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A VIEW TOWARDS AGRIPRENEURSHIP AND INSECTS

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ABSTRACT

Nearly 70% of the Indian population living in rural areas contributes substantially to the Indian economy. Agriculture is a major part of the livelihood in rural areas. Development of agriculture to entrepreneurship is considered "Agripreneurship". If farmers develop the quality of an entrepreneurship, they will show the major contribution to the economy of their nation. The possible way is shipment of agriculture to agribusiness at large scale. Farmers have to learn about advanced techniques like biocontrol pest management, organic fertilizer, vermin-compost, genetically modified animals and crops, technology and farming equipment and crop management tools to convert agriculture to a profitable business. Agripreneurship opens avenues for diversifying agricultural product-based services, including dairy farming, goat farming, sericulture, sheep rearing, floriculture, and fisheries. Engagement in agribusiness at both national and international levels extends beyond individual benefit—it contributes to increased income levels, generates employment opportunities in both rural and urban areas, and supports efforts to alleviate poverty and hunger. Furthermore, agriculture is heavily reliant on insects, which play a vital role in sustaining agricultural systems. Insects provide essential ecosystem services such as pest control (biocontrol), nutrient recycling, seed dispersal, bioturbation, and pollination, all of which are crucial for maintaining agricultural productivity and ecological balance.

Key words: Agripreneurship, entrepreneurship, agriculture, insects.

INTRODUCTION

India ranks among the world's leading exporters of agricultural products. In the fiscal year 2020–21, the country's spice exports achieved a record high, demonstrating a growth of 17% in terms of U.S. dollar value and a 30% increase in volume (IBEF 2022e). India's agriculture and allied sectors continue to play a crucial role in the national economy, not only for domestic sustainability but also in global trade. In FY 2024, agricultural and food exports reached approximately US$48 billion, with the processed food segment alone contributing over US$8 billion (IBEF 2024a). The marine sector has positioned India as the world's fourth-largest exporter, with products reaching 130 countries (IBEF 2024b). Despite regulatory challenges, India remains the second-largest tea producer globally, with Assam and Darjeeling contributing significantly to exports (IBEF 2024c). The silk industry also holds economic and cultural importance, with Karnataka accounting for nearly 45% of India's mulberry silk production (IBEF 2024d). Furthermore, India is a dominant force in the global spice trade, consistently ranking as one of the top producers and exporters (IBEF 2024e). These figures reinforce the strength of India's diverse agricultural sectors and their integral role in economic growth and international trade.

India is one of the world's leading exporters of agricultural products, with rice accounting for over 19% of total agricultural exports in FY 2021–22, followed by sugar (9%), spices (8%), and buffalo meat (7%) (IBEF 2022a). The spice industry recorded significant growth with a 17% increase in export value and a 30% rise in volume in FY 2020–21 (IBEF 2022e). India is the world's second-largest producer of tea and silk, with the sericulture sector supporting nearly 9.76 million rural and semi-urban livelihoods (IBEF 2022c; IBEF 2022d).

Andhra Pradesh leads marine product production with 4.2 million metric tons in 2019–20, while Gujarat, Karnataka, Odisha, and Maharashtra also contribute notably to this sector (IBEF 2022b). Wheat exports surged to US$2.1 billion in FY 2021–22 from US$568 million in the previous year, reflecting robust export potential (IBEF 2022a). This diverse agricultural export portfolio highlights the critical role of agriculture in India's economic growth and global trade presence. Thus, India is the third-largest producer of agricultural commodities in the world.

However, good agricultural yield cannot be achieved without the contribution of insects, as they play a vital role in crop growth. Insects comprise the most diverse and successful group of multicellular organisms on the planet and contribute significantly to vital ecological functions such as pollination, pest control, decomposition, and maintenance of wildlife species (Nee 2004). The annual value of four ecological services provided primarily by native insects in the United States was estimated to exceed $57 billion—$0.38 billion for dung burial, $3.07 billion for pollination, $4.49 billion for pest control of native herbivores, and $49.96 billion for recreation (Losey and Vaughan 2006).

Insects have also been identified as an alternative protein source, from production to consumption (Gravel and Doyen 2019). Insects offer high protein value (40–60%) and additionally contain key nutrients such as zinc, amino acids, and vitamins. In pet food, insects can substitute for ingredients that provide these nutrients and even enhance the nutritional profile. Insects contain taurine, an essential amino acid typically found only in meat and fish. Edible insects may have superior health benefits due to their high levels of vitamin B12, iron, zinc, fiber, essential amino acids, omega-3 and omega-6 fatty acids, and antioxidants (Nowakowski et al. 2021).

