geographical conditions. Moreover, our specially developed Superabsorbent polymer, created from lignin-rich biomass, reduces irrigation needs by 33% by significantly improving the soil's water-holding capacity. Additional benefits include the enrichment of soil microbial populations, improved carbon-to-nitrogen ratios, stronger root development, and increased plant resistance to environmental stress. Through this technology, LCB Fertilizers aims to transform apple farming in Jammu & Kashmir into a more profitable, climate-resilient, and sustainable model, ensuring long-term growth and empowerment for farmers across the region.

2. Objective:

- To utilize agricultural waste materials as sustainable carriers for customized microbial consortia, enabling the development of apple-specific biofertilizers through advanced biotechnology, nanotechnology, and chemical engineering, aimed at improving soil health, enhancing nutrient availability, and boosting overall orchard productivity.
- To achieve a 20%–25% reduction in total cultivation costs for apple farmers by replacing expensive chemical inputs with natural, cost-effective biofertilizers, while simultaneously enhancing fruit yield by 15% to 35%, depending on local agro-climatic conditions.
- To significantly improve soil health by increasing beneficial microorganism populations, enhancing the carbon-to-nitrogen (C/N) ratio, and enriching humus content, thereby promoting long-term orchard productivity and ecological balance

- To reduce groundwater consumption by at least 33% in the very first crop cycle through the application of superabsorbent polymers developed from agricultural biomass, which can absorb up to 268 times their weight in water, improving soil moisture retention and irrigation efficiency.
- To generate employment through rural production units, creating at least 5 skilled and 25+ unskilled jobs per unit, with a dedicated focus on empowering women, ensuring that at least 35% of the workforce comprises female workers engaged in production, packaging, and field support roles.

3. Background and Motivation:

The apple industry in Jammu & Kashmir stands as a pillar of the region's agricultural identity, sustaining the livelihoods of thousands of farming families. However, the long-term sustainability of apple farming is under threat due to the widespread use of chemical fertilizers and pesticides. While these chemical inputs have historically boosted productivity, they have also led to serious environmental and health consequences. Across India, the release of harmful gases from chemical fertilizers contributes to thousands of pollution-related deaths annually. More critically, these inputs are degrading soil quality disrupting natural pH levels, depleting beneficial microorganisms, and reducing the soil's ability to retain water.

Furthermore, with nearly 85% of irrigation in Indian agriculture dependent on groundwater, apple farmers in the region face increasing pressure due to declining water tables and inefficient irrigation practices. Apple farming is rooted in the urgent need for a sustainable alternative by shifting to bio-based, crop-specific fertilizers developed from agricultural waste using advanced technologies, we aim to restore soil health, reduce groundwater usage, and build resilience in apple farming systems.

4. Crop, Market Demand, and Agricultural Context:

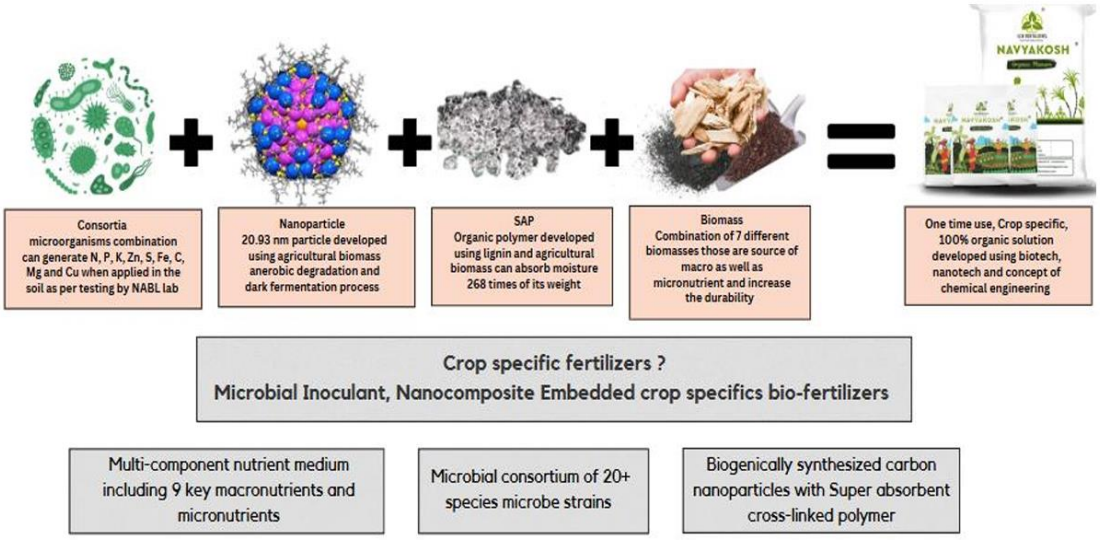
Apple is the dominant horticultural crop of Jammu & Kashmir, contributing over 75% to India's total apple production. Popular varieties include Red Delicious, Royal Delicious, and Gala, grown across 1.6 lakh hectares. With rising health awareness, demand for organic, chemical-free apples is increasing rapidly, creating new market opportunities. However, apple farmers face challenges like soil degradation, excessive chemical use, water scarcity, and climate variability. There is an urgent need for sustainable solutions that enhance productivity, reduce costs, and meet growing domestic demand while preserving ecological balance.

