MSc Prosperity, Innovations & Entrepreneurship

FINAL DISSERTATION:
Start-ups & Sustainability: Entrepreneurial Solutions for Addressing Food Security Challenges in India

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ABSTRACT

This dissertation examines the pivotal role of start-ups in bolstering food security in India, particularly by addressing nutritional deficiencies through innovative solutions. As the United Nations targets eradication of hunger by 2030 and with the global population anticipated to reach 10 billion by 2050, food demand is set to rise dramatically. India's diverse population, varied climate and supportive governmental policies like the Make in India and Start-Up India initiatives, create a unique environment for these start-ups to thrive, scale and replicate globally.

The study uses an inductive approach, relying on qualitative methods, including thematic analysis of semi-structured interviews, case studies, and documentary evidence, to explore the landscape of food security being addressed by start-ups. Start-ups in India are leveraging technology to address the limitations of unsustainable practices due to traditional reliance on wheat and rice. They aim to reshape the nutritional landscape by advancing product development and influencing policy amidst ongoing challenges like malnutrition, undernutrition, and obesity.

Start-ups, although pioneering, encounter significant barriers, including socio-cultural divides, stringent regulations, and financial constraints, which impede their ability to achieve sustainability. Nonetheless, the post-COVID-19 era presents substantial growth opportunities, particularly with the rising demand for healthy foods. Despite governmental efforts since independence, the impact on food security has been inconsistent. Thus, this dissertation concludes by advocating for a collaborative and enabling ecosystem that integrates various stakeholders. The proposed ‘Enabling Ecosystem’ model emphasizes the potential of such collaborations to harness individual strengths and enhance collective efforts in integrating more sustainable practices to address food security in India.

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LIST OF ABBREVIATIONS:

AI: Artificial Intelligence
ASER: Annual Status of Education report
CAGR: Compound Annual Growth Rate
COVID: Coronavirus Disease
CS: Case Study
EEA: European Economic Area
eNAM: e-National Agriculture Market
FAO: Food and Agriculture Organization
FIFO: First In, First Out
FPO: Farmer Producer Organizations
FSIN: Food Security Information Network
FSSAI: Food Safety and Standards Authority of India
GHI: Global Hunger Index
GIS: Geographic Information System
ICDS: Integrated Child Development Scheme
IFPRI: International Food and Policy Research Institute
IoT: Internet of Things
LIFO: Last In, First Out
MOFPI: Ministry of Food Processing Industry
NFSA: National Food Security Act
NFHS: National Family Health Survey
NGO: Non-Government Organisation
NITI: National Institute for transforming India
NPO: Non-Profit Organization
PCOD: Polycystic Ovarian Disorder
PDS: Public Distribution System
PIB: Press Information Bureau
PPP: Public-Private partnerships
SaaS: Software as a service
SDG: Sustainable Development Goals
UCL: University College London
UN: United Nations
UP: Uttar Pradesh
USD: US Dollar
WCED: World Commission on Environment and Development

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CHAPTER 1: INTRODUCTION

Food security is a central objective of the UN's Sustainable Development Goals (SDGs), aiming to eradicate hunger worldwide by 2030 (Mechiche et al., 2021). The global population is projected to increase by two billion, reaching around 10 billion people by 2050 (Tripathi et al., 2019). This growth will place immense pressure on global resources, especially food supplies. The World Food Programme and the FAO define food security as a state where every person has consistent physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for an active and a healthy life (Mok et al., 2020). This definition includes four key elements: physical access to food, proper utilization, availability, and stability. With growing populations, climate change, and limited resources, ensuring food security and promoting sustainable agricultural practices have become critical priorities. The challenge lies in balancing the nutritional needs of a rapidly increasing global population while preserving the environment, necessitating innovative solutions (FasterCapital, 2024).

Figure. 1. Components of food security. Source: FAO, 2020

India, with a population of 1.45 billion, constituting about 17.6% of the global population (The Hindu, 2024), faces significant food security challenges due to interconnected issues of climate change and flawed government policies. The country deals with a triple burden of malnutrition, including inadequate

calorie intake, widespread micronutrient deficiencies, and increasing rates of overweight and obesity. Around 307 million Indians experience severe food insecurity, 224 million suffer from chronic hunger, and 200 million are malnourished (Prentice, 2023).

India's food and nutrition policies have predominantly focused on supply-side measures, like the Public Distribution System (Reddy et al., 2023), which provides subsidized food grains but lacks focus on diverse and nutritious diets. The government is, however, increasingly fostering an environment for the growth of start-ups to address these nutritional deficiencies. Thus, the need to examine how start-ups are addressing India's nutritional gaps is urgent, alongside government efforts. The study involves analysing the causes and impacts of food security challenges, the role of start-ups, their potential scalability, and replicability, and proposes a holistic 'Enabling Ecosystem', a theoretical framework which aims to integrate various stakeholders' efforts to address food security effectively.

In 2015, 193 sovereign nations committed to the UN's 2030 Agenda for Sustainable Development, which includes 17 SDGs. Previously, the Millennium Development Goals (MDGs) aimed to reduce poverty and hunger significantly, highlighting the ongoing global commitment to these issues (SDG, 2023). Despite India's high agricultural output and status as the world's leading organic food producer (Statista, 2024), the 2023 Global Hunger Index ranked India 111th out of 125 countries, indicating severe hunger issues (GHI, 2023). This paradox underscores inefficiencies in food supply chains, distribution systems, environmental concerns, and unsustainable agricultural practices.

Figure. 2. Sustainable Development Goals addressed while tackling food security. Source: UN SDG

India's National Food Security Act (NFSA) ensures subsidized food grains to 75% of the rural population and 50% of the urban population and aims to enhance access to food for low-income households (Puri, 2017). However, the low nutritional density of these foods and evolving food habits

limits these policies' long-term effectiveness and sustainability. Poor production practices, inefficient processing, and storage (Reddy et al.,2023), combined with food inflation and economic recession, exacerbate food insecurity (WFP, 2024). According to FAO data, over 74% of India's population cannot afford a healthy diet (The Hindu, 2023).

India ranks as the world's sixth-largest food and grocery market, with the food processing industry holding a substantial share. A 2016 PWC survey indicated a growing trend among consumers, especially millennials, towards healthy eating, driven by increased media exposure and awareness (PWC, 2016). This trend has led to a rise in healthy food options, particularly among young, urban customers seeking sustainable, nutritious alternatives (Margaret et al., 2019). Government support for food-based start-ups has encouraged entrepreneurs to explore healthier, sustainable food options (Olayanju, 2019). Recent literature indicates that the upper-middle-income population is increasingly demanding safer, higher-quality food products, creating opportunities for food-based start-ups to offer healthier alternatives (Shah, 2023). Thus, its crucial to delve into the role of food-based start-ups in entering in the nutritious food domain.

Start-ups in the food sector encounter challenges such as scalability, affordability, and infrastructure, limiting access to healthy alternatives mainly to the affluent, and exacerbating malnutrition. Nevertheless, these obstacles present opportunities for innovation through technology, new business models, and creative approaches. This study examines how start-ups contribute to food security in India, their challenges and opportunities, and their potential to impact malnutrition. It also evaluates the policy environment and stakeholders' roles in empowering start-ups to address food security and support India's progress towards SDG 2.

Based on this aim, the primary research questions that will be addressed in this study are as follows:

1. What is the role of start-ups and the government in addressing food security in India?
2. What are the challenges and opportunities for start-ups in India's current and future eco-system?

To answer these questions, the next chapter deals with literature review which includes the evaluation of current food security conditions globally and in India, the evolution of government policies in the food sector since India's Independence and the growth and the role of the start-ups using the information derived from existing literature in the food and nutrition segment and policy analysis of reports by organizations like FAO, Start-Up India and the theoretical frameworks from different scholars belonging to fields like social work, human relations, sustainability, food security, food policy, nutrition, supply networks, ecological and human concepts.

The third chapter will discuss the methodology which includes use of an inductive approach, relying on qualitative methods, including thematic analysis of semi-structured interviews, case studies, and documentary evidence to generate results and thus conclude the discussions. Following this, the fourth chapter highlights the factors and impacts of food security in India and the transforming role of start-ups in leveraging innovations to address food security in India, the challenges, opportunities and the future outlook. The fifth chapter discusses India's alignment with global trends along with the crucial role of start-ups in alignment with theoretical frameworks discussed in Chapter 2. The perspectives of the scholars as discussed in Chapter 2 and analysis of the individual entities' actions towards food security led the author to evolve a theoretical framework of enabling ecosystems with multiple

stakeholders for start-ups. It also highlights the policy implications and the recommendations for stakeholders after having a future outlook.

CHAPTER 2: LITERATURE REVIEW

This chapter explores the global trends and state of food security, focusing on India. It lays the study's foundation by integrating theories on food security and sustainable entrepreneurship, highlighting the roles of governments and entrepreneurs in developing sustainable food systems to address these challenges.

2.a. Current Status of Food and Nutrition Security in the Developing World:

Despite extensive efforts by scientists, policymakers, farmers, and other stakeholders, global hunger remains a critical issue. Since 2014, the number of undernourished people has steadily risen, reaching 783 million by 2022. Currently, over 40 million people face emergency levels of hunger across 51 countries, signalling severe risks of pandemics and famines (Owen, 2023). The 2023 Global Report on Food Crises indicates a sharp increase in global hunger, with 258 million people in 58 countries experiencing acute food insecurity, up from 193 million in 53 countries in 2021 (FSIN, 2023).

Developing countries face the dual challenges of hunger and undernutrition, along with growing rates of overweight and obesity (IFPRI, 2016). Globally, one in three people suffer from some form of malnutrition, with 3-3.5 billion individuals experiencing deficiencies in vital nutrients like iron, zinc and Vitamin A—four to five times the number of those undernourished impacting health and reducing life expectancy (Poole et al., 2021) . Maintaining a nutrient-adequate diet is costly; it is 2.7 times more expensive than a calorie-sufficient diet, making it inaccessible for many (Shah et al., 2023). Poor diet quality is linked to one in five deaths worldwide, often due to low consumption of whole grains and fruits and high sodium intake (The Lancet, 2019).

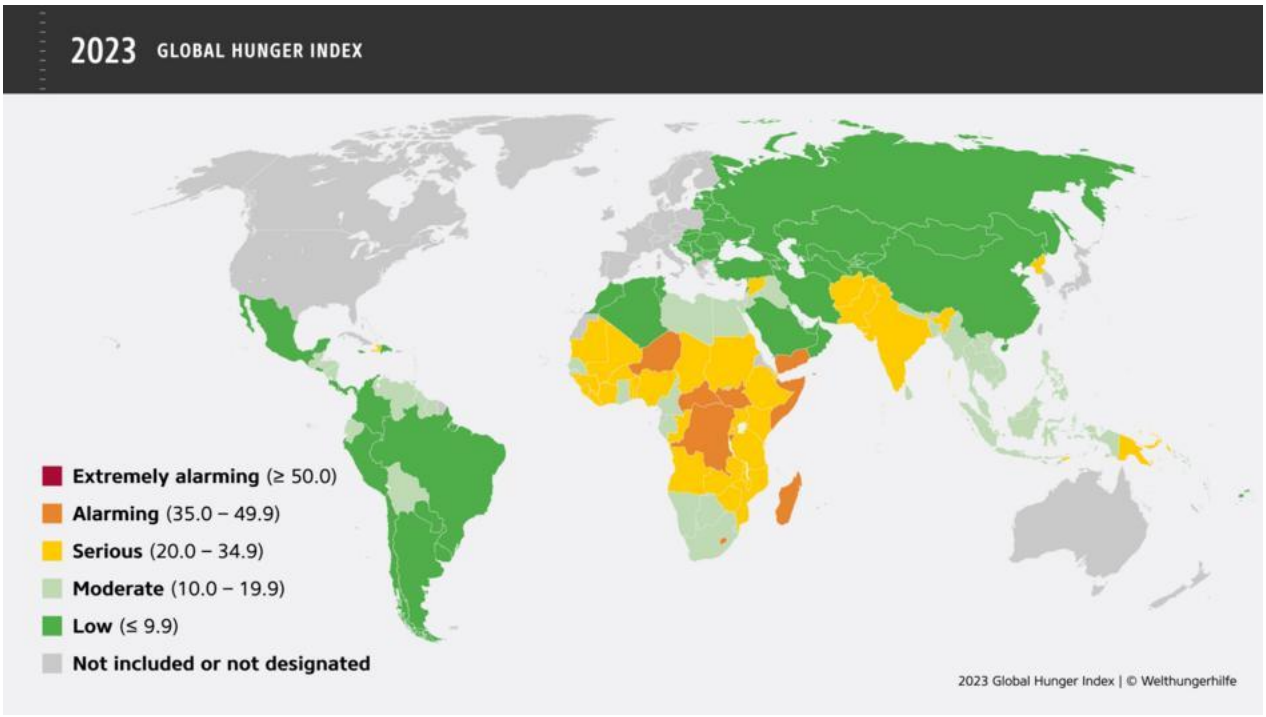

Figure. 3. Status of Food Security according to GHI, 2023. Source: Welthungerhilfe, 2023

While the primary challenge in the 20th century was to reduce hunger and undernourishment, today's challenge is ensuring universal access to healthy, non-obesogenic diets. Overweight and obesity now

surpass underweight cases, collectively affecting more than half of the global population (The Lancet, 2024). The economic burden of diseases and deaths associated with overweight and obesity is estimated at $2 trillion (World Bank, 2023). Simultaneously, about 795 million people suffer from chronic hunger, and almost a quarter of children under five are stunted, leading to diminished physical and cognitive development, and less than a third of young infants in 60 low-and-middle income countries achieve the minimum dietary diversity required for growth (IFPRI, 2016).

Children in developing nations are especially vulnerable to illnesses related to food insecurity, suffering from micronutrient deficiencies and underweight conditions. This situation is exacerbated by food inflation, rising prices, poor production and handling, high costs of nutritious foods, and unsafe practices like excessive use of untreated waste and chemicals (IFPRI, 2016). Climate change, rapid urbanization (expected to reach 70% by 2050), and a growing global population further complicate the scenario, increasing the demand for sustainable agricultural intensification (Foresight, 2011). The risk of extreme weather events impacting several key agricultural regions at once could triple, posing additional threats to global food security (IFPRI, 2016).

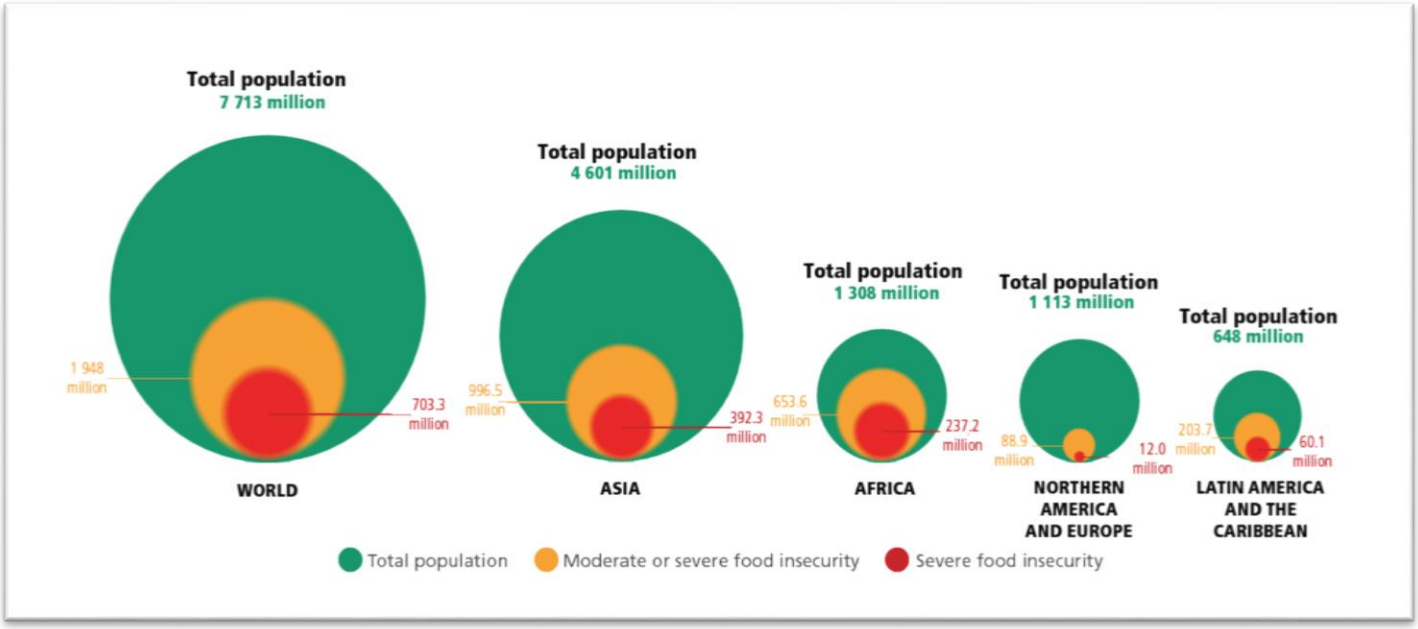

Figure. 4. Population levels affected by food security globally. Source: FAO, 2023

2.b. Global Trends in Food Security

Leveraging technology to enhance food security globally is crucial, with innovations like precision agriculture, the Internet of Things (IoT), and blockchain improving productivity, traceability, and supply chain efficiency. In 2023, the global agritech market was valued at $24.19 billion, projected to reach $54.17 billion by 2029, growing at a 14.38% CAGR (Businesswire, 2024). Sustainable agricultural practices, including organic and regenerative farming, aim to reduce environmental impacts and minimize waste. The global organic food and beverages market was valued at $231.52 billion in 2023, expected to grow at a 13.9% CAGR from 2024 to 2030 (Grand View Research, 2021).

Digitization is another key trend, with e-commerce platforms and digital payments enhancing food access and supply chain management. The global online food delivery market is projected to grow 9.04%, reaching $1.85 trillion by 2029 (Statista, 2024). Public-private partnerships (PPPs) are vital in reinforcing food security, with investments projected to hit $51 trillion by 2030 (IFC, 2012).

Start-ups are increasingly focused on empowering smallholder farmers by providing market access, credit, and advanced technologies to increase productivity and income. Smallholder farms, covering 12% of global agricultural land, contribute to 35% of global food supply, particularly in Asia and sub-Saharan Africa (Lowder et al., 2021). The global approach to food security emphasizes sustainability, recognizing technology and collaboration as key to achieving these goals.

2.c. Current Status of Food and Nutrition Security in India

India plays a critical role in global food security due to its large population and significant impact on global food and nutrition statistics. According to the 2023 State of Food Security and Nutrition in the World report, 74% of India's population cannot afford a healthy diet, and 39% lack access to a nutrient-adequate diet. India's GHI (2023) score stands at 28.7, indicating a serious hunger situation. In India's growing food industry, which contributes increasingly to global food trade and value addition, food processing occupies 32% of the total market. It ranks fifth globally in terms of production, consumption, and export growth yet the nation faces challenges, including a reported decline in per capita calorie consumption (Gustafson, 2013).

The Global Food Security Index 2022 reveals that 16.3% of India's population (PIB, 2023) is undernourished, amounting to approximately 200 million malnourished people (Rautela et al., 2020). Factors contributing to this include poverty, lack of clean drinking water, and inadequate sanitation (Dhamija et al., 2020). Approximately 30% of India's land suffers from degradation due to unsustainable agricultural practices (Dhyani et al., 2023). Although data linking food insecurity to malnutrition in India is scarce, connections have been observed between food insecurity and childhood stunting, wasting, and being underweight, underscoring the need to address food insecurity as a public health priority (Saxena et al., 2020). Socioeconomic inequalities, particularly those affecting women and children, exacerbate these challenges (Pathak et al.,2020).