In addition to their nutritional importance, insects have the potential to serve as a more environmentally friendly and sustainable nutrient source compared to other widely consumed animal-based proteins (Halloran et al. 2014). Insect proteins have many favorable attributes, such as high nutritional value and digestibility, while being environmentally sustainable due to low greenhouse gas and ammonia emissions (Oonincx et al. 2010). Moreover, insects contribute to ecosystems by aerating the soil, pollinating flowering plants, acting as predators, parasites, and parasitoids for pest control, and sometimes as pests themselves (Hill 2012; Scudder 2017; Raghavendra et al. 2022).

AGRIPRENEURSHIP AS EXPORT BUSINESS

Agriculture remains the backbone of the Indian economy. Although the overall economy has consistently grown at a rate exceeding 8% in recent years, the agricultural sector has experienced relatively stagnant growth, averaging around 2%. As the second-largest producer of fruits and vegetables globally, India holds significant untapped potential in the agricultural sector, which could benefit both domestic consumption and export markets (Kular and Brar 2012). In the Indian economy, agriculture plays a leading role in driving overall growth through its strong linkages with manufacturing and per capita GDP. The analysis shows that agriculture significantly influences other sectors, making it a key driver of economic activity and an essential focus for growth-oriented policies (Singariya and Sinha 2015). Punjab's agro-industry plays a crucial role in the region's economic development, demonstrating strong potential to fulfill both local demands and international export requirements. It serves as a significant source of income and employment, particularly for the rural poor, including smallholder farmers and marginalized or disadvantaged segments of society (Bharathi 2016).

India's major agricultural export commodities include basmati and non-basmati rice, oil meals, spices, cashew nuts, fresh fruits and vegetables, tea, and coffee (Shinoj et al. 2009). During FY 2016–17, India's export of fresh and processed food products was USD 0.40 billion, and the share of India's export of fresh and processed products in the overall export portfolio was 11% in the same year. Thus, the agriculture sector holds significant potential to contribute to national income while simultaneously offering direct employment and income to a substantial and vulnerable segment of the population. Agripreneurship plays a vital role in the economic system by enhancing productivity among smallholder farmers and integrating them into local, national, and global markets. This integration helps reduce food costs, minimize supply uncertainties, and improve the nutritional standards of both rural and urban populations. Moreover, agripreneurship acts as a catalyst for economic growth, income diversification, and the creation of entrepreneurial opportunities across rural and urban regions (Uplaonkar and Biradar 2015).

In Gujarat, approximately 10,755 village cooperatives collectively procure 6.1 million litres of milk daily from around 2 million members. One notable

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example, the Banas Dairy cooperative, began its journey by educating rural communities on cattle management and hygiene practices (Bowonder et al. 2005). During 2009–10, France was the major importer of Indian dairy products at ₹70.47 crores, followed by Italy (₹25.55 crores), Germany (₹15.96 crores), the UK (₹14.56 crores), and Denmark (₹12.62 crores). Among the nations, Turkey was recorded as a significant importer of Indian dairy products with ₹355.9 crores, followed by the United Arab Emirates (₹305.32 crores), Egypt (₹289.36 crores), Bangladesh (₹270.03 crores), and Bhutan (₹144.32 crores) (Madhavan et al. 2020).

Vermicompost serves as an effective organic fertilizer that enhances the physical, chemical, and biological properties of soil (Joshi et al. 2015). Plants have demonstrated significantly improved responses to vermicompost compared to other commercial potting or rooting media. Vermicompost positively influences a range of soil processes—physical, biological, and chemical—that directly affect plant growth. Moreover, plants treated with a combination of vermicompost and chemical fertilizers showed superior growth outcomes compared to those treated with either vermicompost or chemical fertilizers alone (Goutam et al. 2011).

Economic Value of Insects Through Their Provision of Ecological Services

Insects play a crucial role in agroecosystems by providing valuable services such as suppressing weeds and invasive herbivorous species, facilitating the decomposition of dead plant and animal matter, and enhancing soil quality. The economic value of these ecological services contributed by insects is estimated to be worth billions of dollars (Losey and Vaughan 2006). Scarabaeidae beetles are highly efficient decomposers of organic waste, contributing to enhanced forage palatability, nitrogen recycling, and the reduction of pest habitats. These ecological functions collectively provide substantial economic benefits to the cattle industry (Ratcliffe 1970; Fincher 1981). In the United States, nearly 100 million head of beef and dairy cattle are raised annually, with the estimated economic value of reduced nitrogen loss amounting to approximately $58 million. This valuation considers nitrogen's role in enhancing forage quality, increasing beef production, and its availability through fertilizer application or natural deposition via buried dung. Additionally, native pollinators—primarily bees—are estimated to contribute to nearly $3.07 billion worth of fruit and vegetable production. This estimate is based on a total production value of $50.5 billion and accounting for $7.5 billion in losses attributed to insect damage in North America between 1988 and 1990 (Yudelman et al. 1998). Estimating from North American data to the United States alone appears reasonable. The value of crop production was approximately USD 4,549.20 million, with the economic contribution of insect pollination valued at USD 1,235.06 million, accounting for 8.52% of the total agricultural GDP (Madau et al. 2020).