5. Conventional solutions:

- Chemical Fertilizers - Farmers commonly use inputs like Urea, DAP, NPK, and Zinc Sulphate to supply essential nutrients to apple orchards. While these fertilizers offer quick nutrient delivery, their prolonged use alters soil pH, depletes organic matter, and reduces microbial activity. This degradation of soil health results in declining

productivity over time, increased irrigation needs, and rising input costs, making apple farming less sustainable in the long run.

- Organic Manure - Organic manures like compost, cow dung, and vermicompost improve soil health and boost microbial activity. However, they require large quantities for effective results, making them labour-intensive and costly to transport. Due to slow nutrient release, they are often used alongside chemical fertilizers, limiting their effectiveness as a standalone solution in apple farming.
- Biofertilizers - Products like mycorrhiza, Azotobacter, and Rhizobium are available in the market to enhance nutrient uptake and promote plant growth. However, these inputs are relatively expensive and typically require simultaneous use with both organic manure and chemical fertilizers to achieve standard yield levels. This mixed approach often fails to deliver economic sustainability and increases the complexity of orchard management.



6. Novelty:

Our approach to apple farming introduces a novel blend of biotechnology, nanotechnology, and engineering to develop one-time use, crop-specific, and 100% organic biofertilizers tailored to the unique needs of apple orchards in Jammu & Kashmir. Unlike conventional solutions, our products are designed with precision to suit specific agro-climatic conditions and apple crop cycles. The biotechnology component focuses on customized microbial consortia for nutrient release and disease resistance, nanotechnology ensures targeted nutrient delivery at the root level, and engineering innovations enable efficient fermentation and formulation processes. This integrated approach not only improves orchard yield and soil health but also reduces the

dependency on repetitive inputs, making apple farming more sustainable, cost-effective, and environmentally friendly.

i. Biotechnology Part:

In apple farming, our biotechnology-based approach focuses on developing a crop-specific microbial consortium composed of 18 carefully selected microorganisms that produce essential plant growth nutrients, including Nitrogen, Phosphorus, Potassium, Zinc, Carbon, Sulphur, and Iron. These microbes are isolated from diverse natural ecosystems such as forests, orchards, and water bodies, ensuring high adaptability and effectiveness under the agro-climatic conditions of Jammu & Kashmir.

This consortium is tailored to meet the nutrient demands of apple trees throughout their growth cycle, from flowering to fruit development. In addition to supporting plant nutrition, these microbes play a vital role in restoring soil fertility, improving humus content, and enhancing the population of beneficial soil microorganisms. We use a blend of eight organic biomass types including cow dung, agricultural residues, and by-products from dairy and rice mills as carriers and nutrient sources for these microbes. These carriers are rich in organic carbon and trace minerals, making them ideal for microbial activity and slow nutrient release.

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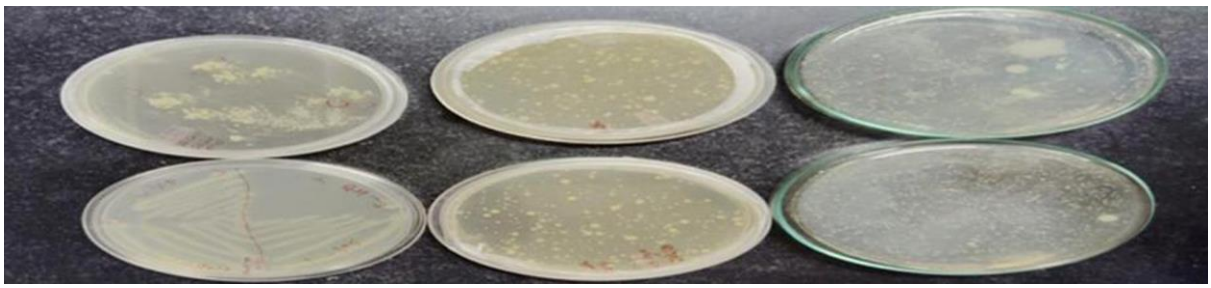