India’s agricultural policies, influenced by the Green Revolution, have traditionally prioritized rice and wheat production, which has reduced hunger but also marginalized more nutritious grains like millet, coarse cereals, and pulses (Victora et al., 2021). This focus has discouraged farmers from diversifying to meet the rising demand for non-staple foods like fruits, vegetables, and livestock products due to the benefits provided by the government for growing wheat and rice. The resulting imbalance in protein, vitamin, and micronutrient supply, compounded by poor sanitation, limited clean water access, and low women’s empowerment, contributes to India’s high malnutrition rates (Downing et al., 2022).

The nutrition challenges in India are complex, with simultaneous issues of undernourishment, overnutrition, and micronutrient deficiencies. While adult obesity is rising at 5.2%, child obesity is also a significant concern at 9.1%. Moreover, 35.5% of children under five are stunted, and 32.1% are underweight (Siddiqui et al., 2020). In response, India is promoting nutrition-rich cereals (nutri-cereals) like maize, bajra, and millets as alternatives to rice and wheat. However, expanding the cultivation of nutri-cereals by just 10% could push India below self-sufficiency, potentially turning the nation from a net exporter to a net importer of food grains, negatively impacting the zero-hunger sustainable development goal (Singh, 2023).

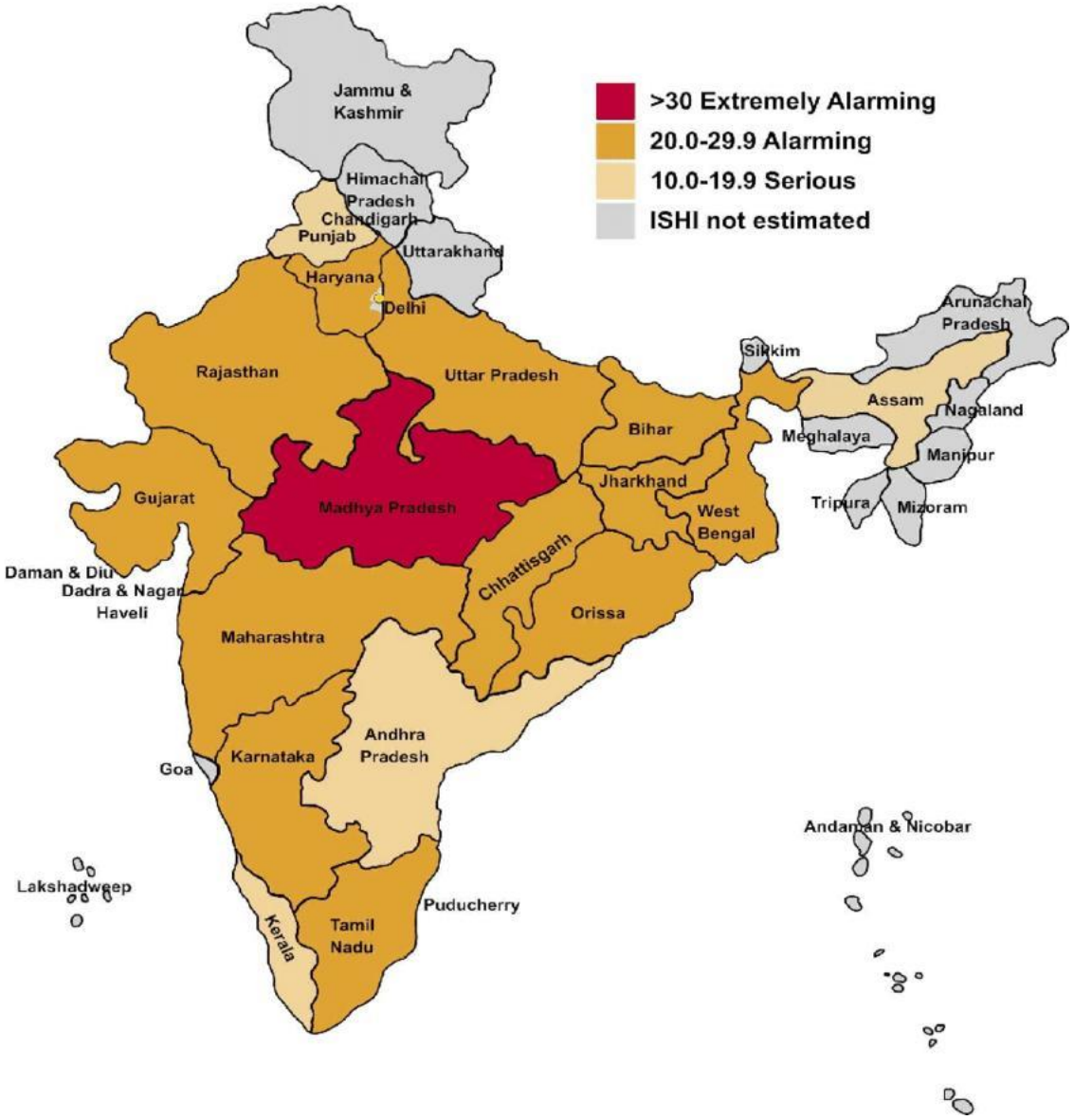

Figure. 5. Food Security and Hunger Conditions in India. Source: ISHI, 2011

2.d. Evolution of Government Initiatives and Policy Environment in India Addressing Food Security

The government's efforts to address food security in India have been shaped by two landmark initiatives: The Green Revolution and Operation Flood. The Green Revolution, initiated in the 1960s, aimed to significantly boost agricultural production through the introduction of high-yielding varieties (HYVs) of seeds, chemical fertilizers, pesticides, and advanced irrigation techniques. This initiative was instrumental in transforming India from a food-deficient nation to a food-surplus one, with food grain production soaring from 82 million tonnes in 1960-61 to 170 million tonnes by the mid-1990s. This remarkable increase not only ensured food self-sufficiency but also mitigated the risk of famines and bolstered economic growth (John et al., 2021).

Operation Flood, launched in 1970, focused on dairy development and created a nationwide milk grid that linked rural producers with urban markets. This initiative successfully transformed India into the

largest milk producer in the world, with milk production increasing from 21.2 million tonnes in 1968-69 to 209.96 million tonnes in 2020-21. It also improved the livelihoods of over 10 million farmers and enhanced the nutritional intake of millions of people through increased milk availability (The Statesman, 2024).

To further address food and nutrition security, the Public Distribution System (PDS) was introduced during World War II to address food scarcity, price stability and market's malpractices. It continues to provide subsidized food grains to a large segment of the population (Chakraborty, 2005). In 2013, the NFSA was enacted, ensuring the right to food for every citizen by providing subsidized food grains to approximately two-thirds of India's population (Sandhu, 2015).

Other significant initiatives include the Integrated Child Development Services (ICDS) Scheme, launched in 1975, which targets young children, pregnant women, and breastfeeding mothers to break the cycle of malnutrition and morbidity and also addresses preschool education (Sachdeva et al., 2001). The Food-for-Work program, which evolved into the National Food for Work Program, aimed to provide food grains instead of wages to the poor, later integrating into the National Rural Employment Guarantee Act, guaranteeing 100 days of work for rural households.

The Pradhan Mantri Poshan Shakti Nirman (PM POSHAN) Scheme, approved in 2021, provides hot cooked meals in schools, targeting nutrition improvement and increased school attendance among disadvantaged children (PIB, 2022). Additionally, the government has implemented the One Nation, One Ration Card (ONORC) initiative, allowing beneficiaries, especially migrant workers, to access food grains across the country (Baseler et al., 2023).

These efforts highlight India's comprehensive approach to tackling food security, involving a combination of technological, policy, and institutional measures aimed at ensuring food availability and nutrition for its population.

2.e. Current Status and Growth of Start-ups in India

India's rural market accounts for 65% market with 720 million consumers (Rani, 2013) and the Indian government plays a crucial role in supporting the growth of the food processing industry, primarily through initiatives driven by the Ministry of Food Processing Industries (MOFPI). This ministry promotes investment by enabling joint ventures, foreign collaborations, industrial licenses, and 100% export-oriented units (Reddy et al., 2023). Additionally, the Start-Up India scheme, launched in 2020, strengthens this sector by providing tax exemptions, simplified compliance procedures, and expedited patent applications (MOFPI, 2017). To date, this initiative has recognized over 50,000 start-ups, including 4979 AgriTech start-ups in 523 districts (StartUp India, 2023).

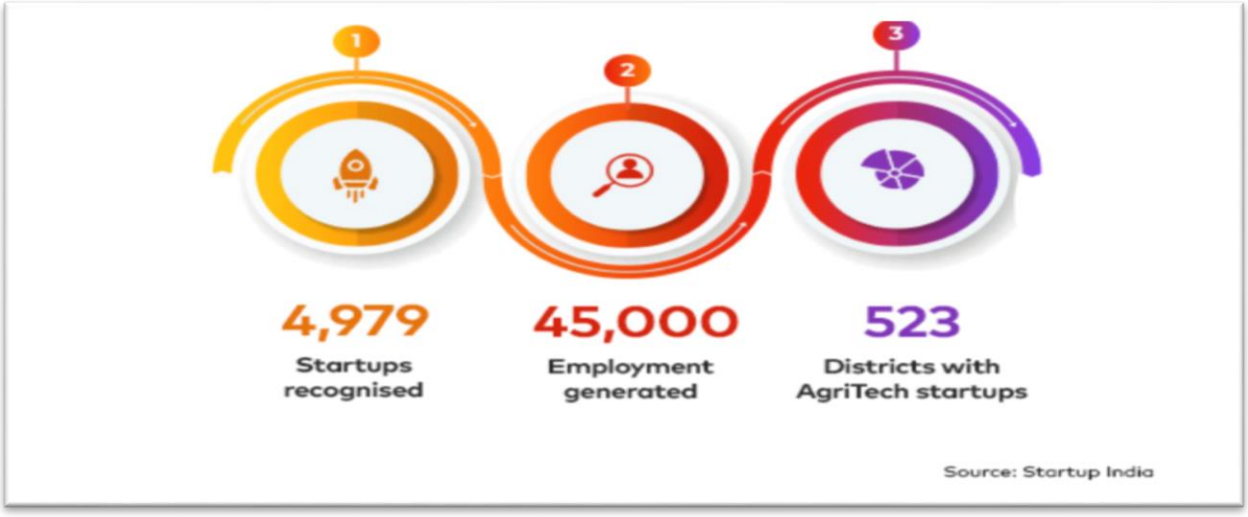

Figure. 6. Growth of AgriTech Start-Ups in India. Source: Startup India, 2023

The Atal Innovation Mission, under NITI Aayog, has also been vital in cultivating an entrepreneurial mindset, particularly in agritech. It supports over 1,500 start-ups through Atal Incubation Centres and Atal Community Innovation Centres, all government-run. The Digital India initiative further complements these efforts by incorporating advanced technologies like satellite imaging, GIS mapping, and data analytics. For instance, the eNAM (Electronic National Agriculture Market) platform, a government-funded and publicly owned electronic trading platform, has connected over 1,000 agricultural markets across India. This integration ensures farmers receive fair prices for their produce and safeguards against black market practices and corruption during procurement. The government has also prioritized training farmers, providing the necessary infrastructure, and ensuring effective implementation across the country. Through start-up-driven platforms like KisanMitr, over five million farmers have accessed digital advisory services that improve their access to government services like procurement and loans by presenting their cases to district administrations (David et al., 2020; MeitY, 2021).

The government of India has also developed Kisan e-Mitra, an AI chatbot that offers digital assistance to farmers in their native languages, breaking down technological and language barriers and empowering them through technology (PIB, 2023). The Start-Up Action Plan, introduced in 2016 under the Invest India Initiative by the Department of Industrial Policy and Promotion, aims to empower start-ups by fostering successful enterprises. The 'Make in India' campaign, launched in 2014, promotes investment across various sectors to reduce food losses, control inflation, and create local employment. Nearly 200 start-ups actively participate in the food processing ecosystem, benefiting from government and private sector initiatives. These start-ups contribute to different areas of the food value chain, such as supply chain solutions, packaging, processing technology, and e-commerce models (Munshi, 2019; Startup India, 2016).

Although funding challenges exist, investor confidence remains strong, with total start-up funding reaching $8.4 billion in 2023 (Mint, 2024). India’s contribution to the global health and wellness market has further propelled start-ups in this sector. With significant growth, with the launch of over 16,000 new tech companies in 2020 alone, India’s start-up sector is positioned to serve as a knowledge hub and support market development in less-developed start-up economies worldwide (Mint,2024).

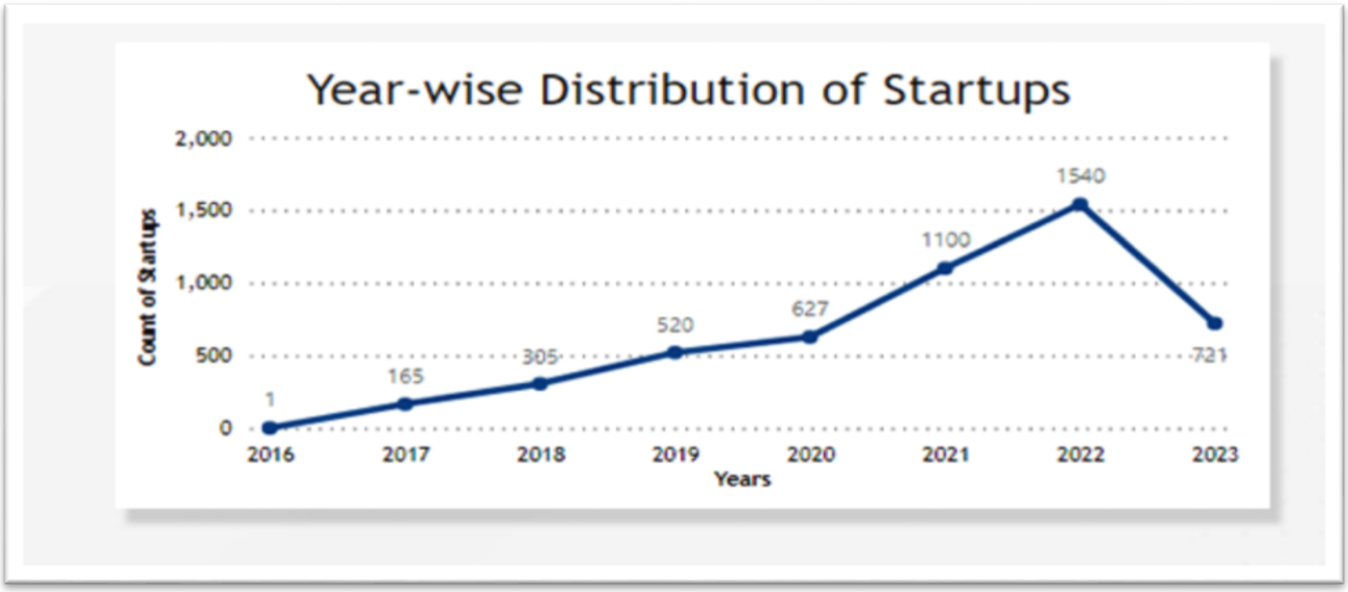

Figure. 7. Growth Trajectory and Year-wise Distribution of Start-ups in India. Source: Startup India, 2023

2.f. Theoretical Frameworks

In the rapidly evolving world, the intertwined challenges of food security and sustainable entrepreneurship demand innovative and integrated solutions. The concepts of food security and sustainable entrepreneurship have expanded and become increasingly complex, evolving through various scholarly perspectives. These perspectives form the backbone of this analysis, addressing key research questions and guiding the entire study. The primary frameworks utilized include Neil Thompson's Sustainable Entrepreneurship (Thompson et al., 2011), International Food Policy Research Institute's (IFPRI) vision of food security and the concept of Sustainable Food Systems (FAO, 2018) which is described as:

> a food system that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases generate food security and nutrition for future is not compromised. It is profitable throughout (economic sustainability), has broad-based benefits for society (social entrepreneurship) and has a positive or neutral impact on the natural environment (environmental sustainability).

- **Food Security**

Food security, as defined by FAO, is the access to sufficient food that alleviates hunger and provides the necessary nutrients for a healthy, active life. This concept has been broadened by different scholars belonging to fields of sustainability, food security, food policy, nutrition and supply networks, led to two primary schools of thought. Lang and Barling categorize these into one focusing on increasing food production to combat under-consumption and hunger, and another that emphasizes a more socially and environmentally conscious approach, addressing issues beyond mere production. The former is agriculture-focused, while the latter focuses on broader food systems but faces criticism for being overly production-centric or incoherent (Wahbeh et al., 2022).

Tsolakis and Srai expand the discussion by incorporating elements such as resilience, trade, self-sufficiency, food waste, and sustainability. These elements integrate environmental and ecological

considerations into the food security debate. Meanwhile, Guiné and Pato suggest that the four pillars of food security—availability, accessibility, utilization, and stability—should be extended to include sustainability and agency. This expanded view ensures that food systems provide long-term food and nutrition security without compromising the economic, social, and environmental foundations for future generations (Wahbeh et al.,2022).

Agency, as described by Clapp and Moseley, refers to the ability of individuals or groups to make decisions regarding their food consumption and production. It also involves their capacity to influence policy and governance within food systems. Incorporating agency and sustainability into food security frameworks is crucial for ensuring access to food for all, both in the present and future. The three components of sustainability—social, economic, and environmental—are integral to maintaining the dimensions of food security and the stability of the food system (Wahbeh et al., 2022).

The IFPRI's 2020 Vision for Food Security aims for a world where everyone has access to sufficient, nutritious food for a healthy and productive life. It envisions a food system that is efficient, effective, and compatible with sustainable natural resource management (Wahbeh et al., 2022).

Thus, the exploration of food security reveals its evolving complexity, extending beyond agricultural production to embrace a holistic approach to food systems. This shift from traditional methods, which mainly focused on boosting food production, to more comprehensive strategies incorporating social, environmental, and economic dimensions, underscores the multifaceted nature of food and nutrition security. Scholars like Srai, Guiné, and others have emphasized the importance of resilience, sustainability, and agency in shaping robust food systems that can sustain future generations without depleting resources.

- **Sustainable Entrepreneurship**

Sustainable Entrepreneurship focuses on entrepreneurial activities aimed at supporting a sustainable society and ecosystem. This concept, rooted in the definition of sustainable development by the WCED, emphasizes meeting current needs without compromising future generations' ability to meet theirs. Sustainable Entrepreneurship blends the goals of sustainable development with economic growth and entrepreneurship (Thompson et al., 2011).

According to Westley et al, from the ecological, political, institutional, and management systems perspective, sustainable development involves the interaction between the natural environment and human innovations such as technology, organizations, and institutions. Sustainable entrepreneurs adopt a Elkington's "triple bottom line" approach promoting social equity, economic stability, and environmental protection through their ventures (Thompson et al., 2011).

Hekkert and Negro, from an innovation systems perspective, argue that sustainable entrepreneurs create bottom-up solutions that shift socioeconomic development toward sustainability. This distinguishes sustainable entrepreneurship from social entrepreneurship, as it aims to achieve simultaneous social benefits, economic viability, and reduced environmental impact (Thompson et al., 2011).

Anderson notes that sustainable entrepreneurs are proactive, seeking opportunities for higher yields rather than merely reacting to stakeholder pressures. Unlike traditional profit-driven managers, they employ alternative business practices and methods.

