Innovations

Seasons and Mental Well Being: A Case Study of Gangotri Region

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Abstract : *This study aims to explore the relationship between humans and their living environment, focusing on the mental wellbeing of residents in Gangotri Municipality, Uttarkashi, Uttarakhand. Data was gathered through a survey on a prepared schedule that included questions on mental health, spirituality, and physical well-being. The mental wellbeing of individuals was assessed through various indicators such as appetite, physical activity, emotional state, sleep patterns, and stress levels. A comparative analysis was conducted based on responses from 47 participants, with Statistical Package for the Social Sciences (SPSS). The results provide statistical evidence showing the influence of seasonal changes on mental wellbeing. The Mann Whitney U Test was employed to assess the significance of differences across various indicators. Additionally, R-Studio software was utilized for Principal Component Analysis and Random Forest Analysis. The findings highlight a notable impact of the summer season on mindfulness and overall wellbeing, offering insights into the complex relationship between seasonal variations and mental health in the region. Results reveal thatemotional regulation and stress management are crucial components for enhancing mental health in the region of Gangotri. The mental wellbeing data of respondents was visualized using Inverse Distance Weighting (IDW) interpolation through ArcGIS 10.4.1 software.*

Key Words: *Mental Well-Being, Seasonal Change, Mental Health, Spiritual Well-Being, IDW*

Introduction

The environment has a profound impact on organisms physically, biologically and chemically. This impact is often subjective to the human understanding of the environment. Human interplay with respect to the natural environment speaks volume about human fitness, both physically and mentally (Loga &Sosic, 2012). Lived experiences in a given environment affect the mental health of humans and affect how they cope with psychological stressors. Mental well-being is deeply influenced by physiological factors and its interconnection with socio-economic, behavioral, psychological and epigenetic conditions. Research highlights that natural environment

can positively influence mental health in forms of visual senses, auditory inputs and sensory inputs (Keniger et al., 2013) (Meyer-Lindenberg, 2014). This research work focuses particularly on the role of environmental phenomena and its impact on mental health. The aim of this research is to analyze the seasonal impact on mental well- being of residents in the Gangotri Municipality, Uttarakhand, India.

Bearer of the mighty *Bhagirathi,* Gangotri-Gaumukh is a glacier situated in the laps of Himalayas. It is of great spiritual significance to visit the source of *Ganga* situated at an altitude of 4,023 m above sea level. The glacier is a sensitive amalgam of *Shakti,* energies of the environment; elements of worship including trees, rocks, soil, glacier and rivers. The site for spiritual renaissance. With such might, its disruption is believed to cause disruptions in the ecological balance of its surrounding area.The presence of Char Dhamattracts tourists in abundance to *Devbhoomi*, Uttarakhand. After the disastrous tragedy of 2013 floods, the influx of tourists had utmost variation depicting a declining trend of faith and belief. As the Char Dham infrastructure braced, people's faith and trust restored leading to higher influx of tourists (Semwal & Upreti, 2019). The study of Drew emphasizes on the religious belief of people about Gaumukh being sacred and changing not due to climatic influence but because of intervention of unethical crowd due to increased tourism. As per the habitants, the course of Bhagirathi that flows from the glacier may become like that of river Saraswati but its importance for the population and holiness would be constant. The spiritual ecology among the locals creates an overly optimistic context with respect to, changing river course, water levels and the disasters associated with Bhagirathi. In order to combat such changes religious and ecological tourism should be propounded (Drew, 2012).

Throughout life, an individual faces mental risk factors followed by development of strength and resilience. Sensitive periods like childhood, effects of anxiety, depression are often misunderstood with fear. The constant urge to stay connected, post technological advancement requires continuous brainstorming that leads to economic stress. Stress in turn is accompanied by anger, depression, irregular sleep cycles and imbalanced diet. Prioritizing wants over needs places individuals in a rat trap of competition, dissatisfaction and self-doubt, creating psychological distress. Eventually, one turns ignorant towards their mental wellbeing that rebuffs mindfulness (Szabo & Lovibond, 2006) (Fan, et al., 2015) (Tandon, 2016) (Postans& Pidgeon, 2016). The over dependence on technological advancement is a perpetual distraction that causes sleep deprivation, work and life imbalance, *fear of missing out* and social validation (Akin & Iskender, 2011). While dealing with mental health issues, the human body transitions physically, mentally, spiritually and emotionally. In order to overcome challenging times, humans require a change of sight to heal.

The environment holds specific meaning to each individual driven by personal incidents, experiences and mental-wellbeing. Human agency, creativity and consciousness associated with a region are embedded in the mind of an individual. A self-conscious drive to connect to a place motivates a person to develop spiritual links.

The human attachment to a place is driven by spiritual awareness not religion. Each individual understands the cosmos in their own way, personal experiences and ideas. Hence, everyone with their own belief is religious. The anarchy of possibilist geographers led to the awakening of the humanistic approach in the field of geography. In order to understand the connection between physical environment, human mind, spirituality and mental healing, it is vital to look at the world from the respondent's point of view (Hussain, 2015).Various researches reveal that nature has a way of mental healing. Individuals who are closer to the natural environment are mentally, spiritually and emotionally sturdy. Nature helps humans in coping with pain, increasing vitality, reducing stress levels and reduces the chances of developing a psychiatric disorder. When compared to the urban environment, the habitants of a natural environment outshine cognitive capability, mindfulness and working memory. The sound and sight of nature heals, protects and prevents from any further mental distress (Weir, 2020) (Schertz & Berman, 2019) (Capaldi et. al., 2015) (Van Hedgar et. al., 2019) (Lee et. al., 2015) (Fry & Cohen, 2008). The slightest contact with natural setting increases happiness, leads to positive social interactions, sources a purposeful life and supplements subjective wellbeing (Bratman, 2015). Scientific studies have been carried out to study the role of nature in mental healing. In Japan, *shinrin-yoku*or a forest bath is believed to cure stress (Sifferlin, 2016). Spending time in nature not only benefits the human body but is beneficial in healing an individual mentally. Beside their journey of mental healing, an individual walks the path of spiritual awakening.

A spiritual being is drawn towards the simplicity of nature. While spirituality holds a different meaning to each living soul, its aim is to help one find the purpose and meaning of life. Spirituality teaches to develop a relation with self by finding peace and purpose. While a person dealing with mental health issues finds it burdensome to value life and pessimism surrounds their mind, spirituality helps seek a higher purpose. The natural environment nurtures like a mother, providing inner strength for recovery. By elevating our relation with natural environment, humans can annihilate negative thoughts and boost consciousness (Bennet & Bennet, 2007) (Fisher, et. al., 2000). The symbiosis of nature, spirituality and mental health is such that it gave rise to religions associated with nature. *Paganism, wicca, pantheism, animism* are a few among the many religions that revolve around nature worship. Some of these communities prefer not to associate themselves with religion but followers of innate indigenous practices (Sponsel, 2014). Spirituality helps endure feelings of anger, guilt alongside improvising coping mechanism. Humans and their relationship with the environment is built in the human psyche since their existence. Therefore, it becomes essential to develop models to statistically and scientifically study the influence of spirituality (Forray & Stork, 2002) (Hodge, 2001).

Gangotri, suiting to its seasonal variation, tranquility, location and topography is well suited to understand the impact of physical environment on the mental well-being of an individual. This study aims to understand if the physical surroundings have an impact on

the mental health of humans. It focuses on the association of human geography with physical geography in the understanding of human behavior and psyche. The research uses a human centric approach that focuses on each individual as a unique entity. In order to analyze this association, physical, economical, mental, emotional and spiritual aspects are covered in this study.