Lack of knowledge has diminished the use of biological pollinators, while the excessive use of pesticides has harmed efficient pollinators. Pollination services are provided by various insect orders, including Hymenoptera, Diptera, Lepidoptera, and Coleoptera. Non-bee pollinators encompass flies (Diptera: Syrphidae, Calliphoridae, Tachinidae, Empididae, and Muscidae), butterflies and moths (Lepidoptera), various beetle families (Coleoptera), and hymenopterans such as ants (Formicidae) and wasps (Calderone 2012). The total pollination service is quantified by multiplying visitation frequency by pollen deposition or fruit set per visit. Among crop flower visits, non-bee insects accounted for 38%, honey bees for 39%, and other bees for 23%. Although per-visit pollen deposition or fruit set was significantly lower for non-bees compared to bees, the higher visitation frequency of non-bees compensated for this, resulting in pollination service levels comparable to those provided by bees (Rader et al. 2015). Honey bees (*Apis* spp.) were the most frequently recorded pollinators, predominantly from temperate regions. Only 30% of these records were based on direct observations, while the remaining 70% originated from indirect analyses, such as pollen or honey samples collected from *Apis* spp. hives, stingless bee colonies, solitary bee nest cells, or from insect bodies and gut contents (Saunders 2018).

Global expenditure on pesticides exceeds US$30 billion annually (Kremen and Chaplin-Kramer 2007). The insect research and innovation agenda requires transforming existing academic knowledge—on both insect ecosystem services and disservices—into applications-driven science with socioeconomic

relevance. Insect research and development initiatives will provide a spark for landholders to manage crops more sustainably (Baptiste et al. 2016; Dangles and Casas 2019).

Insect as in forms of protein

Insects comprise more than half of all described species in the animal kingdom and account for a considerable proportion of all biodiversity on the planet (Stork 2018; Tihelka et al. 2021). Most existing studies have focused on the role of insects in human nutrition across Africa, Asia, and Latin America. Notable research has been conducted in Nigeria (Banjo et al. 2006) and Mexico (Ramos-Elorduy and Conconi 1994; Ramos-Elorduy 1997; Ramos-Elorduy et al. 1997, 2006). Additionally, Barroso et al. (2014) have contributed significant insights into this field. A vast majority of bats, birds, and freshwater fish rely on insects as a primary food source, while humans depend on insect pollination for the production of nutritious fruits and vegetables. Insects also have significant indirect effects, including their roles in nutrient cycling and mediating competitive interactions among plants (Forister 2019). Many insects are beneficial for humans, as they pollinate plants, produce useful substances, control pest insects, act as scavengers, and serve as food for other animals—and potentially for humans shortly (Manno 2018; Forister 2019).

The protein content present in lipid-extracted cricket powder has been studied and found to contain 63.43% protein, 20.86% fat, 4.65% ash, 7.56% carbohydrates, 3.50% moisture, and 472 kcal/100g (Amarender et al. 2020). It has been reported that edible insects belonging to the Orthoptera order can contain up to 7% protein (Rumpold and Schlüter 2013a). Protein content ranging between 52% and 76% (dry weight) has been documented for the larvae of yellow mealworm, adult cricket, and desert locust (*Schistocerca gregaria*) (Nongonierma and FitzGerald 2017; Zielińska et al. 2015). Protein hydrolysates, also referred to as peptones or peptides, are commercially utilized in various industries, including vaccine production, large-scale fermentation processes, and protein hydrolysis manufacturing. Insects contribute ecologically by aerating the soil, pollinating flowering plants, serving as predators, parasites, and parasitoids for pest management, while some also act as plant pests (Allsopp et al. 2008; Hill 2012; Scudder 2017; Raghavendra et al. 2022).

Conclusion

Since India is an agro-economy based country, nearly 70% of the population depends on agriculture for their livelihood and contributes 60% youth population. So, it needs to develop skills and techniques of farming and entrepreneur. Agriculture and agri-farming play a major role by rising day by day Indian economy by their product and services, besides this, insects play a major role in the agroecosystem providing a number of services, since lack of knowledge of insect ecology, demands for awareness about insect and their services. Since insects hold a substantial position in animal kingdom, studies on the nutritional values of some edible insects will generate data that will add to the available database of Insects nutritional contents, which will be of academic value for further references in future studies. Furthermore, the same data will reveal the commercial importance of the studied edible insects according to their nutritional values.

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