Sustainable Entrepreneurship drives both new entrants and incumbents to foster sustainable competition through mutual co-evolution. Neil Thompson's model from human and social work's lens, focuses on organizational design and the process of discovering, evaluating, and exploiting opportunities that address economic, environmental, and social market failures. This model emphasizes entrepreneurial actions that simultaneously aim for social benefits, economic viability, and reduced environmental degradation (Thompson et al., 2011).

Thus, the sustainable entrepreneurship is beyond traditional business models of generating profits and a balance between demand and supply. It plays a vital role by integrating economic, social, and environmental considerations, fostering innovative solutions that promote both current progress and future stability.

2.g. Scholarly Perspectives on Solutions to Food Security Problems

The solutions to food security issues in developing economies like India often lie at the intersection of government intervention and entrepreneurial action. Scholars like Gyimah underscore the importance of government institutions in achieving food security and environmental sustainability, arguing that food security is a multi-domain challenge involving economic, political, engineering, and agronomic issues. Climate change, in particular, significantly impacts agricultural practices, affecting food accessibility and affordability, thereby highlighting the need for resilient agricultural practices and governmental interventions (Gyimah et al., 2023).

On the other hand, scholars like Avelino believe that social innovation, start-ups, and entrepreneurs are critical to reshaping food systems to be economically and socially viable, as well as sustainable within planetary limits (Avelino et al., 2019). Government interventions can address affordability, but individual entrepreneurs are better equipped to improve accessibility and quality. Social enterprises innovate with cost-effective business models, ensuring strong value in delivering quality services and products to underserved markets (World Bank, 2018). This is evident as in 2021, the Indian government provided subsidized food grains to 813 million people through PDS (Shagun, 2022) and reached 85 million beneficiaries via ICDS (NITI Aayog, 2022). However, NFHS-5 data reveals poor nutritional outcomes, with 57% of women (Tiwari et al., 2024) and 67% of children being anaemic (Singh et al., 2023), indicating reliance on nutrient-deficient grains. The inefficiency and unsustainability of relying solely on either government institutions or entrepreneurs is evident, as 735 million people globally suffer from chronic hunger. These unsustainable practices are also contributing significantly to the climate crisis by accounting for a third of global greenhouse gas emissions and 70% of freshwater usage (UN SDG, 2023). Thus, the food system is not yet sustainable as all three components of economic, environmental and social sustainability ensure a sustainable food system.

Marcela Villarreal (Director, FAO) has suggested the huge potential and requirement of the broader involvement and greater recognition of farmers' organizations, NGOs, civil society organizations, academia and others as key participants in national policy dialogues along with appropriate financing (UN Press, 2023).

The ongoing shifts in consumption and production patterns towards sustainability and the multiple societal challenges they present necessitate systemic changes. These changes will require significant disruptions to existing investments, jobs, and power structures, as well as new research, innovation, and demonstration labs (EEA, 2022). Such efforts will require a multipronged approach involving technologies, policies, and institutions (Reddy et al., 2023).

The conclusion drawn from these scholarly perspectives is that a collaborative approach, combining participatory governance and entrepreneurial innovation, is essential for effectively addressing food security issues. The financial support from government institutions, combined with innovative thinking and risk resilience of entrepreneurs, can be leveraged to achieve lasting solutions to food security challenges. This study aims to explore whether these entities can function independently or if a synergistic partnership will prove to be the optimal solution for addressing food security in India, a topic that will be further explored in subsequent chapters.

2.h. Gaps in Existing Literature

A significant shortfall in the current research on sustainable entrepreneurship and food security is the insufficient focus on the Indian context. Most existing literature is global or concentrated on developed nations, neglecting the unique socio-economic and environmental challenges in India. For instance, the insights provided by scholars like Clapp and Moseley, though valuable, may not directly apply to India's complex agricultural and economic landscape, shaped by diverse political, geographical, cultural, and social factors, requires region-specific solutions tailored to its vast rural market. This lack of context-specific research hinders the development of solutions tailored to the needs of Indian start-ups in the agricultural sector.

Another critical gap is the separation of sustainability and entrepreneurship in research, which often treats them as distinct fields. This separation limits the creation of comprehensive strategies that could effectively address food security challenges. For example, Hockerts and Wustenhagen discuss sustainable entrepreneurship in broad terms but do not explore its specific application in the Indian food sector. This lack of integration results in missed opportunities to develop holistic approaches that could better address food security issues through sustainable entrepreneurial practices.

The policy and regulatory environment for sustainable start-ups in India is also under-explored. There is a scarcity of detailed studies analysing how current policies and regulatory frameworks affect sustainable start-ups and how these can be optimized to support food security initiatives. Research by Tsolakis and Srai tends to examine agricultural policies and start-up ecosystems in isolation, without considering how these areas intersect. Understanding these interactions is crucial for formulating effective policy recommendations that could better support sustainable start-ups and food security efforts.

Moreover, the impact of technological innovations on food security in India is another under-researched area. While technologies like agritech, blockchain, and food processing innovations hold significant potential, limited research exists on their specific effects in India. Studies by Hekkert and Negro address innovation systems broadly but lack detailed case studies or empirical data relevant to India. This gap highlights the need for research that investigates the practical applications and outcomes of these technologies within the Indian agricultural sector.

Additionally, empirical data on the outcomes and impacts of sustainable start-ups in improving food security metrics in India is scarce. Existing literature often discusses theoretical benefits without providing comprehensive, data-driven analyses of real-world impacts. This lack of empirical evidence restricts the ability to measure and validate the effectiveness of sustainable start-ups in the Indian context.

Finally, the existing literature frequently addresses the dimensions of food security—availability, access, utilization, and stability—separately, rather than through integrated approaches. There is also

a lack of longitudinal studies tracking the progress and impact of sustainable start-ups over time, which limits understanding of their sustainability and scalability.

This dissertation addresses the identified gaps, except for a longitudinal study due to time constraints. It focuses on India's socio-economic and environmental context to explore challenges and opportunities for sustainable start-ups in improving food security. The study evaluates current policies, recommends improvements with a theoretical model, examines the impact of emerging technologies, and conducts empirical analyses to enhance understanding of how entrepreneurial solutions can advance food security in India.

CHAPTER 3: METHODOLOGY

3.a. Research Approach

The methodology of this study adopted an inductive approach to explore the ways in which start-ups can address food security challenges in India. This approach was chosen due to the exploratory nature of the research, aiming to generate theories and insights specific to the Indian context, which can also have global applications. The study focuses on India, a country with a population of 1.45 billion, representing 17.6% of the global population (The Hindu, 2024), and a leading player in the global food and grocery market. India's diverse sub-tropical climate supports a wide range of agricultural yields, making it the world's leading organic food producer. Furthermore, India's participatory and democratic governance makes it a suitable region to study societal issues as the solutions can be adapted globally due to its diversity.

This research is multifaceted, involving transdisciplinary themes that helped develop a holistic perspective and transcend traditional academic boundaries. The key themes explored include food security in India, the role of start-ups, challenges and opportunities, future outlook, and the collaborative ecosystem. These themes allowed the study to comprehensively view the food security problem through various lenses, including agriculture, economics, sociology, environmental sciences, and public policy (Brandt et al., 2013). By involving non-academic stakeholders such as policymakers and industry practitioners, the research ensured the relevance and applicability of its findings (Parli, 2023). The transdisciplinary approach also enabled the synthesis of concepts, theories, and methods from various disciplines, developing new frameworks and solutions for addressing complex societal challenges like food security (Jahn et al.,2012).

3.b. Research Method

The study employed a qualitative research method, intertwining case studies, semi-structured interviews, documentary analysis. This combination provided depth and breadth, allowing a robust analysis of the complex interplay between entrepreneurship, sustainability, and food security. Qualitative research methods are particularly suited for investigating complex, interconnected issues and formulating context-specific recommendations (Eisenhardt et al., 2016; Patel and Mehta, 2017). The choice of qualitative methods was also influenced by time constraints, which also made the collection and analysis of quantitative data challenging.

3.c. Data Collection

- **Case Studies:** A total of 13 case studies of start-ups like Ecozen and CropIn (Appendix 2) were used to address the research questions and provide an in-depth analysis of how specific start-ups and governments are implementing sustainable practices and addressing food security challenges. The selection of case studies was based on innovative approaches, impact on food security, geographic diversity, sectoral focus, and sustainable practices.
- **Semi-Structured Interviews:** A total of 10 interviews (Appendix 3) were conducted using a predetermined interview guide which allowed flexible exploration of themes while ensuring consistency across interviews (Kvale & Brinkmann, 2009). Due to time constraints and accessibility, Interview sampling was random and convenience-based, focused on industry operations, innovations, experience, and beneficiary impact. Verbal consent was obtained from participants, and the interviews were recorded with consent for transcription and analysis. Key

Interviewees were recruited from relevant fields which includes five start-up founders, two industry experts as well as academicians, one NGO and two nutritionists as well as start-up founders. This approach of wholistic recruitment of interviewees helped gain insights into the roles, challenges and opportunities, experiences and perspectives of entrepreneurs, NGOs, and experts in the field of sustainable food security.

- **Documentary Analysis:** This method was chosen for its cost-effectiveness, easy availability, and broad range of coverage (Bowen, 2009). Policy documents from government websites, various newspaper articles, journals, reports from international organizations, NGOs, think tanks, relevant literature, and government portals were analysed. Legislative documents and bills related to food security and start-ups, as well as reports from Indian regulatory organizations like FSSAI, World Bank, etc were also reviewed to understand the nexus of sustainability, food security, and start-ups.

3.d. Data Analysis

Data analysis was conducted using thematic analysis to identify key themes and patterns from the data collected from case studies and interviews using Braun and Clarke's (2006) principles. A hybrid thematic coding approach was used, combining deductive coding with inductive coding. Deductive coding was employed due to the predetermined nature of the interview guide, while inductive coding allowed themes to emerge from the data set. The analysis began with transcribing the interviews, note-taking, data segregation, and multiple readings to understand the content and generate initial codes. This process was followed by grouping similar data into respective codes, leading to the identification of broader themes. A preliminary list of well-defined themes was created, followed by colour coding based on inductive and deductive themes. A thematic map was then generated to illustrate the relationship between the themes and sub-themes. Content analysis was conducted to analyse data from documents, which helped to support data from interviews and case studies, identify gaps, challenges, opportunities, and the future outlook, leading to the development of a framework.

Figure. 8. Steps Used for Thematic Analysis. Source: Braun and Clarke, 2006

	COLOUR CODING USED FOR THEMATIC ANALYSIS	
No.	THEMES / SUB-THEMES	Colour
1	Causes of Food Security	
2	Consequence of Food Security	
3	Role of Start-ups	
4	Innovative Techniques	
5	Sustainability	
6	Scalability	
7	Social Impact & Community Engagement	
8	Challenges & Barriers	
9	Opportunities	
10	Future Outlook	
11	Balanced Ecosystem	

Figure. 9. Color Coding used to conduct Thematic Analysis. Source: Author

3.e. Limitations

The study encountered numerous limitations, such as the challenges of applying combined methods like content and thematic analysis, which proved complex. Time constraints, deadlines, and word limits precluded the possibility of a longitudinal study. A potential selection bias was present as case studies were chosen based on availability, data volume, and the researcher's familiarity. The generalizability of the findings across the diverse start-up ecosystem is limited due to vast variations. The open ended questions in the interviews yielded subjective data, influenced by the perspectives of both interviewee and interviewer, that generated varied themes, thus introducing researcher interpretation and complex thematic analysis. Securing interview consent was problematic despite personal connections; response delays were exacerbated by a 4.5-hour time zone difference between India and London, complicating scheduling. Of the 12 interviewees who consented, only 10 participated on the final day, with 2 failing to respond within the deadline. The absence of these two participants, who had significant experience in the food and nutrition sector for 6-7 years, likely restricted the depth of insights obtained.

3.f. Ethical Considerations

To ensure ethical standards, multiple data sources and methods were used to cross-verify findings, and the research process and findings were reviewed by academic peers and supervisors for validation. Participants were informed about the study's purpose and their role in it, and their identities and responses were kept confidential. Ethical approval was obtained from the ethics committee of Institute of Global Prosperity (UCL) before commencing the research.

CHAPTER 4: FINDINGS & ANALYSIS

This chapter examines the role of start-ups in addressing India's food security while answering what causes food security and why do we need to address it through thematic analysis of case studies, reports and interviews with stakeholders like entrepreneurs and NGOs, highlighting challenges, impacts, innovative strategies and opportunities.

Theme 1: Food Security in India

This theme underscores the complexity of food security as a social issue, offering critical insights and answers what do we need to address and why do we need to address to get rid of food insecurity as a background for the main research question.

Sub-theme 1: Causes of Food Security in India

Food insecurity in India is a complex issue rooted in poverty, economic inequality, and inefficient agricultural practices. These problems are worsened by income disparities, limiting food access, and by substantial food wastage due to poor infrastructure and supply chains. Additionally, challenges such as market imbalances, lack of awareness, dietary diversity issues, fast food influence, misinformation on social media, socio-cultural divides, and the effects of climate change further complicate the country's efforts to achieve food security. Addressing these issues requires coordinated efforts from start-ups and other stakeholders.

Beyond the skewed agricultural productivity and small size landholdings, the root cause is poverty and economic inequality which leads to restricted purchasing power of large segments of the population, making food inaccessible and leading to hunger and malnutrition. As mentioned by Interviewee 7, "*Inadequate distribution, food accessibility, and affordability issues….".* This problem has also worsened due to a large amount of food wastage as mentioned by Interviewee 7, *"Food wastage…… around 40% of the food produced in India…"* which implies Inadequate infrastructure and supply chain inefficiencies in rural areas increase costs and limit access to affordable food for both producers and consumers.

Interviewee 1 highlights how market imbalances and the export of high-quality products create tensions between market forces and local customer needs and thus inaccessibility as he mentioned, *"the best produce of India is exported for higher profits and the consumers have always got throw away products……"* while Interviewee 2 talks about lack of dietary diversity as he mentions, *"Key factors contributing to this nutritional shortfall include limited access to a diverse range of foods for large segments of the population, with diets predominantly comprising carbohydrate-rich products that lack adequate micronutrients, there is insufficient access to fruits and vegetable"* which again is a result of inaccessibility, unaffordability and awareness leading to micronutrient deficiency.

Busy lifestyles and social media drive people to choose convenient, affordable fast foods, which often lack sufficient nutrition and as mentioned by interviewee 2*, "The increasing prevalence and affordability of fast food further exacerbate nutritional deficiencies"* but *"A healthy meal costs you more than the normal diet*" (Interviewee 3). This leads to unattended children by parents leading to higher obesity rates, diet-related health issues and nutritional deficiencies. Social media exacerbates this problem by spreading misinformation, distorting public perceptions of proper nutrition as discussed by Interviewee 5 *"Social media, Parents are very busy into their lives and children are suffering. The food bloggers make business……..".*

Government bodies are failing to regulate counterfeit products, and this lack of oversight, combined with insufficient awareness, hinders ventures addressing food security by providing authentic and nutritious alternatives as Interviewee 3 mentions, *"Lack of awareness and government guidelines about the health and fitness industry".*

The biggest factor in India is the socio-cultural divide where due to gender inequality women and girls often face discrimination in food distribution within households. The Scheduled castes and Scheduled tribes are among the most food-insecure groups due to historical social exclusion and economic deprivation. "There's still a lack of food sources available for the underprivileged" (Interviewee 3) and *"There is a notable lack of attention to foods that cater to the masses……."* (Interviewee2). There is variation across regions which leads to inequality like *"Nutrition is still a luxury in Rajasthan, in India"* (Interviewee 3).

India is significantly impacted by climate change, ranking 7th on the 2021 Global Climate Risk Index (Germanwatch, 2021). Climate change and environmental degradation have led to unpredictable weather, reduced agricultural productivity, and food shortages. India's land suffers land degradation, primarily due to unsustainable agricultural practices, intensifying the country's vulnerability as evidenced by Interviewee 8, "*mitigate environmental damage that has been caused due to years of conventional agriculture".* Such multivariate factors are required to be addressed through comprehensive and multivariate interventions and approaches.

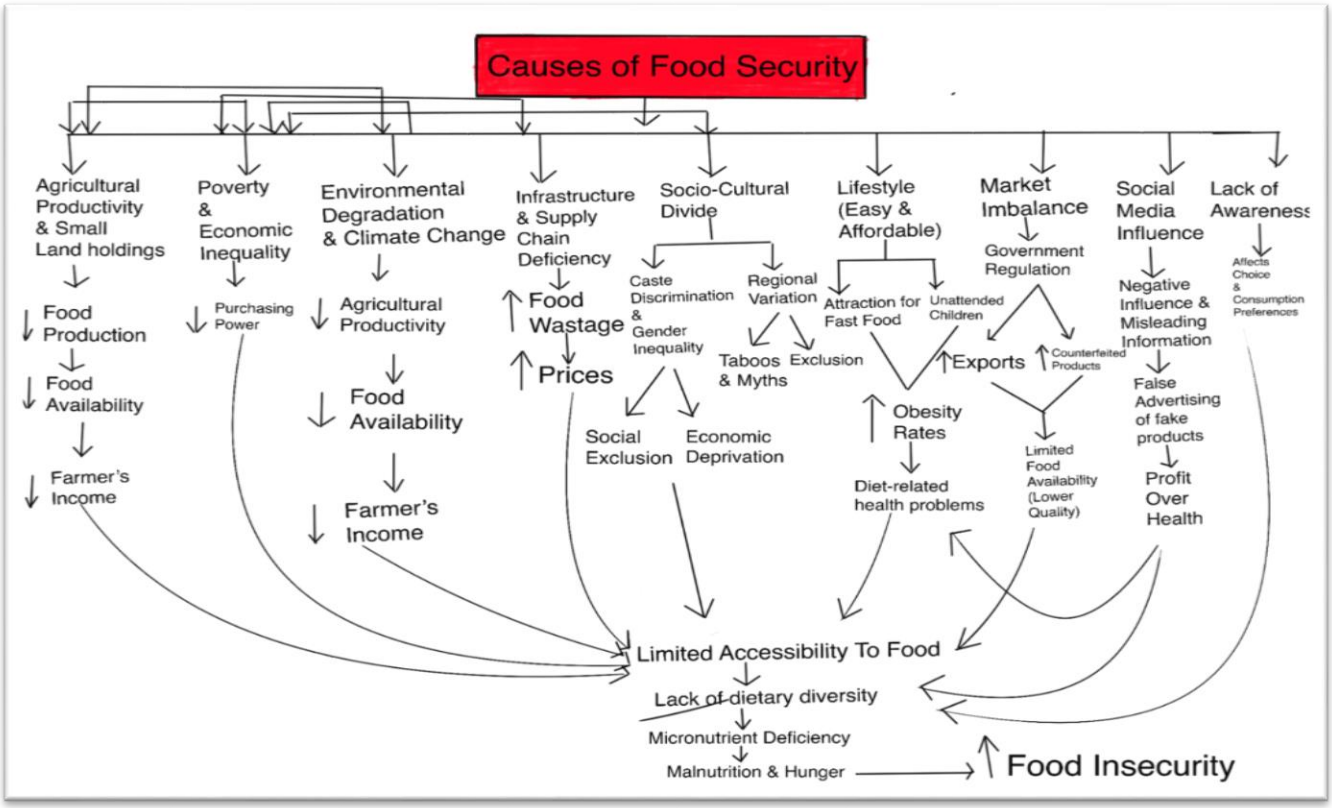

Figure.10. Thematic Map of Causes of Food Security. Source: Author

Sub-theme 2: Consequence of Food Insecurity in India

This sub-theme explores the impacts of food insecurity, including environmental damage, social conflicts, reduced labour productivity, slowed economic growth, and worsened health and poverty, highlighting the urgency of addressing food insecurity.

