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Natural-Resource-Based Approaches to Employee Well-Being under Flexible Work Arrangements: Evidence from IT Companies

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ABSTRACT: Flexible work arrangements have transformed the nature of work in IT organizations, creating opportunities for greater autonomy while simultaneously increasing digital overload, blurred work–life boundaries, and difficulties in psychological recovery. This study examines how natural-resource-based approaches can support employee well-being under flexible work arrangements, with particular emphasis on natural-resource exposure and employee recovery. A hybrid mixed-method approach is proposed, integrating a three-wave longitudinal quantitative design, qualitative interviews, and machine-learning techniques. Illustratively, data from 450 IT professionals are analysed using descriptive statistics, correlation analysis, time-lagged regression, mediation and moderation analysis, while qualitative interviews provide contextual insights into employees' experiences of flexible work and nature-based recovery. Clustering and classification algorithms are additionally employed to identify heterogeneous employee well-being profiles and generate data-driven recommendations. The illustrative findings indicate that flexible work arrangements are positively associated with employee well-being, while natural-resource exposure demonstrates significant positive relationships with employee recovery and well-being. Recovery partially mediates the relationship between natural-resource exposure and well-being, while natural-resource exposure strengthens the positive association between flexible work and well-being. Machine-learning analysis further identifies distinct employee profiles, highlighting differences in environmental resources, recovery, stress, and well-being. The study extends the Job Demands–Resources perspective by conceptualising natural-resource exposure as an environmental resource that can complement flexible work and facilitate employee recovery. The findings offer implications for developing healthier, sustainable, and differentiated flexible-work policies in IT organizations.

1. INTRODUCTION

The transformation of work arrangements in the contemporary digital economy has fundamentally altered how, where, and when employees perform their jobs. Flexible work arrangements, including remote work, teleworking, hybrid work, and flexible scheduling, have become increasingly embedded in organizational practices, particularly in information technology (IT) companies where work is highly digitalized and less dependent on physical workplace presence. Although flexible work can provide employees with greater autonomy, reduced commuting demands, and enhanced opportunities to manage work and non-work responsibilities, its consequences for employee health and well-being are not uniformly positive. Research suggests that remote and flexible working can simultaneously create resources and demands, with outcomes depending on workload, autonomy, social interaction, work-home boundaries, and the availability of recovery opportunities (Allen et al., 2015; Charalampous et al., 2019; Grant et al., 2013; Oakman et al., 2020).

The growing relevance of employee well-being is particularly important in IT organizations. IT professionals frequently operate in environments characterized by continuous connectivity, intensive screen-based work, rapid technological change, project deadlines, high cognitive demands, and expectations of immediate responsiveness. Flexible work may provide greater control over work schedules, but the dissolution of traditional spatial and temporal boundaries can also increase work intensification and make psychological detachment more difficult. The benefits of flexibility therefore cannot be evaluated solely through productivity or work-life balance indicators; they need to be examined through a broader human-health perspective encompassing psychological well-being, stress, fatigue, recovery, and perceived health.

The Job Demands–Resources (JD-R) theory provides an important basis for understanding this duality. The theory proposes that employee well-being is shaped by the interaction between job demands, which require sustained physical or psychological effort, and job resources, which facilitate goal attainment, reduce demands, and stimulate motivation (Bakker & Demerouti, 2007). Flexible work can constitute a job resource by increasing autonomy and enabling employees to regulate their working time and environment. At the same time, it can generate additional demands through work intensification, blurred work-home boundaries, isolation, and persistent digital connectivity. Consequently, flexible work arrangements should not be considered inherently beneficial or harmful; rather, their effects depend on the resources available to employees to cope with associated demands.

One potentially underexplored resource is access to natural environments and nature-based elements. A substantial body of interdisciplinary research has demonstrated associations between exposure to nature and psychological and physical health outcomes. The restorative benefits of nature have been explained through Attention Restoration Theory, which proposes that natural environments can facilitate recovery from directed-attention fatigue (Kaplan, 1995). Similarly, evidence from environmental psychology indicates that exposure to natural environments can reduce stress and support psychological restoration. Ulrich's (1984) seminal study demonstrated that visual exposure to natural environments could be associated with improved recovery outcomes, while subsequent research has established broader relationships between green environments and health (Hartig et al., 2014; Van den Berg et al., 2007).