ii. Nanotechnology -

In apple farming, our nanotechnology innovation focuses on boosting the efficiency of microbial biofertilizers through organically derived nanoparticles. These nanoparticles act as supportive structures that increase the binding surface area for beneficial microbes. A key advantage of our nanotechnology lies in its ability to improve the thermotolerance of beneficial microorganisms, allowing them to remain active at temperatures up to 78°C, a vital trait considering the increasing climate variability in the Himalayan region. Additionally, these nanoparticles accelerate the breakdown of organic biomass, increasing the organic matter content in soil and improving microbial growth. Through detailed experimentation involving pH optimization, temperature variation, fermentation type and duration, and calcination, we have fine tuned the nano compounds to maximize microbial performance.

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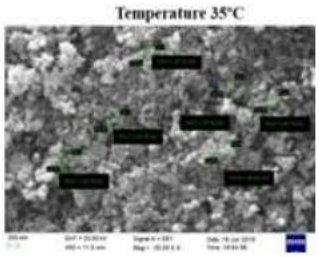
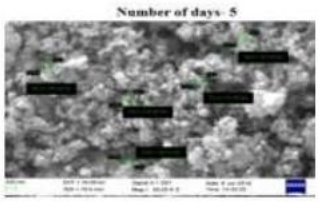
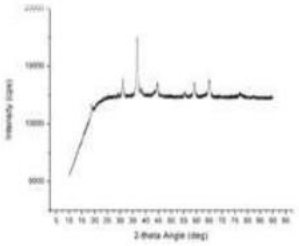
Factor	Set-1	Set-2	Set-3
pH	6	7	8
^{0}C	35	40	45
days	5	8	10

Dark fermentation







Dark fermentation using agricultural biomass paddy s

Calcination at 600 ^{0}C and roasting at 60 ^{0}C

iii. Chemical Engineering:

In apple farming, we integrate chemical engineering advancements to streamline the production and application of specific organic biofertilizers and biopesticides. A key innovation is the development of low cost, customized fermenter tanks that facilitate anaerobic solid-state fermentation under controlled conditions of temperature, humidity, pH, and agitation. We are also engineering organic superabsorbent polymers (hydrogels) made from agricultural biomass. These hydrogels can absorb up to 268 times their weight in water and gradually release moisture into the root zone over 30 days. This significantly reduces the need for frequent irrigation critical in water scarce apple-producing regions like Jammu & Kashmir. These polymers naturally degrade and help in reducing plant stress markers such as relative electrical conductivity, hydrogen peroxide levels, and MDA (Malondialdehyde) content, thus promoting healthier and more resilient apple trees.

Our research has shown that this integrated approach can boost crop yields by 15% to 40%, depending on the region and crop type. It significantly cuts down irrigation needs by over 33% and lowers overall farming costs by up to 45%. As a single-application solution, it eliminates the need for repeated use of fertilizers and micronutrients throughout the growing cycle, thereby reducing labour and input dependency. Additionally, it shortens the crop maturation

period by 5% to 8%, as confirmed through comparative studies with conventional chemical-based farming practices.

7. **LCB Fertilizers has tailored our innovations to develop the following:**

- Super Absorbent Polymer (SAP): Developed from lignin and acrylic acid, this organic polymer can absorb and retain water up to 268 times its weight, sustaining soil moisture for over 35 days post-irrigation. This is especially beneficial for apple farming in hilly and water scarce regions.
- Nobel Enzymes**:** These pH-independent enzymes accelerate the decomposition of organic matter, leading to a significant increase in beneficial microorganisms, humus, organic carbon, and soil fertility all crucial for the long-term health and productivity of apple orchards.
- Green-Synthesized Nanoparticles: Produced using eco-friendly processes, these nanoparticles enhance the heat tolerance of soil microbes up to 78°C and facilitate faster biomass degradation, boosting nutrient availability in the root zone of apple trees.
- Anaerobic Bioreactor: Our specially designed anaerobic bioreactors simulate ideal environmental conditions for microbial fermentation, ensuring stable temperatures even during exothermic reactions. This allows for the efficient production of high-quality, biofertilizers.