Study Area

Gangotri is a nagar panchayat in the district of Uttarkashi, Uttarakhand. Gangotri has a significant influence on the Hindu population due to the presence of the Gangotri shrine. The locational co-ordinate of Gangotri are 30.9947° N and 78.9398° E, at a height of 3,415 m approximately. Characterized by a steep and rocky terrain, the mountains surrounding Gangotri are covered with snow throughout the year. During the 6 months visit period from *akshayatritiya* to *Diwali* the months of May and June are the best time to visit Gangotri. The temperature in the region varies from -2 ℃ to 15 ℃ annually. The months from April to June are the destination's peak visit months due to the pleasant summers. July is the month of monsoon commencement, extending until September, followed by autumns in October. While November to March are the months of snowfall and extreme temperatures, it is significant that December and January provide scenic opportunity for exploration activities in Gangotri. The Gangotri National Park, trek to Gaumukh, photography, rock climbing, rappelling and rafting are some of the activities Gangotri offers. The *Bhagrirathi* range, *Shivaling* range and *Satopanth* range of Gangotri leave the devotees allured by their vigor and might.The temple of Gangotri was constructed by *Gorkha General* Amar Singh Thapa after the natural, self-made idol of *Goddess Ganga* appeared. Ever since, the *Semwals* of *Mukhba* village have been sole caretakers of the temple. They are one of the highest castes among the *Garhwal Brahmins*. The town itself is enriched with numerous ashrams and temples including that of *Bhairav, Pandav Gufa, Lord Bhagirath* and *Vishwanath*. The springs of Gangotri namely, *Gauri Kund* and *Surya Kund* have medical, mythical and spiritual significance. As per Hindu mythology, the Goddess Ganga took the form of a river in order to absolve sins of King Bhagiratha's predecessors. With the aim to minimize the impact of her fall, *Lord Shiva* received her in his locks. Hence descended the ferocious *Bhagirathi.* According to the Census of India 2011, the population of Gangotri Panchayat is 110 with 47 households. The literacy rate of the *nagar panchayat* is 99.09%. Under the Char Dham Project, the *nagar panchayat* of Gangotri is connected to the outside world. Even so, for amenities like school, medical and groceries the residents have to travel a minimum of 30 km to nearby regions of Harshil and Gnagnani. Business activities are the prominent source of income among the population (Census of India, 2011).
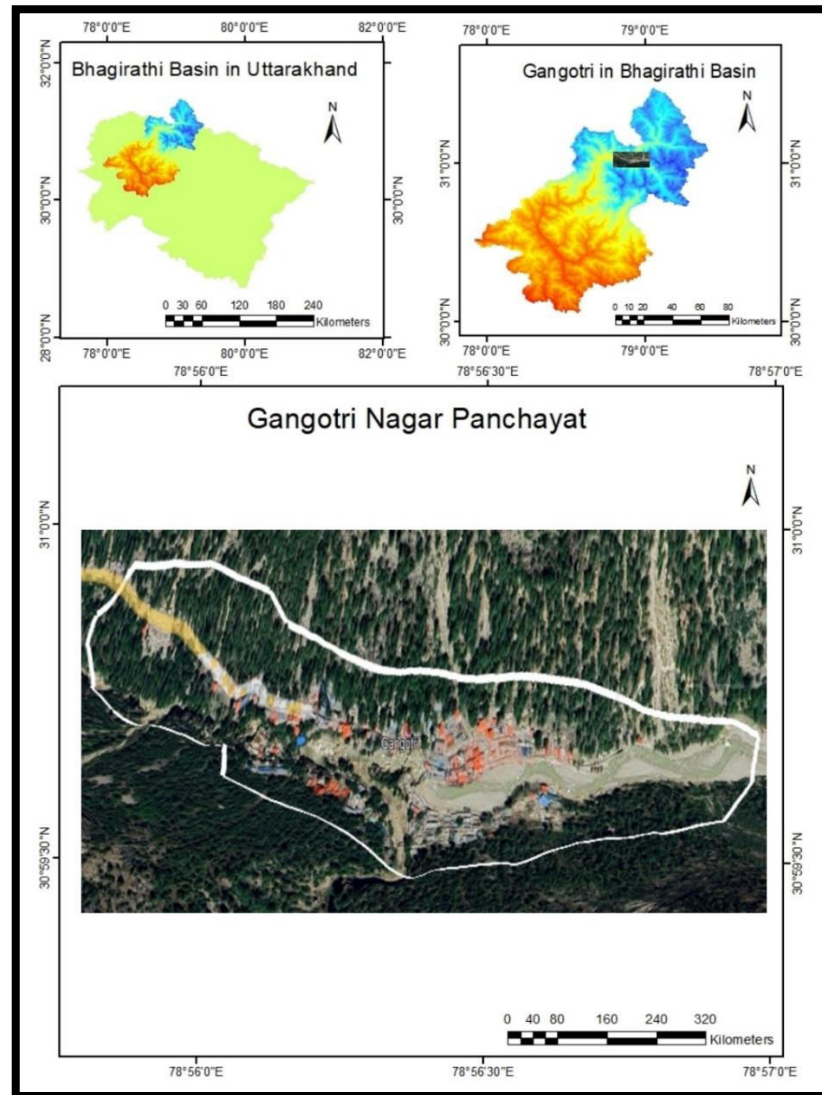
Fig 1.1 – Locational Aspect, Gangotri Municipality, Uttarakhand

Data Base and Methodology

The study is based on an integrated qualitative and quantitative design, using a cross-sectional approach. The data collection for the study was conducted via schedule method and applying random sampling technique. A sample size of 47 households were surveyed based on factors affecting mental health, indicators including work interest, hobbies, spirituality, appetite, role of technology, sleep regularity, emotional well-being, likeness towards season and eagerness to learn. The schedule was prepared on a *likert scale* with a scoring level of 1 to 5, representing lowest to the highest level of satisfaction respectively. In order to create the schedule, the Diagnostic and Statistical Manual of Mental Disorder (DSM) by American Psychiatric Association (APA, 2022) was referred. Data analysis for the same has been carried in the SPSS (Statistical Package for the Social Sciences) and MS (Micro Soft) Excel software. To establish the level of

significance among indicators of mental wellbeing Mann-Whitney U Test statistical technique is put to application. Using the Inverse Distance Weighted (IDW) interpolation technique on the Arc GIS software 10.4.1. The maps representing individual mental well-being is plotted. R-Studio software has been used to plot charts and establish results for Principal Component Analysis and Random Forest Analysis.(Schober & Vetter, 2020) (Macunluoğlu & Ocakoğlu, 2023)

