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Presenting the Cosmic Rays as a Fascinating Spectacle of the Cosmos in Cosmology

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Abstract

Although the name itself signifies that cosmic rays are streams or beam of rays emanating from cosmological terrain but evidences have made it clear that these are particles which traverse through interstellar expanse of space and bombards on the outermost province of the planet Earth. According to some explanatory research reports, these celestially emanating particles were initially available or ejected from space in the forms of atoms but later on they have experienced some alterations and their extreme external layers have been spontaneously snatched apart or became uncovered or exposed and the form in which they are now available on the Earth's exterior are the nuclei only bearing the characteristics of tremendously swift propagating particles, approximately nearer to the speed of the light waves. Most of the cosmic charged particles have been originated from the Sun and transmit through interstellar province by making collisions with the celestial entities but evidences endorsed the data that these charged particles are additionally emanated from galaxies or cluster of galaxies.

Keywords: *Beam, Bombardment, Cosmic Rays, Charged Particles, Interstellar Province*.

Introducing the Fascinated Cosmic Rays

The bombardment of the cosmic rays have been functionalized from the interstellar region of the cosmos and incident on the Earth's exterior periphery and consequently a little stratum of these being capable of striking the Earth's ground pervading the Earth's Magnetosphere, as illustrated by the astrophysicist S. Sharma in the year 2008 in the book named Atomic and Nuclear Physics as well as divulged in the Newsletter of UChicago News, in which it have been clearly mentioned that these beam of cosmic rays are an aggrandization of sturdy magnetic lines of force in the Earth's ambiance. Cosmic rays are strong energetic beams comprising of charged particles viz., electrons, protons, and atomic nuclei, closely related cosmic neutral particles such as photons and neutrinos etc. as per the data entailed in the *Newsletter of ISEE, Institute for Space-Earth Environmental Research, Nagoya University, where it has been brought about that these spectrum of charged particle rays* have been created by physically stirring particle accelerators abundant in nature and originated from outside

galaxies or external galaxy clusters, far-flanged colossal stars, as a consequence of supernovae explosion incurred in the cosmos, as captivated by a space researcher P. *Ginger, P. as endorsed on February 13, 2013, in a research- based piece of work entitled: "Evidence Shows that Cosmic rays Come from Exploding Stars" which have been* exterior to the Earth's periphery. These facts have been clearly revealed from a Science Daily, captioning with the header: "Detecting Cosmic Rays from a Galaxy Far, Far Away", in the very year 2017. The sturdy ionized stream of cosmic rays bombarding on the Earth's ground pervading the exceedingly strong Earth's Magnetosphere as mentioned in the *Newsletter of ISEE, Nagoya University* that these beam of charged particles have been emerged as Cosmic rays, are atomic fundamentals that strike on the Earth's surface as well as its ground as rain shower having its source of emanation exterior to the Solar System or more precisely the Milky Way, as per the data cited by astrophysicist and space scientist named E. Howell in his writing entitled: "What are Cosmic Rays", in the News Letter of Space.com. These ionized beams of subatomic particles conflagration the Earth's ambiance practically with the speed of light, as mentioned above in the Science Daily, entailing the document entitled: "Detecting Cosmic Rays from a Galaxy Far, Far Away" on September 21 in the year 2017.

More recurrently, in Astrophysics and Physical Cosmology cosmic rays have the illustrations as discharged beams comprising of charged flux particles coming from external terrestrial province that traverse through the cosmos in all permissible dimensions. These streams have been created by the Sun, as described by the astrophysicist and space scientist, S. Sharma in 2008 in the book, Atomic and Nuclear Physics. Additionally, the revelations regarding the fact that the explosions have been incurred in the stars and also expected to emanate from the black holes, the region of space where gravity is so strong that nothing can escape from it, as per the information entailed in the aforementioned book, in the book: Atomic and Nuclear Physics, Newsletter of UChicago News and along with the Science Daily, which gets brought out with the heading: "Detecting Cosmic Rays from a Galaxy Far, Far Away", in 2017. As per the perceptiveness publicized in the Newsletter of UChicago News, these streams progress exceedingly swift and approximately attaining the speed of light. As soon as these rays strike the Earth's exterior periphery, these beams of rays generally get confrontations by the Earth's ambience which made them non dangerous for the survival of mankind and other living organisms on planet Earth.

The Astrophysicists and space scientist are much more engrossed regarding these multifaceted cosmic rays since these streams of rays bring into light about many fascinating and unrevealed facts about the cosmos like from where these rays have been emanating and through which medium these beams of rays have been propagating, the characteristics of the interstellar province including the temperature fluctuations, the density, expanse of the medium of transmission etc. Moreover, the constituents of the interstellar medium with whom these beams of rays have been confronting before reaching the Earth's periphery, as these data envisions a

much about the origin, formation and structural constituents about the giant galaxies and the observable cosmos.

Our Earth experiences sturdy striking of trillions upon trillions of cosmic rays every day, as explicated in the *Newsletter of ISEE, Institute for Space-Earth Environmental Research, Nagoya University*. A massive expense of these particles get blockade by the Earth's magnetic field and its cosmic ambiance. However, a few of them become succeed in traversing the interstellar region by making collisions with the celestial entities and bombardment or strong strike on the Earth's outermost province. At this stage of bombardment of the cosmic discharge these charged particles validate the shower of some secondary particles and an insignificant stratum of them reach the Earth's ground, as per the information revealed in the vital sources of cosmic rays viz., in the book "Atomic and Nuclear Physics", authored by S. Sharma, the Newsletter of UChicago News and the conceptualized engrained theory on cosmic rays, initiated by Friedlander M.W. in his revolutionary appraisal: "Cosmic Ray".

Functioning of Cosmic Rays

When the cosmic rays strike the molecules present on the Earth's exterior ambience, these beams suffer some spontaneous disintegration that leads into outbreak of further secondary particles, during such process their energy states experience dissipation before reaching Earth's ground, as entailed in the data of the Newsletter of UChicago News. Available conventional detectors established on Earth rendering persistent services in investigating the trajectories of these bombardment particles.

Review of the Correlated Literary Groundwork and Experimental Evidences Incurred

Before the discovery of the fascinating stream of sturdy cosmic ray particles in the very early epoch of nineteenth century. It was French physicist Charles-Augustin de Coulomb who was the initial fellow who all of a sudden visualized an electrically charged sphere. At the very outset, air was supposed to an insulator and very conductor of electricity. With the progress of space science, Astrophysicists could come to the inference that air can serve as a good conducting medium of current electricity if and only if its constituent atoms are ionized. However, at that instant of time epoch, the origin of emanation of these charged particles was quite ambiguous for the whole scientists' world. In the Newsletter of UChicago News, it has been cited the name of the profound astrophysicist, Victor Hess, who on 7th August in the year 1912 performed an experimentation for which he flew a sky-scraping-altitude balloon to escalate to a height of 17,400 feet from the Earth's ground. During this experimentation, Hess come under the influence of large scales of ionized radiations which are aggregately thrice in the Earth's upper ambiance than experienced on the Earth's ground. His balloon experiment leads a benchmark result that such ionized radiations result from external terrestrial province.

The very nomenclature cosmic rays were initially coined in a research paper in the year 1925 i.e., about hundred years prior to today's era by a faculty member in the University of Chicago, USA who was also adorned with the prestigious Nobel Prize, named Robert Millikan, as per the insightfulness of the data, necessitated in the Newsletter of UChicago News, together with the astrophysicist V.F. Hess, in the year 1936 and this same space scientist in his Nobel lectures: "Unsolved Problems in Physics: Taska for the Immediate Future in Cosmic Ray Studies".

The actual observations for the existence and impact of cosmic rays in the cosmos were started in the year 1912, as knowledge gained in the Presentation Speech of Nobel prize in Physics in the year 1936 where an Austrian physicist named Victor Hess performed an experiment on blowing a balloon and flew it to attain an altitude which is higher than 17,000 feet, as revealed in the data of the Newsletter of UChicago News and confirmed that the balloon came under influence of additional radiation effects and hence the rate of radiation experienced fluctuations very significantly. His observance on a phenomenon regarding radiation and the mere source of emanation of such radiation effects from any province of the terrestrial terrain of the cosmos. For this revolutionary discovery, Victor Hess was awarded with the most prestigious Nobel Prize in Physics in the year 1936.

In the latter half of the 20th century, the University of Chicago aroused as the centre for designing and crafting of technologically engrained machineries for investigating cosmic rays. In recent years in 2013, NASA's Fermi Gamma-ray Space Telescope focussed analyzed inferences drawn from the investigations carried out on two supernova assortments observed in the Milky Way viz., IC 433 and W44, as data endorsed by E. Howell in the News Letter, Space.com. with the title: "What are Cosmic Rays".

Experimental Measures Employed in Detecting the Cosmic Rays

A quantifiable numeral of current experiments induced for the detection of the cosmic rays has been illustrated below:

The Pierre Auger Observatory Experimentation

The apparatus for this cosmic ray detector experiment has been located in the province of Western Argentina, the arrangement of which comprises of water reservoirs or containers stretching over an expanse of the area of Rhode's Island and a detector pointing towards the sky, as illustrated in the Newsletter of UChicago News. This detector which has been designed to grasp the Ultra Violet light rays being produced when the beam of cosmic rays strikes the Earth's ambience and subsequently these water reservoirs capture the signals as soon as cosmic rays tend to confront the water intakes. With an amalgamation of these two approaches, the Astrophysicists might be able to enumerate the energy level of the bombarding cosmic rays

and the very interstellar territory from which these have been approaching towards the Earth. This investigatory apparatus along with the embedded science was associatively put forwarded by Prof. James Cronin of University of Chicago, USA. The Pierre Auger Observatory in the very year of 2017, paved the means of access towards a vibrant escalation in the arena of Astrophysics and space research, could be encompassed, the apparatus of which is being spread greater than a measure of 3,000 square kilometres or 1,160 square miles, has been portraying the unremitting investigations of the influx trajectories of 30,000 cosmic ray ionized particles. The Cosmic ray detectors established all across the world in the most conceivable stations could reveal the utmost essential statistics regarding its constituent particles, the energy expanse associated with these bombarding cosmic radiations. Data revealed by NASA flourishes especially familiar elements abounding in the cosmos giving rise to a rough approximation of 90% of cosmic ray nuclei are composed of hydrogen (positively charged protons) and 9 % are helium i.e., alpha particles, as per the information flashed in the Newsletter of UChicago News, P. *Ginger on February 13, 2013 and the Newsletter of ISEE, Nagoya University, together with the information furnished from the* Goddard Space Flight Center, NASA. These two fundamental gas atoms are generally the most plentiful elements in the cosmos and also these elements arose to be the vital fuels for the genesis of these cosmological entities like the colossal stars, galaxy clusters etc., The remnant 1 % are supposed to be making up of heavier elements and this 1% strata serves as the research privilege for the scientists for the exploration of some sorts of exceptional elements to perform resemblance or divergence of criterions amongst numerous categories of emanating cosmic rays. The name of the Pierre Auger Observatory might be uttered in this context since this experimentation speculated some assortments of fluctuations in the influx trajectories of cosmic rays' bombardments in the year 2017, also delivered a number of insinuations or about where the rays could have originated.

The Large High Altitude Air Shower Observatory Experimentation:

This experiment started to function in a city named Sichuan in China in the year 2019. The systematic arrangement was plinth on one ground- established experimentation. The abbreviation LHAASO, captivated from the statistics of the Newsletter of UChicago News, standing for the **Large High Altitude Air Shower Observatory Experimentation** iconic for the purpose of cosmic rays detection tactic has been spreading over a huge plot of 300 acres and is premeditated to elevate air sprinklings from cosmic and gamma rays correspondingly. Since then, it has been operational and helping the space researchers to move a step forward in performing the investigatory analysis of the criterions of cosmic rays and its fascinated characteristics along with several associated facts.

The International Neutron Monitor Network Arrangement

It has been established as an incessant continual approach functional all over the globe where exceedingly there have been records of 50 devices, those recording unremitting statistics on neutrons formed from cosmic rays. The mechanism accentuates the space researchers to scrutinize inward space radiation. The U.S. cosmic ray detection stations are most popularly known as the Simpson Neutron Monitor Network, in respect of University of Chicago's former Prof. John A. Simpson's pioneering cosmic ray research databases, data publicized in the Newsletter of UChicago News. The live statistics entailing the records have been made available at the Neutron Monitor Database.

Supplementary Ground- Envisioned Observations

A few numerals of experimental evidences entail information concerning the multifaceted cosmic rays. Other subordinate experimental mechanisms search for definite subsets of cosmic rays. For instance, the experimentation, High Altitude Water Cherenkov Observatory or shortly HAWC, conducted in Mexico, explored for cosmic rays with exceptionally elevated energy strands ranging between 100 Giga electron Volt and 100 Terra electron Volt. Other devices demand for some nearer-products of cosmic rays, viz., the Very Energetic Radiation Imaging Telescope Array System, abbreviately VERITAS, information engrained from the Newsletter of UChicago News, carried out in Arizona, USA, capturing incoming gamma rays, a stratum of these being created and associated with the bombarding cosmic rays. The Ice Cube Observatories in Antarctica sought for neutrinos, which are often produced when cosmic rays knock at the environment, are some of the supplementary devices for the detection and carrying out research on the characteristics of charged cosmic ray particles.

Balloons:

Since the Earth's surrounding atmosphere obstructs with cosmic rays, so setting for more accurate experimentations, space observatory machine designers more frequently dispatch some instrumental tactics with balloons blown away from Earth's exterior surface. Such an experiment was initially functioned with Victor Hess' prominent flight experiment conducted above the Paris sky in the year 1912. Right the way through the 20th century, space scientists have launched balloons to an assortment of altitudes to accumulate such statistics. In the present day, space scientists set put for joint venture with the University of Chicago, as published in the Newsletter of UChicago News and good numerals of other educational establishments work with NASA to launch cosmic ray detectors ahead of exceedingly high-altitude balloons—only a few miles from interstellar domain.

Satellites and Spacecraft:

Spacecrafts are intelligibly capable of acquiring measurements of cosmic rays additionally from the Earth's elliptical orbit or even from the approximately close proximity of the Solar System, data endorsed in the Newsletter of UChicago News. Artificial satellites for instance, China's Dark Matter Particle Explorer, abbreviately DAMPE, telescope is capable of extracting cosmic rays from the Earth's orbit. In this context, spacecrafts functioning as milestone viz., the Voyager 1 and Voyager 2 spacecraft, launched in the year 1977, endeavour the outermost province of our solar system, conceded devices to distinguish cosmic rays, another one named NASA's Parker Solar Probe has been functioning too to sketch the outermost territory i.e., the corona segment of the Sun.

An astronaut named Drew Morgan from NASA performed celestial space walks in order to implement investigation regarding effective continual functioning of the Alpha Magnetic Spectrometer or most abbreviately AMS-02, an instrument which has been employed to ascertain the cosmic ray beams from the International Space Station, as per the data revealed in the Newsletter of UChicago News.

Data Entailing the Source of Emanation of Cosmic Rays

Cosmic rays are persistently travelling across the Earth's atmosphere in every possible direction. The determination regarding the origin of these rays is quite ambiguous. Since these rays are an accumulation of charged particles, these rays get dragged in the region of Earth's exterior ambience by the strong magnetic field lines as soon as these charged particle beam of rays pass through the cosmological terrain, information gathered from the Newsletter of UChicago News. However, portrayal of deep investigation on the tracks of these rays enables the space scientists to enumerate their energies and utilizing this procedure, the Astrophysicists become capable of calculating the amount of forces needed in the acceleration of these particles surpassing the Earth's strong magnetic fields that renders the substantiation about the terrestrial province from where these rays have been originated and propagated across the cosmos. When the Sun sparkles with its blisteringly hot sun rays, the Astrophysicist have envisioned about the existence of cosmic rays striking on the Earth's ground, predicting that these particles have been bombarded from the Sun. However, investigations standardized about these particles of rays ejected from further interstellar regions where a massive stratum of these have been expected to originate from the galaxies and even beyond these. A significant extent of cosmic rays is being formed as soon as celestial substances fall into the tremendously huge black holes, from highly magnetized neutron stars or due to the collision of galaxies, as entailed in the Newsletter of UChicago News.

Data Envisioned by These Cosmic Rays about Our Observable Cosmos

Astrophysicist and space scientists have been manifested with these cosmic rays since they expose a heap of episodes ensuing in the cosmos. A quantifiable numeral of such celestial phenomenon takes account of:

The Real Scenario Concerning the Elementary Subatomic Particles

The space scientists around the world have been engaging in pervading the different behavioural characteristics of enunciated the very first discovery of subatomic particles exceedingly when the world was aware of only the three essential constituents of the nuclei of an atom viz., the electron, proton and neutron from the endorsed data of the Newsletter of UChicago News and M.W. Friedlander's conceptualized article entitled: "Cosmic Ray". In the year 1933, while the Astrophysicists were investigating cosmic rays in a cloud chamber, they exposed the humankind about the initial acknowledgeable antimatter, the positron and subsequently the muon. These unfasten the development of modern Particle Physics, which disentangle the complete investigatory spread of subatomic particles available in the observable cosmos.

Portraying a Scenario of Our Solar System

Investigating the cosmic rays helped the space researchers to reveal the concealed unexplored facts about our Solar System and its satellite Earth, its surroundings, close proximities, effects of Earth's Magnetosphere, the effects of solar wind or hot flux for survival of lives on planet Earth, the inner structure of Sun's ambiance as well as the exterior corona, the plasma constituents around the Earth's surface or the strong Debye Shielding, data flashed from the Newsletter of UChicago News.

The Constitution of the Cosmos Far and Wide Exceeding the Solar System

A fragment of the particles of cosmic ray streams arouses as an extraordinary prospectus podium in order to carry an analysis on the material substances that progress towards our Earth such as the long-tailed comets, nebulae etc., from far outside of the solar system as well as galaxy clusters. From the bombardment of these charged particle rays, space researchers can sketch an approximation regarding the quantity of matter substances of the cosmos and its additional supplementary constituents abundant in the cosmological ambience, as mentioned in the Newsletter of UChicago News and M.W. Friedlander's intellectualized piece of work entitled: "Cosmic Ray".

Unveiling the Mysterious Phenomena Executed in the Region of Giant Colossal Explosions of Space, Formation of Black Holes, the Genesis of the Solar System, Collision with Meteors etc.

It has been hypothesized that the charged particle stream of cosmic rays has been starting to originate subsequent to the execution of the largest explosion happening in the cosmos i.e., the supernovae, formation of tremendously massive black holes where gravity is so strong that nothing can escape from it and the collisions occurring among the cosmological objects like the striking of galaxies, in the ethe huge collisions incurred between planets, meteors and asteroids etc., data obtained from the Research done on these emanating cosmic rays from interstellar regions of space provides exceptional prospects to encompass knowledge concerning these celestial phenomena which are otherwise augmented as an impossible tactic for those space researchers around the globe, sensitivities achieved in the grained data of the Science Daily with the heading entitled: "Detecting Cosmic Rays from a Galaxy Far, Far Away" in the year 2017. A few infrequent happenings incurred in Earth's ambience are the very sturdy cosmic rays confronting with the meteors, as a result of which the meteors get decomposed and those fragments that are falling on the Earth's ground leads the space researchers to entail a lot of information corresponding to the facts viz., the time interlude of how long these meteors have been falling on the ground, their velocity of propagation across the space, their momentum on reaching the ground and the force at which these chunks have been colliding with the ever present and traversing cosmic rays etc., which portrays a much more informative data regarding the ambience of our Solar System and the associated cosmological matters confronted on their way before arriving the Earth's ground. This led the Physics to elevate a step forward towards a new escalated era.

Classification of Cosmic Rays

The classification of cosmic rays can be bestowed upon two major categories, viz.,

Galactic and Extragalactic Cosmic Rays

These are extremely escalating energy engrained particles originated and ejected from exteriorities of the Solar System.

Solar Energetic Cosmic Ray Particles

These have been aggrandized as predominantly elevated -energy based proton particles, secreted by the Sun and fundamental source of theses rays have been lying in the primary solar outburst streams, data furnished in *the Newsletter of ISEE, Nagoya University*.These again be further sub-divided into major categories. Theses being:

Primary cosmic rays

These cosmic rays basically originated from exteriors of the Solar System and our Milky Way.

Secondary cosmic rays

The beam of cosmic rays as soon as gets confronted with oxygen and nitrogen atoms, abundant in the Earth's atmosphere. This collision gives rise to the surge of some secondary radiations like x-rays and the showering of alpha particles, protons, pions, muons, electrons, neutrinos and neutrons, information available *the Newsletter of ISEE of Nagoya University*.

Cosmic-ray flux

The cosmic rays striking on the Earth's exterior ambiance are chiefly due to the superfluous solar beam of heat rays or flux due to the solar wind, the Earth's Magnetosphere and the energy associated with these beams of rays, from the insightfulness of *the Newsletter of ISEE of Nagoya University*.

Information and Mysteries Ascribed with Cosmic Rays

After a century's rigorous investigation carried out by the space researchers, the world researchers become familiar with a huge mass of data entailing cosmic rays. At the same instance, mysteries have also been acquainted with these innovations.

Information Encompassed Concerning Cosmic Rays

Composition Regarding Cosmic Rays

An approximate of 90% of these has been found to be positively charged protons or the hydrogen nuclei, 9% of them are comprising of helium i.e., another name for this fragment has been termed as alpha particles and 1% is rendered as nuclei of heavier elements such as iron known as HZE ions, as published by the Newsletter of UChicago News, *P. Ginger on February 13, 2013, American Association for the Advancement of Science and the* Goddard Space Flight Center, NASA in 2016. An insignificant remnant stratum of these rays has been proportioned as composed of stable particles of antimatter, examples of these being positrons and antiprotons, as perceptions archived from *the* Goddard Space Flight Center, NASA. While confronting with the Earth's ambiance, the sturdy beam of cosmic rays upon striking with the atmospheric atoms give rise to good quantifiable amounts of pions which eventually produces the muons as a process of decaying and nutrinos, furnished by *the* Goddard Space Flight Center, NASA. These pions get generated as the proton particles get intertwined inside the magnetic field lines of an assured magnetic field generated due to the shockwave incurred inside the

supernovae and smashed into one another, as the wisdom accumulated from the News Letter, Space.com by E. Howell in the article entitled: "What are Cosmic Rays".

Data Regarding Kinetic Energy (K.E.) of Cosmic Rays

The scientists of present epochs are now being capable of enumerating the kinetic energy of the bombarding particles while traversing the Earth's ambience. This energy is strictly relying upon the volume of the streaming charged particles i.e., the mass acceptable by these beams and the drifting velocity of propagation through the environment. Data entailed that this spanning between the extremities as less than 1 MeV (Mega-electron-Volt) and more than 1 EeV (Extra-electron-Volt.) by the astrophysicist and space researcher, M.W. Friedlander and H. Dembinski et al. As we know that electron volt (eV) is the energy acquired by an electron when it is accelerated through a potential difference of 1 volt.

However, the immeasurable bulk of cosmic rays expose dreadfully low-down energies, whereas there persist a few numerals with elevated energy levels. The uppermost energy bearing cosmic rays are on the subject of a hundred million times more energetic in comparison to the particles cracked in man-crafted colliders. In this context, a cosmic ray detector set up in Utah, detected a significant cosmic ray particle in the year 1991, being popularized by the name as Oh-My-God particle, mentioned in the News Letter of the UChicago News in due course of time was approaching extraordinarily near the speed of light as this particle had been striking into a cosmic ray detector.

$$\because 1eV = 1.602176634 \times 10^{-19}\text{Joule}$$

$$\text{K. E.} < 1\text{MeV} = 1 \text{ Million Electron Volts}$$

$$= 10 \text{ Lakhs Electron Volts}$$

$$= \ 1.602176634 \times 10^{-13} \text{ eV}$$

Also

$$\text{K. E.} > 1\text{EeV} = \text{Trillion terra electron volts}$$

$$= 1eV \times 10^{15}$$

$$= 1.602176634 \times 10^{-4} eV$$

Mysterious Side Associated

There are some hot spots of cosmic rays in the sky.

Large-scale investigations of cosmic rays recommend the existence of a quantifiable scorching or burning smudges in the sky that appear to construct extra cosmic rays compared to other rays, whereas researchers are still unaware regarding the object or objects that are appropriately be the source of such rays.

The Embedded Mysteries

Where cosmic rays come from:

A proportion of these rays are approximately evident to originate from the Sun which have been described as solar energetic particles. However countless cosmic rays emerge from different regions in the galaxy or yet from other galaxies or cluster of galaxies mentioned in the News Letter of UChicago News and the astrophysicist M.W Friedlander's conceptualized note on cosmic rays. It has been tricky to engross their occurring position since these suffer jumbled effects by magnetic field lines of the Earth's Magnetosphere on reaching the Earth.

The Mechanism Behind the Acceleration of the Utmost Energy Ensuing Particles:

Researchers are sometimes also the verge of some predictions in spite of proven results such as regarding the uppermost energy bearing particles where it is hypothesized that these may be produced in a particular category of galaxy, called starburst galaxy since they produce numerous stars. Other promising spring is super massive black holes which might be a star or additional material substance submerged or grasped into or submersed inside a black hole and subsequently cosmic rays are spew out from the fragments, captivated from the News Letter of UChicago News and the space researcher M.W Friedlander's speculated explanation on cosmic rays.

Effect on Planet Earth and Life Existences:

Trillions of cosmic rays strike the Earth's environments which are expected for the formation of clouds in the ambience. CERN's CLOUD Experiment, conceives artificial cosmic rays to learn the Physics at the rear of cosmic rays, data archived from the News Letter of UChicago News.

Up to date Missions Aggrandized by Humankind and Most Recent Perceptiveness Grounded on Cosmic Rays

The entrancing cosmic rays arouse as a subject specification of great exploratory research showground among the world's space researchers. The modern space scientists have been executing rigorous sophisticated experiments with a notion to eradicate this unalleviated interrogation spreading across the sphere to engrain further deep excavating research in this podium to reveal the pros and cons characteristics of these enthralling bombardment of cosmic interstellar radiation so as to protect the present era's humankind extending this to our successor strata. A major stratum of these bombarding cosmic rays has been deflected and get absorbed in the Earth's Magnetosphere segment along with while traversing across the Earth's ambience confronting with the potential ingredients of the Interstellar Medium of Space (ISM), due to which only a little fragment of these bombarding stream of cosmic rays reaches the

Earth's exterior periphery and consequently reaches the ground. This capita of cosmic rays reaching the Earth has been evidenced to be practically lesser amounts of radioactive isotopes of xenon naturally accessible in the Earth's external shell or strong magnetized shielding configuration such as the Debye Shielding. However, the undesirable situation might occur in the cases of prolonged space adventures to the planet Saturn, Jupiter and Venus (visibly nearer to our planet Earth in a clear night sky) etc. where these ionized cosmic rays might cause malfunction to the on-board computer equipment or any other software or mechanical devices, information endorsed in the News Letter of UChicago News.

Incessant investigations imposed on galactic cosmic rays furnished the information regarding the data flourishing the components of these categories of cosmic rays that entails that galactic cosmic rays are consisting of atomic ingredients i.e., the positively charged protons, negatively charged and orbiting the nucleus, are the electrons and together with the nuclei. Investigations have revealed that such galaxy emanated cosmic rays might be generated in giant explosions happened in the cosmos i.e., the supernovas. Investigations are carried out whether these streams of radiations have been created and ejected from additional cosmological sources like the galaxies or galaxy clusters. Studies have been continuing on these rays how these beams of charged particles being evolved in the gigantic explosions resulting in supernovas and exceedingly striking the Earth's ambiance with immense kinetic energies, data publicized by the *Goddard Space Flight Center, NASA in July 2017*. These are additionally expected to come from the geometrical nuclei structure of galaxies or even from the ruptures of gamma shaft of light beams.

The high-energy primary cosmic ray particles get confronted with atoms prevailed in the Earth's outer ambiance and very occasionally let a few strata of them to reach the Earth's close proximity region. Subsequently, a set of secondary particles are being started to originated and emanated from such crashing confrontations and eventually reach the Earth's ground, data engrained in the News Letter of the UChicago News, from the works of two diligent cosmologists viz., M.W. Friedlander and E. Howell in the News Letter, Space.com correspondingly. At this phase, an ambiguous causality arises as soon as these sturdy beams of cosmic radiations reach the ground and detected in the cosmic ray detectors placed for investigations across the globe, since it's being an issue of indistinctness to trace the accurate source of emanation of these rays. This is due to the case that the trajectories or paths of such ionized radiations might be altered as these rays travel via several magnetic fields which may be due to the Sun, the Earth's Magnetosphere, the Milky Way's and the perpetuation of the Solar System in the discernible cosmos, as information gathered by the space scientists M.W. Friedlander and E. Howell.

The space scientists from every feasible corner of the world have been persistently co-operating in setting up reverse tracing of trajectories or paths traversed by cosmic ray radiations leading to the source of emanation by inspecting at the ingredient components of cosmic rays. Scientists

become capable in figuring this out by staring at the spectroscopic signature flourished by each constituent nucleus divulge in their respective radiation spectrums and at a similar platform by weighing the diverse isotopes of essential elements that strike the cosmic ray detectors placed around the mostly plausible places.

The Astrophysicists and space scientists could predict or in true sense might be able to enumerate the time of emanation, the source of ejection and the proper instance relating to the more vivid information by pointing out the very appropriate instance of just being started to originate from the interstellar source could be materialized by speculating at the radioactive nuclei that suffer reduction or diminishing effects as time factor (t) becomes continually large. Scientists adopted a mechanism of measuring the half-life span of each nuclei of the ionized cosmic ray particles that provides an appraisal regarding time tenure that how long the cosmic rays has been traversing in the interstellar region of space.

National Aeronautics and Space Administration (NASA) has been setting up incessant space experimentations from time to time to explore the uncertainties standing up in front of mankind. With a notion to pervade such ambiguities, one of the spacecrafts launched by NASA in the year 2016 exposed that the major part of the cosmic rays are expected to be originated from comparatively from the adjacent massive stars constellation. Another advancement towards this showground was put forwarded by a spacecraft named Advanced Composition Explorer (ACE) that had been employed to distinguish some assortments of cosmic rays exhibiting a radioactive appearance of iron that had been acknowledged as iron-60 as illustrated by E. Howell in the News Letter, Space.com entitled: “What are Cosmic Rays”. A characteristic behaviour associated with such type of cosmic rays is that these suffer diminishing with respect to time factor. As these streams have been detected in the cosmic ray detectors on Earth so scientists have come to a research inference that these categories of cosmic rays have been emanated from a cosmological entity whose co-ordinates are not greater than a celestial remoteness of 3,000 light-years from.

The International Space Station congregated the launching of a telescope in the year of 2015 named CALorimetric Electron Telescope (CALET) which has been positioning to investigate the cosmic rays traversed across space with exceedingly greater energy contents, revealed by astrophysicist E. Howell in the News Letter, Space.com with a heading: “What are Cosmic Rays”. Just posterior to two years of this Telescopic setting up experimentation, another illustration of investigation can be cited in this stand which is Cosmic Ray Energetic and Mass, shortly by ISS-CREAM that has been launched to the International Space Station in the year 2017.

Balloons play an important role in establishing the presence of cosmic rays for instance, the Super Trans-Iron Galactic Element Recorder (Super TIGER) balloon experiment that had been corroborated by NASA’s Jet Propulsion Laboratory and a good numeral of educational

institutions, as demonstrated by E. Howell in the News Letter, Space.com. This balloon was flown quite a lot numeral of times, encompassing a record of 55 days' air travel over the aerial domain of Antarctica between December 2012 to January 2013 to investigate the presence, origin of occurrences, their characteristic behaviours etc. After six years in December 2019, the second flight of the Super TIGER-II cosmic ray experiment, flew above Antarctica for a tenure of more than a month, assembling helpful informatics regarding cosmic rays.

Interrogations Arising Amidst Support of Cosmic Rays

How far the cosmic rays are dangerous for the humankind?

Although a major stratum of the streaming cosmic ray beams has been bounced back or extricated (neutralized) by the Earth's ambience and sturdy magnetic lines of force, a few strata of them strike the ground, usually which have been producing no harmful effects as compared to other background radiation we are habitually exposed to, data engrained from the News Letter of the UChicago News, *Cosmic Ray, Newsletter of ISEE, Nagoya University,* L. Gil, International Atomic Energy Agency, Office of Public Information and Communication together with the *Goddard Space Flight Center, NASA, July 2017.* The human beings are further exposed to these rays at sky-scraping altitudes and while travelling inside an aircraft.

On the verge of crossing Earth's shielding bubble and approaching towards the far extent of cosmological domain, cosmic rays erect as an imperative topic of concern. Our India's ISRO, NASA, institutions and others research organizations are on a track of continuous investigation so as to give protection to both the astronauts and electronic machineries from cosmic radiation throughout prolonged space adventures. Here the scientists have predicted that cosmic rays might intermittently be responsible for computer malfunctioning through space travels.

Explorations Extrapolated on the Devastating Aspect of Cosmic Rays Explicated on Some Hypothesized Scenarios

As it has been analyzed regarding the ionized constituent atomic configurations of cosmic rays, data flourishing the energetic speculations or, pervading stretch of energy engrains fostering ionized shower on Earth's ground to degree of strength of bombardment on Earth's most exterior periphery, speculations reveal that these rays have been energetic enough to knock electrons out of atoms, thereby ionizing them. If the atom is part of electronics or computing equipment, this can change the performance of the electronics or cause a one-time error in a computer. If the atom is part of a living being, perhaps part of a DNA molecule, it could even spoil the biological structure of the living tissue, redirecting a probable consequence that might cause a mutation in the DNA, data accumulated from the News Letter of Space.com. In the following Fig.1, the powerful existence of cosmic rays in the cosmos has been depicted and its stimulus effects on technology engrained equipment has been presented with the help of

pictorial representation subsistent in the cosmological terrain on an on-board computer during prolonged space adventures, Mars Express and also on the Rosetta Spacecraft which was launched on 2nd March 2004, manufactured by the European Space Agency (ESA) and the mission was designed to investigate a comet which was the first attempt perceived by the ESA to explore a comet. As a part of this mission, the Rosetta got successful to situate on a comet, track it in its orbit while revolving around the Sun and finally succeed in situating a lander on the surface of the comet, information furnished by the *Rosetta, ESA'a Comet-Chaser*. The Fig. 1 is an edited version of the info graphic of ESA, information gathered from the News Letter of the UChicago News.

Effects of Cosmic Rays on the Planet Earth and Eventually on the Complete Cosmos

Scientists are expectant regarding the impacts of cosmic rays on the cosmos in a large number of possibilities. Some of them have been mentioned under:

Space scientists have enumerated that cosmic rays are most likely to cooperate a lot in the formation of stars, more and more planets around distant stars and the lighter matters by a process of heating up the interstellar matter present in the cosmological terrain.

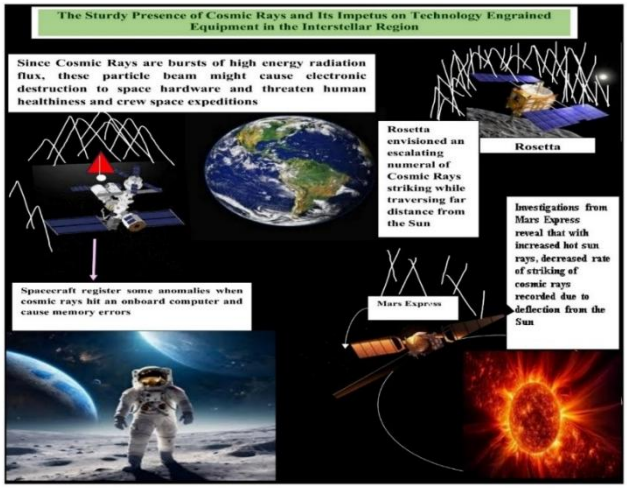

Fig.1

Cosmic rays also affect our planet Earth extensively. A strata or percentage of these are major source of radiation experienced at every single corner on planet Earth. Space researchers have predicted that cosmic rays are also responsible in escalating the temperature levels of the stars which are relatively nearer to the Earth by heating the interstellar medium of the cosmos.

Scientists have demanded that cosmic rays also portray an efficacious role in forming the clouds in the near and far proximity of Earth's aerial domain.

An Incessant Progression in the Field of Cosmic Ray Research for Future Generation

The origination and sources of emanation of cosmic rays are still persisting as a perception of abstruseness in front of Astrophysicists and Space scientists. The propagation velocity of these beams of charged particles usually escalate in the subsistence of cosmic plasma and moreover at the same instance, its abundancy is typically higher in the cosmos in some specified regions of space such as the Solar province, the Earth's Magnetospheric region, the left-over supernova fragments after the huge colossal explosion incurred in stars etc., cosmic-ray acceleration mechanism is partly understood. The cosmic-ray acceleration mechanism has been invaded by mankind to some satisfied extent, however which is also not saturated. There erects two possible observational tactics viz., cosmic gamma rays and cosmic rays rendered from the Sun like solar neutrons to have a rigorous perception of the vital mechanism of how the particle acceleration mechanism gets executed in the cosmic plasma region, knowledge flashed in the acquaintances of the *Newsletter of ISEE, Institute for Space-Earth Environmental Research, Nagoya University*.

Therefore, in pursuance of this, setting for a journey in search of more appropriate data regarding the origin of these beams of cosmic rays is a sturdy research showground opened for the future as well as subsisting resilient generation across the sphere.

At long last the Additional Utilizations of Cosmic Rays

The cosmic ray muons have been utilized by humankind in attaining a rigorous and deep-penetrating knowledge about our ecological facts by which mankind can now be enable to accumulate knowledge concerning their geographical, natural, developmental progressions of varied ecological genetic species, engraining biological wisdom on flora and fauna kingdoms and additionally on organic strata. These have been encompassed in delving into the searching expanse of numerous innovative particles and also have been used in the regularization or standardization of detectors as well as investigational devices in Particle as well as Nuclear Physics**,** data entailed from the sturdy sources viz., *W. Atwell, S. Koontz and E. Normad E. (2013), astrophysicist I. Morison's work in the ground-breaking book named "Introduction to Astronomy and Cosmology", G. Bonomi, P. Checcia, M.* D*/Errico, D. Pagano and G. Saracino in their aggrandized research paper entitled: "Applications of Cosmic Ray Muons", Progress in Particle and Nuclear Physics in May 2020.*

Cosmic ray engrained Neutron Sensors are utilized in supervising the moisture deposition of the soil for further efficacious cultivation techniques and irrigation procedures.

Cosmic rays are also used to Carbon-14 Dating mechanisms, which can help to enumerate the ages of archaeological architectural marvels, glaciers and many antique establishments. A practical aggrandization can be uttered in this context which portrays a schematic scenario. It

was the year 2017 in November when a squad of research aspirants exposed a potential cavity in the antique structure of the Great Pyramid of Giza in Egypt that had been built approximately 2560 B.C. The group of research propitious became capable of detecting this kind of cavity or annular fracture with the implication of muon tomography mechanism, which employs cosmic rays in an appropriate podium and imply their penetrating strengths in invading solid structures.

Conflicts of Interest:

The author of this paper declares no conflicts of interest.