8. Commercialization model:

We begin by building scientific credibility and farmer trust through free sample distribution of our apple-specific natural inputs. These will be tested in comparative field trials across apple-growing belts in collaboration with Krishi Vigyan Kendras, agricultural universities, horticulture departments, and progressive orchardists. The trials aim to demonstrate improvements in fruit quality, yield, soil health, and pest resistance without synthetic chemicals.

Upon observing successful results, we will organize block and village-level training programs, including Kisan Chaupals, horticulture workshops, and interactive awareness camps. Special focus will be given to engaging women, youth, and self-help groups. These sessions will build local capacity in sustainable orchard management and generate employment through knowledge-based natural farming practices.

To ensure accessibility, we will establish a decentralized last-mile distribution system. This will involve empowering local micro-entrepreneurs, FPOs, and rural youth to run village-level natural farming centers and bio-input retail outlets. These hubs will ensure timely and affordable delivery of apple-specific fertilizers, pest repellents, and other organic inputs.

The final step is to set up community-based production units in collaboration with local agro-industries. These units will utilize apple prunings, orchard waste, and other

agricultural residues for the eco-friendly production of bio-inputs. Each unit will create over 200 jobs, with at least 35% roles reserved for women, contributing to regional economic upliftment and environmental sustainability.

9. Benefits:

a. Environmental Benefits:

i. Enhanced Water Efficiency: By integrating Super Absorbent Polymers (SAPs) with beneficial microorganisms and humus-enriching components, our solution significantly reduces the need for groundwater in apple orchards. The SAPs, capable of absorbing up to 268 times their weight in water, improve soil water retention, leading to a 33% reduction in irrigation requirements, especially crucial for hill regions like Jammu & Kashmir.

ii. Soil Microbial Enrichment: Our biofertilizers are rich in active microbial strains that boost soil organic matter by 32% to 74% within a year. This microbial activity rejuvenates the soil ecosystem, supporting long-term orchard health and productivity.

iii. Chemical Detoxification: The microbes in our formulations actively degrade residual chemical contaminants present in the soil due to past synthetic inputs, promoting a gradual shift toward clean and chemical-free cultivation.

iv. Fully Organic & Eco-Safe: All inputs used in our apple-specific formulations are 100% organic, ensuring no harmful residues in soil or produce, and contributing to the restoration of soil fertility, biodiversity, and ecosystem health.

b. Social Benefits:

i. Employment Generation: Our initiative is committed to creating meaningful employment opportunities across India, with a focus on both skilled and unskilled labour. We aim to generate over 500 direct and 2,000 indirect job**s**, actively promoting women's participation in the workforce and enabling livelihoods in rural and semi-urban areas.

ii. Women Empowerment and Inclusivity: Currently, our team includes 28 members, of which 9 are women, along with one female co-founder. We are deeply invested in advancing gender inclusivity and will continue expanding opportunities for women through leadership roles, training programs, and field-level engagement.

iii. Community Engagement and Upliftment: By partnering with Farmer Producer Organizations (FPOs), Self-Help Groups (SHGs), and Non-Governmental Organizations (NGOs), we extend our impact to grassroots levels. These collaborations not only expand our reach but also enable these community-based entities to earn higher margins and reduce input costs—supporting their economic self-reliance and long-term sustainability.

c. Economic Advantages:

i. Crop-Specific Biofertilizers: We are developing a consortium of 22 crop-specific microorganisms that eliminate the need for traditional chemical fertilizers. This innovation

ensures targeted nutrition, reduces dependency on external inputs, and supports sustainable agricultural practices.

ii. Increased Yield Potential: Our solutions have demonstrated a consistent 15–35% increase in crop yields across diverse geographies and crop types, directly boosting farmers' income and productivity.

iii. Significant Cost Savings: Farmers using our products have reported a reduction in overall cultivation costs by 5% to 48%, depending on the crop and region. These savings stem from lower input requirements and improved efficiency.

iv. Water Resource Optimization: With our advanced water-retention and microbial enrichment technologies, we have successfully reduced irrigation needs by 33%, leading to significant water conservation and reduced irrigation expenses.

v. Enhanced Labor Efficiency: Our bio-based inputs simplify the application process and reduce the need for constant manual intervention, optimizing labour use and minimizing operational burdens on small and marginal farmers.

vi. Scalable Impact: We aim to scale our operations to reach 2.5 lakh farmers across India, delivering measurable economic benefits through cost-effective, scalable, and sustainable natural farming solutions.

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