Findings

The scores for the mental well-being of habitants in the summer season fall in the range of severely to extremely well. The highest score for mental well-being in the summer season is 4.32 while the lowest score is 3.83. For the residents, 45 out of 47 families rate summer as the most likable season. Summers have a pleasant climatic condition which make it the most habitable season. Economically, the summer season is beneficial as the temple doors open resulting in high tourist influx. As a consequence of economical, spiritual and religious factors, summers tends to be the season of utter calmness for humans. Despite the rush of the tourist season, summers tend to be effective for improvising the mental health of residents. They feel motivated to learn new activities, perform activities and carry out physical labor. Residents advocate for better sleep cycle, reduced stress levels and peacefulness. In the monsoon season, the level of mental well-being ranges between mild and moderate. The lowest score for the mental well-being is 2.02 and the highest score is 2.76. The mental well-being experiences a lower level in the monsoons due to the rains that disrupt human life. Rainy season in the mountains can be hazardous. In Gangotri, landslides are a common phenomenon that led to road blocks, poses threat to life and disrupt the access to amenities. Therefore, despite living in Gangotri, they constantly worry about the hazardous rainfall might bring. At the same time, the tourist flow is comparatively lower to summers which increases economic difficulties for the dwellers. The sleep cycle is often disrupted and the stress levels rise. Similarly, the physical activities reduce due to seasonal complications as well as the connectivity disruptions.The mental well-being ranges between slight to moderate in the winter seasons. While most residents experience a slight and mild level of mental well-being, some experience a moderate mental well-being level. The reason for these lower levels of mental-wellbeing is migration from Gangotri, lack of economic stability and extreme climatic conditions. Residents move to regions of Uttarkashi, Harshil and Pauri that have an extreme winter climate. At the same time, leaving Gangotri results in closing of business leading to no fixed source of income. Under such circumstances, when the residents have to move away from Goddess Ganga as well, the stress levels increase. Respondents reported increased anxiety and lack of interest in activities. Being distanced from the surreal environment of Gangotri impacts the mental well-being of its habitants; resulting in a lower well-being score.
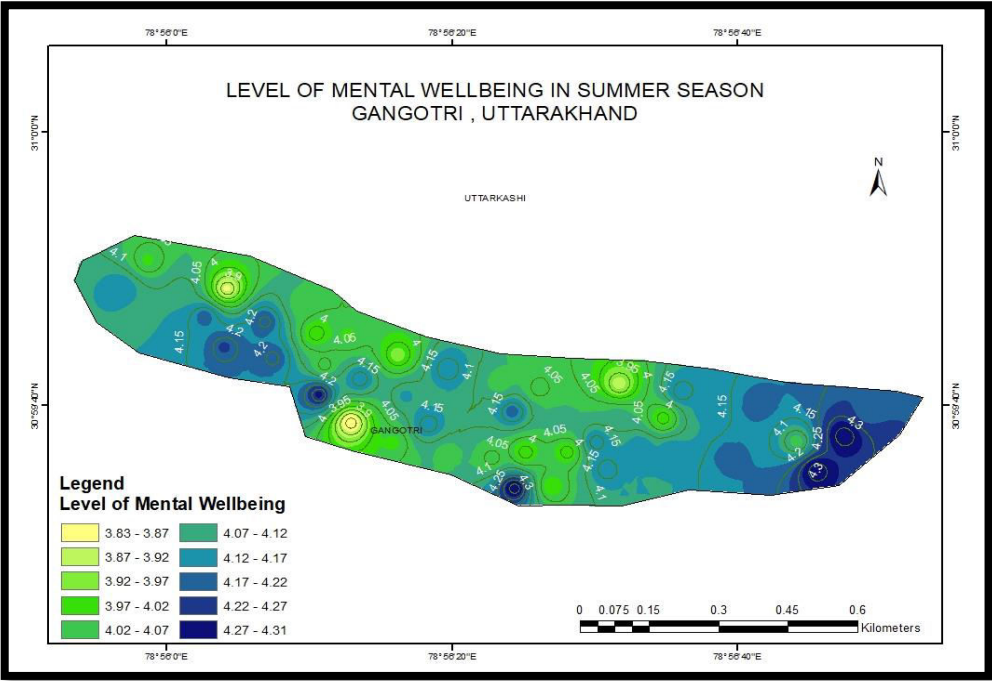
Fig 1.2 – Level of Mental Well-Being in Summer Season, Gangotri Municipality
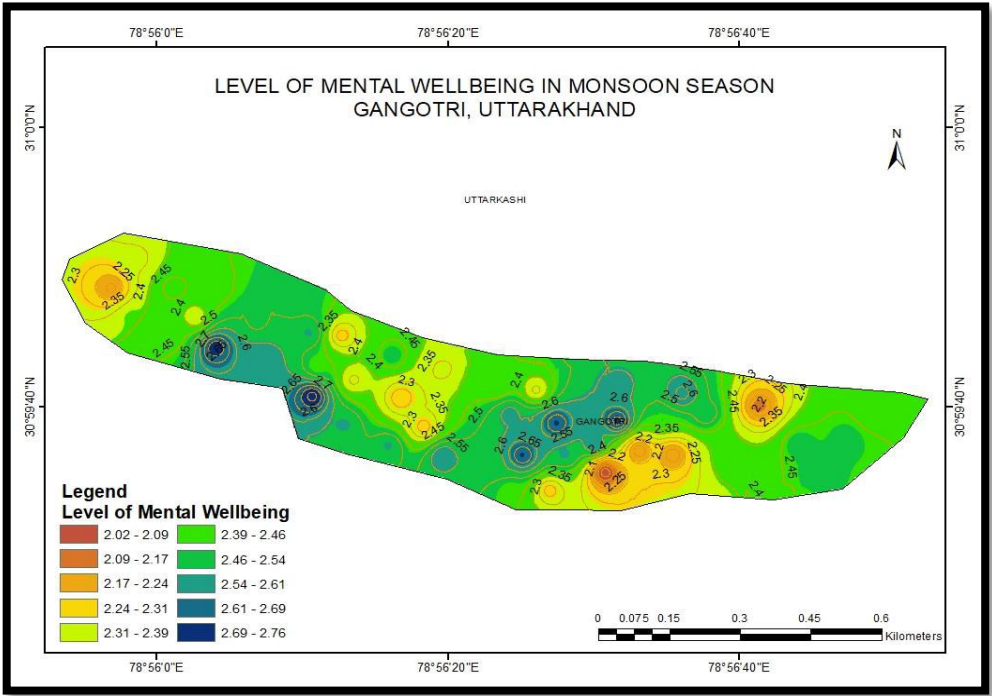
Fig 1.3 – Level of Mental Well-Being in Monsoon Season, Gangotri Municipality
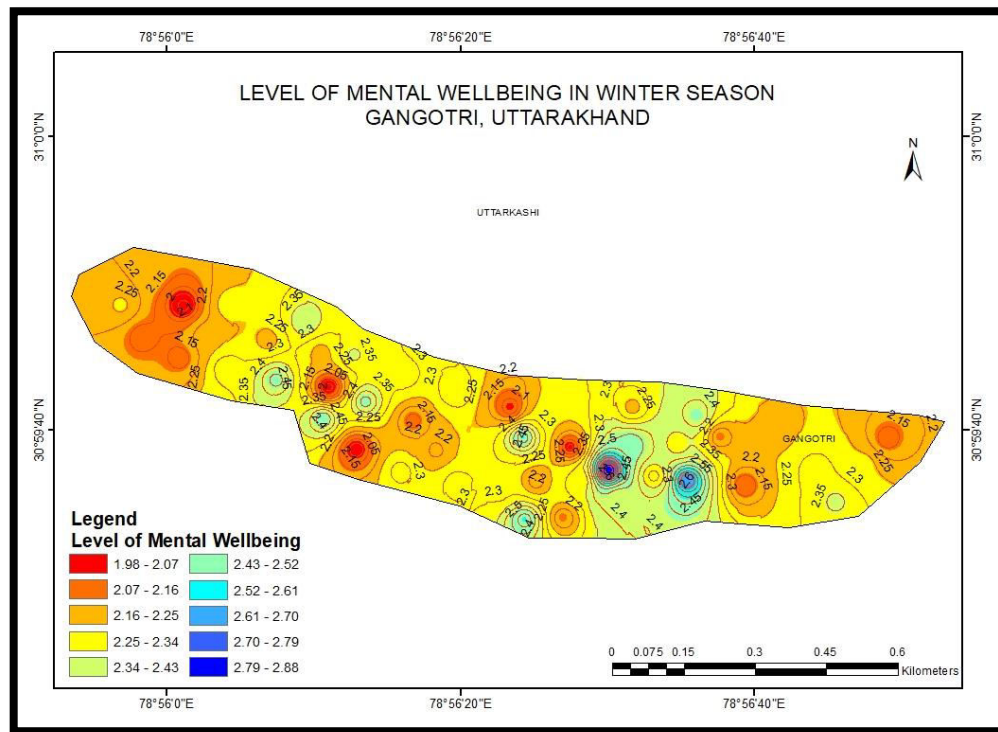
Fig 1.4 – Level of Mental Well-Being in Winter Season, Gangotri Municipality

The analysis of mental well-being in the habitants of Gangotri was based on certain indicators. Habitants were questioned about the indicators with respect to each season including summers, winters and monsoons. The indicators were based on emotional well-being, physical capabilities, mindfulness, sleep cycle, appetite and development in the region. The scores were obtained using Weighted Index Method post which the level of mental well-being in individuals was identified. Each indicator was tested in order to identify the relation between them and their impact on mental health. Using the Mann-Whitney Test on SPSS, the hypothesis was analyzed and varied results were obtained for each season.