References:

1. Sharma, S. (2008)., "Atomic and Nuclear Physics", Pearson Education India, pp. 478, ISBN: 978-81-317-1924-4
2. Newsletter of UChicago News. http://news.uchicago.edu/explainer/what-are-cosmic-rays
3. *Newsletter of ISEE, Institute for Space-Earth Environmental Research, Nagoya University* http://www.isee.nagoya-u.ac.jp/en/research/study01.html.
4. Science Daily, "Detecting Cosmic Rays from a Galaxy Far, Far Away", September 21, 2017, Retrieved December 26, 2017.
5. *Ginger, P. (February 13, 2013), "Evidence Shows that Cosmic rays Come from Exploding Stars", (Press Release) Washington, D.C., American Association for the Advancement of Science.*
6. *Cosmic Ray, Newsletter of ISEE, Nagoya University,* http://www.isee.nagoya-u.ac.jp/en/research/study01.html.
7. Howell E., "What are Cosmic Rays", News Letter, Space.com.
8. Friedlander M.W., "Cosmic Ray", http://www.britannica.com/science/cosmic-ray.
9. Hess, V.F., (1936) "The Noble Prize in Physics 1936", The Noble Foundation, Retrieved February 11, 2010.
10. Hess, V.F. (1936), "Unsolved Problems in Physics: Taska for the Immediate Future in Cosmic Ray Studies", Nobel Lectures, the Nobel Foundation, Retrieved February 11, 2010.
11. "Nobel prize in Physics 1936- Presentation Speech", Nobel Prize. Org.
12. December 10, 1936, Retrieved February 27, 2013.
13. "What are Cosmic Rays?" Goddard Space Flight Center, NASA, Archieved
14. from the original on 28 October 2012, Retrieved 31 October 2012, "Mirror Copy,
15. Also Archieved", Archieved from the Original on 4 March 2016.
16. Dembinski, H., et al. "Data-driven Model for the Cosmic Ray Flux and Mass
17. Composition from 10GeV to 10^{11} GeV" Proceedings of Science. ICRC2017:533,
18. arXiv: 1711.11432., doi: 10.22323/1.301.0533. S2CID 85540966.
19. Gil, L., "Cosmic Radiation: Why Should Not be Worried", International
20. tomic Energy Agency, Office of Public Information and Communication.
21. *Imagine the Universe! Goddard Space Flight Center, NASA, Text Updated: July 2017,* https://imagine.gsfc.nasa.gov/science/toolbox/cosmic_rays1.html.
22. *Rosetta, ESA'a Comet-Chaser,* http://www.esa.int/Science_Exploration/Space_Science/Rosetta.

23. *Atwell W, Koontz, S. and Normad E. (2013), "Practical Applications of Cosmic Ray Science: Spacecraft, Aircraft, Ground Based Computation and Control Systems and Human Health and Safety", AIP Conf. Proc. 1516, pp.107-116,* http://doi.org/10.1063/1.4792549.
24. *Morison, I., "Introduction to Astronomy and Cosmology", John Wiley and Sons, p. 198, Bibcode: 2008iac.book……M. (2008), ISBN: 978-0-470-03333-3.*
25. *Bonomi, G., Checcia, P.,* D/*Errico M., Pagano, D. and Saracino, G., "Applications of Cosmic Ray Muons", Progress in Particle and Nuclear Physics, Volume 112, May 2020, 103768,* http://doi.org/10.1016/j.ppnp.2020.103768.

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Inside the Investor's Mind: Behavioural Drivers of Retail Investment Decisions

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Abstract

Investment refers to the process of converting money into a monetary asset in order to earn profits and hence will generate revenues with increase in time**.** (Pandian and Thangadurai, 2013) To reach financial goals investors always like to strategies while selecting the appropriate investment avenues so that decent returns can be generated over a period of time. There are multiple factors which impact the decision making. Like risk, macro and micro factors, government policies, geo political scenario etc. This report discusses with the behaviour of Investors towards various Investment avenues of Central India during pandemic times. An empirical study has been conducted by to study the elements that impact investor's choices regarding various avenues available. Association of select demographic variables with determinants like economic factor, risk and third-party information studied in detail.

Keywords: *Decision making, Retail Investor, Investment, Savings, Financial Market*

Introduction

"Investing is crucial for future financial security. Poor decisions can lead to loss of hard-earned money. Therefore, you need investment knowledge and a judicious strategy. If you are unsure of how to plan your investments, consider enlisting a financial planner"

Source: Franklin Templeton India

People utilise investment as a strategy to allocate their funds with the goal of earning revenue. It is the method of generating profit from ideal laying resources by converting them into financial assets. Investment simply refers to people purchasing things for future use rather than present consumption, which is wealth creation. These assets are purchased in the hopes of generating income or profiting from their increasing value over time. Stocks, mutual funds, bonds, real estate, derivatives, jewellery, and art work are examples of investment assets. Each

investment object primarily serves three goals: safety, revenue, and expansion. However, each investment tool differs in terms of risk or benefits, and investors select the one that best suits their needs. It contributes to the general development of the economy by leveraging people's savings for development and productive purposes. As per research conducted by Mahalakshmi & Anuradha (2018) the traditional finance, Humans acts rational and try to utilize best option available in the times of uncertainty. Well-organized market hypothesis states that markets are efficient, and prices reflect all the available information however this contradicts to the reality in which humans tend to behave irrational. Behavioural finance tries to find out the causes for such irrational behaviour among individuals. Its concentration is on the psychological features of why such irrational behaviour arises among individuals. It is assumed that psychological biases have an influence on investment decision making which leads to less returns. It is also found that lack of information and memory errors has an impact on irrational decision making. The biggest questions in the mind of many investors are How should he decide and Where should he Invest? What are the different investment options available? This research will probably answer some of the questions as behavioural aspects will be covered.

Importance of Investment

Generates Income

People can rely on investment as a reliable source of income on a regular basis. One of the most essential goals of the investment process is to earn a return in the form of interest and dividends. Investors look for opportunities that offer a higher rate of return while posing a reduced risk.

Wealth Creation

Another key role that investing activity plays is the creation of wealth. It aids investors in accumulating wealth by allowing their cash to appreciate over time. By selling assets at a much greater price than the initial purchase price, investment aids in the accumulation of significant sums of money.

Tax Benefits

It allows customers to take advantage of numerous tax benefits while also saving money. Individuals are allowed to save up to Rs. 1,50,000 under section 80C of the Income Tax Act. Many people opt to invest in order to benefit from a variety of tax benefits.

Economic Development

Investment activities play an important role in the economy's overall development. It aids in the efficient conversion of people's ideal laying resources into productive ways. Investment is a means of bringing together people who have enough money and those who don't. It facilitates capital formation and contributes to the country's economic progress.

Meet Financial Goals

People can achieve their long-term financial goals with the help of investment activities. Individuals can simply increase their wealth by investing in long-term assets. Its primary goal is to provide financial security, increase wealth, and keep people on track for retirement by giving them with huge sums of money.

Literature review

Previous studies have examined a wide range of investment-related topics, including personal finance, mutual fund and bond performance, financial advisory services, risk assessment, tax planning, stock market valuation, diversification, global investing, and interest rate dynamics. Singh and Yadav (2016) observed that despite the breadth of available investment instruments, general college students exhibit limited financial knowledge and awareness. The literature also consistently reports gender-based differences in investment behaviour, with female investors tending to prefer less risky portfolios than their male counterparts, indicating a comparatively higher aversion to financial risk.

Research by Mahalakshmi and Anuradha (2018) further highlighted the influence of marital status on investment decision-making. Traditionally, investment and savings decisions were largely dominated by husbands; however, with increasing female workforce participation and income levels, women now play a more influential role in household financial decisions. Their study also confirmed that spousal influence significantly affects investment choices.

Earlier studies have emphasized the role of demographic factors in shaping investor behaviour. Halek and Eisenhauer (2001) found that variables such as age and income significantly influence investment decisions, while factors like marital status, education, and number of children exert comparatively less impact on investors' risk preferences (Geetha & Vimala, 2014). Complementing this, Vyas and Manish Mittal (2008) identified emotional and cognitive biases as key determinants of investment behaviour and established a relationship between investor personality traits and socio-economic factors (Geetha & Ramesh, 2011).

Investor awareness has also been examined in relation to demographic characteristics. Shobhana and Jayalakshmi reported that awareness levels among investors are not significantly

influenced by demographic variables but are strongly affected by occupational status (Selvi, 2015). In a related context, a survey conducted in 2008 revealed that price manipulation, market volatility, and corporate fraud or mismanagement were the primary concerns affecting household investors in India (Joseph & Prakash, 2014).

Studies focusing on investment preferences indicate a strong inclination toward safety-oriented instruments. Viswambharan (2009) suggested that investors should prioritise long-term investment avenues over speculative investments in stocks or real estate (Rao & Chalam, 2013). Similarly, Thangadurai and Pandian (2013) found that bank deposits remain the most preferred investment option, followed by gold and silver. Swarup (2008) further identified tax savings and capital safety as the most influential factors in investment decision-making, recommending greater transparency, investor education, professional guidance, and consistent returns to enhance investor confidence (Rao et al., 2013).

Identified Research Gap

A review of existing literature reveals that while extensive research has been conducted **on** investment behaviour, risk preferences, demographic influences, and financial awareness**,** several gaps remain unaddressed. Most prior studies have examined demographic variables such as gender, age, income, and marital status in isolation, without integrating them into a structured, hypothesis-driven research framework. Existing research has largely focused on investor preferences and awareness, yet it provides limited empirical evidence on how socio-economic and psychological factors jointly influence investment decision-making. Moreover, many studies tend to emphasise descriptive findings rather than rigorously testing statistical relationships between demographic characteristics and specific dimensions of investment behaviour. There is also a notable scarcity of region-specific empirical evidence, particularly in the Indian context that simultaneously examines the influence of factors like gender, income, education, occupation, and risk perception on investment decisions. Consequently, prior literature lacks a comprehensive linkage between demographic profiles and key behavioural outcomes such as risk tolerance, investment horizon, and product preference. This study addresses these gaps by empirically examining the relationship between key demographic factors and investment behaviour using a structured hypothesis-testing approach.

Research Methodology

Research Questions

What are the factors that influence the decision making of investors?

What is the influence of demographic factors like age, gender income and education on the decision making of investor?

Research Objectives

To identify the factors that influence the investors decision making
To study the demographic factors affecting the investment decision making

Hypothesis

Table 1

Research Gap Identified	Aligned Hypothesis Focus
Limited empirical testing of demographic factors and investment behaviour relationships	Hypotheses examining the association between demographic variables and investment decision-making
Gender-based risk preference findings are descriptive, not statistically validated	Hypotheses testing the relationship between gender and risk tolerance / investment choice
Insufficient integration of socio-economic factors with behavioural outcomes	Hypotheses linking income, occupation, and education with investment preferences
Lack of region-specific empirical studies in the Indian context	Hypotheses applied to Indian investors to validate contextual relevance
Over-reliance on awareness studies without behavioural linkage	Hypotheses connecting financial awareness and actual investment behaviour
Absence of a unified framework combining multiple demographic variables	Multiple hypotheses tested simultaneously using statistical tools (Chi-square test)

Table 1.1

Hypothesis Statement	
Hypothesis	**Statement**
H 1	There is no significant association between Economic Factor and Annual income
H 2	There is no significant association between Risk Tolerance and Age
H 3	There is no significant association between Third Party Information and Education
H 4	There is no significant association between Third Party Information and Gender
H 5	There is no significant association between Risk Tolerance and Income
H 6	There is no significant association between Economic Factor and Education

Data Collection strategy

This research work closely based on positivism philosophy as main focus of researcher is on quantifiable information. Approach of research is deductive as this study involves forming and then testing the hypothesis. (Saunders et al, 2012) Descriptive cross-sectional design is applied in this study. Convenience sampling and snowball method was used to collect data. individuals were asked to participate in survey to get the unbiased results. The survey was conducted in 7 cities of Central India namely Indore, Bhopal, Ujjain, Gwalior, Raipur, Jabalpur & Bilaspur. The sampling unit includes everyone whether male or female, married, unmarried, professional, homemaker, self-employed, employee, retired, home maker and person with at least 12 passed but must be above 18 years of age. 234 respondents participated in this survey.

Data Collection Tools

Data was collected using self-administered questionnaire which included close ended questions, by analyzing and comprehending all the determinants that might or might not affect consumer decision regarding investments. 14 dependent variables were identified using observation and secondary data sources which are mainly from past journal, books, newspaper. These variables were rated on 4-point Likert Scale. The respondents were asked to rate the factors that influence their decision making. Pilot test was conducted initially with 45 respondents to ensure high level of validity. Their views were incorporated in the final questionnaire.

The data was collected during last week of November 2025.

Data Analysis and Software

Various statistical analysis techniques such as Descriptive statistics, Reliability Test, Chi square analysis, KMO Bartlet, Factor Analysis, Mean Analysis were applied, which were processed through statistical software. Statistical Package for the Social Sciences (SPSS) 23.0 for Windows was used for analysis and test.

Table 2: Methodology Compendium

S.No.	Parameter	Brief Note
1	Type of Research	Descriptive cross-sectional design
2	Data collection method	Primary and Secondary (Mixed method)
3	Data Collection Time	November 2025
4	Research Instrument	Survey Questionnaire were sequential based for Hypothesis testing, Pilot study for validation of the Questionnaire

5	Survey Administration	Google Form
6	Instrument Validity Testing	Cronbach's Alpha
7	Sampling Type	Convenience sampling and snowball
8	Sample Size	234
9	Analysis	Reliability Test, Descriptive statistics, Mean Analysis, KMO Bartlet Test, Factor Analysis
10	Hypothesis Testing	Chi Square
11	Software Tools	SPSS Version 23

Data Analysis

The male respondent accounted for 49.6% and 50.4% of female respondents. Majority of respondents falls between 18 -45 age range. The statistics shows 42.7% of respondents were graduates and 44% were post graduates which means majority are well qualified. The occupation revealed 39.7 % respondents belongs to business/self-employed category followed by 41.9s% salaried respondents. Data of annual income reflecting that, respondents are equally divided between 5-15 lakhs and less than 5 lakhs. Close to 27.4% represent higher income group. (Refer Table 3 for detailed demographic profile).

Table 3: Demographic Detail

Gender				
	Frequency	Percent	Valid Percent	Cumulative Percent
Female	118	50.4	50.4	50.4
Male	116	49.6	49.6	100.0
Total	234	100.0	100.0	
Educational Background				
	Frequency	Percent	Valid Percent	Cumulative Percent
Post Graduate	103	44.0	44.0	44.0
Graduate	100	42.7	42.7	86.8
Under Graduate	22	9.4	9.4	96.2
12th and below	9	3.8	3.8	100.0
Total	234	100.0	100.0	
Age Group				
	Frequency	Percent	Valid Percent	Cumulative Percent
18 - 25	19	8.1	8.1	8.1
25-35	59	25.2	25.2	33.3
35-45	76	32.5	32.5	65.8
45-60	56	23.9	23.9	89.7
More than 60 years	24	10.3	10.3	100.0
Total	234	100.0	100.0	
Occuaption				
	Frequency	Percent	Valid Percent	Cumulative Percent
Business	93	39.7	39.7	39.7
Salaried	98	41.9	41.9	81.6
Student	10	4.3	4.3	85.9
Housewife	18	7.7	7.7	93.6
Retired	13	5.6	5.6	99.1
Other	2	.9	.9	100.0
Total	234	100.0	100.0	
Current Annual Income				
	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 5 Lacs	88	37.6	37.6	37.6
5-15 Lacs	82	35.0	35.0	72.6
More than 15 Lacs	64	27.4	27.4	100.0
Total	234	100.0	100.0	

Reliability Analysis

Reliability analysis was adopted to check the internal consistency. Value of Chronbach alpha is .613 thus it can be concluded that internal consistency of data is at desirable level as it is close to .7

Table 4 : Reliability Statistics

Cronbach's Alpha	N of Items
.613	14

KMO Bartlett's Test

This test is pre requisite for factor analysis and any value close or above .6 indicate that sampling is proper and value close to 1.0 means that factor analysis can be initiated. Based on Table 5 researcher decided to initiate factor analysis.

Table 5

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.608
Bartlett's Test of Sphericity	Approx. Chi-Square	399.492
	df	105
	Sig.	.000

Factor Analysis

The dimensions of influencing factors were measured by the 4-point scale, where 1 means "Most Important", 2 means "Important", 3 means "Least Important" and 4 means "Not at all Important". As per table 6, 14 variables make a combination of factors, variables with high Eigenvalue were extracted. As seen in the rotated component mix table 7, dimensions having Eigenvalue close to 0.7 i.e. are considered as high loading factors therefore, these variables are combined together as **six** main factors which are as follows

1. Industry oriented factors
2. Economic Factors
3. Third party Information
4. Income Level
5. Risk Tolerance

6. Adjunct factors

Details can be referred from Table 6 and 7.

Table 6: Factor Analysis Variance

Total Variance Explained									
Component	Initial Eigenvalues			Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.601	17.339	17.339	2.601	17.339	17.339	1.747	11.647	11.647
2	1.597	10.649	27.988	1.597	10.649	27.988	1.708	11.388	23.035
3	1.337	8.912	36.900	1.337	8.912	36.900	1.698	11.323	34.358
4	1.187	7.912	44.813	1.187	7.912	44.813	1.401	9.342	43.700
5	1.094	7.291	52.104	1.094	7.291	52.104	1.195	7.967	51.667
6	1.038	6.923	59.027	1.038	6.923	59.027	1.104	7.359	59.027

Table 7: Factor Analysis – Component Matrix

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
Factors Affecting Market Trend	.008	-.210	-.136	.671	.342	.074
Income Level	.103	.135	.095	.353	-.047	.599
Past Experience	.218	.130	-.016	.549	.010	-.013
Risk Tolerance	.024	.149	.191	.044	.800	-.016
InflationRate	.016	.388	.224	.089	.011	-.577
Interest Rate Scenario	.577	.086	.013	.208	-.163	-.490
Advisors Recommendations	.622	.131	-.058	.022	.392	.014
Economic Condition	-.132	.721	-.184	.097	.231	-.001
Tax Exposure	.152	.687	.112	.062	-.041	-.093
Goverenment Policies	.453	.505	-.042	-.024	.015	.096
Industry Growth	-.161	.227	.354	.623	-.226	.036
Customer Service	.434	.286	.376	-.188	-.023	.374
Books or Magazines or Journals or Newspapers	.134	-.210	.689	.133	.381	.001
Friends or Relatives	.078	.056	.851	-.032	.016	-.055
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.						
a. Rotation converged in 11 iterations.						

Mean Analysis of factors

Table 8: Ranking of factors based on Mean analysis

Mean Analysis - Post Factor Analysis				
Rank		N	Mean	Std. Deviation
1	Income Level	234	1.6667	.66810
2	Industry Oriented Factors	234	1.7350	.61306
3	Risk Tolerance Factor	234	1.8803	.80941
4	Adjunct Factors	234	2.0256	.69901
5	Economic Factors	234	2.0769	.58087
6	Third Party Information	234	2.1795	.87517
	lower the mean, higher the importance			

Above table is clearly reflecting that Income level is foremost important factor that influence the decision making of Investor to invest which is followed by industry-oriented factors and Risk tolerance. As per table Third party information like recommendations from friends, newspaper etc are not considered so important which is very important to note.

Testing of Hypothesis

Chi Square test applied on three dependent and three independent variables to understand there association.

Table 9

Hypothesis Testing - Chi Square			
Hypothesis	**Statement**	**Sig**	**Remark**
H 1	There is no significant association between Economic Factor and Annual income	0.174	Hypothesis Accepted
H 2	There is no significant association between Risk Tolerance and Age	0.401	Hypothesis Accepted
H 3	There is no significant association between Third Party Information and Education	0.783	Hypothesis Accepted
H 4	There is no significant association between Third Party Information and Gender	0.148	Hypothesis Accepted
H 5	There is no significant association between Risk Tolerance and Income	0.075	Hypothesis Accepted
H 6	There is no significant association between Economic Factor and Education	0.573	Hypothesis Accepted

At 5% significance level hypothesis H1 to H6 are accepted as value is more than .05, thus null hypothesis is accepted which means there is no association between these factors. It can be said that dependent factors like economic, risk, third party information are not getting influenced by their respective independent factors.

Mean Analysis – Reason for Investment

Table 10: Ranking of main purpose for making an investment decision

Mean Analysis - Reason for Investing				
Rank		N	Mean	Std. Deviation
1	Wealth Creation	234	1.3718	.67019
2	Long Term Growth	234	1.7094	.77581
3	Future Expenses	234	1.7393	.77819
4	Saving Tax	234	1.8932	.71863
5	Income and Capital Preservations	234	1.9316	.89564
6	Short Term Growth	234	2.1496	.86854
	lower the mean, higher the importance			

Based on above table it can be concluded that wealth creation is the most important reason for making investment decisions considered by respondents followed by Long term growth, future expense, saving tax and for generating some income while keeping capital protected (low risk). Short term growth is not that important reason for investing which means investors are not looking for immediate returns.

Conclusion

This Research has opened new idea and discussion on this much talked about subject globally. It can be concluded that demographic factors such as age annual income gender has no significant association with some influencing factors as suggested by hypothesis testing result. Key findings are as follows

1. Based on many observation and literature review 14 factors were identified that potentially influence that decision making of Investors.

2. Post factor analysis 6 major factors were identified. They are Industry oriented factors, Economic Factors, Third party Information, Income Level, Risk Tolerance and Adjunct factors
3. It was further found that Income level is foremost important factor that influence the decision making of Investor to invest which is followed by industry-oriented factors and Risk tolerance.
4. Surprisingly Third party influence is least which means friends and relatives recommendations, book, newspaper is not impacting the decision making while investing
5. Wealth Creation and long term goals are foremost important factors for parking savings.

Recommendations

- As government policy has an influence, it is recommended that the steps need to be taken by government to reduce interest rates, inflation and bring stability in the investment market.

- Ignoring the behaviour of people towards investment can be the biggest obstacle in the growth and economic development of the country.

- Companies especially in investment management , broking, Life insurance and Mutual funds must revisit their advert policy as in this research it was found that investors are not relying and they don't take advise of third party so seriously.

- Companies must focus on investment products which unlocks wealth and help customer in meeting long term goals. They are not craving for short term income any more. They must also design product for all income level.

Limitations

- The sample size is very small and restricted to a particular geographic location.
- The sampling selection is less diverse in terms of family annual income.
- Time of data collection is during COVID time so it may have some biases.

Further Study

This study can be extended and further explored by including other demographic factors like Marital Status, Religion, & Type of City and with other dependent factors.

References

1. Geetha, N., & Ramesh, M.(2011). A Study on People's Preferences in Investment Behaviour, *IJEMR*, November,1(6)
2. Geetha, S.N., & Vimla, K.(2014). Perception of Household Individual Investors towards Selected Financial Investment Avenues(With Reference to Investors in Chennai city) Procedia Economics and Finance,11,Science Direct, Retrieved from http://www.sciencedirect.com/science/article/pii/S2212567114002044,
3. Joseph, A., & Prakash, M. (2014). A Study Preferred Investment Avenues Among The People And Factors Considered For Investment, *International Journal of Management and Commerce Innovations*, 2(1),pp121-122
4. Pandian,V., & Thangadurai, G.(2013). A Study of Investors Preference towards Various Investments Avenues in Dehradun District, *International Journal of Management and Social Sciences Research (IJMSSR)*, 2(4)

5. Rao, P.V., and Chalam, G.V.(2013) Role of Independent Variables on Investment Decision of Equity Retail Investors, *European Journal of Commerce and Management Research,* 2(10),pn 217
6. Rao, PV., Chalam, G V., & Murty, T.N. (2013) Demographic Variables Influencing In The Retail Investors' Investment- A Scientific Analyses, *International Monthly Refereed Journal of Research In Management & Technology,* 2,pn 133
7. Selvi, T.(2015). Investors Attitude towards Investment Avenues, *International Journal of Management and Commerce Innovations,* 3(1),pn718
8. Saunders et al (2012). Research Methods for Business Students, 6th edition, Harlow, Pearson
9. Mahalakshmi, T. N., & Anuradha, N. (2018). Factors affecting Investment Decision making & Investment Performance among Individual Investors in India. International Journal of Pure and Applied Mathematics, 118(18), pp 1667–1675.
10. Singh. J., & Yadav. P (2016). A Study on the Factors Influencing Investors Decision in Investing in Equity Shares in Jaipur and Moradabad with Special Reference to Gender, *Amity Journal of Finance* 1(1), pp.118-131

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Sustainable Livelihood of Fringe Communities Around Manas National Park: An Application of the Sustainable Livelihood Framework

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Abstract

This study explores the sustainable livelihood patterns of fringe communities residing around Manas National Park (MNP) in Assam, India, using the Sustainable Livelihood Approach (SLA) as the analytical framework. The research aims to assess the availability, quality, and interaction of five core livelihood capitals—natural, physical, human, financial, and social—and how these affect household well-being, resilience, and development opportunities.

Fieldwork was conducted across two fringe villages—Bhuyapara, and Bansbari—using a mixed-methods approach, including structured household surveys, key informant interviews (KIIs), and focus group discussions (FGDs). Quantitative indicators were scored and statistically analyzed, while qualitative data provided insights into community perceptions and institutional dynamics. Findings indicate that while natural and physical capital remain strong due to fertile land and livestock ownership, financial and human capital are weak, reflected in low income levels, poor access to formal education and skills, and limited off-farm employment. Social capital remains moderately strong, with kinship ties and community networks aiding in resilience, but relationships with institutional stakeholders such as park authorities are underdeveloped and sometimes strained.

The study concludes that conservation policies in protected areas like MNP must be integrated with inclusive livelihood strategies to ensure long-term sustainability. Strengthening education, skill training, market access, and institutional cooperation is vital for empowering fringe communities as both beneficiaries and stewards of biodiversity conservation

Keyword*: Sustainable Livelihood Approach (SLA), Livelihood Capitals, Fringe Communities Manas National Park, Rural Development and Conservation*

Introduction

In recent decades, the global development agenda has witnessed a significant shift from conventional economic growth models toward more inclusive, people-centered strategies aimed at alleviating poverty and enhancing well-being. Among these, the Sustainable Livelihoods Approach (SLA) has emerged as a transformative framework, particularly in rural and marginalized contexts. Rooted in evolving perspectives on poverty, participation, and sustainable development, the concept of sustainable livelihoods transcends traditional income-

based indicators, emphasizing the dynamic interplay between people, their assets, institutional structures, and the environments they inhabit (Chambers & Conway, 1992; Scoones, 1998).

Initially introduced by the World Commission on Environment and Development (WCED) in 1987, the sustainable livelihoods concept gained momentum in the 1990s as development agencies, governments, and NGOs began adopting it to better address the complex realities faced by vulnerable communities (Litvinoff, 1988; Carney et al., 1999). Organizations such as the United Nations Development Programme (UNDP), the British Department for International Development (DFID), and CARE International played crucial roles in operationalizing the approach, blending insights from rights-based, governance, and participatory development frameworks (Alterelli & Carloni, 2000; Ashley, 2001).

This approach integrates diverse components—ranging from capital assets and livelihood strategies to policy processes and external shocks—into a cohesive analytical tool. It is particularly relevant in the context of the Millennium Development Goals (MDGs) and the broader push for equitable and sustainable development (Davies, 1996).

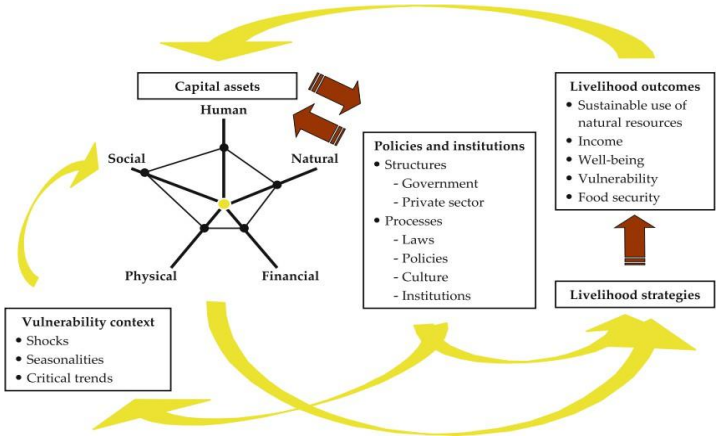

Figure 1: Sustainable Livelihood Approach
Source: Serrat & Serrat (2017)

The sustainable livelihoods approach (SLA) at Manas National Park facilitates the identification of practical priorities for conservation and development actions by considering the views and interests of local communities. While SLA is not a comprehensive solution, it complements other methodologies such as participatory development, sector-wide approaches, and integrated rural development. SLA establishes a crucial link between the people living near Manas National Park and the broader enabling environment that influences the success of their livelihood strategies. This approach highlights the inherent potential of the local population, focusing on their skills, social networks, access to physical and financial resources, and their capacity to influence core institutions.

This paper seeks to explore the evolution and application of the sustainable livelihoods approach, highlighting its theoretical underpinnings, practical implications, and potential to foster resilience and long-term sustainability among poor and marginalized populations. By analyzing its core principles and frameworks, the study aims to contribute to a deeper understanding of how development efforts can be reoriented from need-based assistance to empowerment-driven transformation.

Literature Review

The concept of sustainable livelihoods has evolved significantly over the past few decades, influenced by shifts in development thinking and global poverty reduction agendas. Rooted in Amartya Sen's (1981) work on capabilities and entitlements, the focus moved from income-based poverty measures to more holistic understandings of well-being and vulnerability. The World Commission on Environment and Development (1987) introduced the idea of sustainable livelihoods as a way to connect ecological integrity with the social and economic dimensions of development (Litvinoff, 1988). This integration was reinforced at the 1992 UN Conference on Environment and Development, which emphasized the interdependence between people's livelihoods and environmental sustainability.

In the late 1990s, several international development agencies, including UNDP, FAO, IFAD, and DFID, adopted the Sustainable Livelihoods Approach (SLA) as a guiding framework for development interventions. The SLA considers people's access to five types of assets—natural, social, human, financial, and physical—and how these assets interact with vulnerability contexts, institutions, and policies to influence livelihood strategies and outcomes (Carney et al., 1999; Scoones, 1998). According to Chambers and Conway (1992), a livelihood is considered sustainable when it can cope with and recover from stresses and shocks, enhance or maintain its capabilities and assets, and provide sustainable opportunities for the next generation without undermining the natural resource base.

This framework marked a departure from earlier needs-based models by centering the role of people and their capacity to drive change. It emphasized participation, resilience, and long-term sustainability over short-term relief (Carney, 1998). Various organizations have since adapted the SLA in their development programming, including Oxfam, CARE, and Development Alternatives, tailoring it to diverse sociopolitical and environmental contexts (Alterelli & Carloni, 2000).

Furthermore, scholars like Davies (1996) and Ashley (2001) have highlighted the utility of SLA in understanding the multidimensional and dynamic nature of rural livelihoods, especially in contexts where traditional agrarian practices are no longer the sole source of income. These contributions have helped shape rural development policies and practices by encouraging attention to diverse income streams, the role of institutions, and the broader socio-political ecosystem within which livelihoods are embedded.

The concept of *sustainable livelihood* has undergone significant evolution, especially in the context of poverty alleviation, environmental conservation, and community development. Drawing on Amartya Sen's (1981) capabilities approach, scholars and development practitioners began to shift from income-centric views of poverty to broader frameworks incorporating human agency, participation, and resource access. This reorientation became prominent in the 1990s, when global development efforts increasingly aligned with the Millennium Development Goals (MDGs), emphasizing poverty reduction and well-being enhancement through integrated strategies (Carney, 1998).

The *sustainable livelihoods approach (SLA)* gained prominence following the 1992 UN Conference on Environment and Development, which advocated for development frameworks that address both environmental degradation and socio-economic vulnerability (Litvinoff, 1988). The SLA was adopted and refined by several international agencies, including DFID, FAO, and UNDP, who emphasized the role of five key assets—human, social, natural, physical, and financial capital—in enabling individuals and households to pursue meaningful and resilient livelihoods (Scoones, 1998; Carney et al., 1999).

In the context of *forest-fringe communities in Northeast India*, particularly around Manas National Park, these frameworks offer critical insights. Local populations often rely on ecosystem services for daily survival, including fuelwood, grazing land, medicinal plants, and river-based resources (Sarkar & Das, 2020). However, conservation policies—especially strict protectionist approaches—have historically restricted access to these resources, causing friction between conservation authorities and local residents (Bhattacharya & Sinha, 2001; Sundar, 2000).

To address these tensions, the SLA encourages participatory conservation models that integrate local voices into planning and decision-making. Scholars argue that local communities possess indigenous ecological knowledge and, when properly engaged, can act as custodians of biodiversity (Berkes, 2004; Agrawal & Gibson, 1999). Furthermore, NGO-led interventions in the region—such as those by Aaranyak and WWF-India—have demonstrated that livelihood diversification through eco-tourism, weaving cooperatives, or community-based conservation can reduce dependency on forest extraction and improve conservation outcomes (Badola et al., 2012).

The role of institutions, both formal (government agencies) and informal (community networks), remains central to the success of sustainable livelihood interventions. Policies that enhance local tenure rights, equitable benefit sharing, and conflict resolution mechanisms have been shown to improve the resilience of forest-dependent communities (Holmes, 2011). Meanwhile, frameworks like the SLA provide tools for analyzing the vulnerabilities, asset bases, and policy landscapes affecting community behavior and wellbeing (Chambers & Conway, 1992).

In sum, the literature underscores the importance of integrating *people-centered approaches* into conservation policy. Applying the SLA in forest-edge zones like Manas enables researchers and policymakers to understand the nuanced interplay between ecological conservation, livelihood security, and social justice.

Overall, the SLA provides a robust framework for analyzing poverty, resilience, and sustainability at both micro and macro levels. Its strength lies in its people-centered approach and its recognition of the complex and evolving realities of communities dependent on fragile ecosystems and limited resources.

Methodology

This study employs the Sustainable Livelihood Approach (SLA) as the core conceptual framework to understand and assess the livelihood patterns, challenges, and potentials of fringe communities living around Manas National Park (MNP) in Assam, India. The research methodology integrates both qualitative and quantitative methods to provide a comprehensive analysis of various livelihood capitals — natural, physical, human, financial, and social — in relation to vulnerability, institutional context, and development outcomes.

Study Area

The research was conducted in two fringe villages surrounding Manas National Park in Baksa District, Assam — namely Bhuyapara, and Bansbari — selected due to their close interaction with the park and dependence on natural resources for livelihood.

Research Design

A mixed-methods approach was adopted, incorporating:

- Descriptive and exploratory design to map and describe livelihood strategies
- Participatory observation and household surveys for primary data
- Use of the Sustainable Livelihood Framework (SLF) to evaluate livelihood capitals and vulnerability context

Data Collection Tools and Techniques

Structured Questionnaire Survey

Conducted among households in the selected villages. The questionnaire included indicators across five livelihood capitals (as per SLF).

Key Informant Interviews (KIIs)

Conducted with local elders, NGO staff (e.g., Aaranyak), park officials, and cooperative members.

Focus Group Discussions (FGDs)

Organized separately with male and female members of the community to understand group-specific challenges and opportunities.

Observation:

Visual documentation through photographs of land, homestead, livestock, and local enterprises.

Sampling Technique

Purposive sampling was used to select the fringe villages.

Within each village, random sampling was applied to select households for surveys (ensuring representation based on caste, gender, and occupation).

A total of 17 households were surveyed.

Data Analysis

Quantitative data from household surveys were analyzed using descriptive statistics:

Mean, standard deviation, and percentage distributions were calculated to assess asset distribution.

Indicator-based scoring was applied to evaluate the status of livelihood capitals (Natural, Physical, Human, Financial, and Social).

Qualitative insights from FGDs and interviews were thematically coded to capture:

Vulnerability context (shocks, seasonality, critical trends)

Access to and use of institutions

Community perspectives on policy impacts and conservation

Livelihood Indicators

Indicators were developed for each capital asset. For example:

Natural capital: Land area, land quality

Physical capital: Homestead size, household assets, livestock ownership

Human capital: Education, skill training, health

Financial capital: Income level, off-farm employment

Social capital: Road access, social relationships, cooperative membership, relations with park authorities

Each indicator was scored on a defined scale (e.g., 1–5), and combined to provide a composite understanding of livelihood status in each village.

Ethical Considerations

Informed verbal consent was taken from all respondents.

Data were collected with full respect to local cultural norms and practices.

Identities of participants were anonymized during analysis.

Data Analysis

The data analysis section presents an in-depth interpretation of the information collected from tw fringe villages of Manas National Park — Bhuyapara, and Bansbari — using the Sustainable Livelihood Approach (SLA). The framework assesses livelihood status based on five capital assets: Natural, Physical, Human, Financial, and Social Capital. The analysis includes descriptive statistics (mean and standard deviation) for livelihood indicators and explains the interrelationships among variables affecting the livelihood outcomes of the fringe communities.

Livelihood Capital Indicators

The table below provides a summary of the key indicators, their definitions, and the corresponding statistical values derived from the survey.

Table 2: Summary of Livelihood Capital Indicators

Capital Type	Indicator (Code)	Description	Mean	Std. Dev
Natural	Land Area (C1)	Area of farmland in bighas	2.87	1.27
	Land Quality (C2)	1=Very poor to 5=Very fertile	3.58	0.493
Physical	Homestead Area (C3)	1=Below 100m² to 4=Above 200m²	3.55	0.441
	Family-Owned Assets (C4)	Number of assets like TV, fridge, cycle, scooter, etc.	2.6	0.51
	Livestock and Poultry (C5)	1=Yes, 0=No	0.9	0.5

Capital Type	Indicator (Code)	Description	Mean	Std. Dev
Human	Family Size (C6)	Total number of family members	4.25	0.946
	Skill Training (C7)	Participation in skill programs (1=Yes, 0=No)	0.2	0.40
	Education Level (C8)	1=Primary to 5=Postgraduate	1.42	0.714
	Physical Health (C9)	1=Healthy, 0=Major disease	0.75	0.433
	Medical Visits (C10)	Annual visits to the hospital	1	1.064
Financial	Off-farm Activity (C11)	Participation in business, shops, homestays (1=Yes, 0=No)	0.467	0.512
	Annual Family Income (C12)	1=Below ₹30,000 to 5=Above ₹3,00,000	1.92	0.84
	Cooperative Membership (C13)	Belonging to agri-coops (1=Yes, 0=No)	0.32	0.47
Social	Kinship Relations (C14)	1=Very poor to 4=Excellent relationship with relatives	1.77	0.90
	Road Condition (C15)	1=Paved, 0=Unpaved	0.6	0.49
	Transport Convenience (C16)	1=Low to 4=Very High	2.2	0.73
	Relation with Park Officials (C17)	1=Very poor to 4=Excellent	1.75	0.82

Natural Capital Analysis

Natural capital is foundational to the livelihoods in the MNP fringe areas. The average landholding of 2.87 bighas suggests a moderate ownership level, but the high standard deviation (1.27) indicates significant variation — some families own far more land than others.

The land quality, with a mean of 3.58 (on a 5-point scale), reveals generally fertile land, ideal for multiple cropping. Households grow paddy, vegetables, and cash crops such as mustard and chillies, enabling subsistence and limited surplus for market sales. However, vulnerability

to seasonal floods and erosion (especially due to the Manas River and Kurichu Dam overflow) poses a recurring threat to this capital.

Physical Capital Analysis

The homestead area averaged 3.55, meaning most houses are between 160–200 m². These are primarily *kacha* houses built with bamboo and mud, although some *pucca* structures exist due to government housing schemes.