Food insecurity in India profoundly impacts societal health and economic stability affecting 16.3% of the population, and with 34.4% of children underweight. As India's population ages, expected to comprise 34% of the total population by the century's end, food insecurity could exacerbate various adverse health outcomes, including chronic diseases, poor mental health, disability, and reduced quality of life. Food insecurity has been linked with poor mental health, including depression, anxiety, sleep disorders, poorer subjective well-being, and cognitive decline. Physically, it is associated with cardiometabolic risks such as excess weight, underweight, hypertension, cardiovascular diseases, dyslipidaemia, diabetes, and physical frailty. Food insecurity is also related to chronic conditions like lung disease, inflammatory diseases, and joint pain (Pengpid and Peltzer, 2023).

Food insecurity also undermines educational and socio-economic advancement. The 2024 Annual Status of Education Report found that 14% youth in the 14-18 age group were not enrolled in formal education, driven more by girls than boys (ASER,2024), and malnutrition impairs children's ability to concentrate and learn, compromising their future job prospects and perpetuating poverty cycles. Economically, malnutrition-related productivity losses are 10% of lifetime earnings (UK AID, 2009) and estimated to cost India about USD 12 billion annually (World Bank), exacerbating economic slowdown.

The societal strains of food insecurity lead to increased social unrest, especially in regions grappling with food scarcity, which intensifies inequality and ignites conflicts. Food price spikes have triggered protests and instability, with marginalized communities, such as Scheduled Castes, Scheduled Tribes, and women, bearing the brunt of the disparities.

Environmental degradation (around 30%) from unsustainable agricultural practices, which include excessive land use and water mismanagement, exacerbates climate change challenges, further jeopardizing long-term food security.

Addressing food insecurity in India necessitates a comprehensive strategy that integrates enhancements in agriculture, expansion of social protection measures, promotion of sustainable practices, and substantial poverty alleviation efforts.

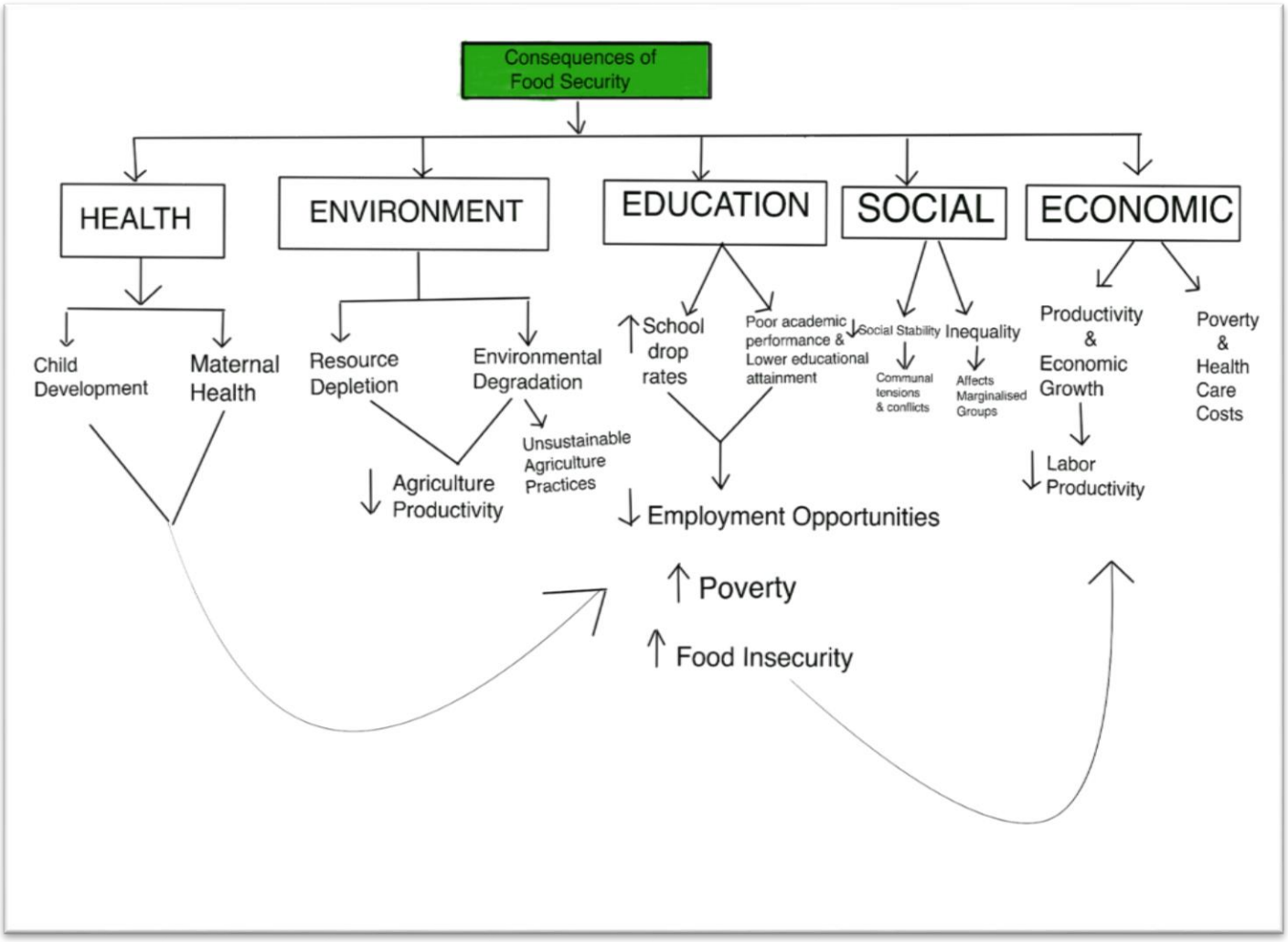

Figure.11. Thematic Map of Consequences of Food Security. Source: Author

Theme 2: Why are Start-ups Considered Transformative?

This theme is holistically answering the main research question of what is the role of start-ups in addressing food security in India.

Sub-theme 1: How are Start-ups Addressing Food Security in India?

Indian start-ups are utilizing technology and innovation to enhance nutritional security by advancing agricultural methods to boost crop yields and decrease waste. DeHaat, notable for its comprehensive agricultural services, operates in 12 Indian states with 9500 centres connecting 500,0000 farmers and with high-quality inputs, expert advice, and market connections, significantly improving farm productivity (CS_1). *"They are using AI and data analytics to help farmers increase their crop yield and reduce waste"* (Interviewee 7) which depicts that start-ups are using technologies that promote resource efficiency, increase crop yields, and minimize waste, crucial for global food security.

Start-ups are refining the supply chain from farm to consumer, reducing losses significantly. Ninja Cart is India's largest B2B fresh supply chain company that links more than 800,000 farmers with 100,000 retailers, cutting post-harvest losses and ensuring fair farmer prices and fresh consumer produce in

120 cities of India (CS _2). Additionally, drones and electric vehicles efficiently deliver fresh produce to remote and underserved locations.

Start-ups are also trying to return to bring back traditional practices and reduce the dependency on unsustainable modern practices, thus ensuring sustainability. Interviewee 8 said, *"returning to traditional farming methods can help restore the soil and combat climate change".* These start-ups also through their food processing techniques ensure nutrition and safe food to the customers. Interviewee 8 said, "*We deal in in-house grown and organically processed certified products"* and Interviewee 1 said, "*Believe in providing nutrition purity and chemical-free products……..minimal processing without any chemicals and……to save vitamins from denaturing to preserve nutrition in the oil"* which depicts using both traditional methods and scientific techniques to provide nutritious products to consumers.

Start-ups are curbing food waste using innovative logistics and processing methods. Inficold's cold storage solutions, claims being the first universal thermal energy storage enabling off-grid solar cold storage and milk cooler solutions and helping farmers reduce post-harvest losses by 20% (CS_3). Ecozen's climate-smart technology and innovation especially solar cold rooms benefit over 180,000 farmers, cutting spoilage and increasing profits significantly (CS_4). Interviewee 4 mentions resource reuse and zero waste as, "*the trimmings of our cakes…… we reuse them to make a new dessert…"* and thus reduces food waste. Start-ups are also developing platforms for food recovery and redistribution by making food available to those in need and contributing to environmental sustainability. Feeding India, a start-up by Zomato (CS_5) has served over 50 million meals by redistributing excess food from restaurants and retailer, reducing food waste and hunger, and as Interviewee 7 said, *"Food recovery and redistribution……. start-ups are creating platforms and applications to recover surplus food from farms, restaurants, and retailers".*

Start-ups use digital platforms like HealthifyMe, which offers personalized diet plans and nutrition tracking, leading to a decline in 80% of lifestyle diseases through educating over 35 million users on healthy eating and enhancing their nutritional health in more than 300 cities in India and Southeast Asia (CS_6). They influence societal tastes and increase awareness about nutrition and fitness as Interviewee 3 said, *"Start-ups are making aware……..people about wrongs"* which emphasizes the role of start-ups in creating awareness.

Start-ups create innovative, nutritious products to attract health-conscious consumers. Interviewee 9 said, *"Millets…… in the Indian society as being a poor man's food …….to change that perception of it. One of our prime objectives was to help encourage Millet consumption in the younger generations".* This highlights that start-ups can reshape customer's perceptions and innovate during crises like COVID-19, where many emerged to support government efforts in supply chain management.

Start-ups are developing and marketing fortified foods and supplements to address micronutrient deficiencies and improve overall nutrition. Interview 4 mentions, "*100% vegetarian bakery and café"* whereas Interviewee 5 mentions, "*type of vegetation which is called as organic food"* and Interviewee 8 said*, "Our goal is to provide consumers with healthier alternatives by offering organic products……free from harmful chemicals".*

Start-ups in India are playing a pivotal role in addressing food security and complementing government initiatives by providing scalable, sustainable solutions to ensure food security for all.

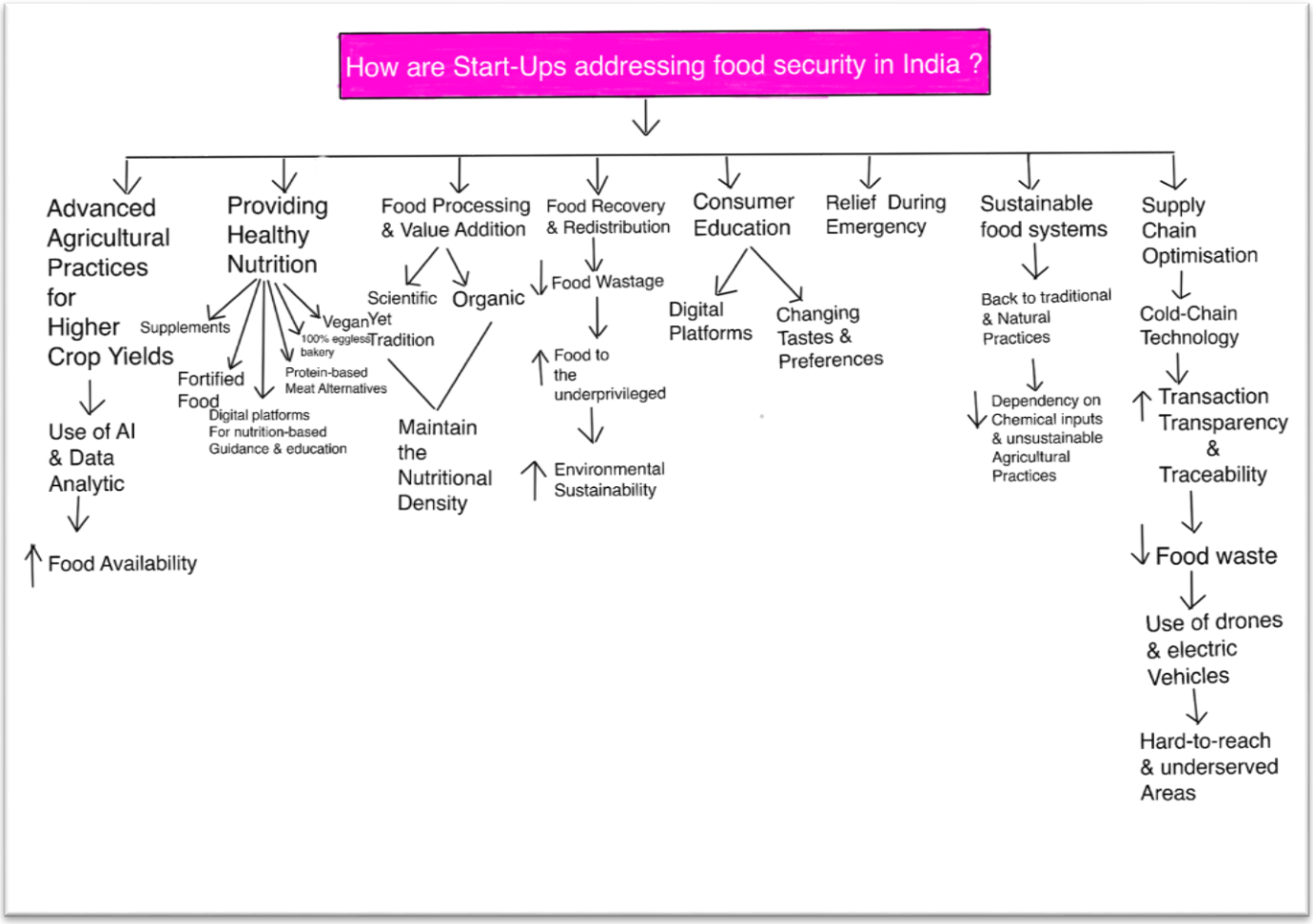

Figure.12. Thematic Map of How Start-ups address food security in India.
Source: Author

Sub-theme 2: Innovation Techniques

This theme explores how Indian start-ups are leveraging technologies such as data analytics, precision agriculture, vertical farming, hydroponics, fortification, smart packaging, blockchain, and Internet of Things (IoT) to enhance food security, with ongoing evolution.

"*Start-ups are developing and implementing innovative farming methods such as vertical farming, hydroponics, and precision agriculture"* which illustrates how start-ups like AgroStar innovate in food security, helping farmers with crop management solutions by using precision farming to boost crop yields by up to 27%, empowering over 9 million farmers, reshaping agriculture's future (CS_7). Thus, "*the adoption of precision agriculture is likely to increase in the coming years*" (Interviewee 7*).* Technological innovations are critical in addressing food security by improving food preservation, storage and distribution. *"Innovative solutions like AI-powered platforms are transforming the agricultural sector"* (Interviewee 7). These advancements help in reducing food waste, extending shelf life, and ensuring efficient delivery of food to consumers.

One of the trending technologies is the fortification of food products like rice as Interviewee 10 *explained "Just taking a rice, we are grinding it. We are making a powder ……. we are mixing some*

proteins like folic acid, vitamin A, vitamin B12, iron, and ferric pyrophosphate…., huge machines which have big heaters. ……...machine converts the powder into that rice kernel, technically called fortified rice kernels". This makes the staple food of the Indian population, normal rice, a rich source of nutrients without altering their diet as mentioned by the Interviewee also *"Seeks to enhance grains, nutrients value".* State governments' pilot projects help start-ups in boosting public health by enriching staple foods' nutritional value and *"aiming at eradicating anaemia which currently affects 60% population"* (Interviewee 10). But as mentioned by Interviewee 2, *"these efforts predominantly focus on fortifying carbohydrate-based foods like wheat flour and rice, with insufficient attention given to promoting dietary diversity among the population*".

Innovative products with millet introduces this underused nutritious grain to India's youth, enhancing their dietary options. as mentioned by Interviewee 9, *"We made a Millet product called Millesta. We made a Millet doughnuts…...*" Not only this but Interviewee 4 mentioned, *"We are 100% vegetarian bakery and café".*

Cold chain technology involves temperature-controlled supply chains, crucial for preserving perishable foods like fruits, vegetables, dairy and meat which extends the shelf life, reduces spoilage, and maintains food quality during transportation. In India, Ecozen Solutions through its solar-powered cold storage (Ecofrost) and IoT integration reduced food spoilage by 20-30% and increase in income by 30% (CS_4).

Blockchain technology is widely employed to improve traceability, minimize fraud, and ensure food safety by detailing product origins, handling, and storage. Agri10x, an Indian startup, uses it to directly connect farmers with buyers, ensuring fair prices and fewer intermediaries (CS_8).

Smart Packaging uses sensors to monitor food condition, detecting spoilage and ensuring quality to reduce waste which is still in the process of advancements.

The IoT connects devices and sensors for real-time monitoring, enhancing inventory, storage, and distribution. NinjaCart (CS_2) leverages IoT to cut wastage by linking retailer, traders and farmers. Interviewee 4 mentions *"software to maintain FIFO and LIFO..... ensures the food's freshness".* The current trend in start-ups is to innovate within the food industry by developing alternatives like plant-based proteins and vegan products as mentioned by Interviewee 2 *"The majority of emerging start-ups…… 21st-century food innovations, such as plant-based proteins and vegan alternatives",* although, matches global sustainability trends but may neglect broader nutritional needs and public health.

Thus, the use of technology and innovation to address food security is growing and has the potential to revolutionize food security.

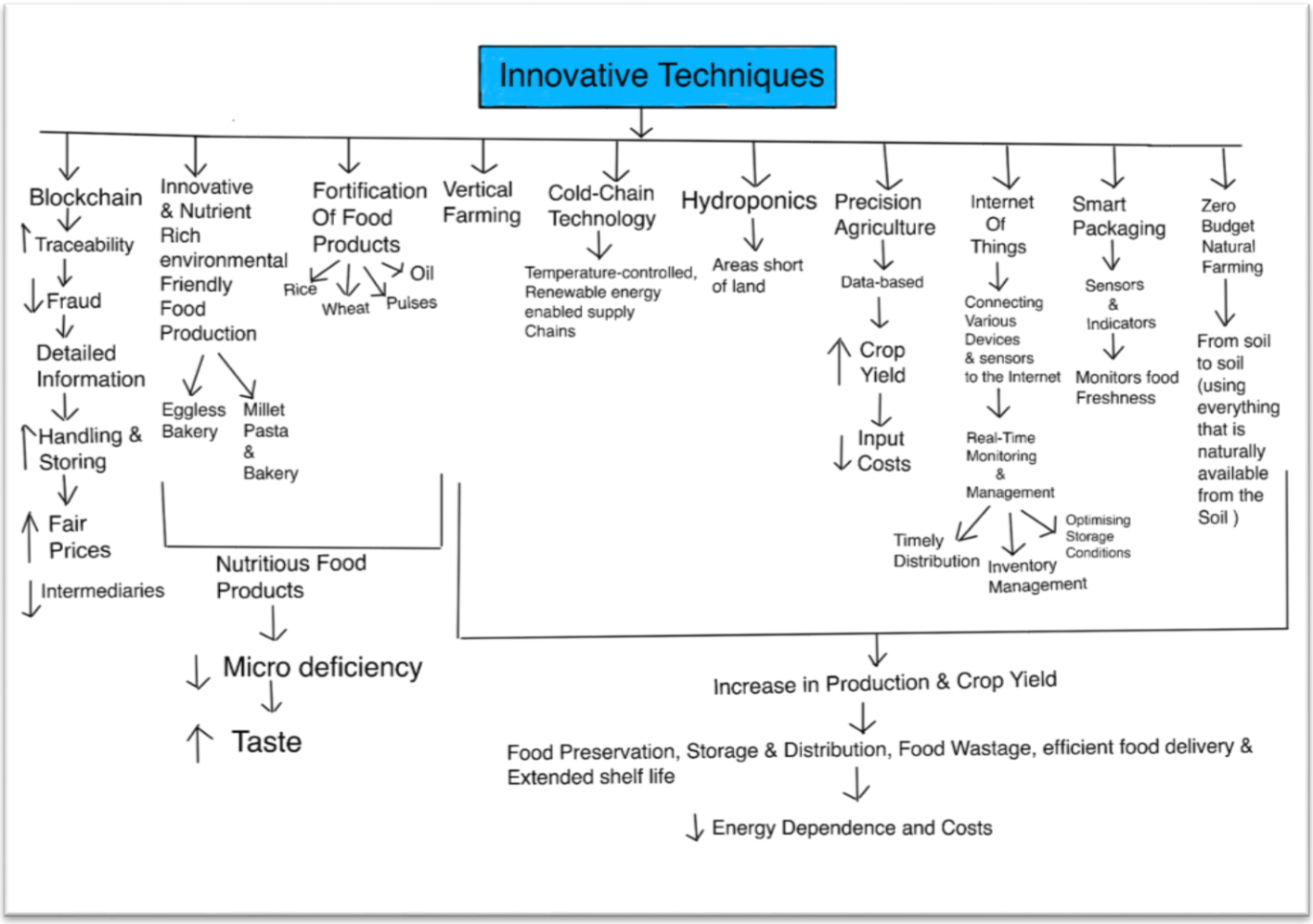

Figure.13. Thematic Map of Innovative Techniques leveraged by Start-Ups in addressing food Security in India. Source: Author

Sub-theme 3: Sustainability

Sustainability – social, economic and environmental is being addressed and should be an essential part of a start-up's strategies through waste reduction, use of traditional and natural practices which should benefit environment, society and future generations.