Nature-based resources may be particularly relevant within flexible work arrangements because the location and physical environment of work become less standardized. Employees working remotely may perform their tasks from home offices, balconies, gardens, shared spaces, or other environments that vary considerably in their access to natural elements. Similarly, hybrid workers move between organizational workplaces and home environments. This creates an opportunity to investigate whether access to nature and nature-based workplace features can function as a health-promoting resource that complements the autonomy offered by flexible work.

The workplace itself may also incorporate natural-resource-based features. Biophilic design emphasizes the integration of natural elements, materials, vegetation, natural light, views of nature, and other connections to the natural environment into built environments (Kellert et al., 2008). Research has indicated that workplace exposure to natural elements may have implications for employee well-being. For example, Korpela et al. (2017) examined relationships between window views, indoor plants, outdoor activities, and employee well-being, highlighting the potential relevance of everyday contact with nature in occupational settings. Similarly, research on green versus conventional office environments suggests that workplace design can influence employee perceptions and experiences (Nieuwenhuis et al., 2014).

The potential importance of nature-based resources becomes even more apparent when considered alongside employee recovery. Recovery refers to processes through which individuals restore psychological and physiological resources depleted during work. Sonnentag and Fritz (2007) identified psychological detachment, relaxation, mastery, and control as important recovery experiences, while the stressor-detachment model subsequently conceptualized recovery as an important mechanism connecting occupational stressors with well-being (Sonnentag & Fritz, 2015). Nature exposure may provide an environmental context that supports relaxation, attentional restoration, and psychological detachment. Thus, natural-resource-based approaches may complement flexible work by providing employees with opportunities to recover from the cognitive and emotional demands associated with digitally intensive work.

The relationship is especially relevant in the IT sector because employees often experience work environments in which physical and digital boundaries are increasingly fluid. Flexible working can reduce commuting and provide greater control, but extensive home-based digital work may also increase sedentary behaviour, screen exposure, social isolation, and the difficulty of

psychologically disengaging from work. Oakman et al. (2020), in their review of working from home, emphasized that both physical and mental health consequences need to be considered when evaluating home-based work. Similarly, Charalampous et al. (2019) demonstrated that the well-being of remote workers is multidimensional and influenced by organizational, social, technological, and individual factors.

Existing research nevertheless leaves an important conceptual and empirical gap. First, much of the flexible-work literature has focused on work-life balance, productivity, job satisfaction, commitment, and psychological outcomes, while comparatively less attention has been given to the role of natural resources as health-promoting resources within flexible work systems. Second, studies examining nature and well-being have often been situated within environmental psychology, public health, urban planning, or workplace design rather than integrated with flexible-work research. Third, many studies rely on cross-sectional self-reported data, limiting the ability to understand how flexible work conditions, nature exposure, recovery, and well-being evolve over time. Allen et al. (2015) highlighted the importance of carefully examining the conditions under which telecommuting produces positive or negative outcomes rather than treating telework as a uniform intervention.

A further limitation concerns heterogeneity among employees. The same flexible work arrangement may produce substantially different experiences across employee groups. Employees with high workloads, weak social support, limited home-office resources, or low access to natural environments may experience flexible work differently from employees with greater autonomy and restorative environmental resources. Consequently, average relationships may obscure meaningful subgroups. Machine-learning techniques, particularly clustering and classification algorithms, provide an opportunity to identify such patterns without imposing a priori assumptions about homogeneous employee populations. Integrating machine learning with conventional statistical analysis can therefore contribute to a more nuanced understanding of employee well-being and support data-driven recommendations for differentiated workplace interventions.

Against this background, the present study conceptualizes natural-resource-based approaches as potentially complementary resources within flexible work environments. Rather than assuming that flexible work automatically improves employee well-being, the study investigates how flexible work arrangements interact with access to and engagement with natural-resource-based workplace or recovery experiences. The study focuses specifically on IT professionals because of the sector's high dependence on digital technologies and its widespread adoption of remote and hybrid work practices.

The study adopts a mixed-method and longitudinal approach to examine this relationship. Quantitative data are used to assess patterns in flexible work, natural-resource exposure, stress, recovery, and employee well-being over time, while qualitative evidence is used to explore employees' lived experiences and the mechanisms through which natural environments may influence their well-being. Data triangulation is employed to strengthen interpretive rigor. In addition, clustering and classification algorithms are incorporated to identify distinct employee well-being profiles and generate evidence-based recommendations for organizations.

Accordingly, the study seeks to contribute to the emerging interdisciplinary literature by connecting flexible work practices, natural-resource-based approaches, and human health within the IT workplace. The study moves beyond a purely descriptive examination of employee perceptions and seeks to identify mechanisms and employee profiles that can inform healthier flexible-work systems. In doing so, it responds to the increasing need for workplace models that recognize employee well-being not merely as an organizational outcome but as a multidimensional human-health concern shaped by interactions among work demands, personal resources, recovery processes, and the physical environment.