Summer Season: The level of significance for each indicator was at 0.05. Out of 13 questions, only 1 depicted significance. When questioned about the interest in work, the level of significance was 0.953 thus the null hypothesis was accepted. Similarly, for interest in hobbies, the level of significance was 0.259 and for the level of concentration towards work, the significance level was 0.741. Thus, it is evident that the interest to learn or perform physical activities in summer season have no role to play with respect to mental well-being. Among the emotional indicators, the level of mental stress is not influenced by the summer season as it had a significance level of 0.488. The emotional and spiritual well-being of residents also had no significance with the arrival of summers with a significance level of 0.488 and 0.969 respectively. The sleep cycle and appetite also remain unaffected by the summer season and stand at a significance of 0.693 and

0.257. The only significant indicator with respect to influencing moods, behavior and mental well-being among the residents was the level of likeness towards the summer season. The level of significance for the likeness towards summer season in regulating moods and behavior was 0.023. Thus, rejected the null hypothesis.
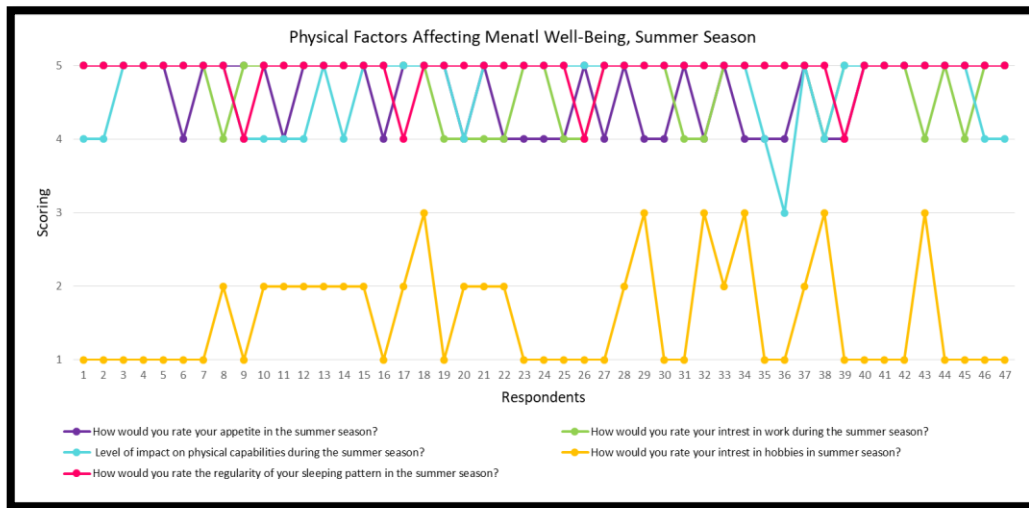
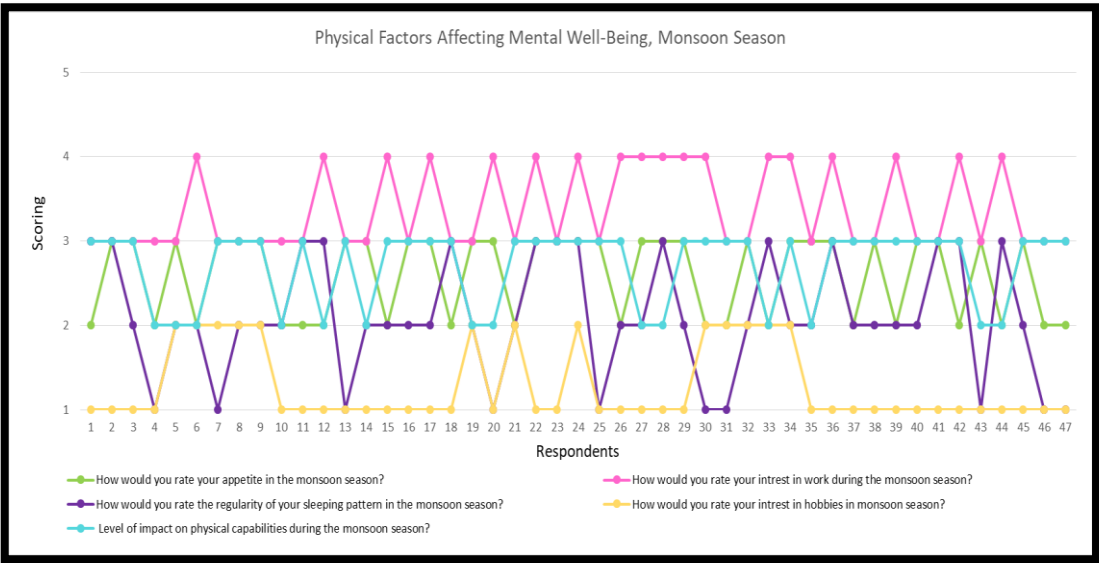**Fig 1.5 - Physical Factors Affecting Mental Well-Being in Summer Season, Gangotri Municipality**
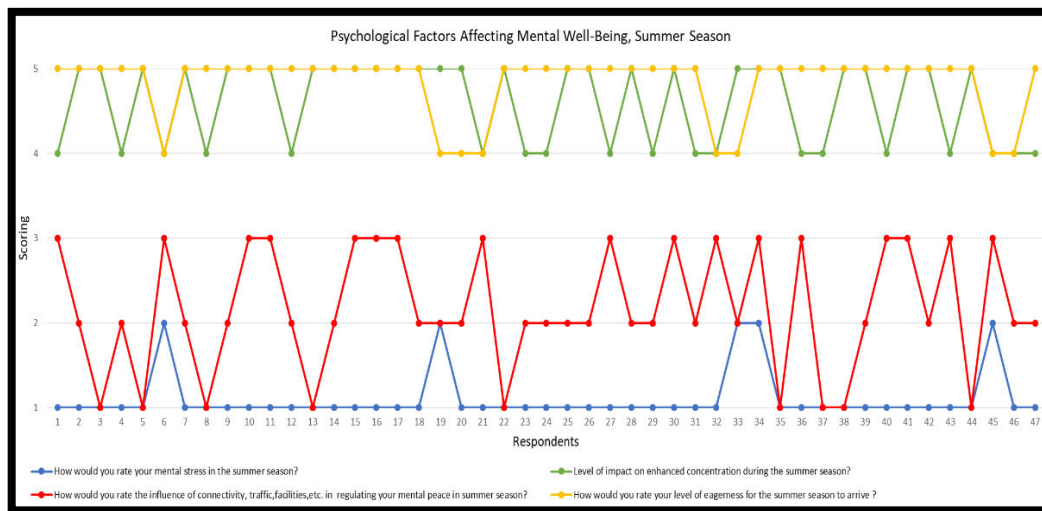
Fig 1.6 - Psychological Factors Affecting Mental Well-Being in Summer Season, Gangotri Municipality
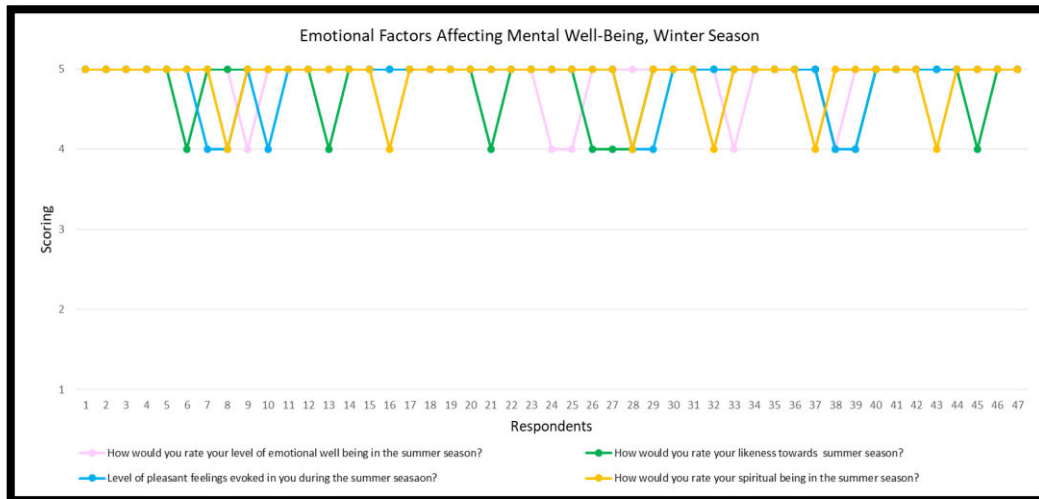
Fig 1.7 - Emotional Factors Affecting Mental Well-Being in SummerSeason, Gangotri Municipality
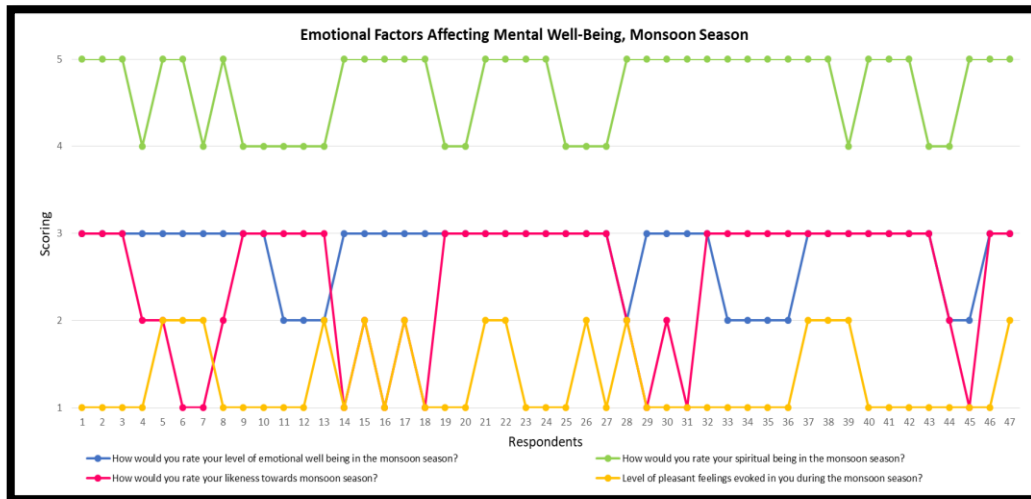
Monsoon Season: The indicators of mental health were tested with respect to the monsoon season on a significance level of 0.05. The indicators associated with physical activities including capability to work, interest in hobbies and interest in work do not hold any significant relation with monsoon as they have a significance level of 0.936, 0.610 and 0.100 respectively. As for the emotional well-being, the stress levels are not affected by the arrival of monsoon and hold a significance level of 0.979. Spirituality and emotional capability levels in the residents have no role to play with monsoons and hold a significance level of 0.559 and 0.235 respectively. Responses associated with likeness towards monsoons were analyzed by questioning about eagerness for the season to arrive and the likeness of residents towards monsoon. For both the indicators, the level of significance was higher than 0.05 (0.261 and 0.284 respectively) which led to the acceptance of null hypothesis. The sleep cycle and appetite account for no significance with monsoon as the have a significance level of 0.300 and 0.362. The only factor that affects the mental well-being of residents is the influence of transportation, connectivity and development in the rainy season as it has a significance of 0.018. It rejects the null hypothesis, and thus accepting that external factors including growth of technological development affects the mental health of people living in Gangotri in the monsoon season.