"Start-ups are focusing on reducing the waste and emissions throughout the supply chain. There are efforts to ensure that their operations are sustainable and environmentally friendly" (Interviewee 7), which depicts start-ups' efforts towards sustainability, including returning to traditional, economically viable natural practices. Interviewee 8 mentioned, *"A start-up aims to mitigate environmental damage caused due to conventional agriculture……adoption of zero budget natural farming…….to increase the yield and is empowering farmers to produce chemical-free nutrient-dense crops…..".* This depicts entrepreneurs' commitment to reversing environmental harm from traditional farming, fostering sustainable, eco-friendly agricultural methods. This shift challenges modern unsustainable practices, with start-ups focusing on minimizing food waste and using environmentally friendly packaging as evidenced: *"we don't waste any product. We use environmentally friendly packaging"* (Interviewee 4) and *"our prime focus was…. using minimal packaging and use zero plastic packaging"* (Interviewee 9). Social and economic sustainability hinge on efficient supply chains and local adaptation, enhancing market penetration and start-up viability as evidenced by Interviewee 2, *"To create a sustainable food*

system that is both affordable and accessible to the local population, a focus on short supply chains is essential".

CropIn, an Indian SaaS-based AgTech to enhance transparency and traceability across the food supply chain, reducing contamination by digitizing over 30 million acres (CS_9). Digital start-ups boost sustainability with wide customer reach and minimized environmental footprints as Interviewee 6 said, "*Our sustainability…..everything is just online".*

Although sustainability looks like an attractive opportunity but its challenges are multifaceted affecting both resource availability and business viability as *"sources available are sometimes scarce in resources"* (Interviewee 3). It's a challenge to maintain a balance between sustainable goals and financial growth as, "*The challenge is balancing sustainability with business growth…….the financial strain of maintaining these standards is significant"* (Interviewee 8) and "*Sustainability comes with a cost……"* (Interviewee 4). It distracts many entrepreneurs from sustainability to profit-making.

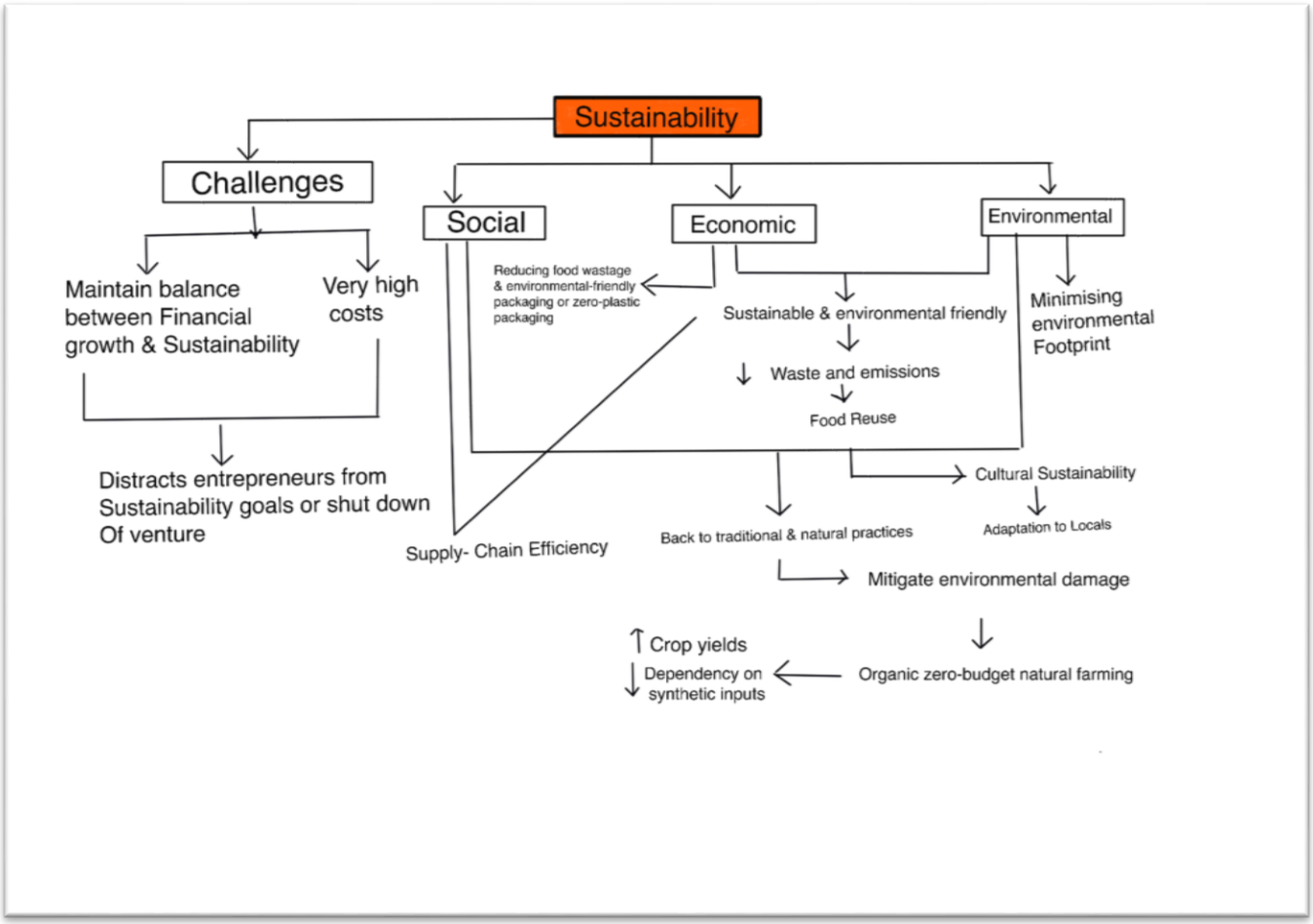

Figure.14. Thematic Map of Start-ups' Approach to Sustainability. Source: Author

Sub-theme 4: Scalability

This theme focuses on the factors that promote scalability of a start-up and they consider in their operations and the challenges they face during scaling their operations which forms the background to answer the main research questions.

A start-up's success hinges on effective marketing, adaptability, and strategic planning to expand operations and scale the business as mentioned by Interviewee 8, *"Scale up operations by increasing our production capacity and expanding our reach in both domestic and international markets".* Understanding and addressing a large market need is essential just like Interviewee 4 who focuses on *"Products which have no eggs or gelation to the market of India and abroad".* Adaptation to local markets is also essential, "*the higher acceptability of local foods among the population……start-ups should prioritize localized solutions……."* (Interviewee 2). A venture rooted in community practices enhances cultural and economic sustainability, making it more effective due to its affordability and local acceptance. Branding and promotion are crucial for customer engagement as Interviewee 6's, *"The glow-up program..... black and pink".* The product uniqueness also decides the scalability of the start-up like Interviewee 6's solution is *"The issue of PCOD… hormone balancing, and of course skin care health care. We don't believe in diets... customizing and balancing your whole program".* This uniqueness sets her apart from other health programs globally. This also includes Interviewee 3's one-on-one personal health training which makes him different as he said, *"We've introduced to….. personal training studio and its Rajasthan's first ever one-on-one personal training studio…..,*" making him unique in this sector and helped him scale. Digital presence boosts customer outreach, scalability, and the ability to replicate start-ups in other regions as Interviewee 6 said*, "Starting my marketing... on social media platforms".* It comes with numerous challenges like Interviewee 4 faced*, "trouble finding good quality skilled labour, a physical outlet, searching for the appropriate location……, manage rents as well, then investing the money".*

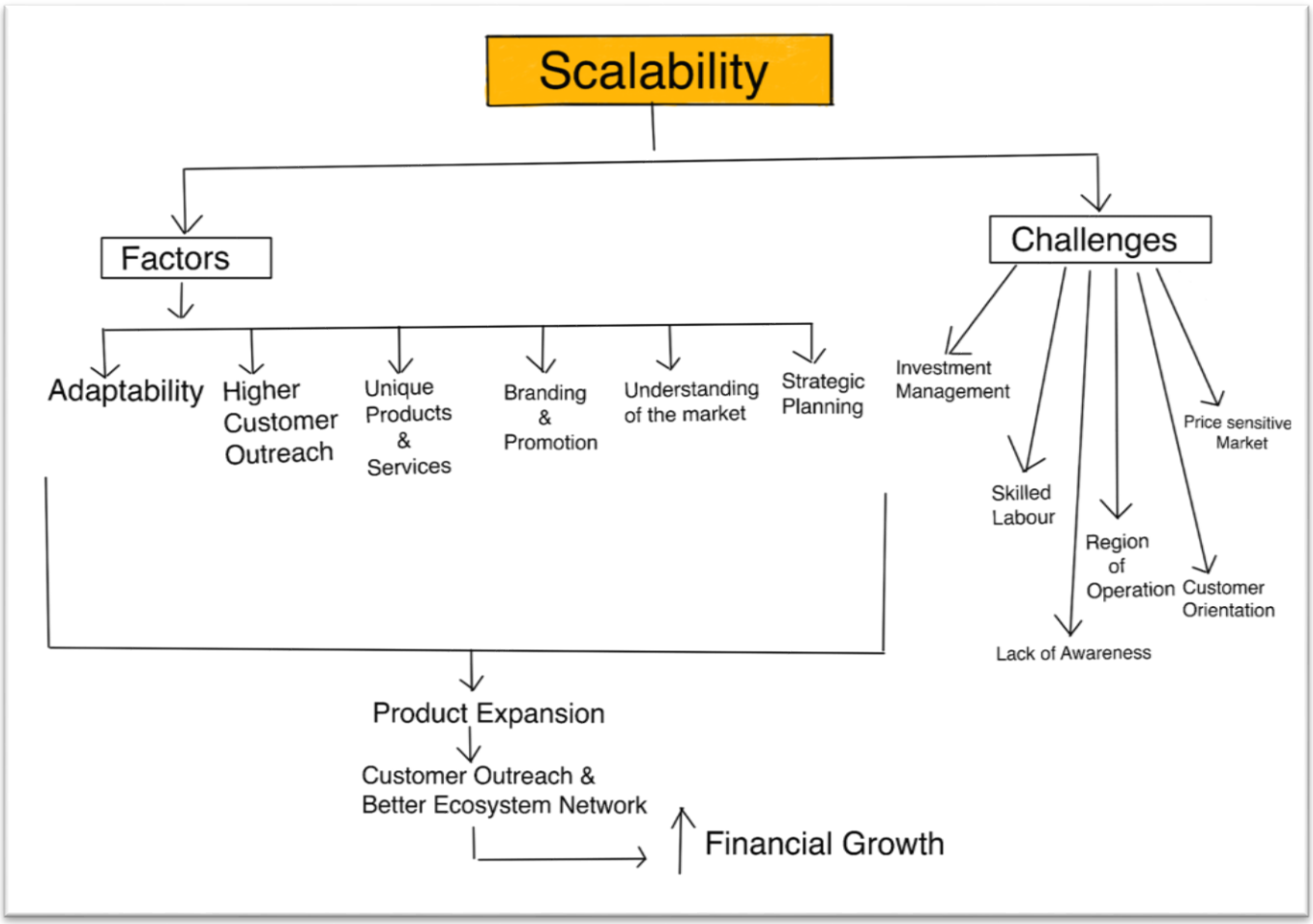

Figure.15. Thematic Map of Scalability of Start-ups. Source: Author

Sub-theme 5: Social Impact and Community Engagement

Start-ups are emerging as agents of social change through inclusive business models and community engagement.

By forming and managing Farmer Producer Organizations (FPOs), they empower small farmers to pool resources and access training, impacting over 2 million farmers through more than 7000 FPOs in India through economies of scale and better market access. Dairy cooperative AMUL supports 3.6 million milk producers through 18600 village milk cooperatives, ensuring fair prices and empowering local farmers (CS_10).

Additionally, start-ups like Samunnati and State Bank of India's Co-Lending agreement provide tailored financial solutions and social capital to FPOs and smallholder farmers (CS_11). Gram Cover, a tech-enabled insurance market place for rural India covering over 3.2 million farmers in 13 states (CS_12). Start-ups also influence dietary habits, as demonstrated by introducing millets to Indian youth through innovative bakery products, changing consumer preferences and behaviours toward healthier food options.

Entrepreneurs aim to integrate social values into their profit-making businesses like Interviewee 5 who said, "*40% of the fees goes for the cause……"* which depicts a strong commitment towards social responsibility. He also indicated the integration of social engagement into its business operations as he mentioned "*We visit the underprivileged in the village area……..".* Similarly, Haqdarshak Empowerment Solutions trains women to help citizens access welfare schemes, aiding over 500,0000 individuals and training 22,773 women, showing how start-ups can support underserved communities with essential services and education (CS_13).

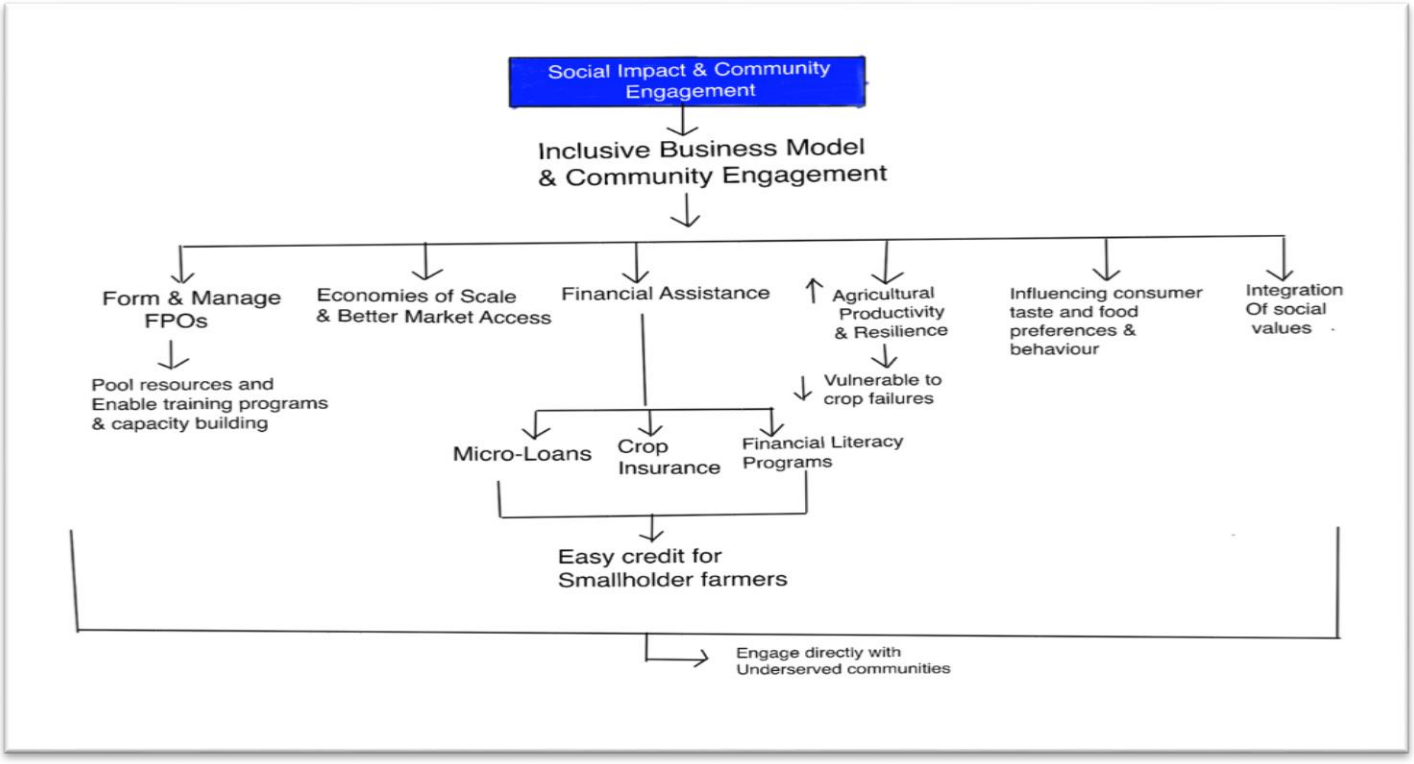

Figure.16. Thematic Map of How Start-Ups Enhance Social Impact and Community Engagement. Source: Author

Theme 3: Challenges and Opportunities

Sub-theme 1: Opportunities

This theme addresses the second research question by exploring how start-ups can leverage ecosystem's opportunities, by capitalizing on increasing demand from population growth and crises like pandemics. Community-based, collaborative models enhance their growth potential and strength.

India's agritech sector opportunity, valued at USD 24 billion with only 1% market penetration and this difference indicates a massive opportunity for new and existing agritech start-ups (NITI Aayog, 2023). The online grocery market in India is expected to grow at a CAGR of 37.1% from 2021-2028 to reach USD 38.9 billion by 2028 (Grand View Research, 2021). Technological innovations will be a boon to improve efficiency, reduce losses, and enhance market access.

COVID-19 has opened doors for vast opportunities as *"Post-COVID, there's a large drastic change in the kind of nutrition people are having"* (Interviewee 3). There is a large market for organic food products as noted by Interviewee 8, *"So the organic sector is a booming sector……the demand for organic products has grown significantly……..".* COVID-19 transformed attitudes toward health, altering consumer behaviour and preferences. Demand for sustainable food like plant-based proteins is increasing as Interviewee 2 also said, "*The majority of emerging start-ups are focused on ……..plant-based protein and vegan alternatives".*

Community-based models that engage local communities through cooperatives, FPOs and NPOs have higher chances of being accepted by the local society as the growth of AMUL (CS_10) proves.