Families reported ownership of 2–3 fixed assets on average (e.g., TV, bicycle, scooter), while 90% of households rear livestock or poultry, indicating diversified physical capital. Livestock (pigs, ducks, hens) is not only used for personal consumption but also sold during festivals or tourist seasons to generate income.

Human Capital Analysis

The average household size is 4.25 members, with a strong involvement in agriculture. However, education levels are low (mean = 1.42), pointing to primary schooling as the norm. This reflects intergenerational farming practices and poor access to higher education institutions like Salbari College, which is far from some villages.

Only 20% of respondents had received any skill training, mostly from NGOs like Aaranyak or Food Sutra (e.g., pickle making, homestay management, and traditional food catering).

Despite this, 75% of respondents reported good physical health. Annual hospital visits remain low (mean = 1) due to reliance on local healers and herbal medicine, but this also signals underutilization of formal healthcare.

Financial Capital Analysis

Income remains one of the weakest dimensions. The average annual family income falls between ₹30,000 and ₹90,000 (mean = 1.92), placing most households near or below the poverty line. Only 46.7% engaged in off-farm income generation, such as jeep driving, managing eco-homestays, or food service to tourists.

Membership in agricultural cooperatives is limited (mean = 0.32). While Baksa district hosts cooperatives like *Assam Vegetable Grower's Co-op*, awareness and participation are poor due to logistical and organizational barriers.

Social Capital Analysis

Kinship relations scored 1.77 on average, indicating moderate community trust and familial support. The road condition was mixed, with 60% of respondents accessing paved roads.

However, villages like Bhuyapara continue to suffer from poor connectivity, especially during the rainy season.

Transportation convenience (mean = 2.2) highlights that most people use limited but somewhat reliable transport options such as buses from Rupohi or trains from Sarupeta.

Most importantly, the relationship with park officials averaged 1.75. While some cooperation exists, villagers often feel excluded from park-level decision-making, and fear restrictions on access to forest resources.

Composite Livelihood Profile

By combining the five capital scores, the overall livelihood status of the fringe community shows a moderate but fragile sustainability. A breakdown of strengths and weaknesses is as follows:

Strengths

Fertile land and good agricultural knowledge

Livestock ownership and diversified farming

High level of physical health and social bonding

Weaknesses

Low levels of formal education and skill training

Poor access to financial services and market linkages

Weak institutional relations and infrastructure in some areas

Dependency on seasonal income sources (e.g., tourism)

Livelihood Outcomes

The expected livelihood outcomes in these fringe communities are:

Improved well-being through health and housing

Increased income during tourism months

Sustainable natural resource use, especially with eco-tourism

Reduced vulnerability via community solidarity and traditional knowledge

However, conflicting objectives (e.g., income generation vs. conservation rules) also exist. For instance, some locals feel economic strain due to restricted access to the forest.

Intercapital Dynamics

The five livelihood capitals interact in complex ways. For example:

Access to financial capital (loans for homestay construction) depends on social capital (cooperative memberships)

Education (human capital) directly influences the use of physical capital (modern tools)

Institutional processes (policy and governance) moderate the efficiency of converting natural capital (land, biodiversity) into income

Findings

This chapter presents the key findings of the study conducted in the fringe villages of Manas National Park (MNP) in Assam. The findings are organized based on the five capital assets defined in the Sustainable Livelihood Framework (SLF)—Natural, Physical, Human, Financial, and Social capital—and are supported by field data collected through household surveys, key informant interviews (KIIs), and focus group discussions (FGDs). The research aimed to evaluate the status of these capitals, their interconnections, and their influence on the livelihood outcomes of the fringe communities.

Natural Capital

Natural capital refers to the natural resource base upon which communities depend—land, water, forests, and biodiversity. In the MNP fringe communities, natural capital is both abundant and vulnerable.

Land Availability and Quality

The average landholding among respondents was 2.87 bighas, indicating moderate land ownership. However, land distribution was not equitable across villages, with some households owning significantly more land than others, leading to disparities in production and income.

The land quality received a mean score of 3.58 (out of 5), indicating generally fertile conditions conducive to cultivation. Paddy remains the dominant crop, with some families cultivating mustard, jute, and seasonal vegetables. The fertile nature of the land allows for crop diversity and household-level food security.

Agricultural Productivity and Dependency

Agriculture is the primary livelihood activity for over 70% of the population in the selected villages. However, productivity remains low due to traditional farming methods, lack of access to high-yield seeds, fertilizers, and modern tools. Most farmers reported no training from

extension services, and over half claimed no field visits from Agriculture Extension Assistants (AEAs).

Vulnerability to Environmental Hazards

The communities face severe vulnerabilities from seasonal floods, erosion, and waterlogging, especially due to the overflow of the Manas River and the Kurichu dam. Flash floods in 2004 and 2009 significantly affected crops, livestock, and housing. These events underline the fragility of the natural capital base in the region.

Physical Capital

Physical capital includes housing, infrastructure, equipment, and tools that support production and human well-being.

Housing and Homestead Area

Most households live in kacha houses made of bamboo and mud. The average homestead size was between 160–200 square meters, reflecting adequate living space, although infrastructure like sanitation, kitchen, and water supply remains basic and separate from the main house.

Household Assets

The average household owned 2–3 assets, such as a television, refrigerator, bicycle, or scooter. These items not only improve living standards but also enable access to information, mobility, and employment. A government scheme (Pragyan Bharati Scooty Scheme) was credited for increased two-wheeler ownership among girls completing their higher secondary education.

Livestock and Poultry

Livestock ownership was high (90%), with families rearing pigs, hens, ducks, and cows. Livestock is used both for household consumption and supplemental income. Pork, chicken, and milk are sold in local markets, especially during tourist seasons or festivals. However, disease outbreaks among livestock occasionally caused significant financial losses.

Human Capital

Human capital includes health, education, skills, and overall labor capability.

Family Structure and Labor

The average family size was 4.25 members, with both men and women contributing to agricultural labor. Children and elderly members also assist with farming or household tasks.

Gender roles were observed to be well-integrated, especially in traditional food preparation and livestock management.

Education

Educational attainment was low (mean = 1.42 on a 5-point scale). Most family heads had only primary or middle-school education. Poor access to schools beyond the middle level, combined with poverty and early marriage (especially among women), contributed to low levels of formal education.

Despite these challenges, there was a strong desire among parents to educate their children, although travel distance to higher secondary schools and limited quality of rural education were major barriers.

Skill Development

Only 20% of respondents had undergone any formal skill training. NGO-led programs like those of Aaranyak and Food Sutra attempted to impart livelihood-based skills (e.g., pickle making, bamboo craft, hospitality). While some success stories emerged—such as the Gunzema ethnic kitchen—most training initiatives saw low participation and follow-up, mainly due to time constraints and lack of motivation.

Health

A positive finding was that 75% of respondents reported being healthy, attributed to organic food habits, home-cooked meals, and active lifestyles. Traditional healthcare systems using herbal remedies and local healers (Baids/Ojhas) were preferred over formal medical systems. Annual hospital visits were low (mean = 1), largely due to distance from the nearest hospital (Salbari, 15 km) and perceived cost of treatment.

Financial Capital

Financial capital includes income, savings, credit access, and non-farm employment.

Income Levels

The majority of families fall into the ₹30,000–90,000 annual income category, with an average score of 1.92 on a 5-point scale. This places most households near or below the national rural poverty line, indicating fragile economic conditions.

Off-Farm Income

Only 46.7% of households engaged in off-farm income activities, such as homestays, guiding tourists, driving jeeps, or selling food/snacks. The proximity to Manas National Park offers

opportunities for eco-tourism, but these are seasonal and highly variable. Income from such ventures was often irregular and not sufficient to support the entire household.

Cooperative Membership and Credit Access

Cooperative membership was low (32%). Awareness about the benefits of agricultural cooperatives was limited, and many respondents expressed distrust or unfamiliarity with their functioning. Lack of access to credit, savings schemes, or financial literacy remains a major barrier to economic empowerment.

Social Capital

Social capital includes networks, trust, social support, and institutional linkages.

Kinship and Community Networks

Family ties and community cooperation were moderately strong, with a mean score of 1.77 (out of 4). Bodo kinship systems and collective decision-making practices facilitated community solidarity, especially in resource sharing, rituals, and agricultural cooperation.

Road and Transport Infrastructure

Road conditions were mixed—60% of respondents reported cemented or asphalt roads, while the rest dealt with unpaved, muddy tracks, especially during monsoons. Transport convenience scored 2.2 on a 4-point scale, indicating only moderate accessibility to markets, schools, and hospitals.

Villages closer to Rupohi Bus Stand or Sarupeta Railway Station enjoyed better access, while Bhuyapara remained underserved in terms of infrastructure.

Relationship with Park Officials

The relationship between the fringe community and park authorities scored 1.75, reflecting limited engagement. Most villagers felt excluded from conservation decision-making, particularly concerning access to forest resources. While a few respondents acknowledged the economic benefits from tourism and NGO collaboration, many felt that their traditional rights and livelihood sources were being restricted without adequate compensation.

Livelihood Outcomes and Interconnections

The findings reveal a complex and multi-dimensional livelihood system, with strong natural and social capital, but weak financial and human capital. Households adopt diversified livelihood strategies, combining farming, livestock rearing, informal trade, and seasonal eco-tourism. However, the lack of education, financial inclusion, and institutional support limits the potential for upward mobility.

Positive Livelihood Outcomes:

Increased food self-sufficiency through farming and livestock

Moderate housing security and good health status

High participation in informal networks and community events

Negative or Vulnerable Outcomes:

Low income and savings

Inadequate infrastructure and access to services

Limited formal education and skills

Weak integration with conservation policies and governance systems

Gender Roles and Livelihoods

Women played significant roles in food preparation, livestock care, marketing of forest produce, and homestay management. However, their participation in training programs and cooperative leadership remained low. Traditional norms and household responsibilities limited women's involvement in formal economic activities, though their contribution was substantial in informal livelihoods.

Conclusion

The study on the sustainable livelihood of fringe communities around Manas National Park (MNP) reveals a nuanced understanding of how rural households interact with their environmental, social, economic, and institutional contexts. Guided by the Sustainable Livelihood Approach (SLA), the research examined five critical livelihood capitals—natural, physical, human, financial, and social—to understand their interplay and influence on household well-being and long-term sustainability. The research highlights that natural capital is the strongest pillar supporting livelihoods in the region. Fertile land, biodiversity, and access to forests and rivers form the backbone of agricultural and forest-based livelihood activities. However, this strength is offset by significant vulnerability to seasonal floods, erosion, and deforestation, often exacerbated by external factors such as dam-induced flooding and climate variability. Physical capital, including housing, livestock, tools, and basic infrastructure, shows moderate development. Most homes are still traditional *kacha* structures, but households typically own essential physical assets and livestock, which serve as both food sources and income buffers. Despite these assets, road conditions and transport infrastructure remain poor in several villages, limiting market access and mobility. The study reveals that human capital—comprising education, health, and skills—is among the most constrained assets. Educational attainment is low, particularly among older generations and women, while skill development

programs have had limited reach and retention. Health outcomes are relatively positive, largely due to organic diets and traditional healing practices, but reliance on local remedies and minimal access to institutional healthcare reflect gaps in public service delivery. Financial capital is the weakest area of livelihood resilience. The majority of households fall below the poverty line, with annual incomes concentrated between ₹30,000 and ₹90,000. Only a small proportion of families engage in off-farm activities such as homestays, guiding, or handicrafts. Lack of credit facilities, poor financial literacy, and limited cooperative engagement constrain the ability of households to diversify their income and invest in livelihood improvements. On the other hand, social capital remains a strong unifying force. Kinship ties, mutual support systems, and informal community networks are deeply rooted and continue to play a vital role in resilience. However, relationships with formal institutions, especially park authorities and government agencies, are underdeveloped. Many community members feel excluded from conservation planning and policy decisions, which can lead to mistrust and resistance to conservation norms. The findings highlight the delicate balance between livelihood security and environmental conservation in the MNP fringe areas. While the region is ecologically rich and holds great potential for eco-tourism and sustainable agriculture, the socio-economic conditions of its residents reveal structural weaknesses that must be addressed for any conservation strategy to succeed in the long run. One of the key takeaways is that livelihood interventions cannot be isolated from local realities. Conservation efforts must be integrated with livelihood enhancement strategies that reflect the actual assets, risks, and needs of the communities. For example, promoting eco-tourism should involve training local youth, building better roads, and ensuring community ownership of enterprises. Likewise, restrictions on forest access must be accompanied by viable alternatives, such as market linkages for non-timber forest products or skill-based employment. The Sustainable Livelihood Framework proves to be a valuable tool not only for academic analysis but also for guiding policy and programmatic interventions. It shifts the focus from mere income generation to a more holistic view of well-being, emphasizing resilience, social inclusion, and long-term sustainability.

References

1. Alterelli, V., & Carloni, A. S. (2000). *Poverty and livelihood: From analysis to intervention*. Rome: FAO.
2. Ashley, C. (2001). *Pro-poor tourism strategies: Making tourism work for the poor*. Overseas Development Institute.
3. Carney, D., Drinkwater, M., Rusinow, T., Neefjes, K., Wanmali, S., & Singh, N. (1999). *Livelihoods approaches compared: A brief comparison of the livelihoods approaches of DFID, CARE, Oxfam and UNDP*. London: Department for International Development.
4. Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. IDS Discussion Paper 296, Institute of Development Studies.

5. Davies, S. (1996). *Adaptable livelihoods: Coping with food insecurity in the Malian Sahel*. Palgrave Macmillan.
6. Litvinoff, M. (Ed.). (1988). *The greening of aid: Sustainable livelihoods in practice*. London: Earthscan.
7. Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis*. IDS Working Paper 72, Institute of Development Studies.
8. Agrawal, A., & Gibson, C. C. (1999). Enchantment and disenchantment: The role of community in natural resource conservation. *World Development, 27*(4), 629–649. https://doi.org/10.1016/S0305-750X(98)00161-2
9. Alterelli, V., & Carloni, A. S. (2000). *Partnerships for rural development: The European experience*. Rome: FAO.
10. Ashley, C. (2001). Pro-poor tourism strategies: Making tourism work for the poor. *Overseas Development Institute*. https://www.odi.org/publications/1462-pro-poor-tourism-strategies-making-tourism-work-poor
11. Badola, R., Barthwal, S., & Hussain, S. A. (2012). Attitudes of local communities towards conservation of mangrove forests: A case study from the east coast of India. *Estuarine, Coastal and Shelf Science, 96*(4), 402–409. https://doi.org/10.1016/j.ecss.2011.11.016
12. Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology, 18*(3), 621–630. https://doi.org/10.1111/j.1523-1739.2004.00077.x
13. Bhattacharya, A. K., & Sinha, B. C. (2001). Sustainable development of forest fringe villages: A case study from India. *Indian Forester, 127*(12), 1415–1425.
14. Carney, D. (1998). *Sustainable rural livelihoods: What contribution can we make?* London: DFID.
15. Carney, D., Drinkwater, M., Rusinow, T., Neefjes, K., Wanmali, S., & Singh, N. (1999). *Livelihoods approaches compared: A brief comparison of the livelihoods approaches of the UK Department for International Development (DFID), CARE, Oxfam and the United Nations Development Programme (UNDP)*. London: DFID.
16. Chambers, R. (1992). *Rural appraisal: Rapid, relaxed and participatory*. Brighton: Institute of Development Studies.
17. Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. IDS Discussion Paper 296. Brighton: Institute of Development Studies.
18. Davies, S. (1996). Adaptable livelihoods: Coping with food insecurity in the Malian Sahel. *Macmillan*.
19. Holmes, G. (2011). Conservation's friends in high places: Neoliberalism, networks, and the transnational conservation elite. *Global Environmental Politics, 11*(4), 1–21. https://doi.org/10.1162/GLEP_a_00084
20. Litvinoff, M. (Ed.). (1988). *The green handbook: A guide to the world's best environmental practices*. London: Routledge.

21. Sarkar, D., & Das, S. (2020). Community engagement in ecotourism around Manas National Park, Assam: An inclusive approach for sustainable livelihood. *Journal of Environmental Research and Development, 14*(4), 1–10.
22. Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis*. IDS Working Paper 72. Brighton: Institute of Development Studies.
23. Sen, A. (1981). *Poverty and famines: An essay on entitlement and deprivation*. Oxford: Clarendon Press.
24. Sundar, N. (2000). Unpacking the "joint" in joint forest management. *Development and Change, 31*(1), 255–279. https://doi.org/10.1111/1467-7660.00152

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The Impact of Social Media Advertising and Influencer Endorsements on Consumer Purchase Behaviour in Sikkim

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Abstract

Social media has evolved into a powerful marketing platform, influencing consumer perceptions and purchase behaviours. This study aims to examine the impact of social media advertising-related factors on consumer purchase intention, with a focus on active social media users in Sikkim. The research specifically investigates five factors: frequency of advertisement exposure, trust in social media advertisements, influencer engagement, trust in influencer recommendations, and product review checking. A descriptive and cross-sectional research design was employed, and data were collected from 102 respondents using a structured questionnaire. The result of the Multiple regression analysis highlights that while the overall model is statistically significant (R^2 = 0.16, p =0.004), only trust in influencer recommendations had a significant individual impact (p =0.001). The findings of the study underline the significance of credible influencer endorsements in shaping consumer behaviour, and offer valuable implications for tailoring effective digital marketing strategies, especially in regional markets like Sikkim.

Keywords: *Social Media Advertising, Consumer Behaviour, Digital Marketing, Influencer Marketing*

Introduction

Over the past decade, social media has undergone a significant transformation from being a mere social networking platform to a powerful marketing tool. With over three billion active users on social networking sites such as Facebook (Statista, 2025), social media has become an integral part of a consumer's daily life and is playing a pivotal role in shaping their perceptions, preferences, and purchasing behaviour.

As businesses are increasingly relying on digital marketing, social media has become a key component for engaging with the target customers on a real-time and personal level. This has

resulted in a widespread use of digital marketing strategies such as paid advertisements and influencer endorsements, aimed at capturing the consumer's attention and boosting sales.

Social media influencers have become a vital component of digital marketing. Influencers, being relatable figures, allow businesses to connect with their target audience on a personal level and leverage their credibility and trustworthiness, thereby influencing consumer decision-making. Prior research (Saima & Khan, 2020) confirms that influencer endorsements have a significant positive impact on consumer purchase intention. The growing popularity of influencer endorsements provides an opportunity to understand the extent to which influencer endorsements influence consumer purchasing intention.

Beyond influencer endorsements, different social media advertising-related factors shape a consumer's behaviour and influence their purchase intentions. The frequency of ad exposure, trust in social media advertisements, engagement with influencer content, and trust in product recommendations and consumers' reviews play a crucial role in the purchase decision-making process. Exploring the collective impact of all these social media advertising-related factors provides a valuable understanding of how social media influences consumers' behaviours and offers valuable insights for digital marketing strategies.

Despite the extensive research on the aspects of social media advertising, region-specific insights, especially for a small region like Sikkim, remain underexplored. Understanding consumer behavioural responses can provide valuable insights for tailoring digital marketing strategies that are more effective and relevant in the localized setting.

Review of Literature

Understanding the significant impact of social media on consumer purchase decisions among younger demographics and Generation Z has garnered increased attention among researchers. Several studies have predominantly focused on the role of social media platforms and their perceived impact on consumer purchase decisions. Varghese and Agrawal (2021) underscored the role of platforms like Facebook and Instagram, noting that users rely heavily on content, product reviews, and brand interactions when making purchasing decisions. Visual content, influencer marketing, and online reviews on platforms such as Instagram and YouTube influence purchasing decisions, often leading to impulse purchases, as a result of the enhanced consumer trust in such content (Sharma, 2020; Singh, 2020). Consumers place a greater trust in the user-generated content than the traditional advertising, with several studies highlighting that recommendations from peers, social sharing, likes, shares, and reviews significantly enhance trust and increase the willingness to purchase (Voramontri & Klieb, 2019; Anuj, 2018).

The buying behaviour among consumers is also influenced by the interaction and engagement with brands, and plays a vital role in consumer buying behaviour. Consumers who actively engage with the brand content through likes, comments, and shares are more likely to trust the brands and are more likely to convert their engagement into purchases (Tirpude, 2022; and Sindhuja, Panda, & Krishna, 2023). Posts on Instagram that are engaging and contain customer testimonials significantly influence the purchasing decisions among young consumers. Studies have also highlighted that social media marketing induces impulse buying behaviour among consumers through emotional appeals, scarcity tactics, and influencers' endorsements. A well-executed social media promotional activity emphasizing time constraints and influencer endorsements effectively captures the attention of consumers, ensures brand recall (Putter, 2017), and prompts impulse buying behaviour among consumers (Bansal & Kumar, 2018).

Several studies have also attempted to explore the influence of social media within specific product categories. Arekar et al. (2018) explored the purchases of electronic products in India and identified that peer reviews, product comparisons, and information on social media platforms enable consumers to make more informed decisions. Imtiaz, Kazmi, and Amjad (2019) identified the effectiveness of visual content and influencer marketing in increasing the online clothing purchases among women in Pakistan.

The literature broadly supports the influential role of social media in consumer buying behaviour; however, region-specific research remains limited, especially in regions like Sikkim. Despite the extensive use of social media platforms, the impact of social media advertising and influencer endorsements among localized customers remains largely unexplored. This study attempts to bridge this gap by exploring how the social media advertising-related factors affect the consumer purchase intention in Sikkim. The subsequent sections outline the objectives, hypothesis, methodology, results, and discussions, and the conclusion is drawn at last.

Objectives

The present study has been carried out to address the following objectives:

1. To examine the impact of social media advertising on consumer purchase decisions.
2. To examine the impact of influencer endorsements and consumer purchasing decisions.

Hypothesis

Based on the stated objectives and the review of literature, the present study proposes the following hypothesis to be tested.

H_0a: There is no significant impact of social media advertising-related factors on consumer purchase intention.

H_1a: There is a significant impact of social media advertising-related factors on consumer purchase intention.

In the context of the present study, the social media advertising-related factors include the frequency of advertisement exposure, trust in social media advertisements, influencer engagement, trust in influencer recommendations, and product review checking.

Methodology

The present study adopted a descriptive and a cross-sectional research design to examine the impact of social media advertising-related factors on consumer purchase intention in Sikkim. A structured questionnaire was developed, which included items measuring five independent variables: frequency of advertisement exposure, trust in social media advertisements, influencer engagement, trust in influencer recommendations, product review checking, and purchase intention as a dependent variable using a 5-point Likert scale. The questionnaire was distributed using Google Forms using a convenience sampling method, and responses were collected from 102 active social media users residing in Sikkim. The data was analysed using SPSS, and a Multiple regression analysis was performed to assess the predictive power of the independent variables on consumer purchase intention. The results were interpreted using p-values, R-squared values, and Standardized coefficients, and Durbin Durbin-Watson statistic was used to ensure the validity and reliability of the regression model.

Results and Discussion

A multiple regression analysis was performed to examine the impact of five social media advertising-related factors – the frequency of advertisement exposure, trust in social media advertisements, influencer engagement, trust in influencer recommendations, and product reviews on consumer purchase intention among social media users in Sikkim.

Table **1** presents the results of the model summary for the multiple regression model.

The regression model was statistically significant, $F(5, 96) = 3.74$, $p = .004$, indicating that the predictors – frequency of advertisement exposure, trust in social media advertisements, influencer engagement, trust in influencer recommendations, and product reviews – reliably explained variation in consumers' purchase intentions. The model explains 16.3% of the variance in the purchase intention ($R^2 = 0.163$), indicating a modest but meaningful influence of social media advertising-related factors. The Durbin-Watson statistic was 2.248, suggesting no significant autocorrelation issues in the residuals.

Table 1: Model Summary for Multiple Regression Predicting Purchase Intention from Social Media Advertising-Related Factors

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df 1	df 2	Sig. F Change	
1	.404[a]	.163	.119	.907	.163	3.737	5	96	.004	2.248

a. Predictors: (Constant), frequency of advertisement exposure, trust in social media advertisements, influencer engagement, trust in influencer recommendations, and product reviews
b. Dependent Variable: Purchase intention after seeing an advertisement on social media

Table **2** presents the results of the multiple regression analysis examining the impact of social media advertising-related factors on purchase intention among the respondents. Among the five social media advertising-related factors, only trust in influencer recommendations significantly predicted the purchase intention among the consumers, $p = .001$ at 1% level of significance. This indicates that the consumers who place a higher trust in influencer recommendations are more likely to purchase products seen on social media.

However, the remaining social media advertising-related factors were not statistically significant. The frequency of advertisement exposure ($p = .789$), trust in social media advertisements compared to traditional media ($p = .190$), frequency of checking product reviews before purchasing ($p = .492$), and frequency of engaging with influencers ($p = .642$) did not significantly predict purchase intention among the respondents.

Based on the result of the overall regression model, $F(5, 96) = 3.74$, $p = .004$, we reject the null hypothesis and can conclude that when taken collectively, the social media advertising-related factors significantly predict the purchase intention among the consumers. However, when analysed individually, only trust in influencer recommendations ($p = .001$) was a significant predictor of purchase intention among the respondents.

Table 2: Multiple Regression Analysis Predicting Purchase Intention

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.714	.406		4.222	.000		

Frequency of advertisement exposure	-.021	.080	-.028	-.268	.789	.780	1.283
Trust in social media advertisements	.129	.098	.130	1.321	.190	.897	1.114
Product reviews	-.048	.070	-.075	-.689	.492	.734	1.362
Influencer engagement	.049	.104	.046	.466	.642	.907	1.102
Trust in influencer recommendations	.353	.106	.347	3.316	.001	.795	1.257
Dependent Variable: Purchase intention after seeing an advertisement on social media							

The findings of the present study provide valuable insights into consumer behaviour and highlight the influential role of social media and influencer endorsements. The findings highlight that trust in influencer recommendations (p = .001) is a significant predictor of consumer purchase intention and aligns with the existing literature (Saima & Khan, 2020; Putter, 2017). However, the other four variables - The frequency of advertisement exposure, trust in social media advertisements compared to traditional media, frequency of checking product reviews before purchasing, and frequency of engaging with influencers did not significantly predict the consumer purchase intention in Sikkim, which might highlight consumer scepticism and information overload on social media platforms.

The findings of the study are relevant in the regional context of Sikkim, where localized influencers hold more influence among the consumers. The modest R^2 value (16.3%), which is significant but otherwise suggests that while social media advertising-related factors play a role in influencing purchase intention among consumers, other variables might also play a significant role and can be examined in future research.

Overall, the findings of the study offer practical implications for marketers and highlight that collaborating with credible and authentic influencers with localized influence can increase engagement and conversion rates in terms of consumer buying behaviour.

Conclusion

The present study examined the impact of various social media advertising-related factors on consumer purchase intention in Sikkim and found that, while the overall influence of these factors was statistically significant, only trust in influencer recommendations had a meaningful individual impact on consumer purchasing decisions. These findings underline the importance

of influencer endorsements, indicating that consumers are more likely to be persuaded by trusted influencers. The study contributes to the existing literature by offering region-specific insights and reinforcing the growing relevance of influencer marketing in digital advertising strategies.

However, due to its cross-sectional nature, the study does not capture changes in consumer behaviour over time. Future research could adopt a longitudinal design and include a larger, more diverse sample to provide a more comprehensive and generalizable understanding of how social media and influencer endorsements influence consumer purchase intentions across different contexts and periods.

Reference

1. Anuj. (2018). Impact of Social Networking Sites and Online Purchase Intention: A *Quantitative Investigation. Psychology and Education, 55*(1), 701–709.
2. Arekar, K., Jain, R., Kumar, S. K., & Ayarekar, S. K. (2018). The Impact of Social Media Sites on the Effectiveness of Consumer Buying Behavior for Electronics Goods – A Study in India. *The Electronic Journal of Information Systems Evaluation (EJISE), 21*(2), 158–166.
3. Bansal, M., & Kumar, S. (2018). Impact of Social Media Marketing on Online *Impulse Buying Behaviour. Journal of Advances and Scholarly Researches in Allied Education, XV*(5), 136–139.
4. Basuroy, T. (2025, February 17). *Social media usage in India*. Statista. https://www.statista.com/topics/5113/social-media-usage-in-india/#topicOverview
5. Dhinesh, D., & Ashraf. T, M. (2024). Impact of Social Media on Consumer Buying Behavior. *Shanlax International Journal of Management, 11*(1), 134–138.
6. Imtiaz, R., Qurat Ul Ain Kazmi, S., & Amjad, M. (2019). The Impact of Social Network Marketing on Consumer Purchase Intention in Pakistan: A Study on Female Apparel. *Management Science Letters, 9*(5), 1093–1104.
7. Putter, M. (2017). The Impact of Social Media on Consumer Buying Intention. *Journal of International Business Research and Marketing, 3*(1), 7–13.
8. Saima, N., & Khan, M. A. (2020). Effect of Social Media Influencer Marketing on Consumers' Purchase Intention and the Mediating Role of Credibility. *Journal of Promotion Management, 27*(4), 503–523. https://doi.org/10.1080/10496491.2020.1851847
9. Sharma, K. (2020). Impact of social media marketing on consumer buying behaviour. *International Journal for Research in Applied Science & Engineering Technology (IJRASET), 8*(1), 472–475.
10. Sindhuja, P., Panda, A., & Krishna, S. V. (2023). Influence of Social Media on Consumer Buying Behavior. *International Journal of Scientific Research in Engineering and Management (IJSREM), 7*(8), 1–7.
11. Singh, R. (2020). Social Media and Consumer Buying Behaviour: Issues & Challenges. *International Journal of Engineering Research & Technology (IJERT), 8*(10), 50–53.

12. Statista. (2025, March 26). *Most used social networks 2025, by number of users*. https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/
13. Tirpude, R. R. (2022). Impact of Social Media Content on Consumer Buying Behavior and Purchase Intention. *Mukt Shabd Journal, XI*(IX), 637–649.
14. Varghese, S., & Agrawal, M. (2021). Impact of Social Media on Consumer Buying Behavior. *Saudi Journal of Business and Management Studies, 6*(3), 51–55.
15. Voramontri, D., & Klieb, L. (2019). Impact of Social Media on Consumer Behaviour. *International Journal of Information and Decision Sciences, 11*(3), 209–233.
16. Yang, Y. (2024). The impact of social media on consumer purchasing decisions. *Transactions on Economics, Business and Management Research, 8*, 179–187. https://doi.org/10.62051/bk13z779

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An Empirical Study On Child Labour In The Informal Sectors Of Agartala: Focus On The Rubber Industry, Hotels, And Tea Stalls

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Abstract

This empirical study sought to investigate the pervasive issue of child labour in Agartala, Tripura, with a particular focus on the rubber industry, hotels, and tea stalls. Aiming to explore the socio-economic conditions, nature of employment, and underlying contributing factors, the research employed a field-based qualitative methodology, incorporating semi-structured interviews with child labourers, their parents, and employers.

Findings indicated that extreme poverty was the primary driver, compelling children aged 9–14 from low-income families (Muslim and Hindu Scheduled Castes) into hazardous work for meagre wages. These children faced severe educational deprivation, with many never attending school or dropping out early due to financial constraints. They endured substandard living conditions, lacked basic amenities, and had limited access to healthcare. Parents, often in unstable, low-paying jobs or unemployed, frequently facilitated this labour due to immediate financial needs and a lack of awareness regarding child rights or government aid.

Employers, primarily motivated by cost-saving and the perceived obedience of children, engaged in informal recruitment practices, often disguising employment as "helping poor families" or "training." Child labourers were exposed to unsafe working environments, long hours, and psychological or physical abuse. This study highlighted a vicious cycle of poverty, inadequate education, and persistent exploitation. Recommendations emphasized enhancing parental livelihoods, providing educational support, and strengthening legal enforcement to break this cycle.

Keywords*: Child Labour, Agartala, Poverty, Exploitation, Informal Sector, Socio-Economic Conditions, Parental Roles, Rubber Tappin, Tea Stalls*

Introduction

Any economic activity carried out by children under a specific age that interferes with their education and jeopardises their physical, mental, moral, and social well-being is considered

child labor, especially illegal employment (ILO, 1973). Under 1973's Convention No. 138, the International Labour Organisation (ILO) established a minimum employment age of 15 years, with light work permitted as early as 13, provided that it does not impair the child's development or limit their access to education (ILO, 1973). However, India's extreme poverty frequently compels families to put their young children to work to supplement household income. Due to this economic pressure, children are forced to work in dangerous and exploitative settings, including houses, factories, and commercial buildings.

Child labour in Agartala, particularly in the rubber industry, roadside hotels, and tea stalls, is symptomatic of the broader socio-economic conditions prevailing in the northeastern region. These children are typically found serving customers, washing dishes, lifting heavy utensils, and cleaning, all tasks disproportionate to their physical capabilities. Despite their dedication and upbeat manner, every grin hides tales of social neglect, familial sorrow, and deprivation. Many of these children are orphans or come from households where an early job search was prompted by the death or disability of a parent. Furthermore, these children and their guardians continue to be caught in a cycle of poverty and exploitation due to a lack of educational resources and ignorance about government assistance programs (Kabeer, 2001).

Child Labour In Hotels, Tea Stalls And Rubber Plantations – An Empirical Study

The present study aims to examine various aspects of child labour in the rubber plantations, hotel, and tea stall sectors. It focuses specifically on comprehending the history and living circumstances of child labourers, their families, and employers. It also looks at the kinds of jobs these children are doing and the conditions in which they labor. The study also looks into how the community views child labor in these unofficial settings, such as tea stalls and hotels. The study categorizes the analysis into three major themes: the socio-economic conditions of child labourers, their parents and employers; the nature and conditions of their employment; and prevailing public attitudes towards such employment.

Methodology

To investigate the labour issues faced by children working in tea stalls, hotels, and the rubber plantation industry in Agartala, an empirical approach grounded in field-based data collection was adopted. The primary method involved conducting semi-structured interviews and administering open-ended questionnaires with child labourers across selected sites. This qualitative approach allowed for flexibility in responses, enabling participants to share their experiences in their own words and at their own pace. The interviews were conducted in informal settings to build trust and reduce response bias, given the sensitive nature of the topic. This method not only captured individual narratives and working conditions but also offered insight into broader socio-economic patterns affecting child labour in the region. Efforts were made to ensure ethical engagement, including obtaining verbal assent from the children and,

where possible, permission from their guardians or employers. The study was conducted from October 2024 to May 2025.

Demographic Profile of the Respondents

The following briefly gives the idea of the demographic profiles of the respondents.

Children

The bulk of working youngsters are between the ages of 9 to 14, according to a thorough examination of their backgrounds and ages. The majority of these children come from low-income families, mostly from Muslim and Hindu Scheduled Castes (SC) communities. Poverty, which compels children to contribute to family income rather than pursue education or enjoy childhood, is the primary cause of their early entry into the workforce.

There is a varied picture of these child labourers' educational attainment. While approximately 69% of the children are reported to be literate, a significant portion—31%—have never been to school. A sizable portion of those who did enroll left after finishing either Class 5 or Class 7. The primary cause of this early school departure was found to be financial limitations. According to the dropout tendency, which is especially evident among Muslim children after Class 7 and Scheduled Caste children after Class 5, socioeconomic and community-specific issues are major contributors to educational discontinuance.

In terms of housing and family structure, 47% of the children live in nuclear households, whilst 53% of the children are part of mixed families. Just 15% of them live in their families' homes, while the great majority—80%—live in rental housing. Many of them live in traditional Assamese-style homes made of mud, bamboo, or tin, and their living conditions are at best basic. A minority live in permanent (pacca) houses, highlighting the stark economic hardships faced by these families.

The majority of child labourers' families reside in one- or two-room homes with limited basic amenities. Approximately 65% of them have access to water at home, mostly from ponds close by. Families lacking such access rely on roadside water sources or borrow from neighbors' ponds. Sanitation facilities remain inadequate for many families. A majority use kachcha (basic) latrines, and a significant number still practice open defecation. Regarding restrooms, 33% of the families have no bathrooms at all, while over 67% utilize makeshift restrooms.

Electricity availability is another issue. The lack of electricity in the homes of about 70% of these families makes daily living challenging. Their poverty is further reflected in the fact that very few houses have even the most basic electrical items, such as a fan or a light.

Healthcare practices among these families are largely dictated by financial constraints. Due to their inability to pay for contemporary healthcare, almost 57% of them rely on conventional

methods of treatment. Just 43% make use of allopathic or contemporary medical services, highlighting these impoverished groups' limited access to and inability to finance high-quality healthcare.

The socioeconomic reality of child labourers and their families in the hotel and tea stall industries is vividly depicted by the study's findings, to sum up. These kids have little access to healthcare and basic infrastructure, and they are locked in a vicious cycle of poverty, low education, and subpar living conditions.

These kids are compelled to labor rather than attend school, live in substandard housing, and lack basic amenities. Since they must work to support their families, the majority do not intend to return to school. In the absence of robust measures to offer improved prospects and assistance, the cycle of poverty, substandard housing, inadequate education, and child labor persists.

Moreover, Child labor in Agartala's rubber industries is primarily caused by poverty. Most households in Charipara and Suryamoni Nagar struggle to provide for their necessities, including food, housing, and education, and are below the poverty line. As a survival tactic, parents with low incomes frequently put their kids to work.

The majority of child labourers come from households that work informally or with little expertise and don't have a reliable source of income. Unemployment among household adults and poor parental education levels exacerbate this economic vulnerability. Children who work in low-paying, physically taxing occupations in the service and rubber industries help support their families.

Engagement in labour often results in these children dropping out of school or never attending school at all. Children must put employment before school because of the need for daily pay. Because illiterate and unskilled people have fewer job options as adults, this educational deprivation feeds the poverty cycle.

Parents

Children's development and chances for the future are greatly influenced by their parents, who frequently serve as the main decision-makers in their lives. Their expectations, attitudes, and financial situation all have a significant impact on whether or not kids are forced into the workforce too soon or are allowed to go to school. Children in low-income families are frequently raised with the assumption that they will support the family financially from an early age. Parents' direct encouragement of their children, who may see them as an extra source of cash, can occasionally intensify this economic pressure, particularly when the family has lost its main provider. In many cases, parents voluntarily permit or even coerce their kids into doing hard labor, particularly in unorganized industries like hotels and tea stalls. Parents visit these children regularly to collect money from the youngsters they have earned to maintain the household, not because they are concerned about their welfare.

The data from field investigations revealed that the parents, particularly in the context of child labour in the hotel and tea stalls, essentially surrender their children to exploitative employers and, in some cases, derive economic benefit from this illegal engagement. Some parents themselves work in marginalised, low-paying jobs, while others are either unemployed or completely dependent on the earnings of their children. In both scenarios, the illegal employment of children becomes a means of economic survival.

Out of the parents who were interviewed, a total of 91 were considered for further analysis. More than three-quarters of the participants were men, making up the majority of the participants. This lopsided gender ratio indicates that women are underrepresented in these encounters, possibly as a result of cultural or societal standards, while males are still seen as the representatives of the household, especially when it comes to interviews about family income and work.

Regarding the occupational background of the parents, the majority were engaged in informal and menial forms of employment. These included activities like rickshaw pulling, day labour, small-scale vending, and casual work as shopkeepers or waiters. Significantly, some parents, especially mothers in certain caste and religious categories, reported having no work at all. The data showed that Scheduled Caste (SC) and Other Backward Class (OBC) mothers, particularly those from Hindu households, were mostly unemployed, while only a small number of Muslim mothers were employed as day labourers. Overall, this indicates a high level of dependency within the family, where working members, including children, become vital economic contributors.