2. LITERATURE REVIEW

2.1 Flexible Work Arrangements and Employee Well-Being

Flexible work arrangements have become an important feature of contemporary employment, particularly in knowledge-intensive and technology-oriented organizations. Flexible work encompasses several arrangements, including teleworking, remote working, hybrid working, flexible scheduling, and working from home. These arrangements alter the traditional relationship between employees, time, and the physical workplace and can provide employees with greater autonomy over when and where work is performed. Allen et al. (2015) argued that telecommuting can generate important benefits, including reduced commuting time and greater flexibility, but also emphasized that the outcomes of telecommuting depend on contextual and individual factors. Thus, flexibility should be understood as a work characteristic whose consequences depend on the balance between the resources and demands it creates.

The relationship between flexible work and employee well-being is particularly complex. Grant et al. (2013) found that remote working can influence psychological well-being, work effectiveness, and work-life balance through mechanisms involving autonomy, isolation, work-home boundaries, and organizational support. Similarly, Charalampous et al. (2019), through a systematic review of remote e-workers' well-being, demonstrated that remote working has multidimensional consequences extending beyond conventional measures of job satisfaction. Social connectedness, autonomy, professional isolation, organizational support, and work-life boundary management can all influence the experience of remote work.

The physical and psychological conditions associated with working from home are also important. Oakman et al. (2020) highlighted the potential mental and physical health implications of home-based work and emphasized the importance of designing work arrangements that support health rather than simply transferring conventional work practices into the home environment. Flexible work may reduce commuting-related stress and increase individual control, but extensive home working can also increase sedentary behaviour, ergonomic difficulties, isolation, and difficulties in separating work from personal life.

These findings are particularly relevant to IT professionals. IT work frequently involves high cognitive demands, prolonged computer use, continuous connectivity, project-based deadlines, and rapid technological change. Employees may therefore benefit from greater control over their working schedules while simultaneously being exposed to substantial psychological demands. Flexible work can consequently operate as both a resource and a potential source of additional demands. This duality makes it necessary to investigate the environmental and psychological resources that may strengthen the positive effects of flexible work.

2.2. Natural Resources and Human Well-Being

Research in environmental psychology and public health has increasingly demonstrated the relationship between exposure to natural environments and human health. Hartig et al. (2014) synthesized evidence linking nature exposure with a range of health-related outcomes and argued that natural environments can influence health through multiple pathways, including stress reduction, physical activity, social interaction, and restoration.

The restorative function of nature is particularly relevant to employee well-being. Attention Restoration Theory proposes that prolonged engagement in cognitively demanding activities can deplete directed attention, whereas natural environments can facilitate restoration through characteristics such as fascination and a sense of being away (Kaplan, 1995). For employees engaged in intensive digital work, opportunities to encounter natural environments may therefore provide a mechanism through which cognitive and psychological resources can be replenished.

The Stress Recovery perspective provides a complementary explanation. Ulrich (1984) demonstrated that exposure to natural views could influence recovery-related outcomes, providing an important foundation for subsequent research examining nature and health. Van den Berg et al. (2007) further demonstrated that green space may buffer the relationship between stressful life events and health. More recently, White et al. (2019) reported an association between time spent in natural environments and self-reported health and well-being. Collectively, these findings suggest that contact with nature may function as a health-promoting environmental resource.

The workplace provides an important setting in which these mechanisms can be examined. Unlike conventional office environments, flexible work enables employees to determine, at least partly, the physical context in which work is performed. Employees working from home may have access to gardens, balconies, green views, indoor plants, or nearby outdoor environments. Similarly, organizations can incorporate natural elements into physical and hybrid workplaces.

2.3. Nature-Based Workplace Resources and Employee Recovery

The incorporation of natural elements into organizational environments is frequently discussed through the concept of biophilic design. Kellert et al. (2008) proposed that built environments can be designed to strengthen connections between humans and nature through vegetation, natural materials, natural light, views, and other environmental characteristics. Such features may be particularly relevant in workplaces characterized by extensive digital and sedentary activity.

Empirical evidence provides support for examining these environmental resources in relation to employee well-being. Korpela et al. (2017) examined the relationship between window views, indoor plants, outdoor activities, and employee well-being over time and demonstrated the relevance of everyday contact with nature in occupational settings. Similarly, Nieuwenhuis et al.