Collaborations with government, NGOs, and institutions provide start-ups with infrastructure, funding, and networks. Incubators and investors in the entrepreneurial ecosystem offer crucial strategic and financial support, enhancing growth and scaling opportunities. Interviewee 1 highlighted this as, "*While incubators provide support to aspiring entrepreneurs, investors drive the development of the venture".* The government gives opportunities through its enabling policies and financial support like the Start-up India Seed Fund and Agri-Infrastructure Fund as Interviewee 7 mentions *"The first support is….from the government. There are N number of subsidies"* which shows that the government increasingly recognizes start-ups' role in food security, leading to more support and opportunities.

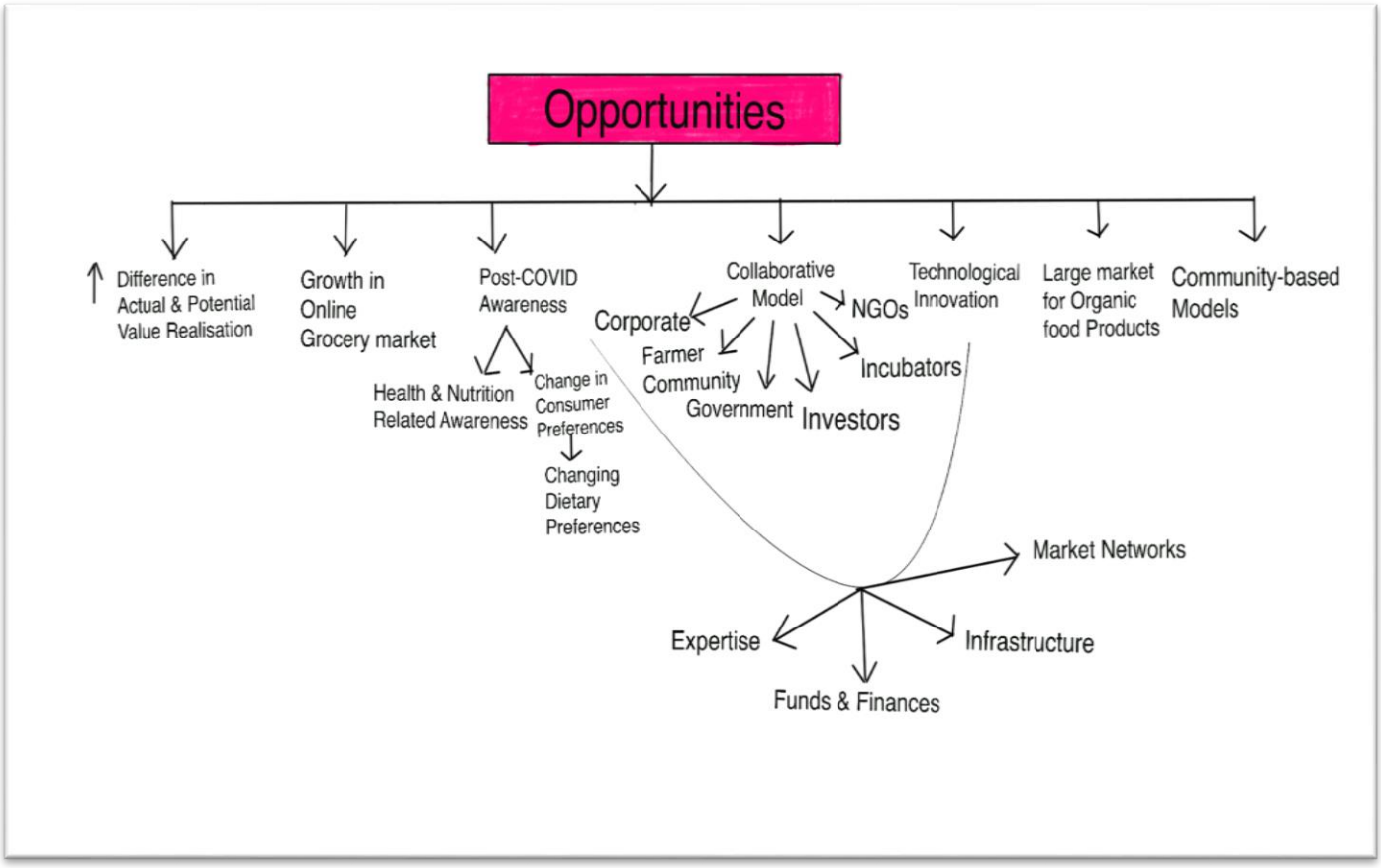

Figure. 17. Thematic Map of Opportunities that the Start-Ups have. Source: Author

Sub-theme 2: Challenges and Barriers

Despite huge business potential and opportunities, start-ups face major challenges like a skilled labor shortage and intense competition for growth.

Indian market is very price-sensitive and customer-oriented, "*as the consumer behaviour in India is very price sensitive……..the customer asks for justification"* (Interviewee 4). This leads to marketing and customer outreach challenges as a few interviewees mentioned such as Interviewee 4 said, "*Bloom is a premium bakery, we have to market ourselves".* Similarly, Interviewee 1 mentioned, "*Obstacles: Marketing"* which suggests that start-ups often struggle against larger brands due to poor marketing, thus, making effective strategies is vital for customer acquisition and brand recognition. Interviewee 3 said, "*Start-ups are not getting the right kind of clientele.."* and interviewee 1 talked about the costs of entering the digital markets which act as financial barriers such as "*In big retail superstore chains the cost of entry is high on online platforms like Amazon…..".* There lies a tension between the ideals of sustainability and the realities of a profitable business.

Lack of consumer awareness is considered to be the biggest challenge for start-ups in health and nutrition. Interviewee 3 mentioned*, "Supplements in India are one of the most taboo in India and ……. are convincing their clients to shift on the medication*" which also indicates the prevalence of counterfeit products and ethical concerns in the fitness industry. Interviewee 5 said, "*There are a lot of myths that need to be busted in India about healthcare"* which directly aims at the need for consumer education

and awareness. This challenge was also highlighted by Interviewee 8 who said, "*Consumer education is a major challenge, and managing a complex supply chain……..”* which also highlights complexity of the supply chain as a challenge.

Financial constraints like certification and licensing costs challenge sustainable business operations from the initial phase, beyond regular business activities. Interviewee 8 said, *“The initial challenges were monetary - the soil health……..regulatory aspects of the certification for organic farming ….is very expensive as securing organic certification was a major financial hurdle due to its cost”* and this makes the product expensive, reducing accessibility.

Government inefficiency in regulating the market leads to widespread counterfeit products, harming public health and undermining trust in genuine, albeit pricier, sustainable start-ups. This regulatory failure impacts the food industry's authenticity and competition as Interviewee 10 said, *“Government has banned the sale of fortified rice in retail…..”* which restricts use of fortified rice to ration recipients and government underpays producers, pushing them towards corruption or shutdown. Complex procedures also discourage start-ups from pursuing necessary registrations and certifications. Interviewee 4 said, "*India’s food safety and license is pretty absurd, ……the government to get your license whose application is pretty bad …… and their new website is not even user-friendly”.* India's 63rd ranking among 190 countries on the Ease of Doing Business Index (World Bank’s Doing Business Report, 2020), highlights the complex regulatory landscape, bureaucratic delays, and corruption that challenge start-ups as Interviewee 10 said, *“the government has ordered 2700 crores for this project. due to corruption ……. not able to offer us a good price”.* Inadequate infrastructure in rural areas increases logistics costs and post-harvest loss in India which is estimated at 10-20% for grains and 30-40% for fruits and vegetables (Ranjan and Sahani, 2023) and Interviewee 9 added, "*didn’t have the right equipment to make the bakery products ……..more labour and time …….no profit-margins….. we stopped”* which shows lack of adequate infrastructure is a big challenge.

Thus, a start-up has to face several challenges before being a successful and sustainable start-up which have to be addressed in the future through required steps.

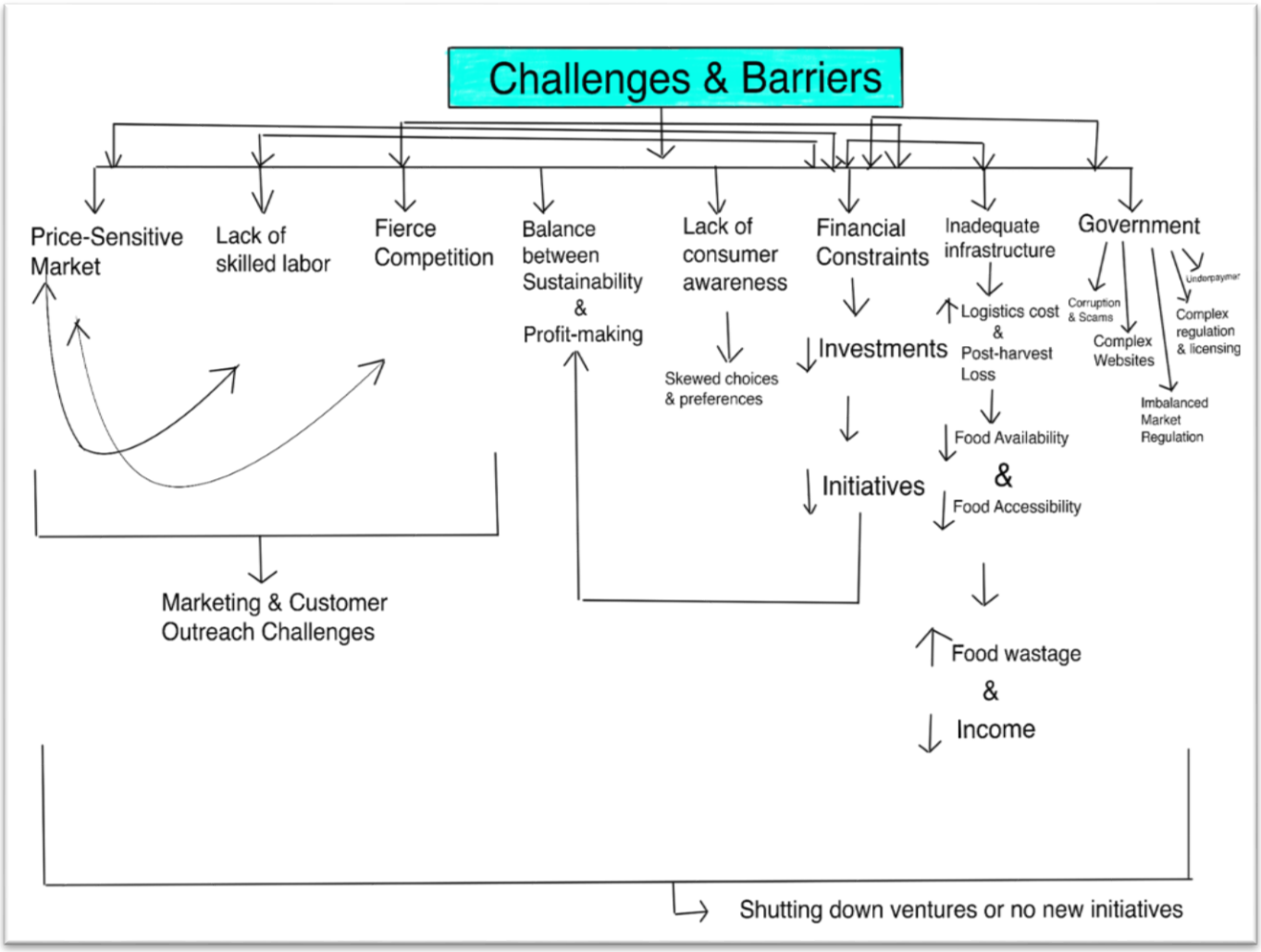

Figure. 18. Thematic Map of Challenges and Barriers Faced by Start-ups.
Source: Author

Theme 4: Future Outlook

This theme outlines the future landscape for the upcoming start-ups and actions stakeholders should take to enhance innovation potential.

Improving consumer education, government standards, and certified training to raise awareness about nutrition and fitness is essential for an informed and health-conscious population as Interview 3 said, "*Lack of awareness and government guidelines about the health and fitness industry in India and professionals certified by the government must be operating such start-ups".* Using technology to educate and empower clients with personalized health solutions as Interviewee 6 said, "*Girls need to be taught a lot of things…. Burst a lot of myths".* The focus on product functionality and traceability indicates a commitment to transparency and consumer trust as said by Interviewee 1, "*Making Product more functional, bring more product traceability to the consumer…..".* Competitive edge has to be maintained by "*Maintaining product uniqueness with a good marketing team and a robust supply chain"* (Interviewee 1). Government must enhance regulation and support for recognition of start-up's potential as said by interviewee 10, "*government…….. will pay us better and will regulate the market to avoid counterfeiters".* Transitioning from altruism to profit-driven operations challenges social enterprises,

requiring strong ethical frameworks and support as said by Interviewee 6, "*Once they start with food after 34 months they started getting influenced with earning money".*

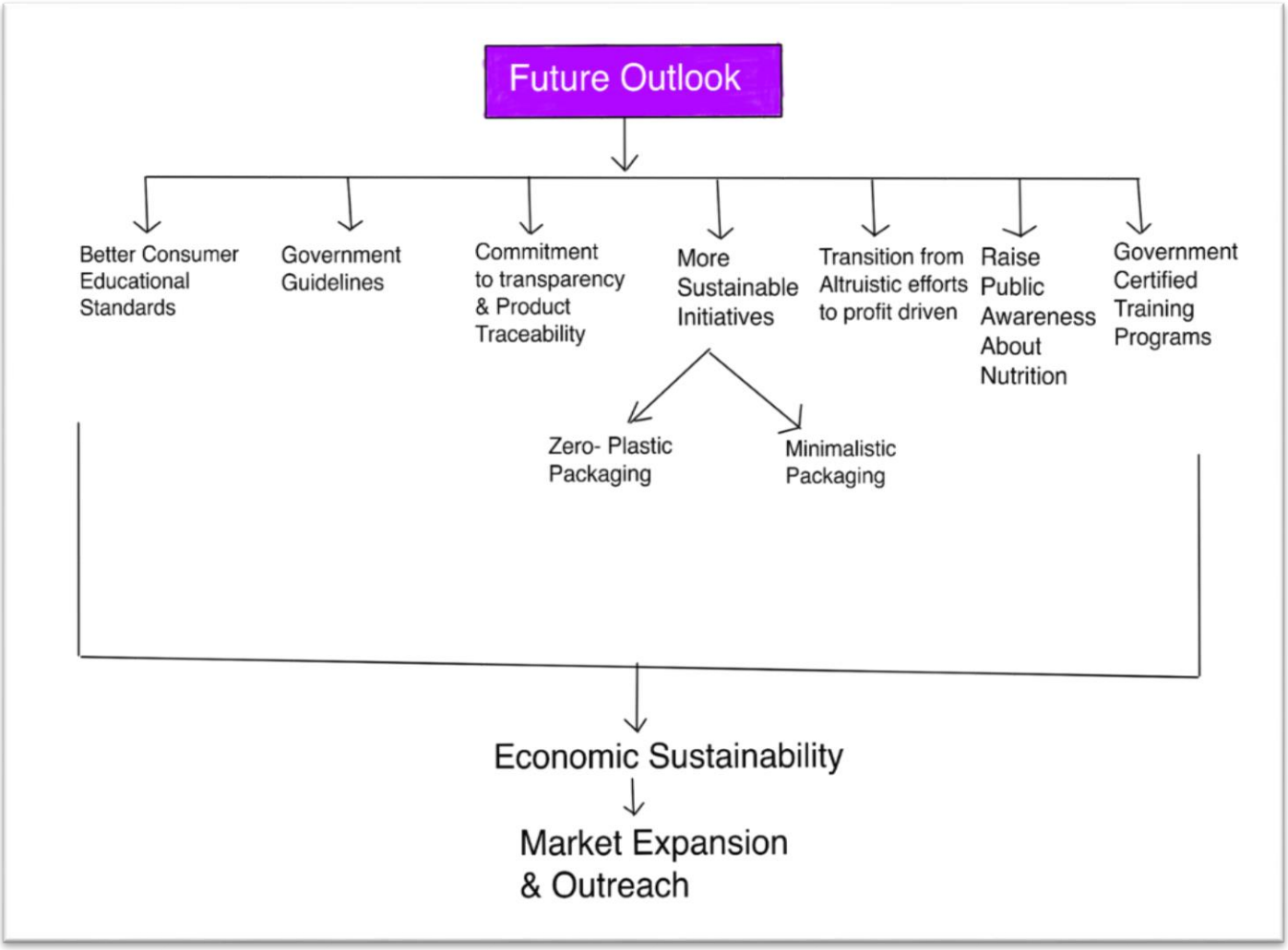

Figure. 19. Thematic Map of Future Outlook for Start-Ups in Addressing Food Security Source: Author

Theme 5: Balanced Ecosystem

This theme summarizes all previous themes, encapsulating their opportunities and challenges, and offers conclusive insights.

"*The private sector, foundations, and NGOs are already actively implementing various nutritional programs across different regions"* (Interviewee 2) which signifies private sector, foundations, and NGOs are vital for innovative solutions, collaborating with government efforts to improve nutrition and public health.

Interviewee 2 focused on the shift of the government's role from direct intervention to a more supportive one, facilitating the efforts of the private sector, NGOs and other stakeholders for which he said, **"***The government's role should be limited to that of an enabler within this system. The government can contribute by monitoring and evaluating these efforts,……..".* The government financially supports agritech food start-ups, promoting innovation and scalability. The 2020 Agriculture Infrastructure Fund aided start-ups in 688 cold storages, 6623 warehouses, and 21 silo projects (Elets, 2024). The Start-

up India Scheme offers agritech start-ups tax breaks, simplified compliance, and expedited patent processes (Startup India, 2020), recognizing over 50,000 start-ups by 2021 (IBEF, 2021), many in agritech. The government encourages private-sector involvement in nutrition projects through financial incentives, subsidies, and tax breaks, enhancing investment attractiveness. "*Government initiatives such as subsidies and incentives play a crucial role in supporting the economic viability of start-ups"* (Interviewee 7) and Interviewee 3 also said, "*We've got a start-up tax from the Government of India….".* Interviewee 2 said, "*A few start-ups, such as Fortify Health, are actively collaborating with state governments on food fortification"*, to complement this Interviewee 10 has produced fortified rice kernels with the collaboration of Telangana, Tamil Nadu and UP government in India. *"The government is taking of course some initiatives like…. double farmer's income. The PDS and other food distribution networks……. sustainable agricultural practices like organic farming to ensure long-term food security"* (Interviewee 7) which depicts the government's strategy enhances agricultural productivity and nutrition for vulnerable groups, leveraging private sector innovation, NGOs, and start-ups. Interviewee 2 said, "*The government can incentivize the private sector……..*" implying that the government helps start-ups grow and turn emergencies into opportunities.

Interviewee 9 also said, "*Government has helped us to expand…….Millet……UN's 2023 a year of millets……to make food that is climate-friendly"* which illustrates the government's role as an enabler in promoting and educating about product benefits and drawbacks. Even Interviewee 8 said, *"government schemes has been a welcome change…….much-needed support and resources to expand our operations"* which suggested that continued advocacy and engagement with policymakers are essential for the organic farming sector's success.

Collaborations with companies, organizations, or institutions could provide access to additional resources, expertise and markets**.** Interviewee 1 highlighted, "*tie-ups with retailing & distribution partners*". Researchers and academics provide essential data for policy-making and interventions, ensuring public health strategies are up-to-date and effective as Interviewee 2 said, "*Researchers and Academics ……nutritional profiles of the population and can recommend accessible food options that meet the nutritional parameters in local areas*". The government encourages R&D in agricultural and food technology to drive innovation and sustainability. Effective regulations, awareness, and funding support enhance scalability, while partnerships in key markets strengthen investment potential.