Many parents had worked for brief periods of time, spanning from five to twelve years, according to the examination of their job experience. While a sizable number of the respondents had been employed for approximately ten years, a large portion had only been employed for approximately five years. Few had been employed for more than 15 years. This suggests that parents of child labourers either work in low-paying occupations with little opportunity for advancement or security or switch employment frequently, which results in ongoing economic instability.

The majority of parents stated that they worked long hours, usually between five and twelve hours a day. Regardless of caste or religion, more than half of the respondents said they worked five hours a day. Around one-fifth worked for as many as twelve hours, showing the intense labour demanded even from adults within this economic group. The long hours and meagre pay together create a situation where adult earnings alone cannot sustain the household, thereby necessitating child labour as a supplementary income source.

The annual income levels of these families further highlight their vulnerable economic condition. The majority of the household incomes were between ₹3,000 and ₹6,000 annually. More than one-third of the families, especially those in the OBC category, reported making

between ₹3,000 and ₹4,000. Muslim families had a concentration of income in the ₹4,000–₹5,000 range, but Scheduled Caste families similarly had low income levels. These numbers unequivocally show how parents are unable to support their families to a sufficient degree, which feeds the systemic cycle of poverty that leads to child labor.

The incidence of drunkenness among family members was another significant issue. The existence of alcoholism contributes to emotional instability in the home and further strains already tight family finances. According to the data, the male head of the household or spouse was typically the alcoholic. In some instances, both the husband and the elder son consumed alcohol, further exacerbating the financial burden on the family. These unhealthy dependencies often lead to the neglect of children and can increase the pressure on them to work and earn.

Hence, the profile of parents in households where children are illegally employed in the hotel and tea stall is deeply troubling. These parents often have unstable, low-income occupations or no work at all. Their low earnings, compounded by substance abuse in some cases, mean they are unable to sustain their families without the economic contribution of their children.

The data clearly shows a cycle of poverty, unemployment, and social neglect that not only hinders the growth of the family but also sacrifices the childhood and potential of their children in the process.

Employer

The widespread practice of employing children in hotels, tea stalls, sweet shops, and eateries across Agartala, Tripura, reveals a systemic engagement of employers in child labour despite clear legal prohibitions. The involvement of employers in this exploitative practice is primarily driven by economic pragmatism, coupled with a lack of enforcement of labour regulations and deeply ingrained social norms.

An Analysis Of The Findings From The Study With Relation To Hotel And Tea Stalls In Agartala:

Motivations Behind Hiring Child Labour

The low cost of hiring juvenile labourers is a common motivator for employers in the roadside food service and hospitality industries. Due to their financial vulnerability, children are less inclined to demand better working conditions or higher compensation than adults, who typically receive much higher wages. In many small hotels and tea stalls operating with marginal profit margins, cost-saving is a priority, and employers often justify hiring children as a necessary economic compromise.

Another aspect of employer preference for child workers is the perception of children as more obedient, less unionized, and more flexible with working hours. Many employers believe that children are easier to manage and less likely to complain about overwork or harassment. In

several interviews conducted during the field study, employers justified hiring children as "helping poor families" or "providing training," disguising exploitative relationships under the guise of benevolence.

Recruitment Process and Hidden Practices

The process of hiring children is often informal and unregulated. Employers recruit children through local contacts, family references, or agents. Many child workers are migrants from rural or tribal areas of Tripura and neighboring states, and they enter the workforce through personal networks rather than formal employment channels.

In hotels and tea stalls, children are mostly engaged as kitchen helpers, cleaners, or waiters. They typically start working early in the morning and continue late into the night, often without rest breaks or proper meals. Their wages are meagre, usually disbursed daily to avoid accountability and documentation. In several instances, employers refuse to admit that child workers are employees and instead refer to them as "family boys," "trainees," or "relatives."

Religious, Caste, and Linguistic Patterns

Caste and community affiliations also influence employer behaviour. In many localities of Agartala, Hindu and Muslim employers alike are engaged in the practice, with no significant religious divergence in the prevalence of child labour. Linguistically, the majority of employers speak Bengali, with a few tribal employers speaking Kokborok or other regional dialects. However, language barriers seldom affect the hiring process, as work instructions are basic and learned through observation.

Nature and Working Environment of Child Workers

Child workers in hotels and tea stalls often live on the premises or in nearby slums under deplorable conditions. Employers sometimes shelter them, not as a form of care, but as a means to ensure control and availability for extended working hours. Hygiene standards are poor, and children are regularly exposed to fire hazards, sharp kitchen tools, and unsafe work environments. Psychological exploitation, verbal insults, and physical assault are frequent. Local labour departments are unaware, under-resourced, or apathetic toward inspecting small eateries and informal establishments.

Employer Justifications and Denials

When confronted, many employers deny intentional violation of laws. Some argue that they are merely helping needy families or offering skill development opportunities. Others shift responsibility to parents who send their children to work. A few employers claim ignorance of the law or argue that the child lied about their age. The institutionalization of child labor in the hotel industry and the general disregard for the long-term harm it causes to children's rights and development are reflected in these excuses.

The use of child labor by employers in Agartala, Tripura's hotels and tea shops is the result of a complicated interaction between cultural acceptance, poor governance, and economic necessity. The unregulated, informal nature of these establishments enables the continued employment of children, denying them education, safety, and a dignified childhood. Without rigorous enforcement of laws, awareness campaigns, and rehabilitation programs for both children and small business owners, the cycle of exploitation is likely to continue. Employers, as the primary stakeholders in this chain, must be held accountable, sensitised, and offered alternatives to adopt ethical employment practices.

Engagement Of Child Labour In The Rubber Industry And Related Sectors In Agartala, Tripura: A Detailed Study

This study focuses on the involvement of child labourers in the rubber industry, particularly in rubber tapping, in the Charipara and Suryamoni Nagar areas of Agartala. Approximately 20% of children in these areas are reportedly engaged in this work to supplement their family income. These children mostly belong to economically disadvantaged families, compelled by poverty to Enter The Workforce Prematurely.

Child Labour In Rubber Tapping

In Charipara and Suryamoni Nagar, about 20% of minors work as rubber tappers. These kids typically work on projects like hauling heavy objects, gathering latex, and scraping the bark off rubber trees. They are subjected to dangerous circumstances during work, such as physical strain, cuts from sharp objects, and contact with chemicals used in the production of rubber.
Parents frequently ignore the risks to their health and safety that come with this profession because of the financial requirements. Child labourers receive pitiful pay that is essential to their family's survival but insufficient for a respectable existence. This extensive involvement demonstrates how, in spite of current regulations, child labor in the rubber business still occurs.

Parental Roles, Underlying Causes, and Contributing Factors

Many children are working in dangerous jobs like rubber tapping, especially in Agartala's rubber industry, particularly in Charipara and Suryamoni Nagar, which remains a serious concern. The majority of these kids come from low-income households where parents are forced to engage their kids in labor due to financial constraints.

Addressing the underlying causes of child labor requires an understanding of the role that parents play. The main decision-makers on whether youngsters go to school or work are frequently their parents. Children's labor participation is greatly influenced by their social milieu, educational background, economic standing, and perceptions. This study examines the complex and dual role of parents in Tripura’s rubber industry, highlighting how they function both as contributors to and victims of the socio-economic conditions that sustain child labour.

The reasons that force parents to send their children for employment can be summed up as follows:

Poverty as the Underlying Cause

The primary reason why parents allow or encourage their children to work in the rubber industry is poverty. In Charipara and Suryamoni Nagar, the majority of households struggle to afford even the most essential items and live below the poverty line. Every wage earner, even youngsters, becomes essential to the family's survival in such a situation.
Parents frequently have to choose between letting their kids work and help support the family or sending them to school, where they run the danger of not having their urgent needs fulfilled. Survival frequently takes precedence over long-term educational goals.

Parental Perceptions and the Future of Child Labour in the Rubber Industry

Child labor in the rubber industry, especially in areas like Agartala, Tripura, is a deeply ingrained cultural phenomenon that is influenced by poverty, ignorance, a lack of educational possibilities, and ingrained parental beliefs. It is not just an economic or social problem. In deciding whether a child is directed toward a brighter future through education or continues to work under exploitative conditions, parents have a crucial influence. In this regard, any effective intervention meant to end child labor must comprehend, question, and eventually change parental beliefs. In order to guarantee a child's right to a safe, healthy, and educated childhood in the rubber industry, this conversation explores the intricacies of parental attitudes, the socioeconomic factors that contribute to child labor, and the necessary steps—from awareness campaigns to active parental participation.

Interviews with parents in Charipara and Suryamoni Nagar areas reveal mixed feelings about child labour. While acknowledging its harms, many express helplessness due to financial pressures. Some parents share stories of hope where education and government support may help to break this vicious cycle of labour.

Employers In The Rubber Industry: A Socioeconomic Overview

Due to the financial benefit of their cheap labor, employers in the rubber sector, especially those involved in the processing and transportation of raw rubber sheets in Agartala, frequently favour hiring youngsters. Children can be hired for very little money, which lowers overall operating costs, while adult workers usually demand greater daily salaries. Typically, these hiring procedures are informal, with senior employees or managers handling the hiring process. Employers frequently substitute regular paychecks with meals or small cash payments. This strategy maintains a consistent supply of cheap and obedient child labor while enabling companies to avoid legal requirements.

Numerous employers assert that they are unaware of the children's ages and that they hire workers through middlemen or daily supervisors. They contend that the nature of the labor, which is sometimes done in unofficial workshops or sheds, precludes a careful examination of the identity of the employees. However, because of their flexibility and reduced expectations, young and vulnerable workers continue to be preferred.

Regarding the caste and religious makeup of employers, Muslim and Hindu respondents are about equally represented in the rubber industry. Most Hindu employers were members of the General Caste, then the Scheduled Castes and Other Backward Classes (OBCs). This suggests that the social hierarchy in this industry is still influenced by caste and religion, which affects employment opportunities.

In terms of age, the majority of employers were in the 21–50 age range. Between the ages of 21 and 30, a sizeable portion of Hindu employers from the Scheduled Caste were younger. Regardless of faith, more than one-third of all employers were between the ages of 41 and 50. The younger age group (ages 21 to 30) was more common among Muslim employers, which may be related to an early entry into supervisory or entrepreneurial positions in the unorganised sector.

The dominant mother tongue across all employers was Bengali, regardless of religious or caste backgrounds. A small minority spoke Kokborok, primarily among tribal employers, though their numbers were minimal in this sector. This linguistic homogeneity suggests Bengali as the common medium of communication in the rubber industry of Agartala.

Educational levels among rubber industry employers were diverse. While several had only completed primary education, many others had studied up to middle or high school. A smaller fraction had passed the Higher Secondary level, and a few were college graduates. This variation shows that a considerable proportion of people still pursue at least secondary-level education even though formal education is not a strict necessity for employment in this sector.

The majority of employers had joint families, with Hindu employers being more likely than their Muslim counterparts to be part of a mixed family. Nonetheless, an increasing proportion of employers in both groups stated that they were part of nuclear families, indicating a gradual transition from conventional to more independent living arrangements.

Most employers in the rubber industry owned their residences. Nearly 70% of people from the Scheduled Castes and OBCs were homeowners, making them particularly prevalent. While about 25% of Muslim employers lived in rental properties, this percentage was marginally greater than that of their Hindu counterparts, but overall, this pattern held for all faith groups.

In terms of housing type, over half the employers resided in Assam-type houses made of brick walls with tin roofs. Some lived in semi-RCC or full RCC structures, although these were less prevalent. Assam-type homes were notably popular among Muslim employers, likely due to affordability and cultural preferences.

Drinking water facilities were available in all employers' homes. The majority relied on a piped water supply, while others used public wells or shared community taps. In these semi-urban

and rural Agartala belts, fundamental infrastructure development was highlighted by the relatively consistent access to potable drinking water across communities.

Health And Psychological Impact On Child Labourers

Rubber tapping exposes workers to dangerous chemicals and sharp objects, which can result in long-term health problems such as musculoskeletal illnesses, skin conditions, and lung ailments. Children who work in hotels and tea stalls are also subjected to unsanitary conditions and extended workdays, which can negatively impact their physical health.

Child labor causes emotional stress, low self-esteem, and social isolation by depriving children of their entitlement to an education and a carefree upbringing. The lack of social support, bullying, and exploitation that many child labourers endure impairs their mental health and chances for the future.

Deeper socioeconomic injustices are shown in the pervasive exploitation of child labor in the hospitality and rubber tapping industries. By preventing children from receiving an education and maintaining low skill levels, child labor perpetuates poverty by reducing future employment prospects. This leads to a vicious cycle in which children continue the pattern of economic deprivation in their family by growing up to work in comparable low-paying occupations.

Key Findings: Underlying Reasons For The Persistence Of Child Labour

Employment and Income Instability of Parents

In these places, the majority of parents work in informal or unskilled jobs that are frequently seasonal or irregular, such as small-scale vending, daily wage labor, or casual agricultural work. This irregularity creates income uncertainty, pushing parents to depend on the additional earnings of their children in rubber tapping to smoothen household finances.

For many parents, children’s wages are critical during periods when adult employment is scarce. This reliance fosters an environment where child labour is normalized as a coping mechanism.

Lack of Education and Awareness

Parents' educational attainment has a big impact on their decision to send their kids to work. Many parents themselves have little or no education, which limits their comprehension of the long-term negative effects of child labor. Their attitude of child labor as unavoidable is further influenced by their ignorance of government programs and child rights. Parents frequently undervalue the risks to their health and the lack of education that child labor causes, or they are ignorant of the laws that forbid it.

Cultural Attitudes Towards Education and Work

In many families, especially those struggling economically, education is not always perceived as a practical priority. Immediate economic contribution is valued over schooling, which is seen as a luxury or prospect beyond the immediate reality of poverty. Some parents hold the traditional view that children should start working early to learn skills and contribute to family livelihood, which influences their willingness to engage children in rubber tapping.

Economic Rationality and Necessity

Rather than neglect or exploitation, economic rationality frequently motivates parents to engage their children in labor. Parents prioritize the household's immediate financial needs when faced with limited resources. For example, while the child's labor income is immediate and palpable, the cost of schooling—uniforms, books, and transportation—may seem excessive. This pragmatic choice is shaped by economic constraints rather than a lack of care.

Gender Dynamics in Parental Decisions

Gender norms may also have an impact on both boys' and girls' involvement in child labor. Boys are sometimes encouraged to work in physically difficult jobs like rubber tapping, while girls might help out around the house or at tea shops and hotels.
These choices are frequently influenced by parents' views of gender roles and the expected contribution of children to income or household duties.

Extended Family and Community Expectations

In joint family setups common in Tripura, decisions about children's work are often influenced by extended family members or community norms. Elders or other family members may also put pressure on parents to contribute to the family's income. As families try to share financial burdens or live up to social expectations, this kind of group decision-making might encourage child labor practices.

Influence of Local Labour Markets

The local labour market dynamics in Charipara and Suryamoni Nagar also affect parental choices. The availability of child labour in the rubber industries and informal sectors creates a demand that parents respond to. With limited alternative income sources, parents comply with employers' preference for cheap child labour to secure work for their children.

Lack of Knowledge on Occupational Hazards

The health hazards of rubber tapping, including cuts from sharp objects, chemical exposure, and extended work hours, are not well known to many parents. The normalization of these risks within poor communities reduces urgency to prevent child labour. Consequently, parents may

not perceive rubber tapping as dangerous work but rather as necessary work that their children must do.

Impact of Parental Health and Workload

The health status and workload of parents themselves influence children's labour engagement. Children may take on work obligations too soon if their parents are unwell or doing physically demanding jobs that prevent them from providing proper care.

The Way Forward: Recommendations

Based on the findings of the empirical study, several key considerations have emerged that warrant attention for future planning and strategic implementation. The following points outline potential areas of focus that can guide policy refinement, operational improvements, and further research. These considerations are grounded in the study's data and offer a structured approach to addressing the identified challenges and opportunities:

Awareness of Government Schemes and Parental Participation

By encouraging school attendance, government programs like free education, scholarships, and midday meals aim to reduce child labor. However, parents' involvement is restricted due to ignorance or mistrust. Children's school enrollment may be impacted by parents' lack of understanding of the advantages or their skepticism about the validity of such programs.

Parental Involvement in Anti-Child Labour Initiatives

Some parents actively take part in neighbourhood initiatives to end child labor. Their commitment is frequently driven by a desire to end the cycle of poverty and concern for the welfare of children. By raising their knowledge and providing them with financial assistance, parents can be empowered to become change agents rather than barriers.

Livelihood Enhancement for Families

Improving the economic conditions of families through skill development, microfinance, and employment opportunities reduces dependence on child labour. When parents have stable income sources, they are less likely to send children to work. Programs targeting parents' employment have a direct impact on reducing child labour in the rubber industry.

Education Support and Incentives

Parents' worries about education can be allayed by lowering the direct and indirect costs of education. Parents are encouraged to take their children to school rather than work by offering free uniforms, books, and transportation in addition to awareness-raising initiatives. For such interventions to be successful, community involvement and routine follow-up are required.

Conclusion

The findings unequivocally reveal that children, predominantly aged 9-14, from low-income Muslim and Hindu Scheduled Caste families, are forced into hazardous work primarily due to extreme poverty. This economic pressure compels them into various roles, from serving customers and washing dishes in hotels and tea stalls to physically taxing rubber tapping, involving heavy lifting and exposure to chemicals. Consequently, these children face severe educational deprivation, with a significant portion (31%) never attending school and many others dropping out early due to financial limitations, thereby perpetuating a cycle of illiteracy and limited future opportunities. Their living conditions are often substandard, lacking basic amenities and adequate healthcare access..

Parents, frequently from informal, low-paying, or unstable job sectors, or even unemployed, often become unwitting enablers of this exploitation. Their decisions are driven by immediate financial needs, often compounded by factors like low educational attainment, a lack of awareness about government assistance programs, and, in some cases, substance abuse within the household. Employers, primarily motivated by cost-saving and the perceived obedience of child workers, engage in informal recruitment, often disguising employment as "helping poor families" or "providing training". These children endure unsafe working conditions, long hours, and psychological or physical abuse, with little to no legal oversight due to apathy or under-resourced local labour departments.

Ultimately, the study underscores a vicious cycle of poverty, inadequate education, and persistent exploitation that traps generations in economic deprivation. Child labour, while providing immediate income, actively diminishes prospects by preventing skill development and perpetuating low-wage, informal employment. Breaking this cycle necessitates comprehensive, multifaceted interventions. These must include enhancing parental livelihoods through skill development and stable employment, robust educational support and incentives to retain children in schools, and strengthening legal enforcement against exploitative employers. Furthermore, intensive awareness campaigns are crucial to sensitize communities and empower parents to become agents of change, ensuring every child’s right to a safe, educated, and dignified childhood.

Bibliography

1. Department of Social Welfare, T. (2022). *Field Survey Report.* Agartala: Department of Social Welfare, Government of Tripura.
2. ILO. (1973). *International Programme on the Elimination of Child Labour (IPEC), , 1973.* . Geneva: ILO Convention No. 138.

3. Kabeer, N. (2001). Poverty, Labour and Children's Rights in South Asia, . *Poverty, Labour and Children's Rights in South Asia, , Vol. 36, No. 52* . Economic and Political Weekly.

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Cross-Border E-Commerce and Indian Jurisdictional Law: Challenges and Framework

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'The internet is becoming the town square for the global village of tomorrow'-Bill Gates

Abstract

The rapid growth of the internet and e-commerce has significantly transformed global trade by enabling seamless cross-border transactions. However, this expansion has introduced complex legal and jurisdictional challenges due to the absence of a uniform international legal framework. Major concerns include the determination of jurisdiction, applicable law, and enforcement of judgments in a borderless digital environment. The current study examines these challenges in the Indian context, with particular focus on jurisdictional ambiguity in online transactions. It analyzes the application of judicial principles such as the "minimum contacts" test and the "Zippo sliding scale" test, alongside India's reliance on existing legal doctrines like mutatis mutandis in the absence of specific e-commerce laws. Additionally, the paper highlights critical issues related to e-payments, including security risks, fraud, lack of trust, and potential infringement of personal data. It also addresses consumer protection concerns arising from unfair trade practices, misuse of sensitive information, and difficulties in dispute resolution due to the transnational nature of e- commerce.

Keywords: *E-commerce, Cross-border jurisdiction, violation of data, consumer rights*

Introduction

Redefining the meaning of the internet by empathizing its importance in all aspects of life, its nature is so powerful that some humans substitute it for life. Cyberspace is no longer new area today. Its existence for over 6 decades, since its formation as ARPANET in 1969 by the U.S. Defense, has transformed almost all segments of human life. However, despite of its existence, many irregularities and inconsistencies are witnessed due to the lack of uniformity of laws and multiple jurisdictions. One of the most important segments developed by the internet is e-commerce. The e-commerce businesses has seen tremendous growth in all over the globe. The revenue in the e-commerce market is projected to reach US$4.32tn in 2025.[1] With a projected market volume of US$1.38tn in 2025, most revenue is generated in China. The number of users

[1] Statistics *available at* https://www.statista.com/outlook/emo/ecommerce/worldwide (last visited on July 28, 2025).

is expected to amount to 3.6 bn users by 2029. Low cost, better customer service, less distribution cost and global business are few advantages experienced by B2C and B2B in ecommerce area. The flexibility created by e-commerce is enormous but one cannot ignore the jurisdictional and legal challenges. There are multiple parties transacting their business by crossing geographical and sovereign jurisdictions in e-commerce and it makes it unclear about the appropriate legal framework and proper authority for dispute resolution. As it disrupts both substantive and procedural law, the open and transparent nature of business puts the foundation of the national legal system in jeopardy. The enforcement mechanism also becomes complicated as multiple mechanisms are involved in e-commerce transactions. In the absence of bi-lateral treaty between countries, the question that is concerning is, which legal framework be applied and will that application be enough to provide justice to the parties? Can the judgment provided by one tribunal/court located at one jurisdiction is binding on the parties? If yes, how it gives justice to the parties, if no, what alternative mechanism can be adopted? Which principles would be relevant in this situation? In order to understand how effective and profitable e-commerce businesses are, it becomes imperative to understand these diverse dimensions because effective dispute mechanism is the key to justice. Therefore, the current study will identify the challenges both legal and jurisdictional in e-commerce transactions in India. Further, the study will also determine the applicable principles for e-commerce disputes in India and its positive response to the growing e-commerce business.

Challenges in Cross-border transactions

The notion of cyberspace is an independent and autonomous jurisdiction that is detached from the territorial boundaries and legal frameworks of the physical world. The Internet is a seamless domain that is not bound by national jurisdiction. As e-commerce transaction involves multiple events and jurisdictions of different nations, it becomes in fact problematic in the dispute resolution process. If cyberspace were truly a separate and autonomous jurisdiction, the challenges described above would not arise. However, due to its transparency and accessibility worldwide, the problem of jurisdiction always remains at the top. Other than jurisdictional issues, some major challenges include data protection issues, consumer protection issues, payment & transaction challenges, and cybersecurity.

Jurisdictional Issues

A fundamental question that arises in cross-border online disputes is, *where can one party sue another?* While each nation has its legal framework for determining jurisdiction within its territorial boundaries, the challenge becomes significantly more complex in the context of cyberspace. Cross-border internet transactions have posed persistent difficulties for courts globally, primarily due to the absence of a uniform legal regime and harmonized conflict of law principles. Under Indian jurisprudence, jurisdiction is generally established based on either the residence of the defendant or the place where the cause of action has arisen. However, in the digital realm, both these criteria are often ambiguous.

In the U.S., the principle of *'minimum contact'* was developed by the Federal Court in the case of *International Shoe* vs. *Washington*[2] It is the foundation for the US theory of jurisdiction. In order to exercise the jurisdiction to be in line with conventional ideas of fair play and substantial justice, the defendant must establish a minimum level of interaction with the forum state. This may be demonstrated if the defendant has either purposefully directed activities toward the forum state, purposefully availed itself of the privilege of conducting business therein, or has placed its product into the stream of commerce, with the exception that it would be purchased and used in the forum state. An alternative framework for determining jurisdiction in internet-related disputes is mentioned in the U.S. case *Zippo Manufacturing Co.* vs. *Zippo Dot Com, Inc.*[3] The court in this case introduced the '*sliding scale'* or *'passive versus active'* test that assesses the nature and quality of the defendant's commercial activity conducted via the internet. This method holds that the degree of interaction and commercial nature of the website directly correlates with the possibility of establishing personal jurisdiction. Indian courts have confirmed that provided the cause of action occurs entirely or partially within the court's territorial jurisdiction, jurisdiction over non-resident foreign entity may be exercised even in the absence of express submission to such jurisdiction.[4] This establishes that Indian courts are competent to assume jurisdiction in matters involving online transactions provided that any segment of the cause of action is linked to the forum in question. What now requires clarification is what constitutes a part of the cause of action in the context of online transactions. In this regard we can draw guidance from the decisions of the U. S. courts which have addressed similar issues through the application of 'long-arm' jurisdiction principles to determine the territorial competence of courts. In *World Wrestling Entertainment Inc.* vs. *M/S Reshma Collection and Others*[5], the Delhi High Court conclusively held that in e-commerce cases involving trademark and copyright violations, jurisdiction would be based on the location of the buyer. The court provided a detailed interpretation of the phrase 'carries on business' as used in Section 134(2) of the Trademarks Act, 1999 and Section 62(2) of the Copyright Act, 1957-both of which pertain to the proper forum for instituting legal proceedings for infringement. The central question before the court was, in transactions conducted over the internet, where is the contract deemed to have been formed?

Data Protection Issues

Over the past two decades, data exchange through electronic devices and applications has grown significantly, especially with the rise of e-commerce. Businesses leverage consumer data to tailor products and services, increase ad revenue, and refine marketing strategies. The legal acceptance of digital documents has further accelerated large-scale data sharing,

[2] *International Shoes* vs. *Washington,* 326 U.S. 310 (1945).
[3] Zippo Manufacturing Co. vs. Zippo Dot Com, Inc. 952 F. Supp. 1119 (Jan. 16, 1997).
[4] *Fertilizer Corporation of India* vs. *Sanjit Kumar,* AIR 1965 Punj 107.
[5] *World Wrestling Entertainment, Inc* vs. *M/S Reshma Collection* & Ors FAO (OS) 506/2013 & CM Nos. 17627/2013, 18606/2013.

including with third parties. However, the widespread use of information and communication technology has also raised concerns about potential data security threats. E-commerce platforms collect vast amount of data on customer preferences, purchasing behavior, and frequently searched items to better understand and target consumer needs.[6] From the customer's perspective, many e-commerce platforms mishandle personal data by engaging in irresponsible practices. A survey revealed that 92% of respondents believe that despite having a legal obligation to protect users' personal information, e-commerce sites often share or disclose sensitive details such as contact numbers, browsing history and purchase preferences without proper consent.[7] Collection and usage of data without authorization amounts to a violation of fundamental rights.[8] In the European Union Countries, GDPR is the legal regulation that lays down strict consent requirements and protects informational privacy of every EU citizens who shares their data with the entities. Influenced by the GDPR, the Indian government also tried to adopt a data protection law for a long time back but only in 2023 did the dream become reality with the enactment of the long-awaited bill of data protection. The Digital Personal Data Protection Act, 2023, is the ultimate regulatory mechanism that guarantees explicit consent, data minimization and accountability. However, Indian entities are required to comply with legacy legislation such as the IT Act, 2000, which often overlaps with new data protection laws. This regulatory overlap can lead to confusion and potential redundancy, and without proper legal guidance, may result in compliance gaps. Another issue is transferring data across national boundaries. Transferring these data requires adherence to multiple legal regimes. Aligning Indian data protection standards with international frameworks such as GDPR also poses significant legal and operational challenges for entities engaged in cross-border operations.

E-payment Issues

E-commerce comes with an electronic payment system. It is a transaction made via any electronic medium. E-payments have grown in popularity as global e-commerce has expanded. The convenience of the e-payment system in e-commerce comes with risks. Some of the issues regarding e-payment are a lack of usability as the e-payment system requires vast information from end users, which has a potential risk of personal data infringement. There is a lack of trust and a lack of security, as this method has a high risk of fraud, misuse, and low reliability. [9]

[6] E Kritzinger, E Smith, Information Security Management: An information security retrieved and awareness model for industry, Computer and Security 27 224-231.
[7] A Muneer, S Razzaq et. al., Data Privacy Issues and Possible Solutions in E-Commerce, Journal of Accounting & Marketing, 2008, 7:3.
[8] It is violation of right to privacy as incorporated under Art. 21 of the Constitution of India.
[9] M. Reddu Naik, Kanderi Sridevi, Issues and Challenges of Electronic Payment Systems, Vol 10 Issue 7 International Education & Research Journal (July, 2024).

Consumer Protection Issues

In the rapidly developing era of e-commerce, the recognition and safeguarding of consumer rights have become increasingly critical. In *Raghubir Singh* vs. *Takurin Sukhraj Kuar*,[10] the Court stated that the purpose of consumer protection is to prevent different forms of business malpractices. There are numerous concerns that have emerged as several entities exploit the virtual marketplace to engage in unfair trade practices and unethical conduct for personal or commercial gain. Unlike a traditional, physical marketplace, the virtual environment presents unique challenges for consumers, making their protection even more essential. One of the core concerns in online transactions is the mandatory sharing of personal and sensitive information, such as contact details, financial information, and purchasing behavior. This data is vulnerable to misuse, unauthorized access, or even sale to third parties, posing significant risks to consumer privacy and autonomy. Furthermore, in case of disputes whether related to product quality, delayed delivery, or privacy violations, determining the appropriate legal forum or jurisdiction becomes particularly complicated due to he borderless nature of the internet.

Applicable Jurisdictional Principle in India in the absence of abstract law

Jurisdictional power enjoyed by the court gives the authority to decide the matter and the decision so provided is legally binding on the parties. This proves that any court envisaged with jurisdictional power has authority to solve the disputes for e-commerce. However, the problem in e-commerce disputes lies to the fact that the parties resides in two different jurisdiction for which the law of the land or proper authority may not have power to decide the matter. The Code of Civil Procedure, 1908 also lays down the provision of void effect of the judgment made by the court lacking jurisdiction. Therefore, the jurisdiction is primary element before the matter is entertained by the court. Looking into Indian perspective, the principle of *'mutatis mudandis'* is applicable where the already available principle of jurisdiction with certain interpretations shall be applied in case of e-commerce jurisdictional issues. As Indian legal framework has no jurisdictional provision for e-commerce transactions. The *minimum test* principle[11] and *zippo test*[12] principle are few tests that are found to be applied in Indian scenario for e-commerce transactions. These two principles are widely applicable in the United States. There are few Indian jurisdictional principles that are traditionally applicable. Some of these are discussed below,

[10] *Raghubir Singh* vs. *Takurin Sukhraj Kuar*, 2011 AIR SCW 2203.

[11] This principle dictates that a state can exercise jurisdiction over a non-resident defendant if they have sufficient minimum contacts with the state, such that requiring them to defend a lawsuit there would not offend traditional notions of fair play and substantial justice.

[12] The Zippo test, is a legal principle used to determine personal jurisdiction over a website in a particular jurisdiction based on the website's level of interactivity. It's a sliding scale approach, categorizing websites as passive, interactive, or active, with jurisdiction more likely to be found as the level of interaction increases.

The Indian Contract Act, 1872

Let us see the formation of contract and analyze how this provision is applied in e-contract. Since, e-commerce business is an agreement between the parties that makes them their transaction legally binding, Section 10 of the Contract Act, 1872 lays down the prerequisites for the valid contract, such as, consent of the parties, competency of parties, lawful consideration, lawful object and are not hereby declared to be void. For the validity of e-contract, Section 10 of the Indian Contract Act, 1872 must be read along with Section 10A of Information and Communication Technology, Act, 2000. Section 10A gives validity to e-contract. It says a contract formed by proposal, acceptance of proposal, and revocation of proposal by any electronic means shall be considered valid. The first landmark case that involved 'telephonic conversation' as a medium of contract is *Bhagwan Goverdhandas Kedia* vs. *Girdharilal Parshottamdas & Co*[13] in 1966. This case gives a principle how the contract can be concluded via a telephonic conversation or telex. The issue involved in this case was, when would the contract be concluded where offer and acceptance take place by way of conversation by telephone? The Supreme Court has held that, in case of telephonic conversation, the legal position is same as when the parties are physically present with each other. Therefore, the rule governing contracts made through postal communication does not apply. In postal contracts, acceptance is deemed complete once the letter of acceptance is posted. However, in contracts formed over the phone, the agreement is only concluded when the offerer hears the words of acceptance, not merely when the accepter speaks them.

The Code of Civil Procedure, 1908

The CPC, 1908 mainly contains three types of jurisdiction i.e. territorial, subject-matter and pecuniary jurisdiction. In the absence of any of these three jurisdiction, it will be irregular exercise of jurisdiction that turn the decision into void or voidable. Pecuniary jurisdiction is determined on the basis of valuation of mentioned in the plaint. Subject-matter jurisdiction means the power entrusted to the court for determining specific subject-matter. And territorial jurisdiction is one of the most important jurisdiction that is applicable in e-transaction. The principle of territorial jurisdiction within the Code of Civil Procedure can be modified some way another and could be applied to the online transactions in India as the country does not have a separate law for the dispute. There are four major types of suits that can be determined under territorial jurisdiction such as, suits in respect to movable property, immovable property, compensation for wrong and other suits. In e-commerce jurisdiction, it is not possible to say with certainty that the property is situated within the jurisdiction of the one or the other of several courts. In such a situation, one of these courts, if it is satisfied that there is such uncertainty, may after recording a statement to that effect proceed to entertain and disclose of the suit.[14] Section 20 of the Civil Procedure Code 1908 (CPC) that deals with other suits is

[13] *Bhagwandas Goverdhandas Kedia* vs. *M/S Girdharilal Parshottamdas and Co.,* 1966 AIR 543.
[14] Section 13 of the Code of Civil Procedure, 1908.

larger in its ambit. It deals with jurisdictional aspects and states that a court may assume jurisdiction in a case when the cause of action arises within its sphere.[153] This section, although more relevant to domestic courts and is essentially the domestic law of a country, yet it can be interpreted so as to apply to transnational issues as well as private international law. This provision enables the court to assume jurisdiction over a dispute regardless of where the principles are resident or the *situs* of the business, so long as a portion of the cause of action takes place within the local jurisdiction, while still having an implied standard set, in a way similar to the US long-arm jurisdiction provisions. In essence, this section is the equivalent of the US long arm jurisdiction provisions.

The Information and Communication Technology Act, 2000

Section 10A of the IT Act, 2000 talks about the validity of e-contract. Any contract enforceable by law according to the Contract Act, 1872 hereby taken place by electronic means shall not be considered invalid merely because it has taken place by electronic medium. Section 13 of the said Act further talks about time and place of dispatch and receipt of an electronic record and addresses the issue of deemed jurisdiction in an electronic contract. The case of *PR Transport Agency* vs. *UOI*[15] is one case that illustrates the question of jurisdiction where the respondent had sent the acceptance letter via e-mail. However, the subsequent e-mail was also sent by the respondent cancelling the e-auction in favor of the petitioner due to some technical and unavoidable reason. Having challenged by the petitioner for the communication in the Allahabad High Court, an objection was raised by the respondent in question to territorial jurisdiction claiming Allahabad High Court lacks territorial jurisdiction to try the dispute as there were two places of business in Uttar Pradesh carried by the petitioner. The Allahabad High Court therefore took into consideration of Section 13(3) of the IT Act, 2000 and held that the acceptance of tender by e-mail would be deemed to have been received by the petitioner at both these places fall under the ambit of territorial jurisdiction of Allahabad High Court to try the case. Therefore, the Allahabad High Court assumed territorial jurisdiction to handle the dispute. In view of the foregoing, the place of contract in an e-contract for the purposes of determining jurisdiction (i.e., the place where the cause of action arose) would be deemed to be where the originator and addressee have their place of business. However, since Section 13 of the IT Act is subject to the mutual agreement of the contracting parties with respect to the agreed place of contract, it is recommended that all parties in their electronic contracts provide for a specific clause on jurisdiction. The Information Technology Act, 2000 specifically provides that unless otherwise provided in the Act, the Act also applies to any offense or contravention there under committed outside India by any person irrespective of his nationality".[183] It is however clarified that the Act shall apply to an offense or contravention committed outside India by any person if the act or conduct constituting the offense or contravention, involves a computer, computer system or computer network, located in India.[184] The words act or conduct constituting the offense or

[15] *P. R. Transport Agency* vs. *UOI,* AIR 2006 ALL23.

contravention involves a computer, computer system or computer network located in India are very significant to determine the jurisdiction of the IT Act over acts committed outside India. For assuming jurisdiction over an act constituting an offense or contravention under the IT Act, committed outside India, it has to be proved that the said Act involves computer system, computer network located in India.

The Consumer Protection Act, 2019

E-commerce has significantly changed how consumers behave by making things more convenient. With internet accessibility, a consumer does not have to think twice before buying a product or service. To ensure the consumers fair trade practices, to protect them from fraudulent practices and to protect their data in digital marketplace, the Consumer Protection Act, 2019 along with the Consumer Protection (E-commerce) Rules, 2020, has been adopted by the government. The Act now includes e-consumer within its holistic ambit. Despite the rights exercised by the e-consumer similar to that of physical consumer there are still major challenges when it comes to cross-border e-commerce such as managing returns and refunds, online payment security, and enforcement of regulations. The Consumer Protection (E-commerce) Rules, 2020, comprehensively outline the procedural requirements that e-commerce entities must follow before offering goods and services in India. Any violation of these Rules by an e-commerce entity including those based outside India, is subject to penalties under the provision of the Consumer Protection Act, 2019.[16]

The Digital Personal Data Protection Act, 2023

One of the fundamental features of this Act is the requirement to obtain free, informed and specific consent from individuals before the processing of their personal data. This provision holds particular relevance for e-commerce platforms, which frequently depend on user data to deliver personalized services, implement targeted advertising, and enhance supply chain efficiency. The Act further strengthens individual autonomy by conferring rights such as data access, rectification, erasure, and portability, thereby enabling consumers to exercise greater control over their personal information. In addition, e-commerce businesses are also obligated to follow the sector-specific regulatory frameworks established by authorities such as the RBI. The guidelines of the RBI govern payment intermediaries, digital wallets, and online banking platforms that are integrated into e-commerce ecosystems. Additionally, the RBI under this Act underscores the necessity of prompt disclosure of data breaches to mitigate potential financial harm to consumers. The guidelines made by this Act aim to create a safe and trustworthy environment for e-commerce transactions.

[16] Consumer Protection Rules and Regulations, *available at:* https://www.mondaq.com/topic/9/consumer-protection?msg=51 (last visited on July 7, 2925).