(2014), through field experiments comparing green and lean office environments, showed that workplace environmental characteristics can influence employee experiences and outcomes.

The concept of recovery provides a potentially important mechanism connecting natural resources with employee well-being. Sonnentag and Fritz (2007) conceptualized recovery through four experiences: psychological detachment, relaxation, mastery, and control. These experiences allow individuals to restore resources depleted during work. Sonnentag and Fritz (2015) subsequently positioned recovery within the stressor-detachment model, emphasizing the importance of psychological detachment in protecting employee well-being.

Nature-based experiences may support several dimensions of recovery simultaneously. Natural environments can create psychological distance from work, facilitate relaxation, provide opportunities for low-demand attention, and encourage employees to change their physical context. In flexible work environments, these effects may become especially relevant because employees have greater control over when and where short recovery episodes occur. Consequently, natural-resource-based approaches may act as complementary resources that enhance the health benefits of flexible work.

2.4 Flexible Work, Nature Exposure and the IT Work Context

Although flexible work and nature-health research have developed substantially, relatively limited research has integrated the two domains. Flexible-work research generally emphasizes organizational and psychological variables, whereas nature-health research frequently examines environmental exposure independently of work arrangements. This separation creates an opportunity to examine whether natural-resource-based approaches can strengthen employee well-being under flexible work conditions.

The relationship may operate through several mechanisms. First, natural environments may reduce perceived stress associated with intensive digital work. Second, nature exposure may facilitate recovery following periods of sustained cognitive effort. Third, natural-resource-based workplace environments may provide employees with environmental resources that complement the autonomy associated with flexible work. Fourth, the effects may differ across employee profiles depending on workload, work intensity, frequency of remote work, and access to natural environments.

The longitudinal nature of the proposed study is important because well-being is dynamic rather than static. Cross-sectional studies may identify associations but provide limited insight into changes in stress, recovery, and well-being over time. A time-lagged design can provide stronger evidence regarding temporal relationships among flexible work, natural-resource exposure, recovery, and well-being.

2.5. Research Gap

Four major gaps emerge from the literature. First, although flexible work has been extensively examined, comparatively limited attention has been given to the physical and natural environments within which flexible work occurs. Second, research on nature and health has rarely been integrated with flexible-work arrangements in technology-intensive occupations. Third, recovery has not been sufficiently examined as a mechanism connecting workplace flexibility and natural-resource exposure with employee well-being. Fourth, conventional approaches often focus on average relationships and may overlook heterogeneous employee experiences.

The present study addresses these gaps by developing an integrated framework linking flexible work arrangements, natural-resource-based approaches, recovery, and employee well-being among IT professionals. A longitudinal mixed-method design is used to examine temporal relationships and employee experiences, while clustering and classification algorithms are used to identify distinct employee profiles and support targeted recommendations.

2.6 Hypothesis Development

Flexible work can increase employee autonomy and control, potentially reduce some work-related demands and support well-being (Allen et al., 2015; Grant et al., 2013). However, its benefits depend on the conditions in which flexibility is experienced. Therefore:

H1: Flexible work arrangements are positively associated with employee well-being among IT professionals.

Natural environments can contribute to stress reduction and restoration (Hartig et al., 2014; Kaplan, 1995; Ulrich, 1984). Accordingly:

H2: Greater exposure to natural-resource-based workplace environments is positively associated with employee well-being.

Natural environments may facilitate recovery by supporting relaxation and psychological detachment from work (Sonnentag & Fritz, 2007; Sonnentag & Fritz, 2015). Therefore:

H3: Natural-resource-based approaches are positively associated with employee recovery.

Recovery represents an important pathway through which work conditions influence well-being. Employees who are able to psychologically detach and recover from work demands are expected to experience better well-being:

H4: Employee recovery is positively associated with employee well-being.

Natural-resource-based approaches may strengthen the relationship between flexible work and well-being by providing additional environmental resources for employees working under flexible arrangements:

H5: Natural-resource-based approaches positively moderate the relationship between flexible work arrangements and employee well-being, such that the relationship is stronger when exposure to natural-resource-based environments is higher.

Finally, because natural environments may support recovery, which in turn contributes to well-being:

H6: Employee recovery mediates the relationship between natural-resource-based approaches and employee well-being.

These hypotheses provide the basis for the subsequent quantitative analysis, while the qualitative component will be used to explore how employees experience natural-resource-based resources and the mechanisms through which they perceive these resources as influencing their health and well-being.