However, the drawback in the current scenario is the lack of coordination among the stakeholders as Interviewee 1 said, *"There were subsidies which we were unaware of before we bought the machinery".* Government's lack of targeted support may limit nutrition-based start-ups' ability to scale and enhance nutritional security as Interviewee 2 said, "*Government support for start-ups in the nutrition sector is limited, with most assistance falling under the broader Start-Up India Scheme".* There is a lack of trust especially in the government among the start-ups as Interviewee 5 said, "*I never trust the government because it's all a business. The government and its policies are too strong".* This indicates a need for specialized government programs tailored to the nutrition sector's specific challenges and opportunities.

CHAPTER 5: DISCUSSION

5.a. Integration of Sustainable Entrepreneurship and Food Security in India

The discussion around start-ups in India reveals a sophisticated approach to tackling nutritional security through technology and innovation, merging theoretical insights with practical applications. These companies are not merely focused on boosting agricultural outputs; they are also embedding resilience, sustainability, and environmental mindfulness into their operational ethos, resonating with academic perspectives like those of Lang and Barling (Wahbeh et al., 2022). They are enhancing agricultural productivity, streamlining supply chains, minimizing food waste, and ensuring the availability of nutritious foods via innovative storage and logistics solutions.

Building on Guiné and Pato's broadened concept of food security, which incorporates elements of sustainability and agency, Indian start-ups have embraced sustainable practices and catered to local demands, thereby influencing consumer behaviour and choices. This notion of agency, as discussed by Clapp and Moseley, emphasizes the role of individual participation in shaping the food system. These enterprises strive to make food both physically and economically accessible, aligning with IFPRI's vision of a sustainable food system that benefits present and future generations (Wahbeh et al., 2022).

Moreover, these start-ups are blending traditional methods with cutting-edge techniques to foster sustainable practices that offer consumers fresh, nutritious, and eco-friendly food options, as indicated by Abrahamson and Gibbs. They utilize advanced agricultural technologies like precision farming and data analytics to enhance crop yields and quality, securing a reliable food supply. These ventures are adept at turning challenges into opportunities, adhering to the "triple bottom line" philosophy that seeks a balance between profitability and social and environmental responsibilities, as theorized by Anderson and Thompson (Thompson et al., 2011).

At the grassroots level, these start-ups interact with both natural environments and human-engineered systems, addressing economic, environmental, and social challenges through entrepreneurial efforts aimed at social good and minimal environmental degradation, supporting the FAO's definition of a sustainable food system (FAO, 2018).

From a broader perspective, scholars like Gyimah stress the pivotal role of governmental action in food security, whereas Avelino underscores the significance of social innovation and entrepreneurial initiatives (Gyimah et al., 2023). This analysis proposes an "Enabling Ecosystem" theoretical framework that encourages a reciprocal, collaborative relationship among various stakeholders. Despite challenges such as coordination and trust, increased cooperation and understanding could make this framework, viable for bolstering food security in India, suggesting a robust platform for future exploration and implementation.

5.b. Contextual Factors and Opportunities

The literature review extensively explores the multifaceted issues exacerbating food insecurity, highlighting factors such as poverty, inadequate access to clean water and sanitation, child stunting, undernutrition, restrictive agricultural policies, and the high cost of healthy diets which is an outcome of the findings also (Dhamija et al., 2023). Echoing scholarly consensus, climate change emerges as a significant contributor to these challenges, particularly in India, where diverse climatic conditions intensify the need for climate-resilient technologies (IFPRI, 2016). These technologies are crucial not

just for addressing the physical aspects of food security but also for meeting diverse dietary, socio-economic, and cultural needs.

Furthermore, the concept of agency (Wahbeh et al., 2022) plays a critical role in shaping governmental policies, with the review underscoring the failure of government regulations to effectively manage the food security ecosystem. This is compounded by socio-economic inequalities, which persist as significant barriers to nutritional equity, as evidenced by the regional and socio-economic disparities pointed out by interviewees in this study. These disparities often result in nutritional deficiencies, particularly pronounced in rural areas where infrastructural deficits and limited access to nutritious food exacerbate the situation.

Adding to the complexity, food waste is identified as a critical factor that worsens food security issues. As noted by Tsolakis and Srai, food waste not only reflects inefficiencies in food systems but also contributes to the broader challenge of ensuring food security. The finding highlights how lifestyle choices, market imbalances, and the pervasive influence of social media affect agency, aligning with the expanded definition of food security by Guiné and Pato. This expanded view includes the role of individual and community agency in shaping food systems, a theme further explored by Clapp and Moseley (Wahbeh et al., 2022).

The discussion reaffirms that the findings of this study are consistent with existing literature. It underscores the complex interplay of environmental, economic, and social factors that influence food security and provides a deeper understanding of the dynamics at play and reinforces the need for multifaceted strategies to address the pervasive challenges of food insecurity.

5.c. Challenges and Opportunities

Indian start-ups face a multitude of challenges, making their journey in the food security sector particularly daunting. These challenges are rooted in a combination of systemic issues and market-specific dynamics. In the existing literature Anderson has focused on seeking opportunities as opposed to reacting to stakeholder’s reaction, similarly start-ups have been converting opportunities from the challenges itself (Thompson et al., 2011).

As discussed in the existing literature, there is a shift in consumption and production pattern posing challenge as well as an opportunity which will require disruptions in existing investments, jobs, power structure, new resources, innovations and demonstration labs (EEA,2022). The growing population can also be seen as an opportunity to innovate because it comes with a rise in demand for food and post-COVID, there is a drastic shift towards nutritious food where changing customer preferences can be a challenge and risk for an entrepreneur while simultaneously allowing for innovating and taking the competitive edge (Foresight, 2016; PWC, 2016).

The government's enabling role and acknowledgment of entrepreneurs' abilities will create more opportunities, fostering collaboration to address social challenges. As discussed by the Villarreal, collaborations have a huge potential and thus broader involvement will give more opportunities with smooth platforms for start-ups to address food security (UN Press, 2023).

The primary hurdle is the lack of skilled professionals, which is largely attributed to an outdated education system that emphasizes theoretical knowledge over practical skills. The findings have led to a gap in skilled expertise labour limiting innovation and high operational costs.

As discussed, agency as an element of food security (Wahbeh et al., 2022), thus government regulation as analysed from the findings is also a challenge cause that's decided by the agency but also decides the potential of the agency to operate in the ecosystem and thus while attempting to address food security, therefore start-ups must navigate a maze of agricultural, food safety, and distribution laws, often dealing with multiple government agencies which delays operations leading to higher cost constraints. Additionally, state-specific regulations further complicate the expansion process for start-ups looking to operate across India.

As analysed from the existing literature review and the findings, funding is another critical issue. Food security start-ups, which often require substantial capital to invest in technology and infrastructure, struggle to secure adequate funding. This financial constraint stifles innovation and prevents these ventures from scaling to a level where they can make a significant impact on food security.

Infrastructural deficiencies, particularly in rural areas, exacerbate these challenges. Inadequate storage facilities, inefficient transportation networks, and unreliable electricity supply leads to higher post-harvest losses and increased operational costs. These issues make it difficult for start-ups to reach remote or underserved regions, limiting their ability to address food insecurity effectively.

As the literature suggests that sustainable entrepreneurship drives both new entrant and incumbents to foster sustainable competition through mutual co-evolution thus market dynamics also pose significant challenges (Thompson et al., 2011). Findings suggest that the Indian market is diverse and price-sensitive, with consumer loyalty to traditional suppliers. New entrants struggle without significant marketing investments. Educating consumers on food security and modern agricultural practices is challenging, especially in rural areas where traditional methods dominate.

Additionally, economic and political instability, coupled with environmental challenges as sustainable entrepreneurship as per the scholars like Westley suggest about sustainable entrepreneurship as an interaction between the natural environment and human innovations such as climate change, create an uncertain environment for start-ups (Thompson et al., 2011). Fluctuations in the economy, changing tax policies, and unpredictable weather patterns disrupt operations and long-term planning, further hindering the growth and scalability of food security solutions.

Despite these challenges, initiatives like Startup India have helped foster a growing entrepreneurial culture. However, navigating the unique landscape of the Indian market requires careful strategy and adaptation to overcome these significant hurdles.

5.d. Social Impact

Start-ups have a profound impact on society by promoting food security through socially and environmentally conscious practices, as described by Lang and Barling (Wahbeh et al., 2022). They align with sustainable entrepreneurship, focusing on the interplay between innovation and the natural environment to create long-term benefits (Thompson et al., 2011). These ventures offer healthier, sustainable, and ethically produced food options, promoting better nutrition and environmental awareness. They advocate for plant-based diets and provide healthier alternatives to traditional snacks, emphasizing whole grains and natural ingredients. Additionally, start-ups tackle malnutrition by creating nutrient-rich and fortified foods for vulnerable groups, particularly children and women. They also preserve cultural dietary habits and adapt their innovations to local needs, fostering a sense of agency in the ecosystem. Start-ups like Ecozen Solutions (CS_4) and NinjaCart (CS_2) promote sustainable agriculture by enabling organic farming and reducing carbon footprints in food production. These efforts

ensure fair prices for farmers and direct consumer connections. Overall, start-ups align with Elkington's (1998) triple bottom line model—focusing on social equity, economic stability, and environmental sustainability—demonstrating their role as sustainable entrepreneurs committed to improving society through innovative, ethical, and sustainable practices (Thompson et al., 2011).

5.e. Policy Implications

When evaluating the policy implications for India's economy, start-ups, food security, and society, it is essential to focus on key areas that can empower entrepreneurial ventures within the food security sector. Historically, India's policies have aligned more with Lang and Barling's concept of increasing food production to address hunger and underconsumption (Wahbeh et al., 2022). However, this approach has faced criticism; while it reduced hunger, it also led to malnutrition and nutritional deficiencies. Policies like those during the Green Revolution emphasized production to combat hunger but failed to promote nutrition-focused strategies, resulting in widespread nutritional deficiencies (Victora et al., 2021). Thus, policy reform should incorporate more socially and environmentally conscious approaches that go beyond mere production, as recommended by Lang and Barling (Wahbeh et al., 2022).

While findings suggest that the government should implement more targeted policies, existing frameworks indicate efforts like the Public Distribution System (PDS) aimed at food scarcity, price stability, and preventing market malpractice (Chakraborty, 2005), and ICDS focusing on children and women (Sachdeva et al., 2001). However, these policies reveal a gap - a lack of dedicated support for start-ups in the food sector to encourage innovation, incentivization, and expansion. The literature highlights that encouraging investments through foreign collaborations, PPPs, joint ventures, and streamlined industrial licenses could spur growth in this sector. Westley et al. emphasize the interaction between the natural environment and human innovation, advocating for start-ups to adopt the triple bottom line model to achieve sustainability (Thompson et al., 2011). However, practical findings reveal a gap in such collaborations and a need for increased engagement with stakeholders to harness higher expertise and investments.

Scholars like Hekkert and Negro highlight that start-ups often create bottom-up solutions, while Guine, Pato, Clapp, and Moseley describe how individuals can influence institutions and governance (Thompson et al., 2011). In theory, the government has been more people-centric in its approach, but in practice, it lacks this dimension. Findings suggest that complex regulations and licensing processes are major hurdles. A more people-friendly government approach, with reduced corruption, would not only address citizens' problems but also make it easier for start-ups to operate and scale. This would push them towards sustainable growth rather than focusing solely on socio-economic development.

The literature underscores the government's role in providing ownership, training, infrastructure, and investment across sectors to reduce food losses, control inflation, and generate local employment. While these objectives align with the findings, there remains a substantial gap in the government's ability to deliver efficient infrastructure, sufficient financial benefits, and user-friendly policies and regulations (David et al., 2020; Munshi, 2019). While some policies discuss tax exemptions, simplified compliance procedures, and expedited patent applications to support start-ups, findings show that these processes are often complex, not user-friendly, and prone to corruption. This reality leads stakeholders to bypass proper channels, thereby missing out on exemptions, subsidies, and other governmental support. If the government were to adopt a more people-centric approach, it would

provide start-ups with a more enabling environment to expand and scale. Streamlined compliance with government standards would foster fair competition and ethical business practices.

There is a complex conclusion derived from these findings. While some interviewees acknowledge the government's support and efforts, others express complete dissatisfaction. This divergence reveals that there is no definite answer regarding the implications of government policies for start-ups in addressing food security. To truly empower start-ups and enhance food security, a more nuanced, responsive, and collaborative policy framework is needed, addressing both the economic and social dimensions of sustainable development.

5.f. India's Alignment with Global Trends

India's strategy for leveraging start-ups in food security mirrors global trends in technological innovation, sustainable agriculture, and digital transformation while incorporating unique elements tailored to its specific demographic, economic, and environmental contexts. This approach offers valuable insights into integrating inclusivity into business models, which other countries could adopt to enhance their food security measures. However, for such models to be replicated abroad, they must be adapted to local conditions, requiring robust infrastructure and a supportive policy environment. Partnerships between governments, local communities, businesses, and international organizations are crucial to this adaptation, facilitating the transfer of expertise and attracting necessary investment (IFC, 2012).

India aligns with global movements by promoting agritech start-ups that develop localized solutions. For instance, companies like DeHaat (CS_1) employ AI, machine learning, and big data to boost farm productivity, optimize resource use, and improve market access. NinjaCart (CS_2) enhances supply chain efficiency through data analytics, reducing waste and maximizing profits. In sustainability, India focuses on organic and traditional farming methods. Start-ups such as Ecozen Solutions (CS_4) advocate energy-efficient agricultural practices and minimize post-harvest losses, promoting sustainable agriculture. Organizations like AMUL ensure fair prices for farmers (CS_9)

Digital transformation also plays a significant role in India's food security strategy. Start-ups like NinjaCart (CS_2) develop digital platforms to connect farmers directly with consumers, eliminating intermediaries and ensuring fair pricing. PPP models, such as eNAM and Start-up India, encourage start-up participation in agricultural markets through supportive policies (David et al., 2020). Notably, India emphasizes empowering smallholder farmers through initiatives like Samunnati (CS_10), which offers tailored financial services and market linkages.

India's model aligns with global food security efforts and provides an adaptable framework that, with proper adjustments, could be employed globally to address similar challenges.

5.g. Enabling Ecosystem

Based on a comprehensive analysis of case studies, interviews, reports reflected through Theme 5 and scholarly documents, the author proposes an enabling ecosystem surrounding a collaborative model. Unlike Gyimah, who emphasizes government intervention (Gyimah et al., 2023) and Avelino, who highlights social innovation (Avelino et al., 2019), the author suggests a two-way process where each entity supports the other, creating a mutually beneficial system to tackle complex challenges like food security. This model aligns with Clapp and Moseley's concept of agency, which views individuals as influential in consumption and governance, but here, represented as groups at the core of the

ecosystem. This approach integrates Guine and Pato's expanded definition of food security, emphasizing collaborative efforts where every stakeholder's contribution enables the overall functioning of the ecosystem, ensuring smoother operations and more comprehensive solutions to food security challenges (Wahbeh et al., 2022). This model can be stated as follows:

Affordability, Outreach and Enabling Platform (Government) + Knowledge and Expertise (Companies, Researchers & Incubators) + Funds and Finances (Investors) + Innovation and Risk-Taking (Entrepreneurs) + Adaptability (Farming Community) = Solution for a Social Challenge

The proposed model integrates Gyimah's emphasis on government intervention (Gyimah et al., 2023), Avelino's focus on social innovation (Avelino et al., 2019), and Villarreal's concept of broad stakeholder involvement (UN Press, 2023). The model suggests six primary stakeholders—government, NGOs, investors, incubators, start-ups, corporates, researchers, and farmers—can maximize its potential while also supporting the capacities of others to address challenges like food security but allows for further expansion based on market research and application. This reciprocal support structure creates a dynamic ecosystem where all parties benefit without causing harm to each other. The findings indicate significant opportunities for collaboration and PPPs in India, as highlighted by interviewees, underscoring the need for such cooperative frameworks.

Government support is crucial in this ecosystem; by implementing effective regulations, providing emergency aid, enhancing training, fostering research and development (R&D), and offering financial incentives, the government can help start-ups scale and achieve broader impact. In return, start-ups can help the government meet policy objectives by delivering high-quality, corruption-free public services.

Farmers and the agricultural community can leverage advanced technologies provided by start-ups, reciprocating with trust, adaptability and fair compensation which indirectly supports other stakeholders. Investors, on their part, offer accessible funding to the ecosystem, expecting financial returns. Researchers and academicians gain a dynamic environment for their studies and, in return, provide critical data, future outlooks, and insights that aid in policy-making, investment decisions, and operational strategies.

Corporates contribute consultation services, expertise, and market access, expecting substantial returns. Incubators offer resources, technical support, and platforms to start-ups and receive innovative ideas and practices in exchange. NGOs act as intermediaries between the government and the private sector, providing platforms and outreach to start-ups while gaining access to resources, expertise, and new platforms in return.

This enabling ecosystem model operates as a pilot framework where each stakeholder acknowledges and leverages the strengths of others to tackle global social challenges like food security collaboratively. However, as with any model, there are inherent opportunities and drawbacks. While the model is grounded in literature and findings, its practical application may yield different results, especially considering the current limited targeted support for start-ups. Although there is emerging collaboration between start-ups and the government, the absence of a unified approach has led to

inefficiencies and conflicts due to a lack of awareness, mutual recognition, and intense competition among stakeholders.

Overall, this is a theoretical framework to enhance collaboration and mutual support, potentially transforming India's food security landscape if adopted effectively.