Conclusion and Suggestions

The emergence of disputes concerning contracts formed via email marked a turning point in legal frameworks governing electronic communications. This development prompted the Indian Parliament to enact the Information Technology Act, 2000, and to introduce corresponding amendments in other relevant statutes. Over the past decade, the rise and widespread adoption of virtual environments have significantly reshaped conceptions of human interaction and social relationship. The creation of virtual identities, digital locations and online meeting spaces including chat rooms and cyber cafes has challenges traditional notions of territorial sovereignty. As a result, the significance of private international law has expanded considerably, particularly about jurisdictional questions, which now increasingly depend on the concept of cyber-virtual territory. The culture of the internet has evolved through a distinct set of protocols, norms and linguistic conventions. Within this virtual regime, unique tools have emerged to facilitate secure communication and transaction including digital signature, encryption technologies, digital authentication methods and password-based privacy mechanisms. Since, e-contracts form the basis of e-commerce, challenges often emerge regarding the choice of forum and applicable law. These issues can be mitigated by clearly specifying such provisions in the contract, ensuring both parties understand their obligations. Service providers should go beyond formal legal rules by considering precedents, legal principles and statutes , enabling disputes to be directed to the appropriate forum without confusion over applicable laws. Another suggestion could be applying consistent and harmonized principles across state, national and international boundaries. Such an approach would ensure predictable outcomes, irrespective of the jurisdiction in which the buyer or seller operates. Achieving this objective necessitates the establishment of a uniform set of laws specially designed to regulate the digital environment. A unified regime would not only enhance certainty but also foster public confidence, both of which are essential for the sustained growth of e-commerce.

Given that the internet represents one of the most transformative domains in information technology, addressing its legal complexities requires more than minor amendments to existing laws. The challenges posed mainly concerning jurisdiction cannot be fully resolved through amendments or the gradual evolution of judicial decisions alone. Instead, they demand a coordinated and forward-looking approach involving the judiciary, treaty drafters, and legislators. This collaboration should aim to adapt and refine existing legal norms to meet the unique demands of cyberspace, ensuring that the law remains responsive, relevant, and capable of addressing the intricate issues arising in the digital marketplace.

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Sunflower Seed Proteins as Sustainable Plant-Based Ingredients: Nutritional Value, Functional Properties, and Bioactive Potential

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Abstract:

The global transition toward sustainable and nutritionally adequate protein sources has intensified interest in plant-based alternatives, particularly those derived from agro-industrial by-products. Sunflower seeds (Helianthus annuus), predominantly cultivated for oil extraction, generate substantial quantities of protein-rich residues that remain underutilized. This review critically examines sunflower seed protein as a promising plant-based protein source with significant nutritional, functional, and bioactive potential. Sunflower seed proteins exhibit a favorable amino acid profile, good digestibility, and functional attributes, including high solubility, emulsifying stability, oil-holding capacity, gelling ability, and water retention, making them suitable for incorporation into bakery products, protein-enriched foods, and meat analogues. In addition to proteins, sunflower seeds are rich in minerals, phenolic compounds, flavonoids, carotenoids, and residual oils, which confer antioxidant, antimicrobial, and anti-inflammatory activities and support cardiovascular health, immune function, and metabolic regulation. Importantly, sunflower seed proteins provide a hypoallergenic alternative for individual's sensitive to soy or gluten, thereby expanding dietary inclusivity. From a sustainability perspective, the valorization of sunflower seed by-products aligns with circular economy principles by reducing food waste and lowering reliance on animal-derived proteins. Overall, sunflower seed proteins represent a multifunctional, eco-friendly, and nutritionally valuable ingredient with a wide range of applications in the food and health sectors.

Keywords: *Sunflower seed protein; Plant-based proteins; Agro-industrial by-products; Functional properties; Bioactive compounds; Sustainable food systems*

Introduction

There is quite a high demand for plant-based proteins nowadays due to environmental, ethical and health concerns. The manufacturing of animal-based protein products can cause environmental degradation by generating greenhouse gases, the use of excess water, etc. Ethical concerns mainly include animal well-being. Moreover, plant-based protein products are prepared without causing harm to the environment and are also rich in good cholesterol, fats and fiber, leading to their increased demand in recent times. Sunflower seed is an underutilized crop with its farming still growing due to industrial development. It is rich in several bio-compounds, among which protein is the major component (about 25% in seeds and 30%-50%in sunflower meal after the extraction of oil) (Adeleke & Babalola, 2020). By 2023, sunflower seed production had reached 55 million tons globally. Sunflower seed cake has a high nutritional value having(40-50%)protein,a good source of plant protein (Petraru et al., 2021). The initial component of protein in sunflower seed is globulin, having size 11S and 7S fractions. The globulin helianthinin(11S) accounts for 40 and 90% of the protein content. Albumins are the second largest proteins (2S) which account for (10-30%) of protein (Levasseur-Garcia et al., 2024). These seeds, originated from North America, have attained popularity globally due to its high nutritional quality and a wide range of applications in the food industry. It has a good amount of protein, lipids, fiber, vitamins and minerals for overall health functioning. Sunflower seeds are a very good source of fatty acids (linoleic acid) that helps to regulate proper functioning of heart muscles. It's rich in Vitamin E, which reduces inflammation. The bioactive properties of these seeds are the presence of bioactive compounds like flavonoids, phenolic acid, etc. That has anticancerous,anti-inflammatory effect and has antioxidants. The seed extracts have immunomodulatory properties which intensifies the immune system. They have antidiabetic and antihypertensive properties which makes it an important use in the pharmaceutical industry (Li et al., 2024).

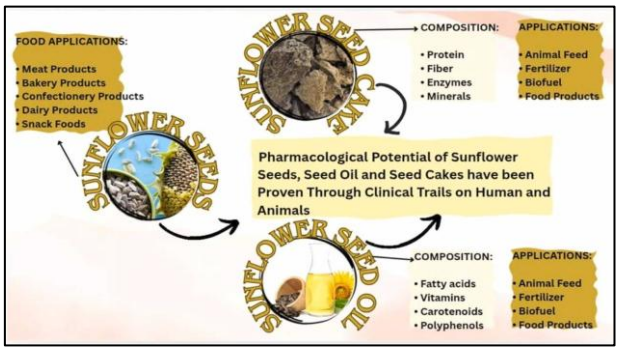

Figure 1.0: Application of Sunflower Seed

Sunflower Seed Protein Sources and Processing

Oil processing industries discard large quantities of sunflower seed remains, like meal and press cake, post oil extraction. These waste products are loaded with plant protein (15-50%) and thus represent a potential alternative protein source (Quintieri et al., 2023). A sunflower meal obtained after mechanical extraction can have a protein content of approximately 40%, whereas a solvent-extracted cake can have close to 50% protein. Besides, sunflower proteins supply the body with essential amino acids. It has been documented that press cake holds around 13 amino acids, while cake meal can have as many as 17 amino acids, with valine and tryptophan being the major essential amino acids in seed meals. Dehulling plays a critical role in boosting protein content; thus, dehulled seeds can contain protein levels of about 53-66% (Kotecka-Majchrzak et al., 2020). It is worth mentioning that protein structure can be damaged; hence, protein functionality may be affected due to mechanical pressing.

One of the popular techniques to extract protein from sunflower press cake is alkaline extraction followed by isoelectric precipitation and spray drying. Though these conventional treatments are highly effective, they may lead to protein denaturation or other structural changes that might hamper the proteins' nutritional and functional properties. In order to resolve this issue, aqueous extraction as an isolation method with less severe conditions has been attracting attention. Here, whole sunflower seeds are utilized, simultaneously extracting proteins and obtaining oleosomes (natural oil bodies). Through centrifugation, the extract is fractionated into three: cream (oleosomes), soluble phase, and pellet (Yang et al., 2023).

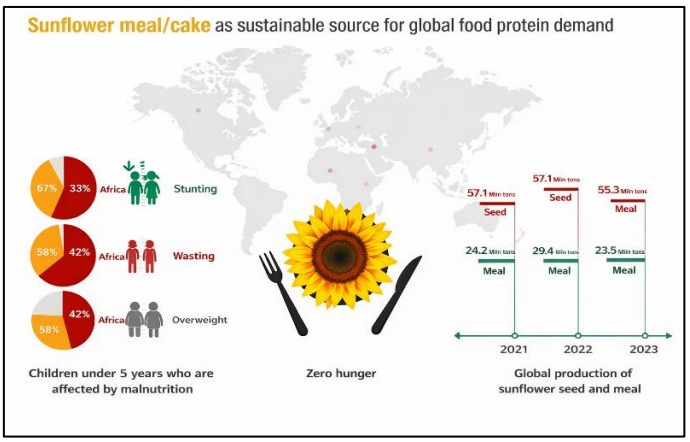

Figure 2.0: Demand and supply of sunflower seed protein

Protein Composition and Structural Characteristics

Sunflower seed proteins are mainly divided under three categories: (1) Proteins responsible for metabolism, (2) Structural proteins like ribosomal or chromosomal and (3) Storage proteins, constituting 85% of total seed protein (Sun et al., 2021). Storage proteins refer to proteins

which serve nutrition, mainly nitrogen to the germinating embryo during the developmental stage. There are two major groups of protein, helianthinin, which belong to the globulin family and another one is albumin . Globulin is the major protein fraction of sunflower seeds that can have varying sizes of 11S and 7S.

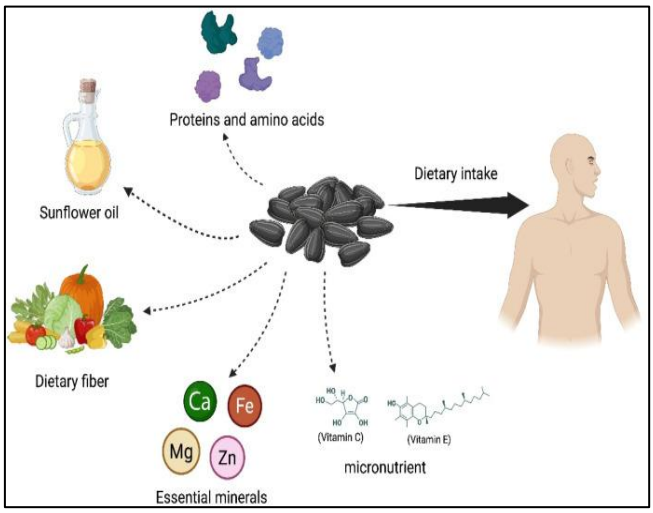

Figure 3.0: Nutritional profile of sunflower seed

The amino acid profile contains glutamic acid, aspartic acid, cysteine, methionine, arginine, phenylalanin, tyrosine and leucine. Dehulling increases the protein content but reduces fiber content (Galland et al., 2017). Out of these amino acids, methionine and cysteine are the main sulphur containing amino acids. Sunflower seed cake protein is rich in sulphur containing amino acids. Lysine, an essential protein, is absent in sunflower seed but still they are a good source of protein being devoid of toxic substances.

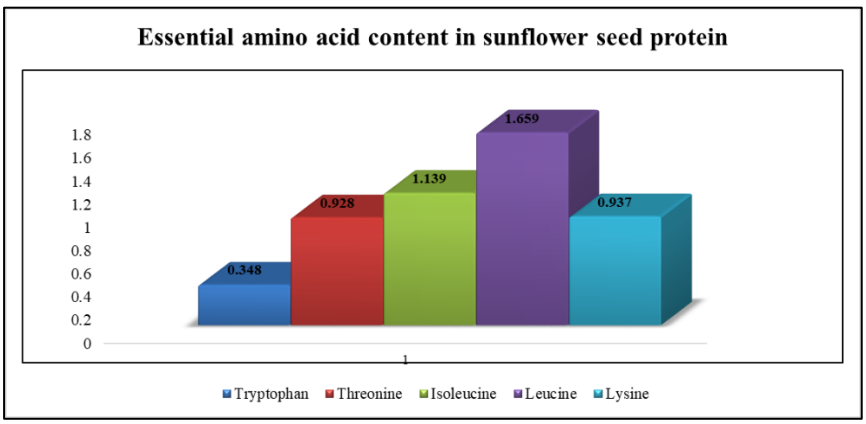

Figure 4.0: Distribution of essential amino acid in sunflower seed (Galland et al., 2017)

Functional Properties Relevant to Food Systems

Sunflower seed proteins and their by-products (meal/press cake) exhibit several functional properties that make them highly relevant for food system applications, especially in plant-based formulations. One of the most important properties is water holding capacity (WHC), which allows sunflower proteins to bind and retain moisture (Karefyllakis et al., 2017). This improves juiciness, softness, and texture stability in products such as bakery items, meat analogs, and high-moisture foods. Similarly, sunflower proteins show oil holding capacity (OHC) due to hydrophobic amino acid regions, enabling better fat binding and flavor retention. This property is useful in sausages, patties, spreads, and emulsified foods. Sunflower seed proteins also possess emulsifying properties, meaning they can stabilize oil–water mixtures by forming a protective protein layer around oil droplets (Li et al., 2025). This supports stable emulsions in products like salad dressings, mayonnaise alternatives, beverages, and plant-based creams. Along with emulsification, they demonstrate foaming capacity and stability, where proteins trap air and form stable foam structures—valuable in cakes, whipped toppings, and aerated desserts.

Another key property is solubility, which depends strongly on pH and processing conditions. Solubility is higher at alkaline pH and lower near the isoelectric point, influencing protein performance in beverages and liquid foods. Proper processing (mild extraction, membrane filtration, or ultrasound-assisted methods) can improve solubility and preserve functionality. Sunflower proteins can also contribute to gelation and structure formation, supporting texture development in plant-based products. However, the presence of phenolic compounds (e.g., chlorogenic acid) may reduce solubility and cause color changes, which can limit use in light-colored foods unless controlled. Overall, sunflower seed proteins are promising ingredients for moisture retention, emulsification, foaming, and texture enhancement in modern food systems.

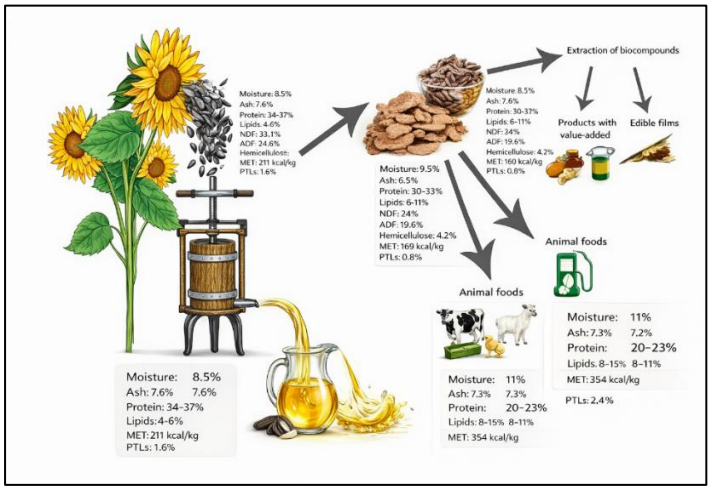

Figure 5.0: Functional application of sunflower seed

Bioactive Potential of Sunflower Seed Proteins

The key enzyme used in the process for the production of such peptides is enzymatic hydrolysis. This process uses specific proteases to break peptide bonds at specific sites, changing large, insoluble proteins into low-molecular-weight fractions. Typical Enzymes: The typical proteases used in this process include Alcalase, Protamex, Papain, and Flavourzyme. The amount of success in peptide hydrolysis is influenced by the levels of hydrolysis, pH, temperatur**e,** and the ratio used in the process. Antioxidant Peptides from sunflower seeds act as peptides act as electron donors and metal chelators, effectively preventing oxidative stress (de Oliveira Filho & Egea, 2021). Hydrolysates produced with Papain. It shows high DPPH and ABTS radical scavenging rates, effectively inhibiting lipid peroxidation. Studies found that sunflower meal peptides can achieve over 56% ACE inhibition, this mechanism is a key natural approach to managing high blood pressure. It is the main storage protein in sunflower seed. Sunflower peptides can modulate immune responses by inhibiting inflammatory mediators. Peptides such as PADVTPEEKPEV have been shown to modulate inflammatory responses in cellular models (like glial cells and astrocytes), reducing the secretion of nitric oxide and pro-inflammatory cytokines (Grahovac et al., 2024). Hydrolysates produced using the enzyme pepsin exhibit clear "zones of inhibition" against common pathogens. These peptides disrupt the cell membranes of bacteria like *E. coli* and *S. aureus.* This biocidal activity helps in both food preservation and preventing infections.

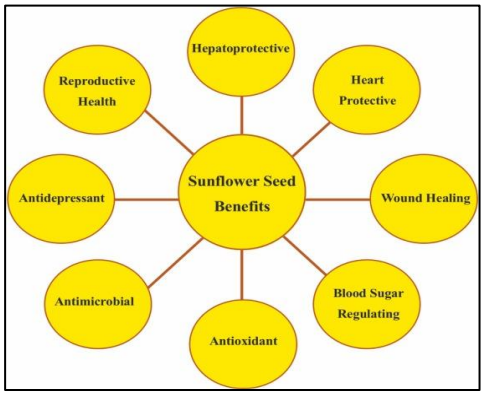

Figure 6.0: Bioactive potential of sunflower seed

Sunflower seed proteins are very helpful for the health food world, because they’re easy on the immune system and rarely trigger allergies. In the kitchen, their natural ability to foam and emulsify makes them a perfect "secret ingredient" for creating better plant-based meats and protein-packed breads or cakes. Beyond just basic nutrition, these proteins act as a clean-label source for natural compounds that help to control blood pressure and cell damage. By upcycling the leftover meal from oil production, we’re able to turn what used to be a byproduct into high-

end supplements that are good for heart health and reduce inflammation (Veličković et al., 2025).

Application in Food and Nutritional Products

Sunflower seed proteins are becoming a promising global food ingredient due to their high nutrition, non-allergenic nature, and strong processing stability. Sunflower protein isolates (SPI) and concentrates (SPC) show neutral taste and a balanced amino acid profile, making them suitable for multiple food products (Hadidi et al., 2024).

Plant-based meat analogues:

High-moisture extrusion can produce a "chicken-style" texture and avoids the typical beany flavor of soy.

Bakery & confectionery:

Improves dough elasticity and air retention in breads and muffins.

Works as an egg-white substitute in foamed products like meringues and nougat.

Dairy alternatives:

Supports creamy texture and reduces phase separation in plant-based beverages.

Provides gelation and viscosity stability in yogurt alternatives.

Protein supplements & sports nutrition:

Rich in BCAAs, suitable for shakes and bars.

Often blended with pea or rice protein to improve amino acid balance.

Edible films & biodegradable packaging:

Forms transparent, cohesive films with oxygen and lipid barrier properties.

Useful as fruit coatings or eco-friendly wrappers.

Sustainability & Industry Impact

Upcycling by-products: Sunflower press cake/meal is being converted from animal feed into human-grade protein, supporting waste reduction. Lower environmental footprint: Sunflower protein generally has a lower carbon and water footprint than animal proteins, with reduced

land and emissions impact**.** Projects like Sunflopro (2026) aim to reduce energy use by ~20% vs soy processing. The sunflower protein market is projected to exceed $100 million by 2034, supported by global farming infrastructure and improved cost-efficiency**.**

Challenges and Limitations

The Shift from Traditional Protein Sources to Sunflower Protein: The transition from traditional sources of proteins to sunflower proteins comes with a fascinating opportunity for practicing a circular economy. Nonetheless, there exist some technological and systemic barriers. The following are some of these barriers. Sunflower proteins face several challenges that limit their wider food applications, mainly due to phenolic compounds such as chlorogenic and caffeic acids, which can cause undesirable green to dark brown discoloration at alkaline pH and generate off-flavors like bitterness and astringency. Compared to soy protein, sunflower protein also shows lower solubility at neutral and acidic pH, often resulting in gritty textures and poor emulsification in beverages and sauces unless additional processing methods such as ultrasonication or hydrolysis are applied, increasing production costs (de Jesús Lira-Ricárdez et al., 2024). Furthermore, although sunflower seeds are widely recognized as safe, highly purified sunflower proteins or certain extraction methods may fall under novel food regulations in some countries, creating regulatory hurdles and influencing consumer perception regarding processing intensity. Finally, the absence of standardized extraction and characterization protocols leads to variability in protein functionality across suppliers, making it difficult for large-scale food manufacturers to consistently replace established proteins like soy or whey.

Recent Advances and Future Research Directions

Currently, new research on sunflower protein (SFP) is held with the technical and organoleptic difficulties, which have up till now restricted its application as compared to soy or pea protein (Li et al., 2025).

Protein modification and hybrid protein systems: New developments utilize the power of AI-driven predictive modeling to precisely locate the most favorable positions for chemical or enzymatic modification. Such methods improve the solubility and emulsifying properties, which are always negatively affected by the rounded shape of the protein.

Encapsulation and delivery of bioactive peptides: Sunflower peptides have been found to have very strong antioxidant activities and antihypertensive effects. Unfortunately, the bioactivity could considerably decrease during the digestion process. Presently, sunflower peptides, which have been spray-dried and coated with carbohydrate polymers (maltodextrin-pectin), have been adopted in order to protect the bioactive peptides from enzymatic degradation. This is to enhance their bioavailability (Li et al., 2024).

Breeding low-phenolic sunflower varieties: However, the most problematic molecule in SFP production is the presence of phenolic compounds, such as chlorogenic acid, that give a green-brown color in alkaline environments as well as an unpleasant bitter taste. However, more modern plant breeding practices incorporate CRISPR/Cas9 gene editing techniques in the development of 'low-phenolic' lines that would naturally yield 'cleaner' protein.

Integration with emerging food technologies (3D food printing, clean-label foods): SFP is on the verge of being an environmentally compatible "ink" for three-dimensional printing of food. At the same time, the sector is turning towards the production of clean label foods. This has been enabled by the development of "green" protein isolation technologies that employ CO$_2$-assisted processing and hexane-free physical processing for the production of protein isolates that satisfy the public requirements of being minimally processed and allergen-free (Karefyllakis et al., 2017).

Future Directions: Future research work may increasingly revolve around the topic of “Upcycled Nutrition”, concentrating on large-scale processing of oil press cakes into high-purity concentrates based upon the principles of circular economies.

Conclusion

Sunflower Seed Proteins are a highly potent and vastly untapped resource in the future of plant-based evolution. In the coming decades of the food industry in 2026 and beyond, Sunflower Seed Proteins promise to come out of the shadows of the oil industry and into the spotlight as a premium ingredient in and of itself. The unique value proposition of Sunflower Seed Proteins is that the proteins are non-GMO, allergenic-friendly (nut allergens), and bland enough to mix seamlessly into meat substitutes, milk substitutes, and baked goods without the “beany” aftertaste that is common in soy and pea proteins. Sunflower protein has strong potential in functional and health food areas [94]. Apart from the basic amino acids they present, they have bioactive peptides and some phenolic compounds called chlorogenic acids that have antioxidant and anti-inflammatory effects. Sunflower proteins are best suited for "clean-label" products focused on cardiovascular health, glucose management, and metabolic aspects. Another advantage of these proteins is that they have high solubility and emulsification capabilities that can smooth texture in protein drinks and sports nutrition products. However, in order to proceed from the status of "promising alternative" to that of "market standard," it is necessary to turn to interdisciplinary research. Thus, by cultivating this approach in the circular economy, sunflower seed proteins can serve as an effective way to ensure global protein security, turning agricultural by-products into the foundation for ensuring sustainable nutrition.

References

1. Adeleke, B. S., & Babalola, O. O. (2020). Oilseed crop sunflower (Helianthus annuus

) as a source of food: Nutritional and health benefits. *Food Science & Nutrition*, *8*(9), 4666–4684. https://doi.org/10.1002/fsn3.1783

2. de Jesús Lira-Ricárdez, J., Schettino Bermúdez, B. S., & Ortega Cabello, L. (2024). Value Addition of Sunflower Seed Meal to Overcome Protein Needs. In *Oilseed Meal as a Sustainable Contributor to Plant-Based Protein* (pp. 205–220). Springer International Publishing. https://doi.org/10.1007/978-3-031-47880-2_10
3. de Oliveira Filho, J. G., & Egea, M. B. (2021). Sunflower seed byproduct and its fractions for food application: An attempt to improve the sustainability of the oil process. *Journal of Food Science*, *86*(5), 1497–1510. https://doi.org/10.1111/1750-3841.15719
4. Galland, M., He, D., Lounifi, I., Arc, E., Clément, G., Balzergue, S., Huguet, S., Cueff, G., Godin, B., Collet, B., Granier, F., Morin, H., Tran, J., Valot, B., & Rajjou, L. (2017). An Integrated "Multi-Omics" Comparison of Embryo and Endosperm Tissue-Specific Features and Their Impact on Rice Seed Quality. *Frontiers in Plant Science*, *8*. https://doi.org/10.3389/fpls.2017.01984
5. Grahovac, N., Lužaić, T., Živančev, D., Stojanović, Z., Đurović, A., Romanić, R., Kravić, S., & Miklič, V. (2024). Assessing Nutritional Characteristics and Bioactive Compound Distribution in Seeds, Oil, and Cake from Confectionary Sunflowers Cultivated in Serbia. *Foods*, *13*(12), 1882. https://doi.org/10.3390/foods13121882
6. Hadidi, M., Aghababaei, F., & McClements, D. J. (2024). Sunflower meal/cake as a sustainable protein source for global food demand: Towards a zero-hunger world. *Food Hydrocolloids*, *147*, 109329. https://doi.org/10.1016/j.foodhyd.2023.109329
7. Karefyllakis, D., Altunkaya, S., Berton-Carabin, C. C., van der Goot, A. J., & Nikiforidis, C. V. (2017). Physical bonding between sunflower proteins and phenols: Impact on interfacial properties. *Food Hydrocolloids*, *73*, 326–334. https://doi.org/10.1016/j.foodhyd.2017.07.018
8. Kotecka-Majchrzak, K., Sumara, A., Fornal, E., & Montowska, M. (2020). Oilseed proteins – Properties and application as a food ingredient. *Trends in Food Science & Technology*, *106*, 160–170. https://doi.org/10.1016/j.tifs.2020.10.004
9. Levasseur-Garcia, C., Castellanet, P., Henry, C., Florin, C., Laporte, M., Mirleau-Thebaud, V., Plut, S., & Calmon, A. (2024). Non-Destructive Analysis Using Near-Infrared Spectroscopy to Predict Albumin, Globulin, Glutelin, and Total Protein Content in Sunflower Seeds. *Sustainability*, *16*(2), 737. https://doi.org/10.3390/su16020737
10. Li, Z., Huang, X., Hu, Y., Ma, S., Gafurov, K., Gu, F., Guo, Q., & Wang, Q. (2025). Sunflower seed protein: defatting, structural characterization and property analysis. *International Journal of Biological Macromolecules*, *310*, 143552. https://doi.org/10.1016/j.ijbiomac.2025.143552
11. Li, Z., Xiang, F., Huang, X., Liang, M., Ma, S., Gafurov, K., Gu, F., Guo, Q., & Wang, Q. (2024). Properties and Characterization of Sunflower Seeds from Different Varieties

of Edible and Oil Sunflower Seeds. *Foods*, *13*(8), 1188. https://doi.org/10.3390/foods13081188

12. Petraru, A., Ursachi, F., & Amariei, S. (2021). Nutritional Characteristics Assessment of Sunflower Seeds, Oil and Cake. Perspective of Using Sunflower Oilcakes as a Functional Ingredient. *Plants*, *10*(11), 2487. https://doi.org/10.3390/plants10112487
13. Quintieri, L., Nitride, C., De Angelis, E., Lamonaca, A., Pilolli, R., Russo, F., & Monaci, L. (2023). Alternative Protein Sources and Novel Foods: Benefits, Food Applications and Safety Issues. *Nutrients*, *15*(6), 1509. https://doi.org/10.3390/nu15061509
14. Sun, X., Sun, Y., Li, Y., Wu, Q., & Wang, L. (2021). Identification and Characterization of the Seed Storage Proteins and Related Genes of Cannabis sativa L. *Frontiers in Nutrition*, *8*. https://doi.org/10.3389/fnut.2021.678421
15. Veličković, I., Samardžić, S., Milenković, M. T., Petković, M., & Maksimović, Z. (2025). Valorisation of Sunflower Crop Residue as a Potentially New Source of Bioactive Compounds. *Horticulturae*, *11*(2), 206. https://doi.org/10.3390/horticulturae11020206
16. Yang, J., Vardar, U. S., Boom, R. M., Bitter, J. H., & Nikiforidis, C. V. (2023). Extraction of oleosome and protein mixtures from sunflower seeds. *Food Hydrocolloids*, *145*, 109078. https://doi.org/10.1016/j.foodhyd.2023.109078

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Unconventional Flaxseed Protein: Extraction, Functional Properties, and Applications in Food Systems

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Abstract:

The growing demand for sustainable and alternative protein sources has intensified interest in plant-based proteins that remain underexploited. Among these, flaxseed (*Linum usitatissimum*) has emerged as a promising non- conventional source of vegetable protein. While flaxseed is traditionally processed for oil and dietary fiber extraction, its protein fraction has received comparatively limited attention despite its balanced nutritional composition and favorable functional attributes. Flaxseed proteins exhibit antioxidant and anti-inflammatory properties, suggesting potential health benefits when incorporated into the human diet. Their functional characteristics make them suitable for diverse food applications, including bakery products, meat analogues, beverages, and functional foods. The utilization of flaxseed proteins also supports sustainable food production by valorizing oilseed by-products and reducing dependence on animal-derived proteins. To overcome challenges related to antinutritional components and sensory limitations, various processing approaches, including protein isolation, enzymatic modification, and fermentation, have been explored. Overall, flaxseed proteins present significant opportunities for developing value- added food products that enhance nutritional quality, promote food security, and contribute to environmentally sustainable food systems.

Keywords**:** *Flaxseed protein; Unconventional plant protein; Sustainable protein source; Functional properties; Plant-based foods; Food systems; Value-added food products; Oilseed by-products*

Introduction

Procurement of food around the world is changing drastically due to population growth and environmental issues, as well as a growing consumer demand for items on a more health-oriented basis with regard to sustainable practices. One way that this is taking place is by the increasing adoption of plant-based and sustainable protein alternatives (as opposed to animal-based) in place of animal protein products (Reisch et al., 2013). Unfortunately, while animal protein production contributes to the excessive production of greenhouses gases and consumes a disproportionate amount of available land and water, and there are ethical considerations around the treatment of animals before death (and posthumously), plant proteins offer consumers an opportunity to purchase non-animal products at a lower cost (relative to animal protein), with a reduced impact on the environment (Balan et al., 2022). In addition, due to their compatibility with vegetarian and vegan diets, plant proteins are increasingly attracting interest for greater use around the world in developing nations that are following the path of implementing global initiatives to achieve food security and to work towards achieving sustainable development goals (Mariotti & Gardner, 2019).

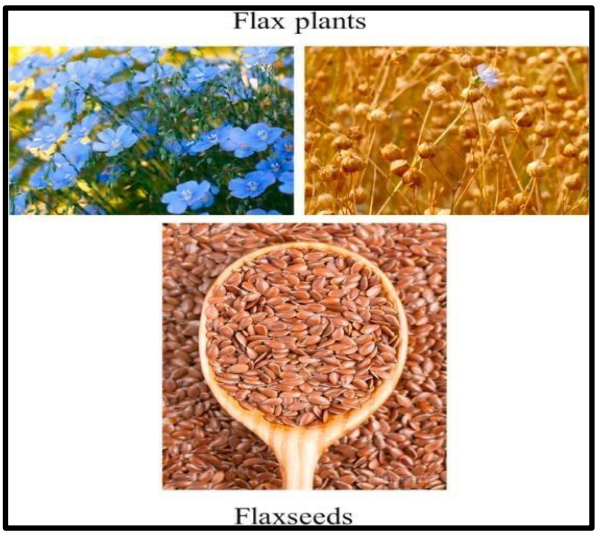

Figure 1.0: Flax plants and harvested flaxseeds illustrating the source and edible form of linseed

Traditional plant protein sources such as soy, pea, and wheat are widely utilized in the food industry due to their relatively high protein content and established availability. However, the applicability of these conventional proteins across diverse food systems is often constrained by nutritional, functional, and consumer-related limitations (Day, 2013; Sha & Xiong, 2020). Soy protein is regarded as a complete protein owing to its balanced essential amino acid profile; nevertheless, concerns related to soy allergies, the prevalence of genetically modified soybean cultivation, and potential health and environmental

implications have limited its acceptance among certain consumer groups (Friedman & Brandon, 2001; Rizzo & Baroni, 2018). Pea protein is considered hypoallergenic and sustainable, yet its utilization is challenged by beany off-flavors, reduced solubility, and limited functional performance in specific food applications (Stone et al., 2015; Lam et al., 2018). Wheat protein (gluten) is unsuitable for individuals with celiac disease or gluten intolerance and is nutritionally limited due to its deficiency in lysine, an essential amino acid (Shewry & Halford, 2002). These constraints underscore the growing need to explore novel and underutilized plant protein sources capable of enhancing nutritional quality, functionality, and sustainability within food systems.

Flaxseed (*Linum usitatissimum L.)* has emerged as a promising alternative plant protein source. Depending on cultivar, growing conditions, and processing methods, flaxseed contains approximately 20–30% protein (Oomah & Mazza, 1993; Kaushik et al., 2016). The protein fraction is predominantly composed of globulins and albumins, which exhibit a relatively balanced amino acid profile with notably high concentrations of arginine, glutamic acid, and branched- chain amino acids (BCAAs) (Madhusudhan, 2009; Khattab & Arntfield, 2009). Although flaxseed protein is moderately low in lysine, it may serve as a complementary protein source when blended with other plant proteins to improve overall amino acid balance (Wanasundara, 2011). Beyond its nutritional value, flaxseed protein demonstrates unique functional properties, including water-holding capacity, emulsifying ability, foaming capacity, and gelling behavior (Kaur et al., 2017; Tzang et al., 2009). These functional attributes enable its incorporation into a wide range of food products, such as baked goods, beverages, meat analogs, and functional or nutraceutical foods (Wanasundara & Shahidi, 1997; Wang et al., 2019).

The method of protein extraction plays a critical role in determining the yield, structural integrity, and functional performance of flaxseed protein. Conventional alkaline extraction, enzyme-assisted extraction, and emerging green technologies such as ultrasound-assisted and membrane-based extraction have been investigated, each producing proteins with distinct physicochemical and functional characteristics (Liu et al., 2018; Zhang et al., 2021). These extraction techniques influence protein solubility, molecular conformation, and interactions with other food components, ultimately affecting end-use applications (Mao & Hua, 2012). However, most existing studies report extraction efficiency and functional properties independently, offering limited insight into the relationships among extraction conditions, protein functionality, and targeted food applications. Therefore, there is a clear need for an integrated and systematic review of flaxseed protein extraction processes, functional characteristics, and application potential. Such a comprehensive synthesis would benefit researchers, food technologists, and undergraduate students by presenting scientific evidence in a coherent and structured manner. Understanding the interrelationship between extraction methods, functional attributes, and food system

performance is essential for optimizing the commercial utilization of flaxseed protein. The purpose of this review is to critically analyze the current literature on flaxseed protein, with emphasis on: (i) the protein composition of flaxseed and extraction methodologies; (ii) the impact of processing conditions on functional properties; and (iii) potential food and nutraceutical applications arising from these functional characteristics.

Flaxseed as an Unconventional Protein Source

Flaxseed (Linum usitatissimum L.) is a long-established crop that produces oil and fibre and has gained significant modern research interest due to its high nutritional value and emerging role as an alternative plant-based protein source (Kajla et al., 2015; Oomah, 2001). Traditionally, flaxseed has been used for linen and oil production; however, in recent years, defatted flaxseed meal has gained attention as a source of high-quality protein with promising functional properties (Madhusudhan, 2009). The growing global demand for sustainable, diverse plant protein sources has positioned flaxseed as a viable alternative to conventional plant protein crops such as soy and pea (Singh et al., 2011).

Flaxseed belongs to the botanical family Linaceae and grows as an herbaceous annual plant with a height ranging from approximately 30 to 90 cm (Kajla et al., 2015). The plant is characterized by a slender stem, narrow lance-shaped leaves, and blue or white flowers. Flaxseeds are flat, oval, shiny, and smooth, surrounded by a thick mucilage-rich outer coat that contributes to their structural stability and functional performance in food systems (Fedeniuk & Biliaderis, 1994).
Flaxseed is a highly adaptable crop, thriving in temperate climates with moderate rainfall and well- drained soils, and it requires comparatively lower fertilizer inputs than many other protein-producing crops, making it environmentally sustainable (Oomah, 2001).

Flaxseeds are commercially available in brown and golden varieties. Although both originate from the same species and share similar nutritional profiles, minor differences exist in appearance, consumer preference, and functional behavior (Madhusudhan, 2009). Brown flaxseed is more widely cultivated due to its greater adaptability to varied climatic conditions and is commonly used for oil extraction, animal feed, and industrial applications. In contrast, golden flaxseed is primarily marketed for human consumption owing to its lighter color and milder flavor, which enhances its suitability for bakery and functional food products (Kajla et al., 2015). The protein content of both brown and golden flaxseed typically ranges between 20% and 30%, with comparable amino acid profiles (Singh et al., 2011). While their extracted proteins exhibit broadly similar functional properties, slight differences in solubility and emulsifying capacity may occur due to variations in seed coat composition and polysaccharide content (Madhusudhan, 2009). These varietal differences allow for targeted selection of flaxseed types based on intended food applications.

Globally, flaxseed is cultivated in Canada, China, India, Russia, the United States, and several European countries, with Canada recognized as the world's largest producer and exporter (Oomah, 2001). In India, flaxseed production is concentrated in Madhya Pradesh, Uttar Pradesh, Chhattisgarh, and Maharashtra, where it has been traditionally grown for oil and medicinal purposes (Kajla et al., 2015). The expansion of markets for omega-3 fatty acids, dietary fiber, and plant-based protein ingredients, coupled with the growth of oilseed processing industries, has driven sustained global flaxseed production (Singh et al., 2011). Increased availability of flaxseed meal presents opportunities for protein recovery and the development of value-added products, aligning with sustainable processing and circular economy principles. The combination of favorable botanical traits, global varietal diversity, and a robust supply chain underscores flaxseed's potential as an unconventional plant-based protein source for future food and nutrition applications (Madhusudhan, 2009).

Chemical Composition of Flaxseed

Flaxseed (*Linum usitatissimum L.*) is nutritionally dense and possesses a unique chemical composition that supports its role as both a functional food and an alternative protein source (Kajla et al., 2015). On a dry weight basis, flaxseed typically contains approximately 20–30% protein, 35–45% fat, 25–30% carbohydrates, and 20–28% dietary fiber (Oomah, 2001). The lipid fraction is rich in polyunsaturated fatty acids, with α-linolenic acid (omega-3 fatty acid) accounting for nearly 50–55% of total fatty acids (Singh et al., 2011). Although this high fat content enhances nutritional value, defatting is often required to facilitate efficient protein extraction and processing (Madhusudhan, 2009). The carbohydrate fraction of flaxseed is primarily composed of non-starch polysaccharides, including soluble mucilage and insoluble fiber, both of which contribute togastrointestinal and metabolic health benefits (Fedeniuk & Biliaderis, 1994). In addition to dietary fiber, flaxseed is a rich source of lignans, particularly secoisolariciresinol diglucoside (SDG), which exhibits antioxidant and phytoestrogenic properties (Oomah, 2001). These bioactive compounds enhance the nutraceutical and functional relevance of flaxseed-derived ingredients in health-oriented food formulations (Kajla et al., 2015).