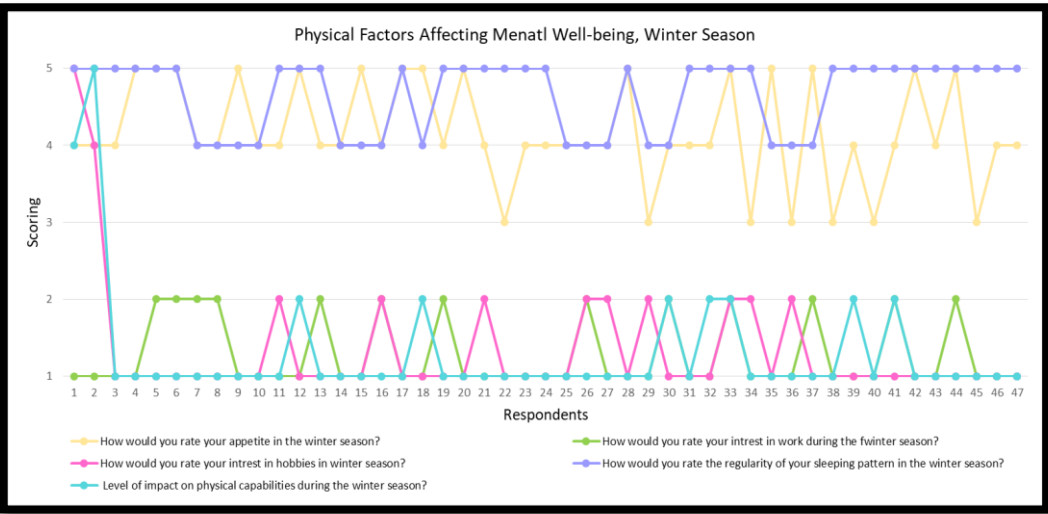**Fig 1.8 - Physical Factors Affecting Mental Well-Being in Monsoon Season, Gangotri Municipality**

Fig 1.9 - Psychological Factors Affecting Mental Well-Being in Monsoon Season, Gangotri Municipality
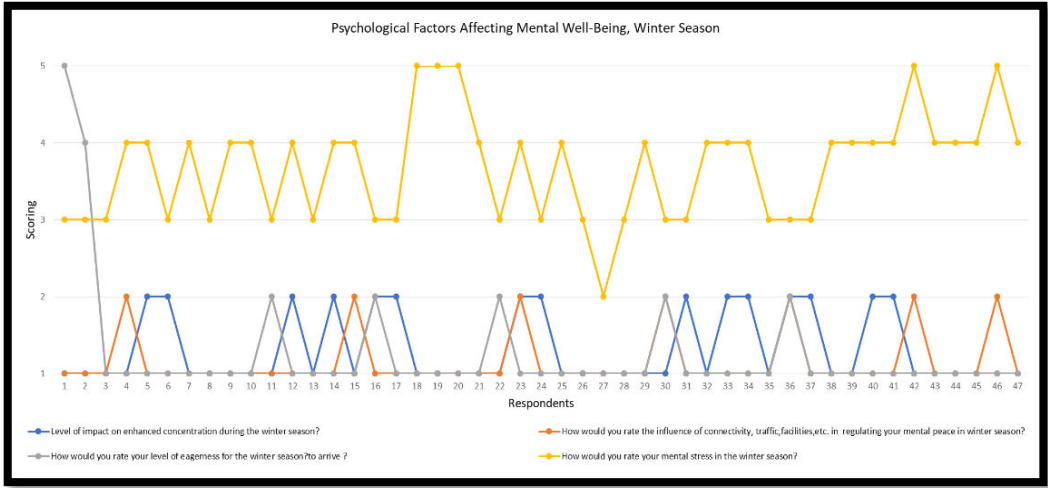
Fig 1.10 - Emotional Factors Affecting Mental Well-Being in Monsoon Season, Gangotri Municipality