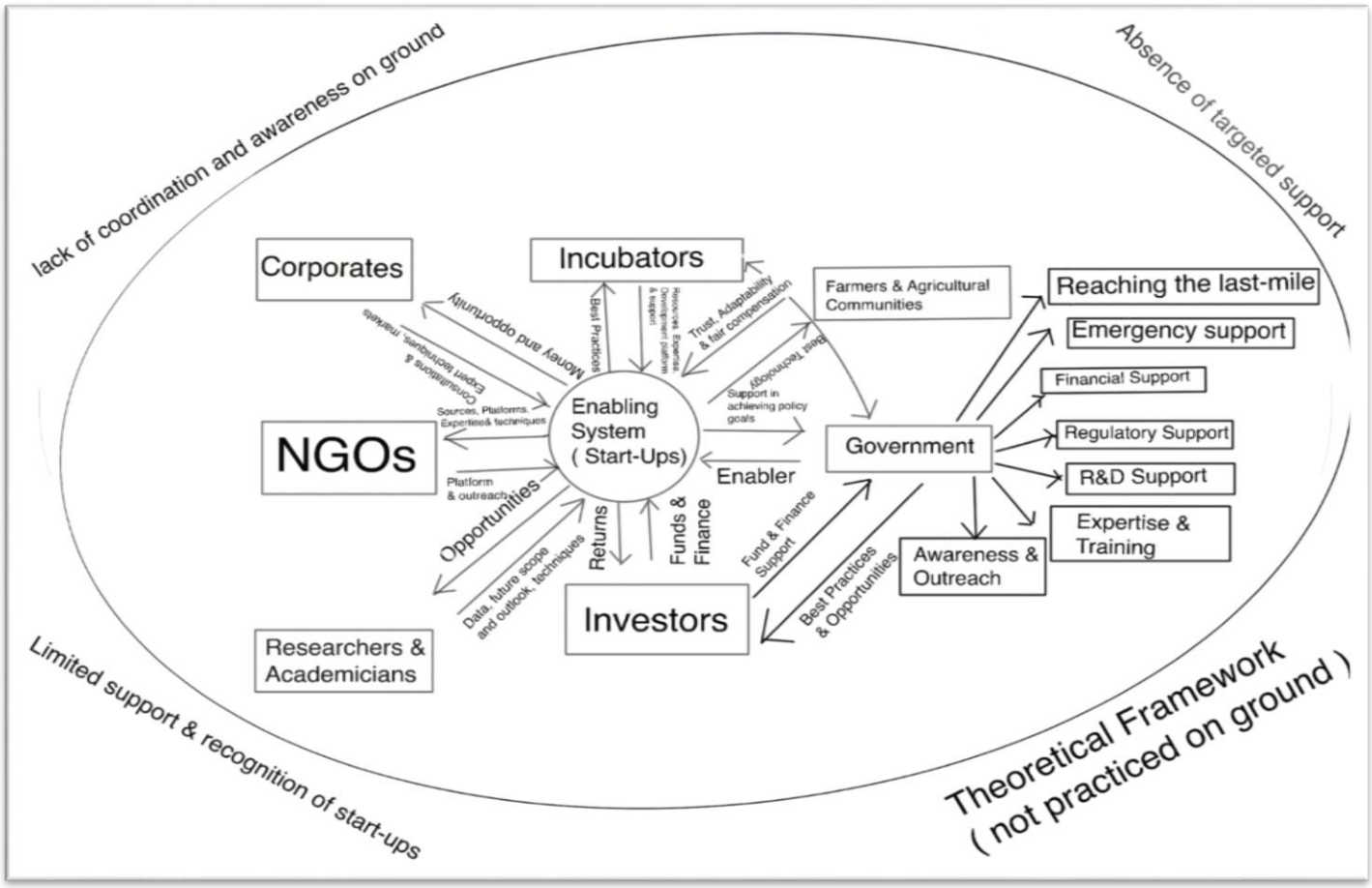

Figure. 20. Enabling Ecosystem Model as proposed by the Author. Source: Author

5.h. Limitations of the Study

The study's focus on India limits the generalizability of its findings to other regions with differing socio-economic conditions. Concentrating primarily on food and agriculture start-ups, the research may lack comprehensiveness. Using a cross-sectional design, it captures data only at a specific point in time, failing to account for the evolving nature of the start-up and food sectors. The sample size is restricted due to delayed responses, difficulties in outreach, and time constraints, leading to convenience-based sampling that limits stakeholder involvement. The analysis is limited by a lack of quantitative data and the researcher’s expertise in blockchain, IoT, and smart packaging, hindering deeper insights into how these technologies could be better integrated by start-ups in food security. Additionally, limited

engagement with policymakers hinders the development of practical, actionable policies. Addressing these limitations in future studies could improve the robustness, relevance, and impact of the findings, offering a more holistic understanding of how start-ups can tackle food security challenges on a global scale.

5.i. Recommendations for Future Research

Future research should provide a comprehensive analysis of the long-term impacts of food security start-ups, focusing on economic, nutritional, environmental, social, scalability and policy aspects. It should further focus on tailoring solutions to the population's diverse needs, imitating the impacts of climate variability, supporting smallholder farmers, and leveraging economic growth while addressing inequality. Using a combination of longitudinal studies, impact assessments, and comparative analysis, researchers can offer valuable insights into how these start-ups on a national level can contribute to global food security. Further research should also provide how widely can the enabling ecosystem model be used, and its further advantages and drawbacks that can only be analyzed after further empirical research in the market.

Start-ups are playing a crucial role in addressing not only food security but also other social challenges. Although they face multiple challenges and have opportunities in the growing market. Their opportunities can grow beyond challenges if they get an enabling atmosphere.

CHAPTER 6: CONCLUSION

This study examines the intricate relationship between start-ups, sustainability, food security, and the Indian government's role in these areas, shedding light on both current realities and future potential. The sustainable start-up landscape in India's food and nutrition sector is expected to grow (PWC, 2016; Margaret et al., 2019), driven by rising health and nutrition demands. As global population and urbanization increase, there is an urgent need for sustainable intensification of agriculture—producing more food on existing land—to meet future demands, particularly in the face of climate change and its potential to disrupt major food-producing regions (Foresight, 2011). Technological advancements such as blockchain, AI, and IoT are expected to play a significant role in this growth, improving food traceability, reducing spoilage, and enhancing distribution networks.

Start-ups play a transformative role in addressing food security in India, leveraging technology, innovation, and sustainable practices to tackle the complex challenges of nutritional security. The dynamic nature of start-ups allows them to respond to the specific needs of farmers, consumers, and communities, providing tailored solutions that optimize agricultural productivity, reduce food wastage, and promote sustainable farming practices. By embracing cutting-edge technologies such as AI, blockchain, IoT, and smart packaging, start-ups are revolutionizing the supply chain, improving transparency, efficiency, and ensuring that food reaches consumers in a fresher, safer, and more nutritious form.

Moreover, the ability of start-ups to innovate in product offerings—such as fortified foods, millet-based products, and plant-based alternatives—addresses both the nutritional needs and changing dietary preferences of the population. These innovations, coupled with their focus on traditional and natural farming methods, also emphasize sustainability, an increasingly critical aspect in today’s environmentally-conscious world. Start-ups are not only providing scalable solutions to food security but are also embedding social responsibility within their business models. By engaging local communities, forming FPOs, and promoting social impact initiatives, they are fostering economic empowerment and driving social change. However, only a small fraction of start-ups (around 30%) have successfully integrated sustainability into their long-term strategies, largely due to financial constraints.

However, the journey of start-ups in this domain is not without challenges. Issues such as market competition, consumer education, financial constraints, and regulatory hurdles present significant barriers. Despite these challenges, the opportunities in India’s agritech and food sectors are vast, particularly in the post-COVID era, where there is a growing demand for health-conscious, sustainable products. The role of the government and ecosystem support through funding, incubation, and policy frameworks is crucial in helping these start-ups scale their operations and achieve broader impact.

In conclusion, while start-ups play a crucial role in India's pursuit of food security, their contributions are not merely a panacea for immediate challenges. Instead, they are pivotal in building a sustainable and resilient food system for future generations. However, the transformative potential of these start-ups is contingent upon receiving robust support and strategic guidance from the ecosystem. Thus, based on the insights from the research, the themes generated and the scholarly documents, this study critiques existing frameworks and introduces the “Enabling Ecosystem”, a theoretical framework inclusive of Start-ups, NGOs, Corporates, Farming Community, Researchers and Academicians, Investors and Incubators. It is a framework based on reciprocating dynamics to address current shortcomings and enhance the system’s ability to foster sustainable food systems.

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APPENDICES

APPENDIX 1

(Interview Questions prepared by the Author)

Interview Questions for Start-ups:

Background: Could you briefly introduce yourself and your role within your start-up? **Company Overview:** What inspired you to start this company, and what problems does it aim to solve?

The Role of Start-ups in Food Security

1. **Mission:** How does your start-up contribute to addressing food security challenges in India?
2. **Impact:** Can you share specific examples or data that showcase your impact on food security?
3. **Innovations:** What innovations or technologies does your company employ to tackle food security issues?

Sustainability

1. **Sustainable Practices:** How does your start-up incorporate sustainability into its operations and strategies?
2. **Challenges:** What challenges have you encountered in maintaining a balance between sustainability and business growth?
3. **Measurement:** How do you measure your start-up's success in achieving sustainability goals?

Policy and Ecosystem

1. **Government Support:** How have government policies influenced your start-up's development in this sector?
2. **Ecosystem:** What role do incubators, accelerators, and investors play in supporting your start-up?
3. **Collaboration:** Have you collaborated with other organizations, NGOs, or government entities to enhance your impact? How?

Challenges and Barriers

1. **Obstacles:** What have been the major challenges in scaling up your start-up and achieving your goals?
2. **Market Barriers:** How has market access or consumer behaviour impacted your business?
3. **Regulatory Hurdles:** What regulatory challenges have you faced while implementing your solutions?

Future Outlook

1. **Growth Plans:** What are your start-up's plans and how do you intend to expand or scale your impact? What factors do you and similar start-ups take into consideration for scalability and replicability?
2. **Trends:** What trends do you see emerging in the start-up space that could help address food security challenges more effectively?
3. **Advice:** What advice would you give to aspiring entrepreneurs looking to enter this field?

Interview Questionnaire for Nutritionist:

Section 1: Introduction and Background

1. Can you please introduce yourself and provide some background information about your work as a nutritionist?
2. What are your primary areas of focus within the field of nutrition?
3. How long have you been involved in addressing food security and nutrition issues in India?

Section 2: Understanding Food Security and Nutritional Challenges

4. How would you describe the current food security challenges in India from a nutritional perspective?
5. What are the key factors contributing to nutritional deficiencies and food insecurity in the regions you work in?
6. Can you highlight any recent trends or changes in nutritional status over the past few years?

Section 3: Role of Start-ups in Enhancing Nutrition and Food Security

7. In your experience, how are start-ups contributing to addressing food security and nutritional challenges in India?
8. Can you provide examples of successful start-ups that have made a significant impact on nutrition and food security?
9. What innovative solutions or technologies have these start-ups introduced to improve nutrition?

Section 4: Sustainability and Impact of Start-up Solutions

10. How sustainable are the nutritional solutions provided by start-ups in the long term?
11. What challenges do start-ups face in ensuring their solutions are both nutritionally beneficial and scalable?
12. How do start-ups address the environmental sustainability of their nutritional solutions?

Section 5: Collaboration and Support

13. How do you collaborate with start-ups to address nutrition and food security issues?
14. What kind of support (financial, technical, etc.) do start-ups need to succeed in providing nutritional solutions?

15. Are there any government or private sector initiatives that effectively support start-ups in this field?

Section 6: Impact Assessment

16. How do you measure the impact of start-ups on nutrition and food security in the communities you serve?
17. Can you share any success stories or case studies where start-ups have significantly improved nutrition and food security?
18. What metrics or indicators are most important when assessing the effectiveness of start-up solutions from a nutritional standpoint?

Section 7: Future Prospects and Recommendations

19. What future trends do you foresee in the intersection of start-ups, nutrition, and food security?
20. What recommendations would you give to new start-ups looking to enter this space to improve nutrition and food security?
21. How can the ecosystem (government, NGOs, private sector) better support start-ups in addressing nutritional challenges?

Section 8: Closing Thoughts

22. Is there anything else you would like to share about the role of start-ups in addressing food security and nutritional challenges in India?
23. How can researchers and academicians contribute to enhancing the effectiveness of start-ups in this sector?
24. Are there any specific resources or readings you would recommend for understanding the role of start-ups in improving nutrition and food security?

Interview Questionnaire for NGOs

Section 1: Introduction and Background

1. Can you please introduce yourself and provide some background information about your NGO?
2. What specific aspects of food security does your NGO focus on?
3. How long has your NGO been involved in addressing food security issues in India?

Section 2: Understanding the Current Food Security Landscape

4. How would you describe the current food security challenges in India?
5. What are the key factors contributing to food insecurity in the regions you work in?
6. Can you highlight any recent trends or changes in food security over the past few years?

Section 3: Role of Start-ups in Addressing Food Security

7. In your experience, how are start-ups contributing to addressing food security challenges in India?
8. Can you provide examples of successful start-ups that have made a significant impact on food security?
9. What innovative solutions or technologies have these start-ups introduced?

Section 4: Sustainability and Scalability of Start-up Solutions

10. How sustainable are the solutions provided by start-ups in the long term?
11. What challenges do start-ups face in scaling their solutions to wider regions or larger populations?
12. How do start-ups ensure that their solutions are environmentally sustainable?

Section 5: Collaboration and Support

13. How does your NGO collaborate with start-ups to address food security issues?
14. What kind of support (financial, technical, etc.) do start-ups need to succeed in this sector?
15. Are there any government or private sector initiatives that effectively support start-ups in this field?

Section 6: Impact Assessment

16. How does your NGO measure the impact of start-ups on food security in the communities you serve?
17. Can you share any success stories or case studies where start-ups have significantly improved food security?
18. What metrics or indicators are most important when assessing the effectiveness of start-up solutions?

Section 7: Future Prospects and Recommendations

19. What future trends do you foresee in the intersection of start-ups and food security?
20. What recommendations would you give to new start-ups looking to enter this space?
21. How can the ecosystem (government, NGOs, private sector) better support start-ups in addressing food security challenges?

Section 8: Closing Thoughts

22. Is there anything else you would like to share about the role of start-ups in addressing food security challenges in India?
23. How can researchers and academicians contribute to enhancing the effectiveness of start-ups in this sector?
24. Are there any specific resources or readings you would recommend for understanding the role of start-ups in food security?

APPENDIX 2

Case Study Information List				
Case Study No.	Name	Headquarters	Function	Impact
CS_ 1	Dehaat	Patna	DeHaat is one of the fastest-growing start-ups in the Agri-Tech sector providing end-to-end solutions & services to the farming community in India. Building AI-enabled technologies to revolutionize supply chain & production efficiency in the farming sector.	12 Indian agrarian states with an extensive network of 11,000+ DeHaat Centers & 503 FPOs, serving 1.8 million+ farmers. Also provide AI-enabled crop advisory to farmers for 30+ crops in regional languages.DeHaat, notable for its comprehensive agricultural services, operates in 12 Indian states with 9500 centres connecting 500,0000 farmers and with high-quality inputs, expert advice, and market connections, significantly improving farm productivity.
CS_ 2	Ninja Cart	Bengaluru	Ninjacart is an Indian agritech company that connects farmers with retailers by transporting vegetables from farms to retailers across the country.	Ninjacart uses a network of over 200 collection centers and 1,200 warehouses to deliver more than 1,400 tons of vegetables daily to over 60,000 retailers in seven major cities in India.. Ninja Cart is India's largest B2B fresh supply chain company that links more than 800,000 farmers with 100,000 retailers, cutting post-harvest losses and ensuring fair farmer prices and fresh consumer produce in 120 cities of India
CS_ 3	InfiCold	Hapur, UP	Inficold design and manufacture cold storage, milk cooler and air conditioner with grid resilient and off-grid solar integration options.Inficold's cold storage solutions, claims being the first universal thermal energy storage enabling off-grid solar cold storage and milk	Inficold's bulk milk coolers can reduce greenhouse gas emissions by 23.6 MT CO_2 [4] annually. One customer's use of Inficold's Instant Milk Chiller reduced their carbon emissions by around 30%. Allowing high quality milk, high milk cooling capacities, significant reduction of overall cooling operations and reduced diesel consumption in case of grid failure. India has

			cooler solutions and helping farmers reduce post-harvest losses by 20%	over 100 M cattle owners, 125 M fruits and vegetable growers who can benefit from Inficold technology.
CS_ 4	Ecozen	Pune	providing portable solar cold rooms that help farmers store their produce. Reduces waste: Ecozen's cold rooms help farmers reduce the amount of produce they waste. Improves prices: Farmers can sell their produce for better prices by using Ecozen's cold rooms. Increases flexibility: Farmers can sell to a wider range of buyers or wait for peak prices. Increases income: Farmers can increase their income by at least 30% by using Ecozen's cold rooms. Promotes sustainable farming practices: Ecozen's technology helps promote sustainable farming practices.	Boosted the incomes of over 180,000 farmers but have also cut greenhouse gas emissions by 2 million tonnes and prevented more than 50,000 metric tons of food loss
CS_ 5	Feeding India	Mumbai	With the Poshan to Pathshala campaign, Feeding India is supporting schools for low-income families through daily meals. The goal is to ensure that all the children in their formative years gets the right nutrition for their holistic development.	Feeding India (FI) has doubled its impact. Currently, we are relentlessly serving over two lakh meals daily across 39 cities in India.
CS_ 6	HealthifyMe	Bengaluru	HealthifyMe is a mobile app that combines health services and technology to have a measurable impact on health and fitness.	It is the largest digital wellness platform in India and Southeast Asia, with over 35 million users in more than 300 cities. leading to a decline in 80% of lifestyle diseases

CS_ 7	Agro Star	Pune	AgroStar is an Indian AgTech startup that impacts farmers by providing access to agricultural products, expert advice, and markets	27% increase in farmer yields with the use of AgroStar advisory and products. 75%+ women workforce at AgroStar packhouses. <1% food wastage. enhance crop quality, increase yields by 30-100%, and reduce expenses.AgroStar innovate in food security, helping farmers with crop management solutions by using precision farming, empowering over 9 million farmers, reshaping agriculture's future
CS_ 8	Agri 10X	Pune	Agri10x is the world's first Artificial Intelligence & Blockchain enabled global e-marketplace connecting farmers with traders.	fair price, transparency and assists them in collecting real-time data to manage their harvests effectively ...
CS_ 9	CropIn	Bengaluru	an Indian SaaS-based AgTech to enhance transparency and traceability across the food supply chain, reducing contamination by digitizing over 16 million acres	Cropin has digitized 30 million acres of farmlands, positively impacting over 7 million farmers worldwide. Our crop knowledge graph, spanning 350 crops and 10,000 varieties in 103 countries, powers the Cropin Cloud in providing predictive intelligence for over 200 million acres of farmland globally.
CS_ 10	AMUL	Anand	**Amul's** farmer-owned cooperative model, with its Rs 72,000 crore success story, **can** be the key to unlocking India's true cooperative potential. The Amul Model has helped India to emerge as the largest milk producer in the world.	More than 16 million milk producers pour their milk in 185903 dairy cooperative societies across the country. Dairy cooperative AMUL supports 3.6 million milk producers through 18600 village milk cooperatives, ensuring fair prices and empowering local farmers
CS_ 11	Samunnati	Chennai	Samunnati and State Bank of India's Co-Lending agreement aims to enhance financing to Farmer	Samunnati works to solve these problems by providing financing, market linkages, and advisory services to more than 6,000 farmer collectives

			Producer Organizations.Helps agri enterprises towards growth and. transformation by offering Agri Commerce solutions in. addition to financial intervention.	
CS_ 12	Gram Cover	Noida	GramCover, an Indian insurtech company, impacts the agricultural industry by providing a shield against unpredictable forces of nature and safeguarding the livelihoods of farmers. GramCover's vision is to redefine the future of agriculture by ensuring food security in the face of a changing climate.	Gram Cover, a tech-enabled insurance market place for rural India covering over 3.2 million farmers in 13 states.
CS_ 13	Haqdarshak	Bengaluru	connects low-income Indians with the government welfare benefits they are eligible for: from disability pensions to crop insurance to education subsidies.	Haqdarshak Empowerment Solutions trains women to help citizens access welfare schemes, aiding over 500,0000 individuals and training 22,773 women, showing how start-ups can support underserved communities with essential services and education

Table. 1: Information on the Case Studies Used in the Research. Source: Author

APPENDIX 3

Interviewee's Information Sheet			
Interviewee No.	City of Operation	Role/Profession	Purpose/Function
1	Kerala	Start-Up Founder	Chemical-free & Nutritious oil
2	N/A	Industry Expert/Policy	Makes policies for the government and an expert in food tech
3	Jaipur	Nutritionist & Start-Up Founder	One-on-One Personalised nutrition and gym
4	Delhi	Start-Up Founder	100% Vegetarian Cakery and Bakery with catering services
5	Pune	NGO	Serves nutritious meals to underprivileged children with education
6	Ghaziabad	Nutritionist & Start-Up Founder	Women centric glow-up program for hormones and PCOD along with supplements
7	Delhi	Industry Expert/Academician	Food Technologist and Professor
8	Pune	Start-Up Founder	In-House grown organic food products
9	Pune	Start-Up Founder	Innovative bakery products and pasta using millets
10	Kanpur	Start-Up Founder	Fortified rice for government supply through PDS

Table. 2: Information of the Interview Participants. Source: Author