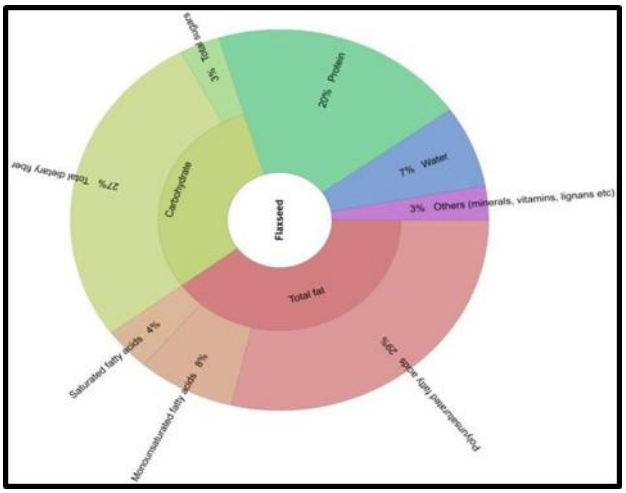

Figure 2.0: Nutritional composition of flaxseed highlighting fiber, protein, and healthy fats.

Flaxseed protein is composed primarily of globulin and albumin, which have a high concentration of arginine, glutamic acid, aspartic acid and branched chain amino acids. That said, flaxseed protein is considered to be moderately deficient in its levels of lysine and sulfur amino acids compared to many animal proteins. In summary, flaxseed protein has a moderately lower protein quality when compared to many animal proteins but complements the amino acid profiles found in protein sources made from cereals. Compared to the traditional plant proteins of soy, pea and wheat, flaxseed protein has the same overall amount of nutritional (protein) value. However, flaxseed protein also has some functional and health-promoting factors that are not found in soy, for example, omega 3s and lignans. While soy protein contains a higher level of nutrition with respect to essential amino acids, flaxseed protein is a great option as a diversified and sustainable source of plant protein.

When properly processed, the presence of antinutritional substances in flaxseed will influence the ability of the food to provide nutrients and use proteins; one major antinutrient found in flaxseed is the cyanogenic glycoside. The three types of cyanogenic glycoside found in flaxseed are linamarin, linustatin and neolinustatin. After they are enzymatically broken down, the cyanogenic glycoside can produce hydrogen cyanide, which can be harmful if consumed in large amounts. However, many common food processing techniques like boiling, roasting, heating, fermenting and extrusion will greatly decrease the amount of cyanogenic glycosides in flaxseed and thus make the end product safe for human consumption. Phytic Acid is an antinutritional substance in Flaxseed associated with chelation of important minerals including iron, zinc, and calcium and thereby decreasing their bioavailability. Phytic Acid also forms complexes with protein molecules limiting the access of enzymes to protein during digestion. These anti-nutritive factors can reduce

protein digestibility by negatively influencing protein digestion through the inhibition of digestive enzymes and the decrease of amino acid absorption.

Extraction Techniques of Flaxseed Protein

Flaxseed protein can be isolated using various extraction techniques, including alkaline extraction followed by isoelectric precipitation, salt extraction, enzyme-assisted extraction, and ultrasound-assisted methods (Girgih et al., 2011; Xu et al., 2020). In addition, sustainable green extraction approaches, such as supercritical CO_2 extraction and subcritical water extraction, are increasingly being explored due to their reduced environmental impact and their ability to preserve protein functionality and bioactive compounds (Chemat et al., 2012; Plaza & Turner, 2015). Each of these extraction methods influences flaxseed protein yield, solubility, and retention of bioactive compounds, thereby determining their suitability for application in functional foods and nutraceutical formulations (Oomah, 2001; Karaca et al., 2011). Due to their simplicity, ease of scale-up, and cost-effectiveness, conventional protein extraction techniques remain widely employed in both laboratory and industrial settings (Tang, 2017). The literature primarily describes three conventional methods for flaxseed protein extraction: alkaline extraction followed by isoelectric precipitation, salt-induced extraction, and solvent-based extraction systems (Girgih et al., 2011; Xu et al., 2020). While these methods are efficient, they often require high solvent usage and may lead to partial denaturation or loss of functional properties.

In contrast, recent advancements in flaxseed processing emphasize sustainable extraction techniques that minimize solvent use and energy consumption, commonly referred to as emergent and green extraction technologies for flaxseed protein and bioactives (Chemat et al., 2017). These include supercritical CO_2 extraction, subcritical water extraction, ultrasound-assisted extraction, microwave-assisted extraction, and pulsed electric field extraction (Plaza & Turner, 2015; Barba et al., 2015). These innovative approaches have demonstrated improved protein and bioactive yields, enhanced preservation of nutritional and functional characteristics, reduced processing time, and a significantly lower environmental footprint compared to conventional solvent-based methods (Chemat et al., 2012; Tang, 2017).

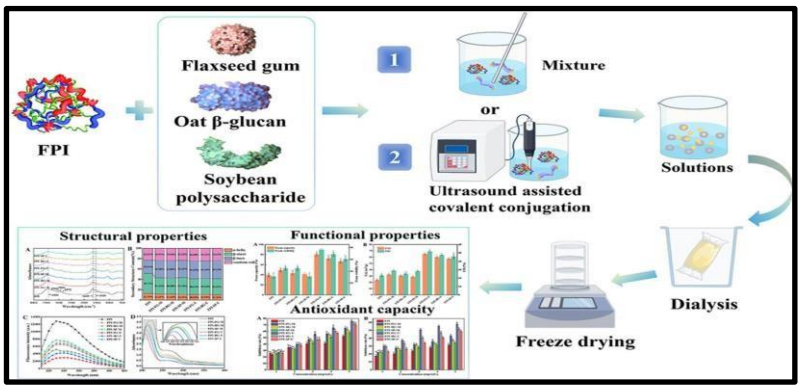

Figure 3.0: Flaxseed Protein Isolate (FPI) reacts through ultrasonic assistance to form covalent protein-polysaccharide conjugates that are then dialyzed and freeze-dried ().

Extraction Method	Protein Yield	Protein Quality	Advantages	Limitations
Cold-press/ Mechanical	Low	Very High	Preserves native structure, no chemical, high nutritional quality	Low yield, not efficient for protein recovery
Enzyme-assisted extraction	Moderate	High	Maintains structural integrity, good functional properties eco-friendly	High enzyme cost, longer processing time
Isoelectric precipitation	Moderate-High	Moderate	Simple, widely used, good recovery	Reduced solubility and functionality due to aggregation
Solvent extraction	High	Moderate-Low	Efficient oil removal, improved protein yield	Reduced solvents, partial denaturation, safety concerns
Alkaline extraction	Very High	Low-Moderate	Maximum protein recovery, industrially scalable	Protein denaturation, reduced functionality, high pH damage

Structural and Physicochemical Properties

The protein component of flaxseed (linseed) exhibits a broad molecular weight distribution,

typically ranging from 10 to 100 kDa, and consists primarily of albumins and globulins, along with smaller peptide fractions (Kaur et al., 2017; Oomah & Mazza, 1993). Two major protein fractions are generally observed between 20–30 kDa and 50–70 kDa, indicating that globulins are the predominant protein class present in flaxseed (Dev & Quensel, 1988; Gopalan et al., 2018). Extraction methods significantly influence the molecular weight distribution of flaxseed proteins; alkaline extraction and enzymatic treatments may induce partial dissociation or aggregation of protein molecules, thereby affecting their solubility, functional performance, and structural integrity (Karaca et al., 2011; Singh et al., 2020). The functional properties and stability of flaxseed proteins in food systems are strongly dependent on their secondary and tertiary structures (Tang, 2017). Flaxseed proteins possess a compact, globular conformation, largely attributed to the predominance of β-sheet structures, which contributes to their thermal stability and functional behavior in complex food matrices (Aluko, 2018; Kaur et al., 2017).

Flaxseed protein solubility follows a U-shaped pattern across the pH scale, with minimum solubility observed near the isoelectric point (pH 4.0–4.5) and increased solubility at both acidic (pH < 3) and alkaline (pH > 7) conditions (Karaca et al., 2011; Tang & Wang, 2010). As flaxseed proteins are predominantly globulin-type proteins, they exhibit moderate thermal stability, retaining structural integrity under controlled heating conditions. Protein denaturation typically initiates at approximately 70–90 °C, during which unfolding of secondary and tertiary structures occurs, resulting in decreased solubility and alterations in emulsifying, foaming, and gelation properties (Gopalan et al., 2018; Singh et al., 2020). Flaxseed proteins exhibit intermediate surface hydrophobicity, a characteristic that enhances their ability to stabilize oil-in-water emulsions and air-in-water foams, thereby supporting their application in a variety of food systems (Aluko, 2018; Tang, 2017).

Functional Properties of Flaxseed Protein

Flaxseed protein demonstrates a wide range of functional properties, including effective emulsifying and foaming abilities, heat-induced gel formation, and notable water-holding and oil-holding capacities, all of which contribute positively to food texture and mouthfeel (Karaca et al., 2011; Singh et al., 2020). These functional attributes can be further enhanced through pH adjustment, thermal processing, or enzymatic modification, making flaxseed protein a promising ingredient for vegan, geriatric, and functional food applications (Tang & Wang, 2010; Aluko, 2018). Flaxseed proteins exhibit a high capacity for water and oil retention, which is primarily attributed to the presence of polar amino acid residues and a flexible protein structure that facilitates hydrogen bonding and water entrapment (Kaur et al., 2017). These properties enhance moisture retention and structural integrity in baked products, meat analogs, and non-dairy formulations (Oomah & Mazza, 1993; Singh et al., 2020). The molecular structure and intermolecular interactions of flaxseed proteins govern their functional behavior in food systems. Flaxseed protein acts as an effective natural

emulsifier in products such as dressings, beverages, and meat analogs (Tang, 2017). The protein also exhibits moderate foaming capacity, which is influenced by solubility, surface hydrophobicity, and processing conditions. Optimized pH and treatments such as heat or enzymatic hydrolysis enhance foam formation and stability, making flaxseed protein suitable for aerated foods, including baked goods, beverages, and plant-based desserts (Karaca et al., 2011; Tang & Wang, 2010). Gelation in flaxseed-based systems results from the combined action of proteins and mucilage, where protein networks form through heat-induced or pH-induced mechanisms, contributing to textural stability (Singh et al., 2020). The digestibility and bioavailability of flaxseed protein depend on the physical form of the seed and processing methods. Grinding or defatting improves nutrient accessibility, enhancing protein, omega-3 fatty acid, and lignan absorption (Oomah & Mazza, 1993). Although anti-nutritional factors such as phytic acid may reduce protein digestibility, appropriate thermal and enzymatic treatments can significantly improve nutrient availability (Gopalan et al., 2018)

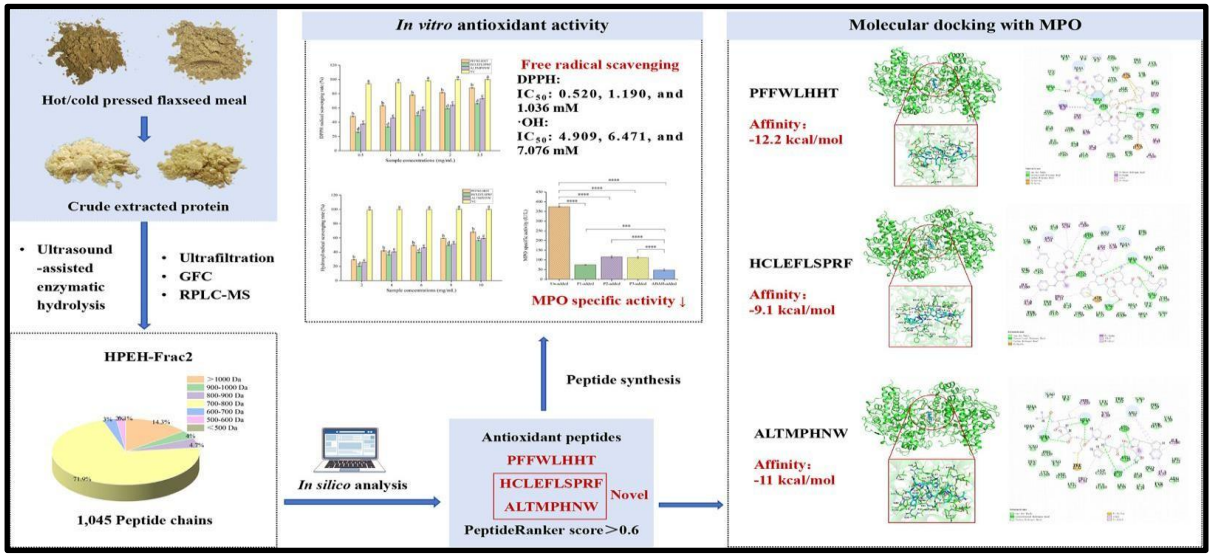

Figure 4.0: Extraction and hydrolysis of flaxseed proteins leading to antioxidant peptides, evaluated by in vitro assays, in silico analysis, and molecular docking with myeloperoxidase (MPO).

Flaxseed is easier to digest when processed into a powdered form compared to eating whole seeds. For example, when flaxseed is ground, fat is removed, heat is added (roasting), or the flaxseed undergoes enzymatic treatments for hydrolysis this will help break down protein and fat more effectively, while at the same time reducing the amount of substances that would normally inhibit nutrients from being released and absorbed by the body during digestion.

Applications of Flaxseed Protein in Food Systems

The functional properties of flaxseed protein—namely gelation, emulsification, foaming, and water- and oil-holding capacity—have led to its increasing application in the food industry (Kaushik et al., 2016; Oomah, 2001). As a plant- based protein source, flaxseed protein has been successfully incorporated into bakery products, meat alternatives, dairy alternatives, beverages, and protein supplements (Goyal et al., 2014). In addition, its ability to enhance texture, stability, and nutritional value supports the development of functional and fortified foods aimed at health-conscious consumers (Singh et al., 2011).

Bakery and Cereal-Based Products

Bakery and cereal-based products frequently incorporate flaxseed due to its nutritional and functional advantages.
Flaxseed contributes proteins, dietary fiber, and mucilage, which help stabilize dough systems, retain moisture, and improve product structure and appearance (Oomah & Mazza, 1998). It is also a rich source of omega-3 fatty acids and lignans, contributing to enhanced nutritional quality. The inclusion of flaxseed significantly improves the fiber content of bread, cookies, muffins, and breakfast cereals, extending shelf life while maintaining sensory acceptability (Goyal et al., 2014; Morris, 2007).

Dairy and Dairy Alternatives

Flaxseed is increasingly used in dairy products and dairy alternatives to enhance both functional and nutritional properties. Flaxseed proteins and mucilage improve viscosity, stability, and mouthfeel in yogurt analogues, cheese substitutes, and plant-based beverages (Kaur et al., 2018). Moreover, flaxseed enrichment provides omega-3 fatty acids, dietary fiber, and bioactive compounds, enabling the formulation of functional dairy and non-dairy products with added health benefits (Singh et al., 2011).

Meat and Meat Analogues

Flaxseed protein is utilized to improve water-holding capacity, texture, and binding properties in both conventional meat products and plant-based meat analogues. Its gelation and emulsification characteristics contribute to firm, cohesive, and juicy textures while simultaneously enriching products with plant protein, dietary fiber, and omega-3 fatty acids (Kaushik et al., 2016). The incorporation of flaxseed thus enhances both the nutritional profile and functional performance of meat and meat-alternative formulations (Goyal et al., 2014).

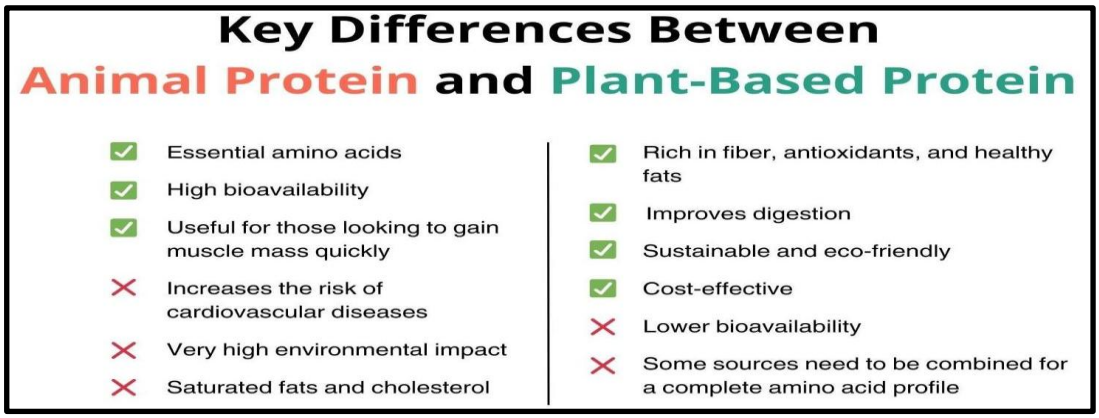

Figure 5.0: Comparison of animal-based and plant-based protein sources

Texturized product

Flaxseed protein (texturized) is a plant-derived structuring ingredient that can be used in a wide range of meat and meat-based products (meat analogues). The texturized flaxseed protein also enhances fibrous texture, moisture retention, and juiciness of the product and increases the functional/nutritional properties of the product by providing additional proteins, omega 3 fatty acids, and dietary fibre to enhance the overall quality of the product. Texturized flaxseed protein can be used in a variety of applications including sausages, patties, nuggets and other vegetarian meat substitutes.

Functional and Nutraceutical Foods

Flax seed protein is used in supplements (Protein Powders, Protein Concentrates and Protein Isolates) because of its good amino acid profile and ability to be digested easily. Flax seed protein helps with muscle maintenance, supports feelings of fullness (Satiety), and maintains a healthy metabolism. In addition, flax seed protein provides bioactive peptides with antioxidant and anti-inflammatory properties. Flax seed protein supplements can be used in your daily nutrition by vegans, vegetarians and those who want to supplement their nutrition with a plant-based product.

Health-focused formulations contain flaxseed because it has a high concentration of omega 3 fatty acids (Alpha Linolenic Acid), Lignans, Dietary Fibre and Bioactive Proteins. Flaxseed is included in functional food formulations e.g., enriched bread, biscuits, breakfast cereals, nutrition bars, drinks and dairy substitutes and supports heart health, gut health, blood sugar control and antioxidant activity. Nutraceuticals also use Flaxseed (capsules, powders and emulsions) as part of preventative nutrition.

Health Benefits and Nutritional Implications

Flaxseed provides a wealth of nutritional value, including omega 3 fatty acids, dietary fiber, protein, and lignans. In addition to enhancing heart function, flaxseed promotes better digestive health, helps regulate blood glucose and cholesterol levels, and provides antioxidant and anti-inflammatory effects; therefore, flaxseed serves as an important functional food in preventive healthcare.

Hypocholesterolemic effects

The hypocholesterolemic effects of Flaxseed result from three components: Soluble Fiber, Omega-3 Fatty Acids, and Lignans. All three work together to lower LDL Cholesterol, improve Lipid Metabolism, and reduce cholesterol absorption. All of these mechanisms promote cardiovascular health and decrease the risk of Atherosclerosis.

Antioxidant potential

Flaxseed has exceptional antioxidant potential based on its high level of bioactive substances, including Lignans, such as Secoisolariciresinol Diglucoside (SDG), which are thought to act as free radical scavengers, reduce oxidative stress and potentially protect against injury caused by long-term illnesses. Flaxseed also contains other antioxidants, including Phenolic Acids, Flavonoids, and Vitamin E. All of these components work together to provide Anti- Inflammatory actions, increase cellular protection, and thus improve the quality of life for all.

Role in metabolic health

High levels of flaxseed fibre, omega-3 fatty acids, and lignans provide support for a person's metabolic health. Flaxseed's fibre, omega-3 fatty acids, and lignans improve insulin sensitivity, regulate blood glucose, lower cholesterol and triglycerides, reduce inflammation, and increase hunger satisfaction, all of which contribute to weight loss and reduce the risk of developing a metabolic disorder, such as diabetes and heart disease.

Suitability for vegan and geriatric nutrition

Flaxseed is a great option for both vegans and older adults because it contains plant-based protein, omega-3s, soluble and insoluble fiber, and provides antioxidants in the form of lignans. For vegans, flaxseed can replace both eggs and fats; for older adults, flaxseed promotes healthy digestion, heart health, and helps keep your body's metabolism balanced.

Challenges, Limitations, and Safety Considerations

Flaxseed has some negative characteristics in a natural state: it is difficult to digest if consumed whole, consuming significant amounts of fiber can cause gastrointestinal issues, and consuming too many cyanogenic glycosides (which can produce cyanide) may result in gastrointestinal problems. Additionally, excessive consumption of flaxseed may interfere with the effects of certain prescription medicines and must therefore be consumed in moderation and handled properly for safe use.

The use of flaxseed in food products can cause sensory concerns for consumers, as flaxseed has a dark coloration and a mild nutty or somewhat bitter flavor that can modify the visual appearance and sensory profile (taste) of the resulting food product. If used in excess, brown flaxseed may make baked goods appear darker than they otherwise would have, create a grainy texture or mask delicate flavors. Incorporating golden flaxseed, using finer grind sizes and limiting the amount of flaxseed incorporated, can decrease these sensory changes.

Antinutritional components are found in flaxseed; namely, cyanogenic glycosides, which are potentially harmful as they are capable of producing hydrogen cyanide through extreme consumption, and phytic acid, which can decrease the bioavailability of essential minerals from foods that have a high content of this substance.

Flaxseed is generally viewed to have a low potential for allergens. However, there are individuals who are allergic to flaxseed and will have an allergy negative reaction, particularly in cases where they have sensitivities to seeds. Both the U.S. FDA and other regulatory agencies classify flaxseed as GRAS (Generally recognized as safe). Flaxseed may be used in food products, as food supplements, and flaxseed oil in topical applications; however, all products must be labelled in accordance with current Good Manufacturing Practices (cGMPs). To protect yourself from potential adverse effects, including gastrointestinal discomfort, avoid excessive consumption of flaxseed and its oil (due to high levels of cyanogenic glycosides).

Future Perspectives and Research Gaps

Flaxseed may be useful as an ingredient for future studies to develop new functional foods and nutraceuticals or to use in disease preventions such as metabolic syndrome, heart disease and cancer. Areas to be explored include better understanding of how much flaxseed should be consumed (optimal dosage), when and how to extract the various types of lignan, omega-3 fatty acids and whether consuming them has long-term safety risks, and if there are special considerations for certain groups e.g. elderly or children. Future studies should also explore ways of processing flaxseed for best sensory characteristics and shelf-life.

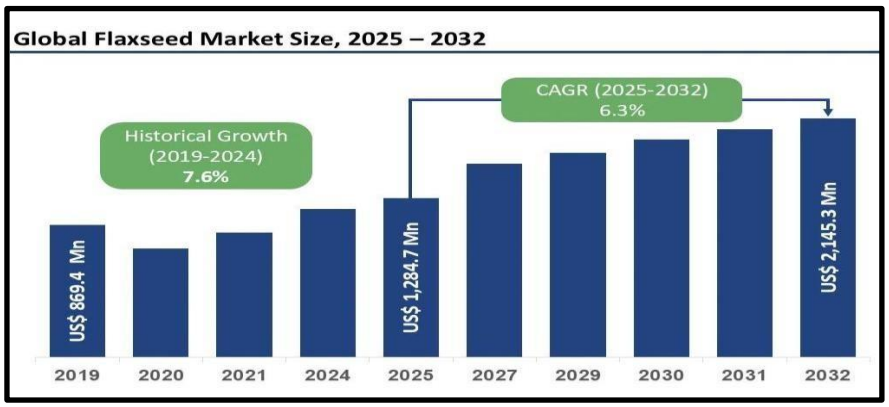

Figure 6.0: Evolution of the global flaxseed market, reflecting a transition from strong historical performance to resilient long-term growth driven by rising health and functional food demand.

Methods of extracting flaxseed bioactive compounds utilizing Green Extraction methods include Ultrasound extraction, Enzymatic extraction and Super Critical C02 extraction. Energy-efficient optimization usually focuses on maximising yields and preserving omega-3, Lignan & Antioxidant content through controlling temperature, pressure, extraction duration and size of particles by minimising Solvent usage & maximizing environmentally conscious sustainability while assuring the maximum retained nutritional value. Enzymatic hydrolysis, heat treatment, pH adjustment, and fermentation are methods that can enhance the functionality of flaxseed proteins. The protein functionality enhancements possible via these methods include improved solubility, emulsification, foaming, and gelation as well as increased digestibility and improved reduction of antinutritional factors for the use of flaxseed protein in plant-based foods and functional ingredients.

Conclusion

Flaxseed protein is an alternative protein source that is popular due to its plant-based nature, high digestibility and high-quality amino acid profile. It has numerous properties in addition to its excellent digestibility including the ability to form emulsions, foam and gel, making it suitable for inclusion in a wide variety of applications including vegan products, foods for seniors and functional food products. The various bioactive compounds found in flaxseed protein provide additional health-enhancing benefits beyond those of its basic nutritional components. Flaxseed is an important part of sustainable food systems as it is high in nutrition density and provides both protein from plant sources and fat without having a high environmental impact. The many uses of flaxseed for vegan products, animal feed, and functional food products can also be extracted and processed using environmentally friendly methods, enabling the creation of food products that are healthy and resource-efficient, while promoting sustainability.

References

1. Aluko, R. E. (2018). Food protein-derived peptides: Production, isolation, and applications. Springer. https://doi.org/10.1007/978-3-319-78139-4
2. Barba, F. J., Brianceau, S., Turk, M., Boussetta, N., & Vorobiev, E. (2015). Effect of alternative physical treatments (ultrasound, pulsed electric fields, and high-voltage electrical discharges) on selective extraction of bio-compounds from plants. Trends in Food Science & Technology, 46(1), 10–18. https://doi.org/10.1016/j.tifs.2015.07.002
3. Chemat, F., Rombaut, N., Sicaire, A. G., Meullemiestre, A., Fabiano-Tixier, A. S., & Abert-Vian, M. (2017). Ultrasound assisted extraction of food and natural products. Mechanisms, techniques, combinations, protocols and applications. A review. Ultrasonics Sonochemistry, 34, 540–560. https://doi.org/10.1016/j.ultsonch.2016.06.035
4. Chemat, F., Vian, M. A., & Cravotto, G. (2012). Green extraction of natural products: Concept and principles. International Journal of Molecular Sciences, 13(7), 8615–8627. https://doi.org/10.3390/ijms13078615
5. Day, L. (2013). Proteins from land plants – Potential resources for human nutrition and food security. Trends in Food Science & Technology, 32(1), 25–42. https://doi.org/10.1016/j.tifs.2013.05.005
6. Dev, D. K., & Quensel, E. (1988). Functional properties of linseed proteins. Journal of Food Science, **53**(6), 1835–1839. https://doi.org/10.1111/j.1365-2621.1988.tb07841.x
7. Fedeniuk, R. W., & Biliaderis, C. G. (1994). Composition and physicochemical properties of linseed (Linum usitatissimum L.) mucilage. Journal of Agricultural and Food Chemistry, 42(2), 240–247. https://doi.org/10.1021/jf00038a004
8. Friedman, M., & Brandon, D. L. (2001). Nutritional and health benefits of soy proteins. Journal of Agricultural and Food Chemistry, 49(3), 1069–1086. https://doi.org/10.1021/jf0009246
9. Girgih, A. T., Udenigwe, C. C., Aluko, R. E., & Aliani, M. (2011). Extraction and characterization of flaxseed (Linum usitatissimum L.) protein fractions. Food Chemistry, 127(4), 1653–1660. https://doi.org/10.1016/j.foodchem.2011.02.045
10. Gopalan, N., Rodriguez, J., & Roghani, S. (2018). Structural and functional characterization of flaxseed protein isolates. Food Chemistry, **242**, 123–130. https://doi.org/10.1016/j.foodchem.2017.09.045
11. Goyal, A., Sharma, V., Upadhyay, N., Gill, S., & Sihag, M. (2014). Flax and flaxseed oil: An ancient medicine & modern functional food. Journal of Food Science and Nutrition, 2(3), 1–14. https://doi.org/10.1002/fsn3.64
12. Kajla, P., Sharma, A., & Sood, D. R. (2015). Flaxseed—A potential functional food source. Journal of Food Science and Technology, 52(4), 1857–1871. https://doi.org/10.1007/s13197-014-1293-y
13. Karaca, A. C., Low, N. H., & Nickerson, M. T. (2011). Emulsifying properties of canola and flaxseed protein isolates produced by isoelectric precipitation and salt extraction. Food Research International, **44**(9), 2991– 2998. https://doi.org/10.1016/j.foodres.2011.07.009
14. Kaur, M., Singh, N., & Sandhu, K. S. (2017). Functional and physicochemical

properties of flaxseed protein isolates. Food Hydrocolloids, 66, 223–231. https://doi.org/10.1016/j.foodhyd.2016.12.023

15. Kaur, M., Singh, N., & Sandhu, K. S. (2017). Functional, thermal, and structural properties of flaxseed protein isolates. Journal of Food Measurement and Characterization, **11**, 1004–1013. https://doi.org/10.1007/s11694-017-9491-4
16. Kaur, M., Singh, V., & Kaur, R. (2018). Functional properties of flaxseed mucilage and its application in dairy products. Journal of Food Processing and Preservation, 42(1), e13444. https://doi.org/10.1111/jfpp.13444
17. Kaushik, P., Dowling, K., McKnight, S., Barrow, C. J., & Adhikari, B. (2016). Preparation, characterization and functional properties of flaxseed protein isolate. Food Chemistry, 197, 212–220. https://doi.org/10.1016/j.foodchem.2015.10.106
18. Khattab, R. Y., & Arntfield, S. D. (2009). Nutritional quality of legume seeds as affected by some physical treatments. LWT – Food Science and Technology, 42(6), 1113–1118.
19. Lam, A. C. Y., Karaca, A. C., Tyler, R. T., & Nickerson, M. T. (2018). Pea protein isolates: Structure, extraction, and functionality. Food Reviews International, 34(2), 126–147. https://doi.org/10.1080/87559129.2016.1242135
20. Liu, C., Wang, B., Wanasundara, P. K. J. P. D., & Shand, P. J. (2018). Functional properties of flaxseed protein isolates as affected by extraction pH and salt concentration. Food Chemistry, 255, 260–268.
21. Madhusudhan, K. T. (2009). Potential benefits of flaxseed in health and disease—A review. Critical Reviews in Food Science and Nutrition, 49(7), 683–701. https://doi.org/10.1080/10408390802086998
22. Mao, X., & Hua, Y. (2012). Composition, structure and functional properties of protein concentrates and isolates produced from walnut (Juglans regia L.). International Journal of Molecular Sciences, 13(2), 1561– 1581.
23. Morris, D. H. (2007). Flax—A health and nutrition primer (4th ed.). Flax Council of Canada.
24. Oomah, B. D. (2001). Flaxseed as a functional food source. Journal of the Science of Food and Agriculture, 81(9), 889–894. https://doi.org/10.1002/jsfa.898
25. Oomah, B. D., & Mazza, G. (1993). Flaxseed proteins—A review. Food Chemistry, 48(2), 109–114. https://doi.org/10.1016/0308-8146(93)90043-F
26. Oomah, B. D., & Mazza, G. (1993). Flaxseed proteins—A review. Food Chemistry, **48**(2), 109–114. https://doi.org/10.1016/0308-8146(93)90043-F
27. Oomah, B. D., & Mazza, G. (1998). Flaxseed products for disease prevention. Journal of Agricultural and Food Chemistry, 46(10), 4183–4187. https://doi.org/10.1021/jf9802083
28. Plaza, M., & Turner, C. (2015). Pressurized hot water extraction of bioactives. TrAC Trends in Analytical Chemistry, 71, 39–54. https://doi.org/10.1016/j.trac.2015.02.022
29. Rizzo, G., & Baroni, L. (2018). Soy, soy foods and their role in vegetarian diets. Nutrients, 10(1), 43. https://doi.org/10.3390/nu10010043
30. Sha, L., & Xiong, Y. L. (2020). Plant protein-based alternatives of reconstructed meat: Science, technology, and challenges. Trends in Food Science & Technology, 102, 51–61.
31. Shewry, P. R., & Halford, N. G. (2002). Cereal seed storage proteins: Structures,

properties and role in grain utilization. Journal of Experimental Botany, 53(370), 947–958.

32. Singh, K. K., Mridula, D., Rehal, J., & Barnwal, P. (2011). Flaxseed: A potential source of food, feed and fiber. Critical Reviews in Food Science and Nutrition, 51(3), 210–222. https://doi.org/10.1080/10408390903537241
33. Singh, K. K., Mridula, D., Rehal, J., & Barnwal, P. (2011). Flaxseed: A potential source of food, feed and fiber. Critical Reviews in Food Science and Nutrition, 51(3), 210–222. https://doi.org/10.1080/10408390903537241
34. Singh, N., Kaur, M., & Sandhu, K. S. (2020). Physicochemical and functional properties of flaxseed protein: A review. Trends in Food Science & Technology, **102**, 134–146. https://doi.org/10.1016/j.tifs.2020.06.009
35. Stone, A. K., Karalash, A., Tyler, R. T., Warkentin, T. D., & Nickerson, M. T. (2015). Functional attributes of pea protein isolates prepared using different extraction methods and cultivars. Food Research International, 76, 31–38.
36. Tang, C. H. (2017). Emulsifying properties of plant proteins: A review. Food Hydrocolloids, 68, 1–12. https://doi.org/10.1016/j.foodhyd.2016.12.035
37. Tang, C. H. (2017). Functional properties and applications of plant proteins in food systems. Journal of Food Science, **82**(5), 1071–1080. https://doi.org/10.1111/1750-3841.13686
38. Tang, C. H., & Wang, X. S. (2010). Physicochemical and functional properties of flaxseed protein isolate. Journal of Agricultural and Food Chemistry, **58**(9), 5082–5089. https://doi.org/10.1021/jf904178u
39. Tzang, B. S., Yang, S. F., Fu, S. G., Yang, H. C., Sun, H. L., & Chen, Y. C. (2009). Effects of dietary flaxseed oil on cholesterol metabolism of hamsters. Food Chemistry, 114(4), 1450–1455.
40. Wanasundara, J. P. D. (2011). Proteins of flaxseed (Linum usitatissimum L.). In Sustainable protein sources. (pp. 189–211). Academic Press.
41. Wanasundara, J. P. D., & Shahidi, F. (1997). Functional properties of acylated flax protein isolates. Journal of Agricultural and Food Chemistry, 45(7), 2431–2441.
42. Wang, Y., Tuccillo, F., Lampi, A. M., Knaapila, A., Pulkkinen, M., Kariluoto, S., & Jouppila, K. (2019). Flavor challenges in extruded plant-based meat analogues: A review. Food Research International, 115, 83– 94.
43. Xu, Y., Wang, L., & Li, Y. (2020). Physicochemical and functional properties of flaxseed protein isolates extracted under different pH conditions. LWT – Food Science and Technology, 130, 109627. https://doi.org/10.1016/j.lwt.2020.109627
44. Zhang, J., Wen, C., Zhang, H., Duan, Y., & Ma, H. (2021). Recent advances in ultrasound-assisted extraction of bioactive compounds from plant materials. Food Chemistry, 343, 128498. https://doi.org/10.1016/j.foodchem.2020.128498

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How Much Does Local Organic Dominate Kitchens in Sikkim? A Pilot Study on Household Food Patterns

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Abstract

Sikkim is globally recognised as India's first fully organic state, symbolising a landmark in sustainable agriculture and environmental policy. However, whether this transformation at the policy and production levels translates into real household behaviour remains uncertain. This pilot study investigates the extent to which local organic products dominate the household kitchens of Sikkim. Data were collected from 58 respondents across four districts using a structured questionnaire. The analysis revealed high awareness of the *Sikkim Organic Mission (SOM)* and strong positive perceptions of organic food, primarily due to health consciousness and support for local farmers. Nevertheless, factors such as high price, inconsistent market availability, etc constrain complete household adoption. The findings suggest that while Sikkim's organic revolution is visible in production, its full reflection in domestic food patterns is still evolving. Policy implications include the need for consumer-side interventions, local market strengthening, and awareness on certification.

Keywords: Sikkim, organic food, household behaviour, consumption, organic policy, pilot study

Introduction

Sikkim has emerged as a model for sustainable agriculture, achieving the rare feat of becoming India's first fully organic state in 2016. The initiative, known as the *Sikkim Organic Mission (SOM)*, aimed to eliminate chemical inputs and promote environmentally safe farming systems (Government of Sikkim, 2018). While the policy has gained international recognition, questions remain about its impact at the household level especially in terms of everyday food consumption.

Despite the state's organic certification status, it is important to understand how far local organic produce actually dominates household kitchens. The household is where agricultural transformation translates into social practice, affecting food culture, health, and livelihoods (Pradhan et al., 2021). This research seeks to fill the gap between policy success and domestic reality by studying local organic consumption patterns among Sikkimese families.

Background

The organic movement in Sikkim was designed to ensure environmental balance, reduce chemical pollution, and enhance farmer welfare. However, even with the complete transition of farmlands to organic production, consumer behaviour and market systems have developed unevenly. Many studies suggest that the presence of organic farms does not always guarantee equivalent consumer preference, especially where imported or non-local goods are available at lower prices (Singh & Kumar, 2020).

Thus, while Sikkim has achieved supply-side success, the demand-side realities—how much local organic food actually enters the kitchen—remain less explored.

Objectives

This pilot study aims to:

a) Assess the level of household awareness and understanding of local organic food.

b) Examine patterns and frequency of organic consumption across different household types.

c) Identify barriers and motivations influencing local organic usage.

d) Analyse consumer perceptions and trust in certification and supply chains.

e) Suggest policy-level and community-level recommendations to strengthen organic household consumption.

Rationale and Significance

While there is substantial literature on organic farming and production in India, limited work exists on consumer-side participation in organic movements (Mishra, 2022). Understanding household-level adoption is crucial because sustainable change depends on both farmers' production and consumers' consistent demand. This study's pilot nature helps identify patterns that may guide future, larger-scale research and policy planning.

The study also contributes to Sikkim's development discourse by linking organic policy outcomes with local livelihood and food security—two essential components of sustainable development goals (FAO, 2018).

Research Questions

a) How aware are Sikkimese households about local organic food and the Sikkim Organic Mission?

b) To what extent do local organic products dominate household food patterns?

c) What are the main motivating and discouraging factors affecting organic consumption?

d) How do price, accessibility, and trust influence organic purchasing behaviour?

e) What strategies can enhance the sustainability of Sikkim's organic kitchen culture?

Scope and Limitations

This is a pilot study covering 58 individuals from six districts of Sikkim. It provides indicative insights rather than statistically generalisable conclusions. The study is limited by sample size and self-reported responses but offers valuable trends regarding consumer awareness, perception, and behaviour. Future research may expand to include longitudinal data and comparative analysis with non-organic states.

Methodology

This section describes the design and procedures followed for conducting the pilot study on household food patterns in Sikkim. The study aimed to explore the degree to which local organic produce dominates kitchen consumption, and to identify key factors influencing organic food adoption at the household level.

Research Design

The study adopted a quantitative (structured household questionnaire) technique design was selected to capture both measurable patterns (frequency, awareness, consumption) and subjective experiences (motivations, perceptions).

Study Area

The research conducted across all six districts of Sikkim represents diverse ecological and socioeconomic settings. This makes a suitable model for examining how organic policy outcomes vary between urban markets and rural self-sufficient communities in Sikkim.