Winter Season: On a level of 0.05, the level of significance between winter season and mental health indicators was analyzed. Among the 13 factors, 2 factors develop significance with the arrival of winters. The physical aspect that involves capability to work, interest in work and interest in hobbies has no significant relationship with the winter season and its impact on mental health. Each indicator has a significance of 0.883, 0.332 and 0.533 respectively. Similarly, the concentration power holds significance level of 0.945 with the extreme winters proving that it has no role to play in the human psyche. The sleep cycle of habitants, as they migrate to different regions also develops no significance with winters and stands at a significance of 0.352. Emotional well-being and spirituality both have a significance of 0.722 and 0.137 resulting in establishment of no relation with respect to winter season. Significantly the stress level have no relation with the extreme winters and the adversities it brings. It retains a significance of 0.729 with respect to moods and behavior. The factors that significantly affect the mental health, moods and behavior of the residents in the winter season includes, eagerness for the arrival of winter season and the pleasant feelings that evoke in individuals by the arrival of winters. The level of significance for both these factors is 0.42. Thus, establishing the relation that the winter season evokes pleasant feelings among the habitants of Gangotri and they eagerly wait for the season to arrive. Together, these factors positively impact the mental health.
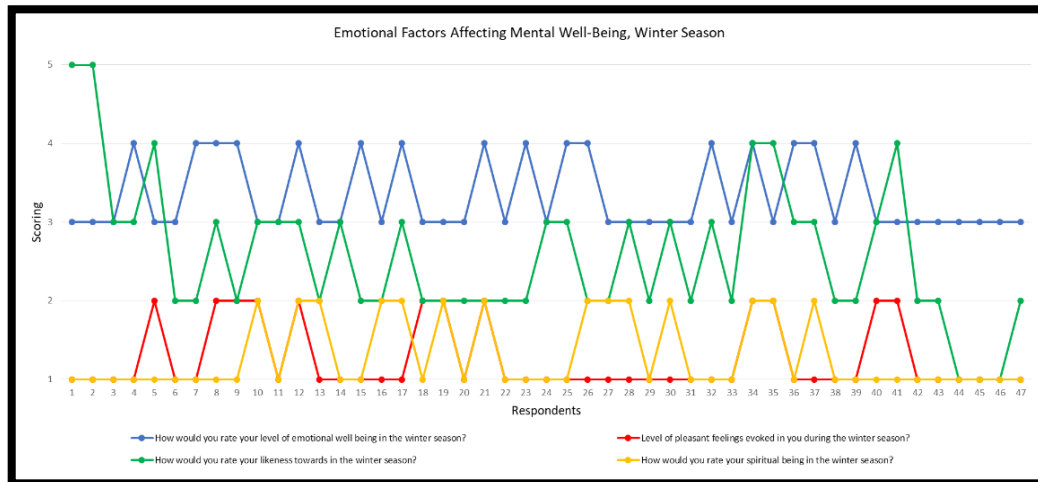
Fig 1.11 - Physical Factors Affecting Mental Well-Being in Winter Season, Gangotri Municipality

Fig 1.12 - Psychological Factors Affecting Mental Well-Being in Winter Season, Gangotri Municipality

Fig 1.13 – Emotional Factors Affecting Mental Well-Being in Winter Season, Gangotri Municipality

Discussion

1- Principal Component Analysis

This image shows a Principal Component Analysis (PCA) biplot, where the axes represent the first two principal components (Dim 1 and Dim 2), capturing 15.26% and 14.79% of the variance, respectively.

- Axes (Dimensions) - Dim 1 (15.26%) and Dim 2 (14.79%) - These dimensions are linear combinations of the original variables, and they explain part of the data's variance. The larger the variance explained, the more meaningful the dimensions are. Together, these two dimensions explain approximately 30.05% of the variance in the data.

- Variables (Arrows) - The arrows represent the original variables projected onto the PCA space. The direction and length of each arrow indicate, Correlation with principal components. Longer arrows imply stronger relationships with the dimensions. Relationships among variable can be studied as, variables with similar directions are positively correlated, while those pointing in opposite directions are negatively correlated. Variables like "spiritual" (representing spiritual health), "development" (representing role of structural development and advancement on mental well-being), and "concentration" (representing concentration capability) are closely grouped and strongly associated with Dim 1. Whereas, factors including "Work" (representing work interest), "pleasant" (representing feeling pleasant in a particular season), and "likeness" (representing likeness towards a season) appear to have a shared influence on Dim 2.

- Clusters and Patterns - Variables that cluster together (e.g., "stress" (representing mental stress), "arrival" (representing eagerness for a season to arrive), "emotional" (representing emotional well-being)) indicate similar patterns across the dataset. Opposing relationships are evident among factors including "stress" " (representing

mental stress), and "hobbies" (representing interest in hobbies) are nearly opposite to "sleep" (representing sleep cycle) and "physical work" (representing capability to perform physical tasks), suggesting a trade-off or contrasting behavior.
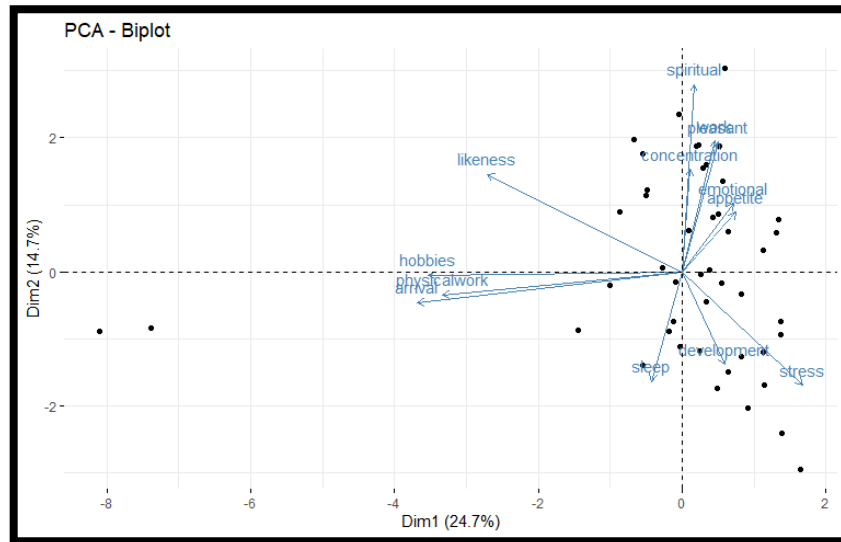
- Key Observations - Stress seems negatively correlated with sleep and physical work. Spiritual and Concentration variables align closely, suggesting they might represent a similar underlying factor or influence in the data.
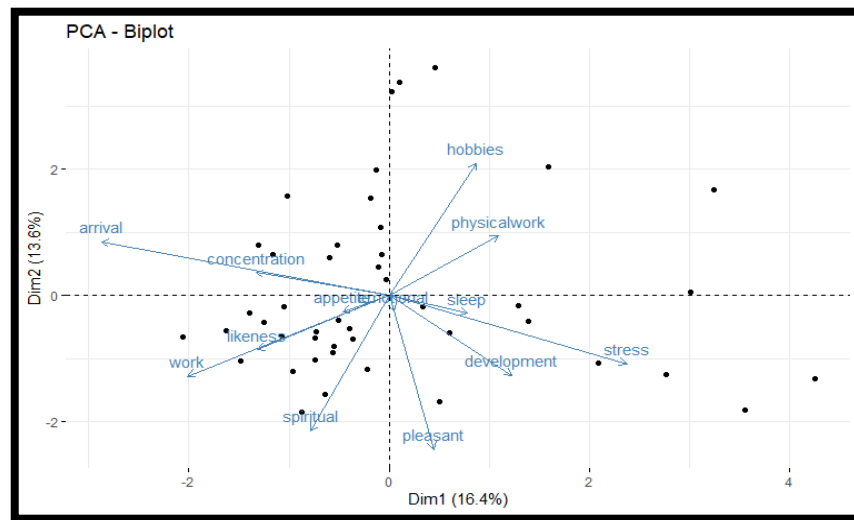
Fig 1.14 - Principal Component Analysis (PCA) biplot Summer Season
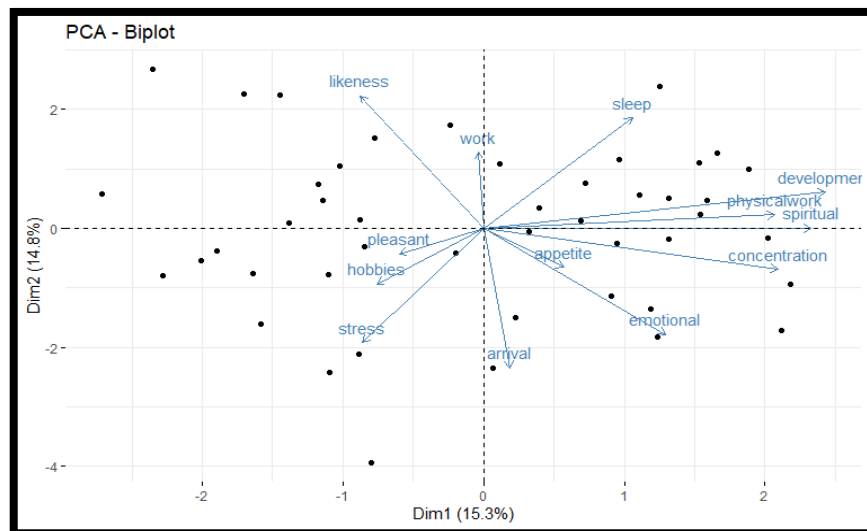
Fig 1.15 - Principal Component Analysis (PCA) biplot Monsoon Season

Fig 1.15 - Principal Component Analysis (PCA) biplot Winter Season

2- Random Forest Model

This plot summarizes the Random Forest Model using Inc Node Purity as a measure of feature importance. Inc Node Purity measures the increase in node purity contributed by each variable during the model's decision-making process. Higher values indicate greater importance of the variable in predicting the target. The most important variable with the highest Inc Node Purity, suggesting that emotional wellbeing (represented with emotional) strongly influence the target variable. Mental stress (represented by stress) is also a significant contributor, indicating stress levels are critical in the model's decision-making. A notable factor, though less significant than emotional and stress is eagerness for a season to arrive (represented by arrival).

"Sleep" (representing sleep cycle) and "likeness" (representing likeness towards a season) are features that are moderately impactful in predicting the target. While, "work" (representing capacity to work) and "appetite" (representing one's appetite) fall in the middle range of importance."Hobbies" (representing interest in hobbies) and "pleasant" (representing feeling pleasant in a particular season) have the lowest Inc Node Purity, indicating minimal impact on the target variable. "Concentration" (representing the level of concentration while performing a task) and "development" (representing role of structural development and advancement on mental well-being) contribute relatively less to the model.Emotional factors depict domination in the model. The model relies heavily on emotional and stress-related factors. Lifestyle Variables like "sleep" (representing sleep cycle) and "likeness" (representing likeness towards a season) are moderately important, showing they influence outcomes but not as strongly as emotional or stress factors. Secondary variable that includes features such as hobbies and pleasantness have minimal roles and may be less relevant for the target.
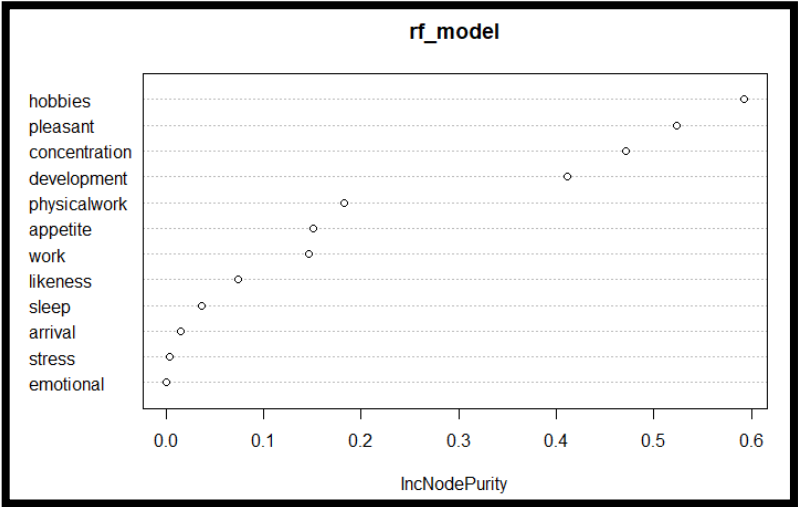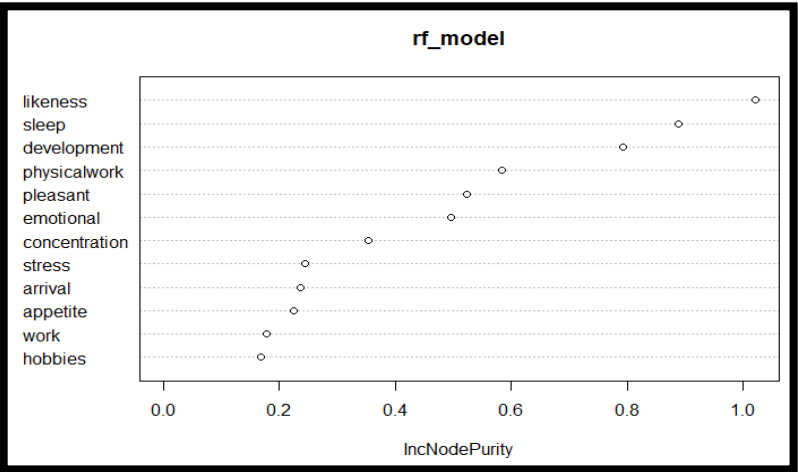
Fig 1.16 – Random Forest Model, Summer Season

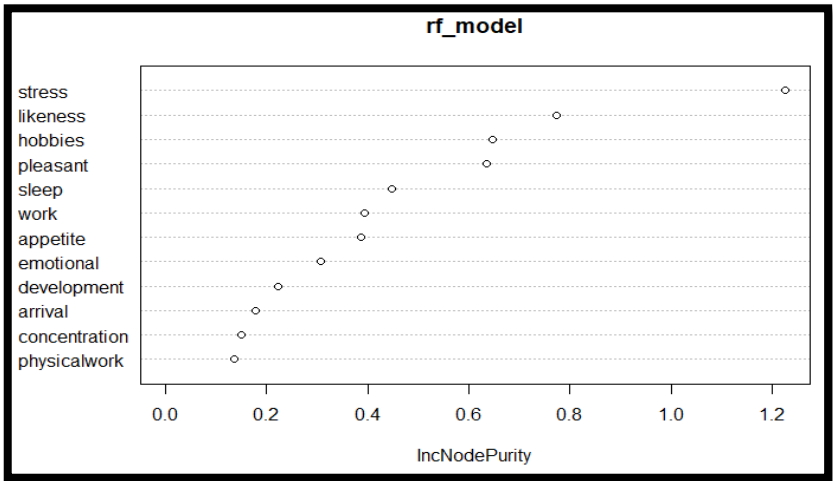**Fig 1.16 – Random Forest Model, Monsoon Season**