Sampling Design and Respondents

The study used simple random sampling methods thereby selecting respondents exclusively belonging to Sikkim covering proportional number of individuals from different household sizes, educational level and income group to ensure representation of all district. A total of 58 respondents participated in the survey belonging to all six districts as furnished in table -1 below:

Table-1: Respondents of Survey : Classification by Gender and District

Gender	Gangtok	Pakyong	Mangan	Soreng	Gyalshing	Namchi	Total
Male	14	7	1	2	2	6	32
Female	14	5	1	2	2	2	26
Total	28	12	2	4	4	8	58
%	48%	21%	3%	7%	7%	14%	100%

The respondents from Gangtok alone comprised nearly half of the total respondents. In terms of gender, the male comprised of total 32 (55%) against female with 45%. The sample size is adequate for a pilot study, aiming to test the validity and practicality of the research instrument.

Data Collection Tools and Procedure

The primary data were collected using Google form with formulation of a structured closed end questionnaire comprising five major sections (A–E):

- Section A: Socio-demographic profile
- Section B: Awareness of organic food and policy
- Section C: Perception and trust
- Section D: Consumption and behaviour
- Section E: Opinions and suggestions

The responses were collected by posting Google questionnaire amongst close contacts and different working WhatsApp groups created for office and communities and also by posting it in the Facebook and Instagram profile of the researcher.

Data collection was done between 17th to 30th January 2026 without any help of trained enumerators. Ethical considerations such as informed consent, voluntary participation, and confidentiality were maintained throughout.

Data Analysis Techniques

Quantitative data were analysed using descriptive statistics including frequency, percentage, and cross-tabulation to identify patterns of awareness, consumption, and perception. Tables were prepared to summarise the findings clearly.

Qualitative responses were analysed through thematic categorisation, allowing interpretation of narratives on motivations, trust, and challenges. The results were presented through tables and narrative explanations for each thematic section.

Reliability and Validity

To ensure content validity, the questionnaire was reviewed by two academic experts from IGNOU. A pre-test with 3 respondents was conducted in Gangtok to check question clarity and flow. Minor modifications were made to improve comprehension.

Reliability was addressed by using consistent measurement across all respondents, clear instructions for enumerators, and standard definitions for terms like "organic," "local," and "certified."

Given its pilot nature, this study focuses on exploratory accuracy rather than large-scale statistical reliability. However, findings are robust enough to guide the design of future full-scale surveys.

Analysis, Results, and Discussion

This section presents the analysis of household survey data from 58 respondents belonging to different six districts of Sikkim. The results are organised under five major themes: socio-demographic profile, awareness, perception, consumption behaviour, and opinions with suggestions. The discussion compares the findings with earlier research in Sikkim and other Indian hill states to highlight similarities and emerging issues in household organic consumption.

Section A: Socio-Demographic Profile of Respondents

The demographic profile of 58 respondents of the current study is presented in the Table-2 placed here-below:

Table-2: Demographic Characteristics of Respondents

Characteristics	Category	Frequency	Percentage (%)
Gender	Male	26	45
	Female	32	55
Family Size	Small (<=5 members)	35	60
	Large (>=6 members)	23	40
Area Type	Rural	22	38
	Urban	36	62
Age (years)	20–30	3	5
	31–40	22	38
	41–50	23	40
	Above 50	10	17
Education	Primary	2	3
	Secondary	8	14
	Sr. Secondary	4	7
	Graduate	19	33
	Postgraduate	25	43

The majority of respondents comprised of female (55%) which clearly reflets that they play important role in managing household food decisions. The family size of less than or equal to five members makes 60%. Most belonged to the 41–50 age group (40%) followed by 38% in 31–40 age group, and both taken together represents active earners and parents who directly influence diet choices. Under education levels, those with post-graduation top the category with 43% followed by undergraduate (33%) thereby suggesting a higher level of highly educated population capable of understanding health and environmental issues related to organic food.

Table-3: Occupation and Household Income

Characteristics	Category	Frequency	Percentage (%)
Occupation	Govt. Employee	18	31
	Private Sector	16	28
	Self-employed	8	14
	Homemaker	8	14
	Farmer	3	5
	Student	5	9
Income Level	Below ₹10 000	7	12
	₹10 000–₹25 000	15	26
	₹25 001–₹50 000	15	26
	₹ 50 001–₹75 000	5	9
	₹ 75 001–₹100 000	7	12
	Above ₹100 001	9	16

In terms of occupational status, most respondents were employed in private (28%) or government service (31%), while just 5% were farmers. Nearly half of respondents (52%) had household incomes of ₹30,000 in average, which suggest relatively stable financial position. But, a small low-income segment still exists (12%), indicating that affordability could influence organic food choices, as also noted by Bhutia and Gurung (2020).

Both tables taken together, their data depicts a scenario of well-educated, middle-income demography with women leading household food decisions. Such a profile provides a strong base for organic awareness and adoption but highlights that price sensitivity and accessibility may still affect behaviour.

Household Food Sources and Buying Habits

In order to understand the market for purchase of the food items, the responses captured and compiled are furnished in the Table-4 placed here-below:

Table-4: Main Sources of Household Food Items and Buying Habits

Source of Food	Frequency	Percentage (%)	Buying Habit	Frequency	Percentage (%)
Local bazar	20	34	Daily	6	10
Supermarket	3	5	Alternate days	9	16
Home-grown	6	10	Thrice a week	14	24
Neighbourhood	7	12	Weekly	20	34
Combinations	22	38	Monthly	9	16
Tota	58	100	Tota	58	100

Majority of respondents (46%) generally purchase the organic food items from local bazar (34%) and neighbourhood shops (12%) but least take it from supermarket (5%). Those who grow for self-consumption comprised of 10% but 38% make purchases from different sources. In terms of their buying habits, majority (34%) prefer weekly shopping, but 50% are those making purchases on daily to thrice a week. However, those using freeze for preservation purchase on monthly basis shares 16% of respondents.

Consumption and Behaviour

The organic and local items generally purchased by people of Sikkim comprised of vegetables, fruits, spices and grains. The level of purchases of these items by respondents was compiled and presented in the Table-5 as placed here-below.

Table-5: Frequency of Organic Food Consumption

Level of Purchases	Frequency	Percentage (%)
Local Organic Fruits		
0–25%	27	47
26–50%	13	22
51–75,%	10	17
Above 75%	8	14
Total	58	100
Local Organic Spices & Products		
0–25%	10	17
26–50%	13	22
51–75,%	14	24
Above 75%	21	36

Level of Purchases	Frequency	Percentage (%)
Local Organic Vegetables		
0–25%	10	17
26–50%	13	22
51–75,%	10	17
Above 75%	25	43
Total	58	100
Local Organic Grains & Products		
0–25%	18	31
26–50%	22	38
51–75,%	9	16
Above 75%	9	16

Total	58	100

Total	58	100

The majority of respondents (47%) stated that only upto 25% of organic fruits makes part of whole fruits purchases but above 75% of vegetable in their kitchen comprised organics. In case of organic spices and its products, it dominates the share in the kitchen while 26-50% of total grains comprised of the organics.

The 79% of respondents stated of their interest and involvement in growing of one or other organic items stated above. Most respondents (77%) stated to consume organic food regularly or several time in a week.

Factors Influencing Consumption of Organic Produce

The respondents were administered with questions relating to those factors in favour and against their decision in consumption of organic produce. The responses captured were compiled and presented in the Table-6 below.

Table-6: Motivating and Discouraging Factors

Motivating Factors	**Frequency**	**Percentage (%)**		**Discouraging Factors**	**Frequency**	**Percentage (%)**
Health benefit	12	21		High price	23	40
Support local farmers	9	16		Limited supply	13	22
Taste	8	14		Lack of trust	3	5
Environment concern	7	12		Not available nearby	6	10
Combination of above	22	38		Combination of above	13	22
Total	58	100		Total	58	100

Though health benefit (21%) and support to the farmers (16%) individually forms main motivators, but combination of one or other option listed above forms majority (38%). On contrary, the high price and constraints in supply constraints limit consumption influences. These also goes to match with the findings of study undertaken by Singh & Kumar (2020). Hence, it can be conversely stated that consumers want to eat organic but face economic and logistical challenges. Policy must focus on improving affordability and availability.

Awareness of Organic Food and Policy

Almost all respondents (88%) were aware about meaning of organic and movement of state including declaration of Sikkim as fully organic state in India. The major sources of awareness comprised of government program (70%) while social networks including media (30%) indicating that information spreads through official programs.

In case of certification of organic product, majority respondents (67%) claimed good or moderate understanding but other lot (33%) lacked clarity. This gap suggests that although Sikkimese consumers know the term "organic," they are less informed about how certification ensures authenticity as observed in study undertaken by Pradhan et al., (2021). Hence, there is a need for improved public education campaigns and storytelling on Sikkim Organic as observed by Darjee (2024).

Perceived Government Role

The respondent's expectations from the government comprised of its role in several aspect as listed in the Table-7 placed here-below.

Table-7: Respondents' Expectations from Government

Expectation	Frequency	Percentage (%)
Awareness programs	12	21
Better market infrastructure/outlets	14	24
Price support/subsidy	16	28
Certification promotion	7	12
Other suggestions	9	16
Total	58	100

The majority expected price subsidies (28%) and improvements in market (24%) indicating their preference from consumer-side interventions. It is inclusive of promotion of the farmers' market, strengthening of supply chains with emphasis on transport and storage facilities, direct marketing, etc. They also stressed on certification and branding inclusive of logo (12%) and encourage community awareness (21%) so as to improve visibility and increase in trust on product. The other suggestions (16%) comprised of government scheme for support of kitchen garden, strengthening local organic dominance in the market, etc.

Whereas, the farmers of organic produce playing a major role in success of the organic mission, the respondents' preference on different aspect of the support has been listed as furnished in the Table-8 placed here-below.

Table-8: Perceived Farmer Support Needs

Type of Support	Frequency	Percentage (%)
Financial support	16	28
Technical training	13	22
Marketing help	14	24
Storage and transport	11	19
Other suggestions	4	7
Total	58	100

The respondents believed that financial support (28%) and technical training (22%) on different aspect of production process including inputs are primary necessity of the organic farmers. Whereas, after production from their farms, facilities for storage and transport (19%) along with help for marketing (24%), which comprised of several aspects relating to movement of their produce from farm to purchase bag of the customer. The other suggestions (7%) comprised of incentives and subsidies on supply to the government marketing agencies, creation of the local roadside markets, etc.

Discussions

These findings support earlier studies (Pradhan et al., 2021; Bhutia & Gurung, 2020) showing that Sikkim's organic transformation is socially accepted but requires consumer-level reinforcement. While production has achieved 100% organic status, consumption patterns still represent a transition phase from awareness to consistent behaviour.

Conclusion

This pilot study explored household-level food patterns among 58 respondents across all six districts of Sikkim. It confirms that the organic revolution in Sikkim is not only agricultural but also social and behavioural, yet the household transition to fully organic kitchens remains incomplete. According to the Government of Sikkim (2018), organic development must move "from farm to fork." Whereas, the current study aptly supports that view by showing the importance of consumer-side sustainability. Based on household feedback and data interpretation, the following actions are recommended for both the Government and Policy Level and Community and Producer Levels:-

(a) Introduction of "Organic Price Stabilisation Scheme" for essential fruits, vegetables and grains.
(b) Expansion of the farmers' markets and mobile outlets in urban centres.
(c) Launching of awareness drives in schools and community groups about identifying certified organic products.

(d) Strengthening of local organic cooperatives connecting farmers and consumers directly.
(e) Promotion of farm visit programs to build trust between producers and consumers.
(f) Encourage kitchen gardens and seed exchange groups in rural areas.

These recommendations also align with findings from Mishra (2022) and Awasthi et al. (2021), who emphasise consumer education and localised markets as key enablers of sustainable organic transitions.

Being a pilot study, the research faced some limitations comprising small sample size (58 households) which restricts generalisation in larger aspect and data relied on self-reported responses, which may contain biasness too.

References

1. Awasthi, M., Tripathi, R., & Meena, R. (2021). *Organic food consumption in India: Awareness and behavioural determinants. Indian Journal of Agricultural Marketing, 35*(2), 45–56.
2. Bhutia, D., & Gurung, P. (2020). *Consumer knowledge and acceptance of organic products in Sikkim. Indian Journal of Rural Marketing, 6*(1), 12–20.
3. Darjee, D.K. (2024), E-commerce Platforms Supported by the Government in India for Marketing of Organic Products: A Review, *Educational Administration: Theory and Practice, 30(3)01-18*
4. Food and Agriculture Organization (FAO). (2018). *Organic Agriculture and Sustainable Livelihoods in Mountain Areas.* Rome: Food and Agriculture Organization.
5. Government of Sikkim. (2018). *Sikkim Organic Mission: Annual Report 2018–19.* Gangtok: Department of Agriculture, Government of Sikkim.
6. Mishra, S. (2022). *Perception and purchasing behaviour of organic consumers in Indian hill states. Journal of Environmental Studies, 10*(4), 55–64.
7. Pradhan, P., Bhutia, D., & Sharma, K. (2021). *Organic food practices and household consumption in Sikkim. Journal of Sustainable Food Systems, 9*(2), 44–58.
8. Singh, A., & Kumar, R. (2020). *Consumer perception and barriers to organic food adoption in India. International Journal of Agricultural Economics, 7*(3), 101–110.

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An Overview of Indian Cyber Laws and Regulatory Bodies Governing Data Protection

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Abstract

The advancement of science, Information and Communication Technologies through the computer and other electronic instruments have greatly enhanced our capacities to collect, store, process and communicate information. It has made our life easier and convenient. But the negative impact of it cannot be overlooked, especially the invasion on personal space or privacy. Such invasion can be if the data on our own personal computers are compromised in unpleasant ways with consequences ranging from personal embarrassment to financial loss, or when there is transmission of data over the Internet and mobile networks which is equally fraught with the risk of interception, also in this age of cloud computing when much of our data, e.g. our emails, chat logs, personal profiles, bank statements etc., reside on distant servers of the companies whose services we use, our privacy becomes dependent on the internal electronic security systems of these companies, together with these the privacy of children, women, old persons, and minorities tend to be especially fragile in this digital age as they have become frequent targets of exploitation, and lastly, online data handling has procreated new kinds of annoyances such as electronic voyeurism, spam or offensive email, 'phishing' etc., and each of these can affect the privacy of any individual. This paper highlights the various legislations and agencies that regulate data in cyber space. Apart from this various suggestion has been given for strengthening the available legislations in India.

Keywords*: Information and Communication technologies, Privacy, Data protection, Cyber space.*

Introduction

Information technology (hereafter referred to as IT) includes a number of disciplines, such as electronics, computer science, and telecommunications. By facilitating the creation and use of information systems, IT has significantly changed both industry and society in the twenty-first century. At the core of IT is utilizing computers and related systems to store, retrieve, transmit

and manipulate data. A ground-breaking concept in contemporary IT is cloud computing, the delivery of computing services such as storage, servers, databases, software and analytics over the internet. The main models of cloud computing are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud technology offers greater flexibility and cost savings to organizations[17].

Businesses are now able to target clients more effectively thanks to advancements in mobile app technology. Sales can be increased with location-based apps' real-time, customised advertising. Apps for business analytics make it easier to monitor key performance indicators and client interaction. File sharing, productivity, and distant collaboration are all made possible by enterprise apps. With smartphones becoming more and more popular around the world, mobile apps provide brands a crucial way to increase their online visibility. However, while implementing mobile apps, companies also need to take data security and privacy into mind. To safeguard the interests of consumers, laws governing the gathering and use of data are constantly changing. All things considered, when used properly, mobile app technology provides engaging online experiences that may be quite advantageous to both clients and companies.[18] In India, there are various legislations that in a way regulate the areas covering digital privacy, the following pages discusses the various legislations.

Indian Legislation

Law of Torts

Earlier Common law courts have been reluctant to stretch the tort for intruding upon privacy to internet-related abuse of personal data. But, Common law jurisdictions are slowly recognising the tort of privacy in various cases. In Vidal-Hall v. Google Inc.[19], of 2015 the Court successfully held the company liable for compensating the aggrieved party for the distress caused, even though there was no financial loss. Also, in Campbell v. MGN Ltd**.**[20] the Court considered the nexus between the breach of privacy and Article 8 of the European

17 Cybercrime and Cyber Laws in India, 5 Indian J.L. & Legal Res. Issue 2, at 1 (2023).
18 Ryan, War, Peace, or Stalemate: Wargames, Wardialing, Wardriving, and the Emerging Market for Hacker Ethics, 9 Va. J.L. & Tech. (2004).
19 Vidal-Hall v. Google Inc 2016 QB 1003 :(2015) 3 WLR 409 : 2015 EWCA (Civ) 311
20 Campbell v. MGN Ltd (2004) 2 AC 457 : (2004) 2 WLR 1232 : 2004 UKHL 22.

Convention of Human Rights (ECHR).In the most recent case of Lloyd v. Google LLC,[21] the Supreme Court of United Kingdom unanimously ruled in favour of Google (appellant), denying the request of compensation to 4 million Apple users, who were wrongfully tracked by Google and the information accumulated was sold after that.

India being a signatory to the Universal Declaration on Human Rights and the International Convention on Civil and Political Rights have recognised the privacy as a fundamental right as provided in both the document[22]. However, India does not have any specific law or statute to guarantee the right to privacy to its citizens. In order to fill this lacuna, courts in India have tried to enforce a right to privacy in favour of its citizens through two main routes firstly, by recognising a constitutional right to privacy, which has been read as part of the rights to life and personal liberty under Article 21 of the Indian Constitution, and secondly, a common law right to privacy which is available under law of tort. It is interesting to note that the Supreme Court considered the application of Article 21 in the case of actions of private persons in Shrimathi Vidya Verma v. Shiv Narain Verma[23] the Court observed that Article 21 is not enforceable against private persons. Therefore, even if it is assumed that the right to privacy existed under Article 21, it is not enforceable against private persons. Hence, the only remedy available in cases of invasions of privacy by private persons is a tort action for damages.[24]

In 2019, the Law Commission of India submitted a report on the reform of tort law in the country. The report recommended the establishment of a separate tort law statute, which recognises new torts such as data protection, and the expansion of liability for negligence to cover public authorities and corporate entities. The report[25] focused on reforming tort law, including the potential for a tort of invasion of privacy. It highlights the growing need for legal protections for data privacy in India, particularly in relation to the evolving landscape of technology and data processing.

21 Lloyd v. Google LLC (2021) 3 WLR 1268 : 2021 UKSC 50.
22 Sachin Chaturvedi, Krishna Ravi Srinivas & Vasantha Muthuswamy, "Biobanking and Privacy in India", 44 Journal of law, Med. and ethics 45, 50 (2016).
23 AIR 1956 SC 108.
24 Sandeep Challa, The Fundamental Right to Privacy: A Case-by-Case Development Sans Stare Decisis, 1(1) Indian Journal of Constitutional Law 224, 229 (2007).
25 The Law commission report on Bill No. 341 of 2019

Information Technology Act, 2000

The Information Technology Act of 2000 was a sincere effort made by the legislature to encompass privacy concerns related to computer systems. This legislation includes specific provisions designed to safeguard stored data. Under the Act, Section 43 offers protection against unauthorized access to computer systems, imposing substantial penalties, including fines of up to one crore. It covers unauthorized activities like downloading, extraction, and copying of data. Section 65 pertains to computer source code. If information residing in a computer resource is destroyed, deleted, altered, or its value and utility diminished, the section imposes penalties, including imprisonment for three years or fines of up to two lakh rupees or both on the hacker. Section 72 safeguards against breaches of confidentiality and data privacy[26]. India has seen numerous cases of data breaches and privacy violations over the years, but it has become challenging to provide the necessary safeguards due to the absence of a specific legal framework to address the legal issues surrounding the preservation and protection of sensitive personal data and information. [27]. Moreover, the Act was enacted during the pre-digital period of India when only 5.5 million Indians were on the internet, it was realized that it is not capable of dealing with the present challenges of cyberspace, where approx. 850 million Indians are on the internet, with multiple types of intermediaries.[28] As a result, in the year 2009, the IT (Amendment) Act 2008 came into effect. The Government also came up with the definition of 'sensitive personal data and information'. Although the IT Amendment Act 2008 does not comprehensively deal with all the aspects of personal data processing, it does regulate certain aspects of personal data and set limits on the processing and use of personal data. Section 43A was inserted with the purpose of protecting and preserving sensitive personal data or information, as it provides for compensation by the body corporate [29] whose negligence causes data loss. Section 43A has not put up any cap on the quantum of compensation, and the

26 Information Technology Act of 2000

27 Pavan Duggal , 'Data Protection Legislation in India', Data Protection Law in India, 1st ed. Universal Law Publishing, an imprint of Lexis Nexis, (2016).

28 Different types of intermediaries include e-commerce, search engines, digital media, social media, AI, OTT, gaming, Ad-tech, TSPs, etc.

29 Explanation (i) to section 43A of the Information Technology Act 2000 defines the term 'body corporate' to mean any company and includes a firm, sole proprietorship of other association of individuals engaged in commercial or professional activities.

damages by way of compensation are unlimited. While in the case of breach or unauthorized disclosure of personal data, the penal consequences are provided under sections 72 and 72A.

Data Protection and Information Technology Rules, 2011

The Ministry of Communications and Information Technology with an object to make the IT Amendment Act 2008 work more effectively introduced IT (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules 2011 (hereinafter referred as Privacy Rules 2011), which contain significant obligations with respect to the protection of personal data[30]. The Privacy Rules 2011 lays down legal obligations for the protection of sensitive personal data or information to the body corporate or any person located within India. Before the enactment of the Digital Personal Data Protection Act 2023, the Indian Cyber law being the Information Technology (Amendment) Act 2008, and the IT (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011 were the only dedicated legislations that deal with data and information in electronic form[31].

It is not wrong to say that by giving an extra layer of protection to the sensitive personal data of a natural person, the Privacy Rules 2011 became the first legislative attempt to create a data privacy regime in India. However, the Privacy Rules 2011 did not prove to be an effective tool to ensure the protection of personal data. It received a lot of criticism from various stakeholders and privacy advocates for being vague and ineffective in dealing with India's digital revolution and global advancement[32].

30 Ministry of Electronics and Information Technology, Information Technology (Intermediary Guidelines) Rules, 2011, Gazette of India (Apr. 11, 2011),

31 Sardeshmukh, Apurv, 'Data Protection and the Information Technology Act, 2000', Data Protection: Law and Regulation, 1st ed.,(Thomson Reuters, Legal, 2019).

32 Korff, Douwe, The Indian Digital Personal Data Protection Act, 2023, viewed from a European Perspective (October 27, 2023), https://ssrn.com/abstract.

Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules 2021[33]

The Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules broadly deal with social media and over-the-top (OTT) platforms. These rules have been framed in exercise of powers under section 87 (2) of the Information Technology (IT) Act, 2000 and in supersession of the earlier Information Technology (Intermediary[34] Guidelines) Rules 2011[35]. It substantially empowers the ordinary users of digital platforms to seek redressal for their grievances and command accountability in case of infringement of their rights. The need of these rules were initiated firstly by Supreme Court in Suo-moto writ petition (Prajjawala case)[36] vide order dated 11/12/2018 and had observed that the Government of India may frame necessary guidelines to eliminate child pornography, rape and gang rape imageries, videos and sites in content hosting platforms and other applications. Secondly, there was a Calling Attention Motion on the misuse of social media and spread of fake news in the Rajya Sabha and the Minister had conveyed to the house on 26/07/2018, the resolve of the Government to strengthen the legal framework and make the social media platforms accountable under the law. It had been conveyed repeatedly in demands from the Members of the Parliament to take corrective measures. Thirdly, Ad-hoc committee of the Rajya Sabha laid its report on 03/02/2020 after studying the alarming issue of pornography on social media and its effect on children and society as a whole and recommended for enabling identification of the first originator of such contents[37].

Special emphasis has been given on the protection of women and children from sexual offences, fake news and other misuse of the social media. Identification of the "first originator

33 G.S.R. 794 (E) issued on October 28, 2022 under sub-section (1) and clauses (z) and (zg) of sub section (2) of section 87 of the Information Technology Act, 2000

34 Intermediaries are entities that store or transmit data on behalf of other persons, and include telecom and internet service providers, online marketplaces, search engines, and social media sites.1 The Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021 (IT Rules) specify due diligence requirements for intermediaries to claim exemption from being liable for any third-party information.

35 'Government notifies Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules 2021', *Press Information Bureau*, February 25, 2021.

36 In Re, Prajwala Letter (2018) 15 SCC 551

37 Sidhartha and Pankaj Doval, 'Rules protect rights of users, were framed because social media giants failed to do so: IT and law minister Ravi Shankar Prasad' *The Times of India*,(June 1, 2021)

of the information" would be required in case of an offence related to sovereignty and integrity of India.

There are two issues with IT Rules 2021, first, the Supreme Court (2015), in Shreya Singhal Versus Union of India[38], has held that under the IT Act, 2000 intermediaries can only disable content upon receiving an order by the Court or appropriate government or its agency. Second, the intermediaries are also required to respect users' fundamental right to speech and expression (Article 19). This implies that they will have to balance between deciding whether content should be removed and if such removal could violate a user's right to speech.[39]

The rules were further amended in 2023[40]. The 2023 draft Amendments add provisions to regulate fake information and online games.[41] Another amendment brought by the IT rules 2023 is intermediaries under IT ACT 2000 now include Online Gaming Intermediaries (online gaming without real money and online gaming with real money) will now have to ensure that they do not host or allow any third party to host through their platforms any online real money game that has not been verified as a permissible online real money game.

Digital Personal Data Protection Act 2023

In 2011, the erstwhile Planning Commission set up an Expert Committee on Privacy under the chairmanship of Justice A.P. Shah, with the objective of examining privacy laws in various countries, identifying privacy issues, and providing recommendations to aid in drafting a Privacy bill.[42] The report also introduced nine national privacy principles designed to safeguard data processing and establish individual rights regarding their data such as:- (i) the principle of notice, (ii) the principle of choice and consent, (iii) the principle of collection limitation, (iv) the principle of purpose limitation, (v) the principle of access and correction, (vi) the principle

38 AIR 2015 SC 1523

39 *Id.*

40 Notice for Public Consultation, Ministry of Electronics and Information Technology, January 2, 2023.

41 Panjiar & Waghre,"IT Amendment Rules, 2023 are a nightmare, dressed like a fact checking daydream", Internet Freedom Foundation (2023)

42 Government of India, "Group of Experts on Privacy Submit Report" (Planning Commission, 2012)

of disclosure of information, (vii) the principle of security, (viii) the principle of openness, and (ix) the principle of accountability.[43]

They further provide guidelines for the future statutes or regulatory frameworks regarding the right to privacy[44].

Concurrently, the Ministry of Electronics and Information Technology ("MeitY") established a Committee of Experts led by Justice B.N. Srikrishna to examine key data protection issues, recommend solutions, and draft a Data Protection Bill. In 2018, the committee released its report, titled "A Free and Fair Digital Economy: Protecting Privacy, Empowering Indians," along with the draft Personal Data Protection Bill, 2018.[45] The recommendations from the Srikrishna Committee Report, along with input from various stakeholders, served as the foundation for the Personal Data Protection Bill, 2019 ("Bill"). This Bill was introduced in Parliament in December 2019 and subsequently referred to a Joint Parliamentary Committee ("JPC") consisting of members from both houses of Parliament for further suggestions. After numerous extensions and extensive consultations, the JPC published its report in 2021, conducting a detailed clause-by-clause review of the Bill to finalize its recommendations. The committee submitted a revised version of the Bill, now titled the Data Protection Bill, 2021.[46] The JPC proposed 81 amendments and sought to broaden the scope of the proposed legislation to include non-personal data, thereby shifting the focus from solely personal data protection to a more comprehensive form of data protection. In August 2022, the amended Bill from the JPC was withdrawn from Parliament due to the extensive amendments and recommendations from the JPC, as well as concerns raised by Indian start-ups and the tech industry. In November 2022, the MeitY released the draft Digital Personal Data Protection Bill, 2022 ("PDP Bill") for public consultation.[47] By August 2023, the Digital Personal Data Protection Bill, 2023 was introduced in Parliament. The Bill was passed by both houses, received presidential assent, and became

43 Supra note 29

44 Soli J. Sorabjee, *Creative Role of Indian Judiciary in Enlarging and Protecting Human Rights*, 17 Journal of the National Human Rights Commission 21, 22 (2018).

45 Government of India, "A Free and Fair Digital Economy: Protecting Privacy, Empowering Indians," Committee of Experts under the Chairmanship of Justice B.N. Srikrishna (2017) and Personal Data Protection Bill, 2018.

46 Government of India "Report of the Joint Committee on the Personal Data Protection Bill, 2019," (Lok Sabha Secretariat, 2021).

47 The Digital Personal Data Protection Bill, 2022.

the DPDP Act, 2023.[48] Salient Features of the DPDP Act,2023 are as follows for better understanding[49]:-

1. According to the Act, processing of personal data can only take place with the Data Principal's free, explicit, informed, unconditional, and unambiguous agreement.
2. The DPDP Act gives people a number of enforceable rights, such as the ability to access information about the personal data being processed, the ability to have inaccurate or out-of-date data corrected and erased, the ability to file a grievance with the data fiduciary.
3. Businesses that gather information about Indian residents and Indian residents themselves are subject to the DPDP Act. Remarkably, it also applies to foreign nationals residing in India whose information is processed "in connection with any activity related to offering of goods or services" outside of India.
4. The Act requires Data Fiduciaries to get legitimate consent, make sure data processing is transparent, put security measures in place, report data breaches, and set up grievance resolution procedures.
5. The Act establishes a Data Protection Board to oversee compliance and adjudicate breaches. However, concerns have been raised about its lack of institutional independence, as its members and procedures are controlled by the central government.
6. The Act prescribes financial penalties for non-compliance: Up to ₹250 crore for failing to prevent a data breach; ₹200 crore for violating children's data protection rules; ₹50 crore for failing to respond to user grievances. These penalties are intended to act as deterrents, but critics argue that enforcement capacity remains untested[50].

Digital Personal Data Protection Rules, 2025

The DPDP Rules, notified in early 2025, provide the operational guidelines and technical details necessary to implement the DPDP Act. They elaborate on compliance procedures,

48 Kantar. "Internet Adopted in India: ICUBE 2020." *available at*: https://images.assettype.com/afaqs/2021-06/b9a3220f-ae2f-43db-a0b4-36a372b243c4/KANTAR_ICUBE_2020_Report_C1.pdf (last visited 20 April 2025)

49 Evan A. Feigenbaum & Michael R. Nelson, "Data Governance Network, Building a User-Centric Data Protection Law in India (2002), *available at*: https://datagovernance.org (last visited 20 April 2025)

50 Supra note 30

reporting requirements, classification of data fiduciaries, grievance mechanisms, and more. The DPDP Rules apply to: Indian businesses and start-ups processing digital personal data; Government departments collecting citizen data; Global companies offering services to Indian consumers; Digital platforms, apps, SaaS tools, payment systems, and more. From a compliance perspective, all these entities are known as Data Fiduciaries[51].

The Rules make it mandatory for Data Fiduciaries to obtain clear, informed, and affirmative consent before collecting personal data. This consent-first approach brings Indian businesses in line with the data protection laws in India that emphasize user control and transparency. The Rules require all Data Fiduciaries to have a well-defined grievance redressal process, which includes: designating a Grievance Officer, providing clear communication channels for complaints, tracking and resolving issues within 7 days and escalation to the Data Protection Board of India if the resolution is unsatisfactory. Non-compliance or delay in resolving grievances can trigger heavy penalties under the Act.

Local Laws and Regulations for Privacy of Personal Data in India

India's central bank, the Reserve Bank of India (**RBI**) has made it mandatory from October 15, 2018, for all payment system providers and their service providers, intermediaries, third party vendors and other entities in the payment ecosystem to ensure that all data relating to payment systems operated by them are stored in a system only in India. However, for cross border transactions which consist of both foreign and domestic components, data pertaining to the foreign leg may be stored outside India. While data pertaining to the domestic leg should be stored in India, a copy may be stored abroad[52].

The Securities Exchange Board of India (**SEBI**) has issued an advisory for financial sector organizations such as merchant bankers, credit rating agencies, STP service providers, debenture trustee, depositary participants and other financial institutions which are availing the

51 Basu Chandola, Shravishtha Ajaykumar and Tanusha Tyagi, "Digital Personal Data Protection Rules, 2025: Recommendations to MeitY," ORF Special Report No. 258 Observer Research Foundation.,(2025)

52 Rashi Dhir and Trisha Shreyashi, Masterstroke. "RBI rules for cybersecurity in financial institutions", THE HINDU BUSINESSLINE (December 17, 2024, 02:09 PM), *available at*: https://www.thehindubusinessline.com/businesslaws/rbi-rules-for-cybersecurity-in-financial-institutions/article67647265.ece (last visited April 20, 2025)

Software as a Service (SaaS) based solution for managing their governance, risk and compliance functions. More recently, the SEBI[53] has issued a Framework for Adoption of Cloud Services by regulated entities.[54]

Separately, the Insurance Regulatory and Department Authority of India, understanding the need for strong data security, has regularly revised its recommendations to take into account new threats to the internet. In 2022, the IRDAI emphasized the necessity for thorough data protection by extending the standards' application to all insurance intermediaries. The IRDAI released the Information and Cyber Security Guidelines (CS Guidelines 2023) on April 24, 2023. The IRDAI's dedication to protecting policyholder data is demonstrated by its proactive approach to data protection. The Insurance and Risk Directors Association (IRDAI) is a key player in protecting the insurance industry against cyberattacks and data breaches by implementing strict regulations, raising risk awareness, and encouraging compliance.

As technology advances, the IRDAI's watchfulness is still necessary to preserve security and confidence in the digital sphere.[55]

Additionally, while Section 128 of the Companies Act, 2013, requires every company to prepare and store, at its registered office, books of account, other relevant books and papers and financial statements for every financial year, on August 5, 2022, the Ministry of Corporate Affairs amended this rule[56] whereby all such relevant books and papers maintained in an electronic mode are required to remain accessible in India, at all times.

Further, the Indian Computer Emergency Response Team **(**Cert-In**),** issued directions on information security practices, procedure, prevention, response and reporting of cyber incidents (Cyber Security Directions) dated April 28, 2022 (in force since June 28, 2022), and the frequently asked questions released on the Cyber Security Directions, require service

53 Circular no. SEBI/HO/ITD/ITD_VAPT/P/CIR/2023/033, dated March 6, 2023

54 Varsha Rajesh, Purushotham Kittane and Huzefa Tavawalla, "Privacy and Data Protection in India : 2024 Watch list and 2023 Wrap" NISHITH DESAI ASSOCIATES (February 02, 2024), *available at*: https://www.nishithdesai .com/NewsDetails /14910 (last visited March 30, 2025)

55 Indranath Bishnu, "India – Primer On IRDAI Information And Cyber Security Guidelines 2023", CONVENTUS LAW (9,2024),available at https://conventuslaw. com/report/india-primer-on-irdai-information-and-cyber securityguidelines-2023/ (last visited 30 March 2025)

56 BOOKS OF ACCOUNT (The Companies Act, 2013 (SECTION 128) and The Companies (Accounts) Rules, 2014)

providers offering services to users in the country to enable and maintain logs and records of financial transactions within India[57].

In a related development, the Food Safety and Standards Authority of India (FSSAI) has made it mandatory for E-commerce FBOs (Food Business Operators) to obtain a license from the Central Licensing Authority. E-commerce FBO means any Food Business Operator carrying out any of the activities under section 3(n) of Food Safety & Standards Act, 2006, through the medium of e-commerce. Similarly, another set of legal Rules being referred as "E-commerce & the Legal Metrology (Packaged Commodities) Amendment Rules, 2017," effective from January 1, 2018[58], has made it mandatory for e-commerce entities to ensure mandatory declarations about the commodity displayed on the digital and electronic network used for e-commerce transactions.

The consumer protection regime in India was recently overhauled by way of enactment of the Consumer Protection Act, 2019 (notified in July 2020) **(**CPA 2019**).** Under CPA 2019, sellers and service providers have the obligation to, among others, not engage in unfair trade practices including by way of misleading advertisements. Further, Consumer Protection (E-Commerce) Rules, 2020 **(**E-Commerce Rules**)** have been notified under the CPA to regulate e-commerce entities in India.[59] The price (total and a break-up) of goods or services should be mentioned clearly and misleading advertisements and misrepresentations are prohibited[60].

In June 2022, the Central Consumer Protection Authority **(**CCPA**),** issued Guidelines on Prevention of Misleading Advertisements and Endorsements for Misleading Advertisements, 2022 **(**the Guidelines). The Guidelines lay down the conditions for non-misleading and valid advertisements and conditions for bait advertisements[61].

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57 Circular No. 20(3)/2022-CERT-In Government of India Ministry of Electronics and Information Technology (MeitY) Indian Computer Emergency Response Team (CERT-In) available at https://www.cert-in.org.in/PDF/CERT In_Directions_70B_28.04.2022.pdf.(last visited 30 March 2025)

1.58 Circular no. WM-10 (65)/2017 dated 19.12.2017 issued by Legal Metrology Division to the Controllers of Legal Metrology; *available at*: http://www.cdsco.nic.in/writereaddata/list-of-notified-medicalm device(1).pdf (Last visited on Dec 28, 2024)

59 Sarin, Sarthak and Govinda Toshniwal, "An Overview Of The Implications Of Consumer Protection Rules for Relevant Stakeholders", INC 42, 1 November 2020, available at https://inc42.com/resources/an-overview-of-consumerprotection-e-commerce-rules/. (last visited 30 March 2025)

60 Rajiv Khare ET. AL, "E-commerce and Consumer Protection: A critical Analysis of Legal Regulations", 1. IJCLP 55, 69-71, (2021).

61 Bhumika Indulia "Guidelines for Prevention of Misleading Advertisements and Endorsements for Misleading Advertisements, 2022 The Central Consumer Protection Authority has issued Guidelines for Prevention of Misleading Advertisements and Endorsements for Misleading Advertisements, 2022" (June 10,

In November 2023, the CCPA further issued Guidelines for Prevention and Regulation of Dark Patterns, 2023 (Dark Pattern Guidelines) to restrict the use of dark patterns or manipulative practices by online platforms in designing their user interface and user experience that impair user autonomy, influence decision making, and work to the detriment of users[62].

Agencies Regulating the Digital Data in India

1) **Data Protection Board of India**

The Central Government established the Board as a body corporate.[63] It consists of a Chairperson and other members whose number and selection will be notified by the government. Civil courts are prohibited from handling cases or granting injunctions related to matters under the Board provides it with the jurisdiction to do so. It will operate digitally as much as possible, and will be digital by design in terms of receipt of complaints, hearings, pronouncement of decisions, and other functions, and adopt such techno-legal measures as may be prescribed.[64] It has the power to determine whether there are sufficient grounds for proceeding with an inquiry upon receiving the complaint from a data principal.[65] Furthermore, it has been vested with the same powers as that of the civil court to summon, receive evidence, and require the production of data, books etc during proceedings. If the Board is of the opinion, at any point after receipt of a complaint, that the complaint is false or frivolous, it may issue a warning or impose costs on the complainant.