**Fig 1.16 – Random Forest Model, Winter Season**

1- **Scree Plot Analysis**
- First Principal Component (PC1): Explains 24.7% of the total variance, the highest among all components indicating, this component captures the most significant variation in the dataset.
- Second Principal Component (PC2): Accounts for 14.7% of the variance, contributing significantly but less than PC1.
- Remaining Components:
  PC3 and PC4 explain 10.8% and 10%, respectively. Beyond PC4, the explained variance drops below 10% for each subsequent component.
- Cumulative Explained Variance: The first few components (PC1 to PC4) cumulatively explain around 60% of the variance. After PC4, additional components contribute less and may be less significant in capturing meaningful variance.
- Elbow Point: The "elbow" occurs around PC4, where the explained variance starts leveling off. This indicates that most of the important information is captured by the first 4 components, and including more components may add diminishing value.
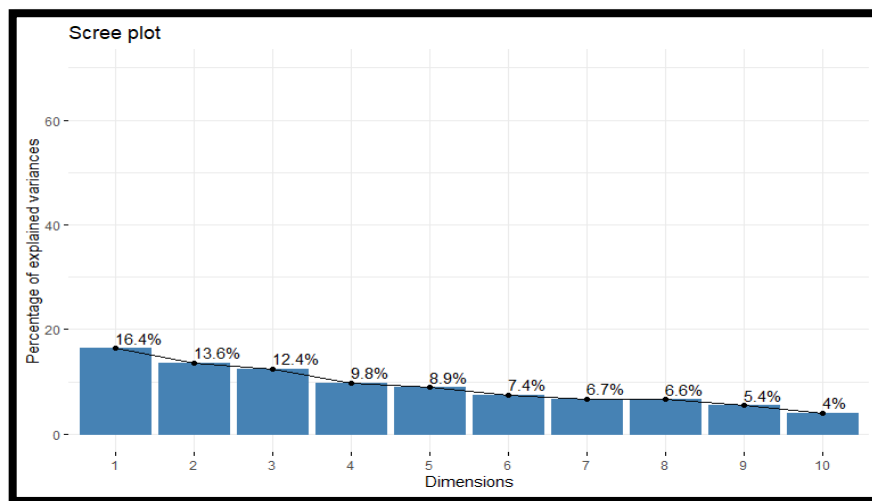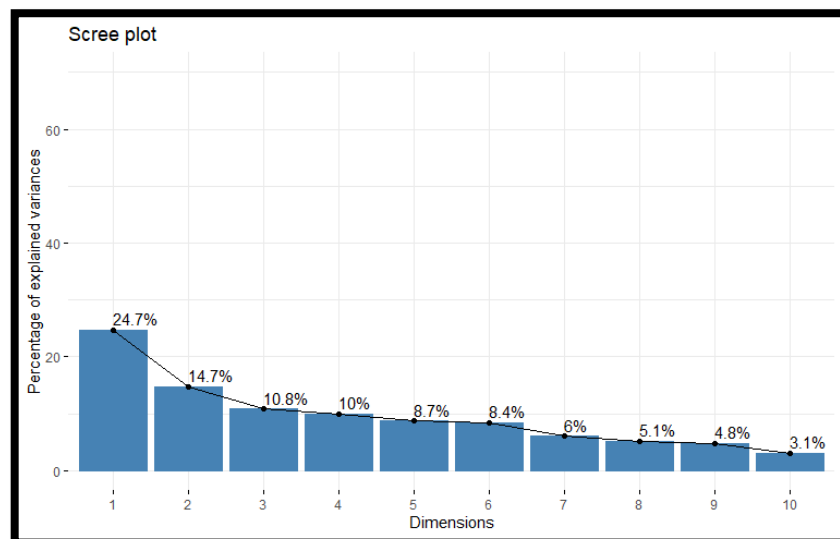

Fig 1.17 - Scree Plot, Summer Season
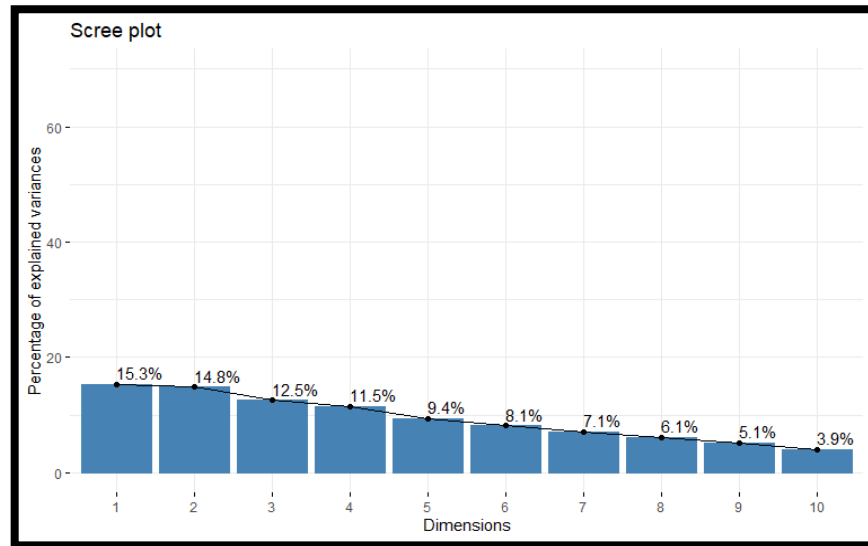
Fig 1.18 - Scree Plot, Monsoon Season

Fig 1.19 - Scree Plot, Winter Season

Conclusion

The Principal Component Analysis indicates that emotional well-being and stress are central to mental health. They are strongly associated with the first two principal components (Dim 1 and Dim 2), it accounts for 30% of the data's variance. Variables like "stress," "emotional," and "spiritual" health have strong correlations, confirming that mental well-being is closely linked to both emotional and stress-related factors. The Random Forest model depicts that emotional well-being and stress are the most important predictors for mental health outcomes, with emotional factors dominating the model. Lifestyle variables such as sleep and work-related aspects are moderate contributors, while interests like hobbies and seasonal preferences have minimal influence. Finally, the Scree Plot supports the notion that the first few components,

especially the first four, capture the majority of the variance, highlighting that emotional and stress factors dominate mental well-being across seasons. This suggests that emotional regulation and stress management are crucial components for enhancing mental health in the region of Gangotri.

Acknowledgement

We would like to thank our home institution Banasthali Vidyapith for providing me with the opportunity and platform to carry out this research.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Statement

This is research has been conducted in a truthful and complete manner. The work is authors' own original work, which has not been previously published elsewhere.

Consent

Participants in this study were informed about the process related to the objective, procedure, benefits, and risks of the study.

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LEGEND	
Appetite	How would you rate your appetite in the following seasons?
Hobbies	How would you rate your intrest in hobbies in following seasons?
Pleasant	Which among the following seasons evokes the highest level of pleasant feelings in you?
Concentration	Which among the following seasons enhance your concentration power?
Development	How would you rate the influence of connectivity, traffic,facilities,etc. in regulating your mental peace in following seasons?
Physical Work	Which among the following seasons increases your capability of physical activities?
Work	How would you rate your intrest in work during the following seasons
Likeness	How would you rate your likeness towards in the following seasons?
Sleep	How would you rate the regularity of your sleeping pattern in the following seasons?
Arrival	How would you rate your level of eagerness for the following seasons to arrive ?
Stress	How would you rate your mental stress in the following seasons?
Emotional	How would you rate your level of emotional well being in the following seasons?