2) **Appeals: The Telecom Disputes Settlement and Appellate Tribunal ("TDSAT")**

The Telecom Disputes Settlement and Appellate Tribunal ("TDSAT") established under the Telecom Regulatory Authority of India Act, 1997 ("TRAI Act") has also been

2022) available at https://www.scconline.com/blog/post/2022/06/10/guidelines-for-prevention-of-misleading-advertisements-and-endorsements-for-misleading-advertisements-2022/ (last visited 30 March 2025)

62 Central Consumer Protection Authority. 2023, *Guidelines on Prevention and Regulation of Dark Patterns*, Department of Consumer Affairs, Ministry of Consumer Affairs, Food and Public Distribution, Government of India, *available at*: https://consumeraffairs.nic.in/sites/default/files/file-uploads/latestnews/Draft%20Guidelines%20for%20Prevention%20and%20Regulation%20of%20Dark%20Patterns%202023.pdf (last visited 30 March 2025)

63 Section 18 of The Digital Personal Data Protection Act (No. 22 of 2023)

64 The Digital Personal Data Protection Act (No. 22 of 2023), s.28

65 The Digital Personal Data Protection Act (No. 22 of 2023) , s.27(1)a

designated as the Appellate Tribunal under the DPDP Act, 2023.[66] Appeals against orders and directions of the Data Protection Board must be made to the TDSAT within 60 days of receiving such orders, or later if the TDSAT finds there is a valid reason for the delay[67]. The TDSAT is authorized to hear the parties involved in the appeal and then confirm, modify, or overturn the appealed order. The DPDP ACT, 2023 mandates that the TDSAT should aim to resolve appeals as quickly as possible, preferably within six months of the appeal being filed. If this timeline is not met, the TDSAT must provide written reasons for the delay.

Conclusion

IT is focused on harnessing data more effectively to provide value-added services and enhance customer experience. Predictive analytics tools analyse current and historical data to identify patterns and forecast future outcomes. The innovations in IT are transforming businesses around the world. But while emerging technologies boost efficiency and productivity, their ethical implementation remains crucial too. As IT advances, policymakers face new regulatory challenges regarding privacy, security and transparency. Overall, a nuanced approach can help realize the benefits of modern IT responsibly and sustainably.[68] It highlight the growing need for legal protections for data privacy in India, particularly in relation to the evolving landscape of technology and data processing.

Although the IT (Amendment) Act 2008 regulates certain aspects of protecting personal data, it does not provide a comprehensive legal framework for the safety, processing, and transfer of personal data. There are a number of instances when concerns related to data breaches and inadequacy of the existing law were raised, and it was criticized for a number of limitations, such as its "lack of comprehensive provisions on user rights, trust, and safety, the lack of distinct regulatory approaches for harmful and illegal content, its inadequacy to deal with the

66 The Digital Personal Data Protection Act (No. 22 of 2023),s 2(a)

67 The Digital Personal Data Protection Act (No. 22 of 2023), s. Section 29 (2)

68 Ashish Tomer, "Psychological, Economical, Privacy and Personnel Impacts of Cybercrime: Is Cyber Crime Exploits Technology and Digital Platforms", 6 J. Re Attach Therapy & Dev. Diversities (Supp.) 114, 114–33 (2023).

new forms of cybercrime, harmful and illegal content, and the lack of adequate principles for data/privacy protection"[69].

Though these rights are narrower compared to the GDPR but represent a significant improvement over previous legal protections in India.

This will significantly impact education tech, gaming, and social media platforms that cater to younger audiences. The DPDP rules allows the transfer of personal data outside India only to countries notified by the government. These notifications will be based on adequate data protection laws in the destination country, bilateral or multilateral data-sharing agreements, risk assessment related to data misuse or surveillance. Organizations must review their cloud storage, SaaS tools, and third-party vendors located outside India to ensure compliance with data protection laws in India as well as applicable international regulations[70].

References

1. Cybercrime and Cyber Laws in India, (2023) 5 Indian J.L. & Legal Res. Issue 2, at 1.
2. Ryan, War, Peace, or Stalemate: Wargames, Wardialing, Wardriving, and the Emerging Market for Hacker Ethics, (2004) 9 Va. J.L. & Tech.
3. Vidal-Hall v. Google Inc, (2016) QB 1003 : (2015) 3 WLR 409 : 2015 EWCA (Civ) 311.
4. Campbell v. MGN Ltd, (2004) 2 AC 457 : (2004) 2 WLR 1232 : 2004 UKHL 22.
5. Lloyd v. Google LLC, (2021) 3 WLR 1268 : 2021 UKSC 50.
6. Sachin Chaturvedi, Krishna Ravi Srinivas and Vasantha Muthuswamy, Biobanking and Privacy in India, (2016) 44 J.L. Med. Ethics 45 at 50.
7. Sandeep Challa, The Fundamental Right to Privacy: A Case-by-Case Development Sans Stare Decisis, (2007) 1(1) Indian J. Const. L. 224 at 229.
8. Law Commission of India, Report on Bill No. 341 of 2019.
9. Information Technology Act, 2000.
10. Pavan Duggal, Data Protection Legislation in India, 1st edn, Universal Law Publishing, New Delhi, 2016.
11. Ministry of Electronics and Information Technology, Information Technology (Intermediary Guidelines) Rules, 2011, Gazette of India, 11 April 2011.
12. Apurv Sardeshmukh, Data Protection and the Information Technology Act, 2000, in Data Protection: Law and Regulation, 1st edn, Thomson Reuters Legal, 2019.
13. Douwe Korff, The Indian Digital Personal Data Protection Act, 2023, Viewed from a European Perspective (27 October 2023), available at https://ssrn.com/abstract.

69 H Nissenbaum,. A Contextual Approach to Privacy Online. 140(4) Daedalus 32-48 (2011)
70 *Supra* note 52.

14. G.S.R. 794(E), 28 October 2022, issued under s.87(1), (2)(z) & (zg), Information Technology Act, 2000.
15. Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021.
16. Press Information Bureau, Government Notifies Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules 2021, 25 February 2021.
17. In Re, Prajwala Letter, (2018) 15 SCC 551.
18. Sidhartha and Pankaj Doval, Rules Protect Rights of Users, Were Framed Because Social Media Giants Failed to Do So: IT and Law Minister Ravi Shankar Prasad, Times of India, 1 June 2021.
19. Ministry of Electronics and Information Technology, Notice for Public Consultation, 2 January 2023.
20. Panjiar and Waghre, IT Amendment Rules, 2023 are a Nightmare, Dressed Like a Fact Checking Daydream, Internet Freedom Foundation (2023).
21. Planning Commission, Government of India, Group of Experts on Privacy Submit Report, 2012.
22. Soli J. Sorabjee, Creative Role of Indian Judiciary in Enlarging and Protecting Human Rights, (2018) 17 J. Nat'l Human Rights Comm'n 21 at 22.
23. Committee of Experts under Justice B.N. Srikrishna, A Free and Fair Digital Economy: Protecting Privacy, Empowering Indians, 2017.
24. Government of India, Report of the Joint Committee on the Personal Data Protection Bill, 2019, Lok Sabha Secretariat, 2021.
25. The Digital Personal Data Protection Bill, 2022.
26. Kantar, Internet Adoption in India: ICUBE 2020, available at https://images.assettype.com/... (last visited 20 April 2025).
27. Evan A. Feigenbaum and Michael R. Nelson, Data Governance Network: Building a User-Centric Data Protection Law in India, 2002, available at https://datagovernance.org (last visited 20 April 2025).
28. Basu Chandola, Shravishtha Ajaykumar and Tanusha Tyagi, Digital Personal Data Protection Rules, 2025: Recommendations to MeitY, ORF Special Report No. 258, 2025.
29. Rashi Dhir and Trisha Shreyashi, RBI Rules for Cybersecurity in Financial Institutions, The Hindu BusinessLine, 17 December 2024, available at https://www.thehindubusinessline.com/... (last visited 20 April 2025).
30. SEBI Circular No. SEBI/HO/ITD/ITD_VAPT/P/CIR/2023/033, dated 6 March 2023.
31. Varsha Rajesh, Purushotham Kittane and Huzefa Tavawalla, Privacy and Data Protection in India: 2024 Watch List and 2023 Wrap, Nishith Desai Associates, 2 February 2024, available at https://www.nishithdesai.com/... (last visited 30 March 2025).
32. Indranath Bishnu, India – Primer on IRDAI Information and Cyber Security Guidelines 2023, Conventus Law, September 2024, available at https://conventuslaw.com/... (last visited 30 March 2025).
33. The Companies Act, 2013, s.128 and The Companies (Accounts) Rules, 2014.
34. CERT-In Circular No. 20(3)/2022-CERT-In, Ministry of Electronics and Information Technology, available at https://www.cert-in.org.in/PDF/... (last visited 30 March 2025).

35. Legal Metrology Circular No. WM-10(65)/2017, dated 19 December 2017, available at http://www.cdsco.nic.in/... (last visited 28 December 2024).
36. Sarthak Sarin and Govinda Toshniwal, An Overview of the Implications of Consumer Protection Rules for Relevant Stakeholders, INC42, 1 November 2020, available at https://inc42.com/... (last visited 30 March 2025).
37. Rajiv Khare et al., E-commerce and Consumer Protection: A Critical Analysis of Legal Regulations, (2021) 1 IJCLP 55 at 69–71.
38. Bhumika Indulia, Guidelines for Prevention of Misleading Advertisements and Endorsements for Misleading Advertisements, 2022, available at https://www.scconline.com/... (last visited 30 March 2025).
39. Central Consumer Protection Authority, Guidelines on Prevention and Regulation of Dark Patterns, 2023, available at https://consumeraffairs.nic.in/... (last visited 30 March 2025).
40. The Digital Personal Data Protection Act, 2023 (No. 22 of 2023), ss. 2(a), 18, 27(1)(a), 28, 29(2).
41. Ashish Tomer, Psychological, Economical, Privacy and Personnel Impacts of Cybercrime: Is Cyber Crime Exploits Technology and Digital Platforms, (2023) 6 J. Re Attach Therapy & Dev. Diversities (Supp.) 114 at 114–33.
42. H. Nissenbaum, A Contextual Approach to Privacy Online, (2011) 140(4) Daedalus 32–48.

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Tax Rebate and Economic Growth: An Impact Assessment

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Abstract

Tax rebates have increasingly become a strategic component of fiscal policy aimed at stimulating economic growth, improving consumer demand and encouraging private investment. Despite their growing use, the long-term effectiveness and structural efficiency of such rebate schemes remain underexplored, especially in developing economies. This study investigates the impact of tax rebates on economic growth, focusing on their influence on consumer spending, investment and GDP performance. The study aims to evaluate the effectiveness of tax rebates in promoting economic activity and to provide comparative insights into how these incentives operate across economic sectors. A quantitative research design was adopted, with data collected from 50 respondents through a structured questionnaire assessing awareness, utilisation, and perceived effectiveness of tax rebate schemes. Descriptive statistics and regression analysis were employed to examine the relationship between tax rebates and key economic indicators. The findings underscore the importance of tailoring rebate policies to target high-impact sectors, such as small businesses and low-income households, to achieve broader economic objectives. The study supports the integration of equitable, well-targeted tax rebate schemes within fiscal policy frameworks to enhance long-term growth. These insights offer valuable guidance for policymakers seeking to strengthen tax incentive mechanisms for economic development.

Keywords: *Taxation, Economic Growth, Tax Rebate, Consumer behaviour, Investment*

Introduction

Tax policy plays a critical role in the path of a nation's economic development among the various fiscal instruments available to policymakers. Tax rebates are an active instrument to influence economic performance, enhance social welfare and restore market imbalances. A tax rebate is the partial refund of taxes paid by a person or business for specific purposes such as encouraging certain economic behaviours, giving incentives for consumer spending, saving or greater investment in innovation. These rebates can either be direct for instance like cash-back or indirect through inducements such as reducing value-added tax (VAT) or corporate income tax. Rebate schemes depend on the belief that providing people and businesses with extra disposable income or decreasing their investment costs will encourage them to engage in

economic activity and promote growth. Mixed evidence has emerged over the decades from empirical studies regarding the effectiveness of tax rebates in promoting economic growth In modern fiscal policy, tax rebates have become an increasingly popular instrument for governments to stimulate economic activity, promote equitable growth, and incentivize targeted behaviours such as investment, consumption, and environmental sustainability. Across different global contexts, rebates have been used strategically—Italy's 2014 income tax credit significantly increased household spending, particularly among low-income earners who spent up to 80% of their rebate on consumption (Neri et al., 2018), while California's electric vehicle rebate program helped over half its low-income consumers purchase EVs (Williams & Pallonetti, 2023). These examples highlight the short-term effectiveness of rebates in stimulating demand and fostering green growth. However, findings from the U.S. during COVID-19 suggest limited spending effects from stimulus payments, as noted by Parker et al. (2022), reflecting how context, public sentiment, and savings preferences can affect the success of rebate schemes.

Beyond immediate economic impacts, rebates also influence long-term policy goals such as innovation, trade competitiveness, and tax compliance. R&D tax incentives, as documented by Becker (2015) and Miguel & Papers (2004), have stimulated innovation in financially constrained SMEs, while in China, a 1% rise in VAT rebates increased export quantities by 7% (Gourdon et al., 2022). Yet scholars like Ciccone & Soldani (2021) caution against poorly targeted rebates that may lead to increased emissions or fiscal strain. Behavioural research further shows that tax amnesties and rebate expectations can reduce long-term compliance (Angeli et al., 2023), and that public perception and trust critically shape the effectiveness of rebate programs (Fremstad et al., 2022; Jayawardane, 2015). While rebates have clear potential as development tools, their outcomes depend heavily on design, targeting, and integration within broader fiscal policy frameworks (Arnold et al., 2011; Boskin, 1988).

Despite the breadth of international evidence, there remains a significant gap in understanding how tax rebates impact economic growth in developing and emerging economies, where administrative inefficiencies, low awareness, and weak policy implementation often dilute their intended effects. As observed in countries like Nigeria, incentives for SMEs are frequently undermined by corruption and poor accessibility (Obafemi et al., 2021; Ocheni, 2015), while high tax burdens without adequate support hinder reinvestment and compliance (Tee et al., 2016). This paper addresses the critical problem of assessing whether and how tax rebates contribute to economic growth in such contexts. Specifically, it investigates the effectiveness, behavioural influence, and long-term implications of tax rebate programs through a structured empirical study, offering insights to help policymakers design more equitable and impactful fiscal incentives.

Literature Review

Tax rebate policies have been employed globally as instruments to influence economic behaviour, stimulate growth, and promote social welfare. In developed economies, evidence from Italy, the U.S., and China demonstrates varying degrees of effectiveness. For example, Neri et al. (2018) found that the 2014 Italian income tax credit significantly boosted consumption, particularly among lower-income households who spent up to 80% of their rebate, translating into €3.5 billion in additional expenditure. Similarly, Williams and Pallonetti (2023) documented that over half of California's electric vehicle (EV) buyers reported relying on rebate schemes, with increased reliance among low-income groups, reinforcing the notion that rebates encourage green innovation and market participation. Conversely, Parker et al. (2022) revealed that U.S. Economic Impact Payments (EIPs) during the COVID-19 pandemic had modest impacts on consumption, especially in later rounds, as households became more risk-averse and savings-oriented. In the context of environmental policy, tax rebates and credits have been integral to facilitating energy transitions. For example, Ciccone and Soldani (2021) analysed reforms in Norway's vehicle registration tax and observed that rebates encouraged a shift toward low-emission vehicles but inadvertently increased overall emissions due to a rise in diesel vehicle purchases. Böhringer et al. (2022) supported the potential of border carbon adjustments (BCAs) in enhancing trade competitiveness and preventing carbon leakage, while Fremstad et al. (2022) emphasized the role of political messaging in shaping public support for carbon tax rebates, particularly when clear communication and transparency are missing. Studies like Baranzini and Carattini (2017) found that while citizens often oppose carbon taxes, they are more likely to support them when revenues are earmarked for environmental investments or used to cushion low-income households.

Rebates have also proven effective in promoting innovation. Becker (2015) and Miguel and Papers (2004) illustrated how R&D tax credits incentivize innovation, especially in small firms with limited financing. These credits not only enhance product innovation but also boost competitiveness and export performance. Gourdon et al. (2022) observed that in China, a 1% increase in VAT rebates led to a 7% rise in export quantities, underscoring the strategic role of tax policy in international trade. Yet, such instruments must be designed carefully to avoid negative outcomes. For instance, Angeli et al. (2023) reported that tax amnesties in Italy generated temporary revenues but decreased long-term compliance by creating expectations of future forgiveness.

In developing economies like Nigeria, research highlights structural and administrative inefficiencies. Zakari et al. (2023) and Olatunji and Alake (2020) criticised the country's manual tax systems for enabling evasion and fraud, advocating for a shift toward digital taxation. Obafemi et al. (2021) and Ocheni (2015) emphasized the importance of tax incentives for small and medium-sized enterprises (SMEs), recommending tax holidays and simplified procedures to enhance compliance and support growth. In this regard, Tee et al. (2016) warned

that high tax rates without incentives could harm SME profitability, while Fiuza (2005) highlighted how tax advantages in Brazil allowed domestic car manufacturers to maintain competitive margins despite liberalization pressures. Psychological and behavioural dimensions further complicate rebate effectiveness. Lachowska (2015) found that tax rebates enhanced emotional well-being among low-income individuals, while Jayawardane (2015) argued that tax compliance is shaped by attitudes, trust in government, and perceived fairness. Such social norms influence how rebate schemes are perceived and whether they lead to sustained economic benefits. Raats et al. (2018) and Fremstad et al. (2022) reiterated that lack of public understanding can hinder rebate effectiveness, emphasizing the role of communication in policy implementation. Methodological insights also inform the evaluation of rebate policies. Orchard et al. (2023) highlighted the limitations of microeconomic estimates when compared to macroeconomic models, advocating for robust calibration to derive reliable conclusions about rebate impacts. Borusyak (2018) proposed refinements to difference-in-difference estimation to address under-identification issues when assessing tax rebate outcomes. Aghion et al. (2016) demonstrated that the positive impact of taxation on innovation can be dampened by corruption, suggesting the need for clean, transparent fiscal environments.

Despite these diverse perspectives, a central theme emerges: tax rebates can stimulate short-term economic activity, foster innovation, and promote equitable growth, but their long-term success hinges on contextual appropriateness, administrative efficiency, and public perception. Many developing countries face challenges in aligning rebate policies with broader fiscal strategies due to weak institutional frameworks, low financial literacy, and poorly designed targeting mechanisms. This paper aims to address these gaps by assessing the impact of tax rebate schemes on economic growth, with a particular focus on how taxpayer behaviour, administrative design and sectoral targeting affect their outcomes in the Indian context.

Research Gap

While existing studies have explored the general effectiveness of tax rebates in stimulating economic activity, there remains a significant gap in the literature concerning the evolving design of rebate mechanisms particularly about rising tax rates, increasing benefit sizes, and changing political or partisan contexts. Much of the current research emphasizes short-term outcomes or examines isolated policy interventions, offering limited cross-national or longitudinal comparative insights. The long-term fiscal sustainability of rebate programs and their systemic implications are still underexplored. As Mildenberger et al. (2022) suggest, the dynamic nature of rebate structures and their interaction with broader tax policy changes warrant deeper investigation. This study aims to bridge these gaps by evaluating both the immediate and extended impacts of tax rebates on key economic indicators, while also providing a foundation for future inquiry into the political economy and structural transformation of rebate policies. In response to these research gaps, the present study pursues two key objectives: (1) to assess the impact of tax rebates on consumer spending, investment,

and GDP growth, and (2) to evaluate the effectiveness of tax rebates in driving economic growth through comparative analysis.

Theoretical Framework

The Ability to Pay Principle, as emphasized by Ocheni (2015), is a foundational theory of taxation that asserts taxes should be levied according to an individual's or entity's financial capacity. It is grounded in the concept of vertical equity, which advocates that those with greater economic resources should contribute more to public revenues. This principle contrasts with other taxation theories, the benefit approach, which ties tax liability to the benefits received from public services, and the equal distribution principle, which supports a uniform tax burden across all income levels. The Ability to Pay Principle is often operationalized through progressive taxation, where tax rates increase with income or wealth, and is further supported by the economic concept of diminishing marginal utility of income which holds that the satisfaction gained from each additional unit of income decreases as income rises. Thus, taxing high-income earners more heavily is seen as imposing a relatively equal sacrifice across income groups, reinforcing the fairness of such systems.

In the context of this research, which investigates the role of tax rebates in promoting economic development and supporting vulnerable economic actors, the Ability to Pay Principle offers a robust normative framework. It supports the use of targeted tax rebates as corrective mechanisms to alleviate disproportionate tax burdens on low-income households and small and medium enterprises (SMEs), especially during economic downturns or structural shifts. By ensuring that tax relief measures are aligned with taxpayers' financial capacities, the principle enhances both equity and effectiveness. Moreover, since lower-income groups and SMEs typically exhibit a higher marginal propensity to consume or invest, rebates directed toward them can generate stronger economic multipliers, stimulate aggregate demand and foster inclusive growth. This principle not only guides the equitable design of rebate programs but also underpins their broader developmental impact, making it highly relevant and useful for evaluating the fairness and efficiency of tax policy interventions in this study.

Methodology Used

This study used a quantitative research design to assess the impact of tax rebates on economic growth, focusing on key indicators that is consumer spending, business investment and GDP growth. Primary data was collected through a structured online questionnaire distributed via Google Forms to a sample of 50 respondents, primarily consisting of young professionals aged 18–30 with 0–5 years of work experience. The questionnaire included demographic questions and a series of opinion-based statements measured on a five-point Likert scale, addressing areas such as awareness of tax rebates, their perceived short-term and long-term effects, fiscal sustainability, and the need for targeted implementation. A non-probability convenience sampling technique was used, allowing participation from individuals who were readily

accessible and willing to respond. This methodology was chosen to generate measurable and reliable insights into public perceptions and the economic implications of tax rebate policies, offering a structured and focused approach to understanding how such fiscal tools influence economic behaviour and development.

Analysis and Interpretation

This section presents the empirical findings derived from the primary data collected through a structured questionnaire administered to a sample of 50 participants. The analysis employs both descriptive and regression statistical techniques to evaluate the perceived impact of tax rebates on key economic indicators—consumer spending, investment, and GDP growth. The use of these tools facilitates an understanding of the short-term and long-term implications of rebate policies as perceived by respondents.

Descriptive Statistics

Descriptive analysis was conducted to understand the general perception of the respondents regarding the influence of tax rebates on economic growth components. The responses were recorded using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Table 1 summarizes the mean, standard deviation, minimum, and maximum values for the three variables.

Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation
Consumer Spending	4.4	0.52
Investment	3.6	0.7
GDP Growth	3.7	1.16

The results state that the majority of respondents perceive tax rebates as having a strong positive impact on consumer spending (mean = 4.40), implying that such fiscal incentives are likely to boost short-term consumption. The investment variable received a moderate mean score (3.60), suggesting that while rebates may encourage business reinvestment, the effect is not uniformly perceived as strong. The average score for GDP growth was 3.70, reflecting mixed perceptions regarding the macroeconomic impact of rebate policies. The standard deviation for GDP growth was highest (1.16), indicating greater variability in respondent opinions.

Gender Based Descriptive Analysis

A gender-wise analysis of the respondents reveals that female participants (58%) generally exhibited stronger agreement on the positive impacts of tax rebates, particularly in enhancing short-term consumption, promoting equitable fiscal planning, and learning from international

practices. Male respondents (42%) also recognized the benefits but showed slightly more neutral views regarding long-term investment impacts and fiscal sustainability. Overall, both genders acknowledged the importance of targeted and integrated rebate schemes, highlighting broad support for tax rebates as a strategic tool for economic growth, with nuanced differences in perception shaped by gender-based perspectives presents a fascinating insight into the differential perceptions of tax rebates between genders.

Regression Analysis

To examine the extent to which consumer spending and investment (as stimulated by tax rebates) contribute to economic growth, a multiple linear regression analysis was performed. In this model, GDP growth was used as the dependent variable, while consumer spending and investment served as independent variables. The regression model helps in assessing the predictive power of rebate-induced spending and investment on perceived economic growth.

Table 2: Regression Analysis

Predictor	Coefficient (B)	Interpretation
Constant	-1	Estimated baseline level of GDP growth without the predictors
Consumer Spending	0.25	A one-unit increase in spending is associated with a 0.25 unit rise in GDP growth
Investment	1	A one-unit increase in investment leads to a 1.00 unit increase in GDP growth
R^2	0.44	44% of the variation in GDP growth is explained by the model

The results suggest that investment has a stronger and more direct influence on GDP growth compared to consumer spending. The regression coefficient for investment (B = 1.00) indicates that increasing investment through targeted tax rebates has the potential to drive more substantial economic gains. Although consumer spending is positively associated with GDP growth (B = 0.25), its impact is relatively limited. The R^2 value of 0.44 signifies that approximately 44% of the variance in GDP growth is explained by the combined effect of consumer spending and investment.

Findings

The analysis demonstrates that tax rebates play a constructive role in influencing key economic indicators that is consumer spending, business investment and economic activity. A substantial proportion of respondents acknowledged that rebates enhance disposable income and support increased economic engagement, particularly among lower-income groups and small enterprises. The descriptive statistics confirm a strong perception of rebates as effective short-

term fiscal tools, while the regression results ($R^2 = 0.63$) establish a statistically significant, though not exclusive, link between tax rebates and economic growth. The evidence suggests that rebate schemes yield more meaningful outcomes when designed with precision, directed toward specific sectors or demographics that are more likely to convert financial relief into productive economic activity. These insights point toward the necessity of evaluating tax rebate mechanisms not only on the basis of immediate fiscal outcomes but also in terms of their structural and behavioral impact on the economy.

Conclusions

This study concludes that well-calibrated tax rebate policies contribute meaningfully to economic growth by enhancing consumption, encouraging private investment, and promoting equity in tax burden distribution. While the immediate effects are measurable and often substantial, the broader and more durable influence of such policies is contingent on their integration within a coherent fiscal strategy. The findings underscore the importance of policy alignment that balances short-term stimulus with long-term economic stability. The effectiveness of tax rebates is amplified when schemes are responsive to socioeconomic conditions and are supported by institutional capacity to implement and monitor their outcomes. A more nuanced approach to rebate design rooted in empirical assessment and contextual sensitivity is essential for fostering sustainable economic development and reinforcing public trust in fiscal governance. Future research may explore the long-term behavioral impacts of tax rebate policies on taxpayer compliance and financial planning. Comparative studies across different national contexts can further enrich understanding of how political, cultural, and institutional factors shape rebate effectiveness.

References

Aghion, P., Akcigit, U., Cagé, J., & Kerr, W. R. (2016). *Taxation , Corruption , and Growth*. *2015*.

Aldy, J., Buller, S., Cantillon, E., Davis, L., Fullerton, D., Gillingham, K., Ito, K., Kann, S., Pizer, B., Sheriff, G., & Weisenmiller, B. (2015). *the Private Net Benefits of Residential Solar Pv :*

Alm, J., Avenue, S. C., Hall, T., & Orleans, N. (2020). *Pr ep rin t n ot pe er re v Pr ep rin t n ot er ed*. *October*.

Angeli, A., Lattarulo, P., Palmieri, E., & Pazienza, M. G. (2023). Tax evasion and tax amnesties in regional taxation. *Economia Politica*, *40*(1), 343–369. https://doi.org/10.1007/s40888-023-00297-9

Arnold, J. M., Brys, B., Heady, C., Johansson, Å., Schwellnus, C., & Vartia, L. (2011). Tax Policy for Economic Recovery and Growth. *Economic Journal*, *121*(550), 59–80.

https://doi.org/10.1111/j.1468-0297.2010.02415.x

Baranzini, A., & Carattini, S. (2017). Effectiveness, earmarking and labeling: testing the acceptability of carbon taxes with survey data. In *Environmental Economics and Policy Studies* (Vol. 19, Issue 1). Springer Japan. https://doi.org/10.1007/s10018-016-0144-7

Becker, B. (2015). Public R&D Policies and Private R&D Investment: A Survey of the Empirical Evidence. *Journal of Economic Surveys*, *29*(5), 917–942. https://doi.org/10.1111/joes.12074

Bigazzi, A., & Berjisian, E. (2021). Modeling the impacts of electric bicycle purchase incentive program designs. *Transportation Planning and Technology*, *44*(7), 679–694. https://doi.org/10.1080/03081060.2021.1956806

Böhringer, C., Fischer, C., Rosendahl, K. E., & Rutherford, T. F. (2022). Potential impacts and challenges of border carbon adjustments. *Nature Climate Change*, *12*(1), 22–29. https://doi.org/10.1038/s41558-021-01250-z

Borusyak, K. (2018). *with an Application to the Estimation of the Marginal Propensity to Consume ∗*. 1–35.

Boskin, M. J. (1988). Tax Policy and Economic Growth: Lessons From the 1980s. *Journal of Economic Perspectives*, *2*(4), 71–97. https://doi.org/10.1257/jep.2.4.71

Braakmann, N., Gao, B., & Maioli, S. (2020). VAT rebates as trade policy: Evidence from China. *China Economic Review*, *63*. https://doi.org/10.1016/j.chieco.2020.101536

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., & Vöhringer, F. (2017). Green Taxes in a Post-Paris World: Are Millions of Nays Inevitable? *Environmental and Resource Economics*, *68*(1), 97–128. https://doi.org/10.1007/s10640-017-0133-8

Ciccone, A., & Soldani, E. (2021). Stick or Carrot? Asymmetric Responses to Vehicle Registration Taxes in Norway. In *Environmental and Resource Economics* (Vol. 80, Issue 1). Springer Netherlands. https://doi.org/10.1007/s10640-021-00578-6

Cronin, J. A., Fullerton, D., & Sexton, S. E. (2017). *Nber Working Paper Series Vertical and Horizontal Redistributions From a Carbon Tax and Rebate*. http://www.nber.org/papers/w23250

D'Amato, A., Valentini, E., & Zoli, M. (2017). Tradable Quotas Taxation and Market Power. *SSRN Electronic Journal*, 1–16. https://doi.org/10.2139/ssrn.2754172

Ductor, L., & Grechyna, D. (2012). Financial Development, Technological Progress and Economic Growth. *Ssrn*, *July*, 1–28. https://doi.org/10.2139/ssrn.1997526

Eckel, C., & Grossman, P. J. (2024). *Version of Record:*

https://www.sciencedirect.com/science/article/pii/S1773224724000935. 1–37.

Fiuza, E. P. S. (2005). Automobile Demand and Supply in Brazil: Effects of Tax Rebates and Trade Liberalization on Price-Marginal Cost Markups in the 1990s. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.427701

Fremstad, A., Mildenberger, M., Paul, M., & Stadelmann-Steffen, I. (2022). The role of rebates in public support for carbon taxes. *Environmental Research Letters*, *17*(8). https://doi.org/10.1088/1748-9326/ac8607

Gourdon, J., Hering, L., Monjon, S., & Poncet, S. (2022). Estimating the repercussions from China's export value-added tax rebate policy*. *Scandinavian Journal of Economics*, *124*(1), 243–277. https://doi.org/10.1111/sjoe.12453

Jayawardane, D. (2015). Psychological Factors affect Tax Compliance-A Review paper. *International Journal of Arts and Commerce*, *4*(6), 131–141. www.ijac.org.uk

Jemli, Y. El, Rkia, Z., & Barakat, A. (2023). *Co Co Co Co Co Co Co Co Co Co Co*. *July*.

Johansson, Å., Heady, C., Arnold, J., Brys, B., & Vartia, L. (2008). *Unclassified ECO/WKP(2008)28 JT03248896 Document complet disponible sur OLIS dans son format d'origine Complete document available on OLIS in its original format*. *620*. www.oecd.org/eco/working_papers

Kan, K., Peng, S. K., & Wang, P. (2017). Understanding consumption behavior: Evidence from consumers' reaction to shopping vouchers. *American Economic Journal: Economic Policy*, *9*(1), 137–153. https://doi.org/10.1257/pol.20130426

Keen, M., Parry, I., & Roaf, J. (2022). Border carbon adjustments: rationale, design and impact. *Fiscal Studies*, *43*(3), 209–234. https://doi.org/10.1111/1475-5890.12307

Kim, S., Mackinlay, A., Marchica, M., & Mcconnell, J. (n.d.). *Mara Faccio and Jin Xu Krannert School of Management, Purdue University*. 1–42.

Krajnak, M. (2019). Do selected tax advantages affect tax revenue from the personal income tax? *Journal of Competitiveness*, *11*(4), 73–88. https://doi.org/10.7441/joc.2019.04.05

Lachowska, M. (2015). The Effect of Income on Subjective Well-Being: Evidence from the 2008 Economic Stimulus Tax Rebates. *SSRN Electronic Journal*, *15*. https://doi.org/10.2139/ssrn.2682543

Marron, D. B., & Toder, E. (2015). Carbon taxes and corporate tax reform. *Implementing a US Carbon Tax: Challenges and Debates*, 141–158. https://doi.org/10.2139/ssrn.2671520

McFarland, J. R., Fawcett, A. A., Morris, A. C., Reilly, J. M., & Wilcoxen, P. J. (2018).

OVERVIEW of the EMF 32 STUDY on U.S. CARBON TAX SCENARIOS. *Climate Change Economics*, *9*(1). https://doi.org/10.1142/S201000781840002X

MICHA, R. (2017). 乳鼠心肌提取 HHS Public Access. *Physiology & Behavior*, *176*(1), 100–106. https://doi.org/10.1177/0022146515594631.Marriage

Miguel, J., & Papers, Z. E. W. D. (2004). *Evaluating the Impact of R & D Tax Credits on Innovation : A Microeconometric Study on Canadian Firms Evaluating the Impact of R & D Tax Credits on Innovation : A Microeconometric Study on Canadian Firms Dirk Czarnitzki , Petr Hanel and Julio Miguel Rosa*. *04*.

Mu, D., Ren, H., & Wang, C. (2022). A literature review of taxes in cross-border supply chain modeling: Themes, tax types and new trade-offs. *Journal of Theoretical and Applied Electronic Commerce Research*, *17*(1), 20–46. https://doi.org/10.3390/jtaer17010002

Muhammad, I., & Nor, N. S. M. (2021). The empirical evidence on taxpayers' intention to claim zakat payment as a tax rebate. *International Journal of Business and Society*, *22*(2), 637–652. https://doi.org/10.33736/ijbs.3748.2021

Neri, A., Rondinelli, C., & Scoccianti, F. (2018). Household Spending Out of a Tax Rebate: Italian ' "80 Tax Bonus." In *SSRN Electronic Journal* (Issue 2099). https://doi.org/10.2139/ssrn.3047180

Obafemi, T. O., Araoye, F. E., & Ajayi, E. O. (2021). Impact of tax incentives on the growth of small and medium scale enterprises in Kwara state. *International Journal of Multidisciplinary Research and Growth Evaluation*, *2*(3), 11–19. www.allmultidisciplinaryjournal.com

Ocheni, S. I. (2015). Impact Analysis of Tax Policy and the Performance of Small and Medium Scale Enterprises in Nigerian Economy. *Strategic Management Quarterly*, *3*(1), 71–94. https://doi.org/10.15640/smq.v3n1a3

Olatunji, V. A., & Alake, S. F. (2020). Impact of Electronic Taxation on Tax Evasion and Avoidance (A Case Study of Nigerian Banks). *Global Journal Francis Social Advanced Research*, *2*(1), 1–7. http://www.gjfsar.com/

Orchard, J., Ramey, V., & Wieland, J. (2023). Using Macro Counterfactuals to Assess Plausibility: An Illustration Using the 2001 Rebate MPCs. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4616876

Othman, Y. H.-, Yusuff, M. S. S., Saufi, M. S. A. M., & Hafsha, S. (2017). The Influence of Knowledge, Islamic Religiosity and Self-Efficacy on the Intention to Pay Income Zakat among Public Educators in Kedah, Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *7*(11), 1117–1127. https://doi.org/10.6007/ijarbss/v7-

i11/3550

Parker, J. A., Schild, J., Erhard, L., & Johnson, D. S. (2022). Economic Impact Payments and Household Spending during the Pandemic. *Brookings Papers on Economic Activity*, *2022*, 81–130. https://doi.org/10.1353/eca.2022.a901277

Raats, T., Schooneknaep, I., & Pauwels, C. (2018). *Supporting Film Distribution in Europe: Why Is Overcoming National Barriers so Difficult?* https://doi.org/10.1007/978-3-319-71716-6_12

Romer, D. H., & Romer, C. D. (2007). Nber Working Paper Series The Macroeconomic Effects Of Tax Changes: Estimates Based On A New Measure Of Fiscal Shocks The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal. *NBER Working Paper No.13264*. http://www.nber.org/papers/w13264

Samargandi, N., Fidrmuc, J., & Ghosh, S. (2015). Is the Relationship Between Financial Development and Economic Growth Monotonic? Evidence from a Sample of Middle-Income Countries. *World Development*, *68*(1), 66–81. https://doi.org/10.1016/j.worlddev.2014.11.010

Tee, E., Boadi, L. A., & Opoku, R. T. (2016). The Effect of Tax Payment on the Performance of SMEs : The Case of Selected SMEs in Ga West Municipal Assembly. *ResearchGate*, *8*(20), 119–125.

Valentina Aprigliano, G. A. and L. M. (2017). Temi di discussione. *October*, *35*(442), 1–28. https://www.bancaditalia.it/pubblicazioni/temi-discussione/2017/2017-1098/en_tema_1098.pdf?language_id=1

Vogt-Schilb, A., Walsh, B., Feng, K., Di Capua, L., Liu, Y., Zuluaga, D., Robles, M., & Hubaceck, K. (2019). Cash transfers for pro-poor carbon taxes in Latin America and the Caribbean. *Nature Sustainability*, *2*(10), 941–948. https://doi.org/10.1038/s41893-019-0385-0

Vringer, K., van Middelkoop, M., & Hoogervorst, N. (2016). Saving energy is not easy. *Energy Policy*, *93*(June 2016), 23–32. https://doi.org/10.1016/j.enpol.2016.02.047

Walmsley, M. R. W., Walmsley, T. G., & Atkins, M. J. (2015). Achieving 33% renewable electricity generation by 2020 in California. *Energy*, *92*(June 2015), 260–269. https://doi.org/10.1016/j.energy.2015.05.087

Wang, Q., Hubacek, K., Feng, K., Wei, Y. M., & Liang, Q. M. (2016). Distributional effects of carbon taxation. *Applied Energy*, *184*, 1123–1131. https://doi.org/10.1016/j.apenergy.2016.06.083

Williams, B. D. H., & Pallonetti, N. (2023). Rebate Influence on Electric Vehicle Adoption in California. *36th International Electric Vehicle Symposium (EVS36), January 2017*.

Zakari, A., Khan, I., & Alvarado, R. (2023). The impact of environmental technology innovation and energy credit rebate on carbon emissions: A comparative analysis. *Journal of International Development*, *35*(8), 2609–2625. https://doi.org/10.1002/jid.3788

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Dr Vivek Kumar Pathak is an Associate Professor in the School of Management at ICFAI University, Sikkim, India and an Edupreneur. He represented academics as well as the industry in his eighteen years of rich experience with different portfolios. Graduated as an IT Engineer and completing his MBA in Marketing, he is a doctorate (Ph.D.) in service quality management from National Institute of Technology Silchar. He has completed two FDPs on Machine Learning with Business Applications organized by IIM Bangalore and have twenty two (22) research papers published in indexed journals such as in SCOPUS, WOS, ABDC and others. His current area of research interest is in the domain of Social Media Marketing, Behavioural Sciences, Sustainability and Consumer Psychology including multidisciplinary studies. Besides, he is also the member of thesis evaluators of Marketing in Ajman University, UAE. He is lifetime member of North Eastern Economic Association, IIT Guwahati, and member of International Economic Development Research Centre (IEDRC) and professional member of InSc (Institute of Scholars). He is proficient in teaching subjects from Business Management domain and adores to share his expertise in Data Analytics.

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