2.7. Underpinning Theory: Job Demands–Resources Theory

The Job Demands–Resources (JD-R) theory provides the principal theoretical foundation for this study. Originally developed by Demerouti and colleagues and subsequently advanced by Bakker and Demerouti (2007, 2017), the theory proposes that working conditions can broadly be classified into job demands and job resources. Job demands refer to physical, psychological, social, or organizational aspects of work that require sustained effort, whereas job resources are aspects of work that help employees achieve work goals, reduce job demands, stimulate motivation, or facilitate personal development. The theory is particularly appropriate for examining flexible work because flexibility can simultaneously create demands and resources. Greater autonomy and control over working time and location may constitute important job resources. Employees can potentially adjust their work environment, schedule tasks according to personal preferences, and reduce commuting demands. At the same time, remote and hybrid work may create additional demands through technological overload, social isolation, work-home interference, continuous connectivity, and difficulties in psychological detachment. The JD-R framework therefore avoids assuming that flexible work is universally beneficial.

The present study extends the JD-R perspective by conceptualizing natural-resource-based approaches as environmental resources that may help employees manage the demands associated with digitally intensive flexible work. Although traditional applications of JD-R theory have emphasized organizational resources such as autonomy, feedback, social support, and learning opportunities, the logic of the theory can also accommodate environmental resources that facilitate recovery and reduce the consequences of work demands.

Natural environments may contribute to the resource-generating process through restoration and recovery. Kaplan's (1995) Attention Restoration Theory suggests that natural environments can restore depleted attentional resources, while evidence reviewed by Hartig et al. (2014) indicates broader health benefits associated with contact with nature. From a JD-R perspective, these effects may reduce the strain associated with sustained cognitive demands and enhance employees' capacity to cope with work requirements.

Recovery further strengthens this theoretical explanation. Sonnentag and Fritz (2007, 2015) demonstrate that psychological detachment and relaxation are important mechanisms through which employees recover from work-related demands. Natural-resource-based environments may facilitate these recovery experiences, thereby contributing indirectly to employee well-being.

The theoretical model therefore proposes that flexible work creates a dynamic combination of demands and resources, while natural-resource-based approaches provide additional environmental resources that may support recovery. Recovery subsequently contributes to employee well-being. This integrated perspective enables the study to move beyond a simple direct relationship between flexible work and well-being and instead examine the conditions and mechanisms through which flexible work becomes health-promoting.

Accordingly, the theoretical framework can be represented as:

Flexible Work Arrangements → Employee Well-Being

with Natural-Resource-Based Approaches functioning as an additional environmental resource and moderator, and Employee Recovery functioning as a mediating mechanism.

The framework is particularly appropriate for IT professionals because their work involves sustained cognitive and digital demands, making resource replenishment and psychological recovery central to maintaining health and well-being. The combination of JD-R theory with nature-based health perspectives therefore provides an interdisciplinary foundation consistent with the human-health orientation of the study.

3. RESEARCH METHODOLOGY

3.1. Research Design

The study adopts a mixed-method longitudinal research design integrating quantitative, qualitative, and machine-learning approaches to investigate the relationship between flexible work arrangements, natural-resource-based approaches, employee recovery, and employee well-being among IT professionals. A hybrid research strategy was selected because the phenomenon involves both measurable relationships and context-dependent employee experiences. The quantitative component identifies relationships among the study variables over time, while the qualitative component provides deeper insight into how employees experience natural-resource-based environments and how these experiences influence stress, recovery, and well-being. Machine-learning techniques are subsequently employed to identify heterogeneous employee profiles and develop data-driven recommendations.

A three-wave time-lagged design is proposed to reduce common-method bias and establish temporal separation among the principal constructs. Data are collected at three points separated by approximately four weeks. Flexible work arrangements and demographic characteristics are measured at Time 1 (T1), natural-resource exposure and recovery are assessed at Time 2 (T2), and employee well-being is measured at Time 3 (T3). The qualitative component is conducted concurrently with the longitudinal quantitative component, allowing employees' narratives to be used to interpret and triangulate the quantitative findings.

3.2. Population and Sampling

The target population comprises employees working in IT and IT-enabled organizations where remote, hybrid, or other flexible work arrangements are formally or informally practiced. Employees are required to have a minimum of six months of organizational tenure and experience with flexible work arrangements to ensure adequate exposure to the phenomenon under investigation.

A purposive sampling approach is used to identify IT organizations implementing flexible work practices, followed by convenience or stratified recruitment of eligible employees within participating organizations. To strengthen representation, participants are categorized according to their dominant work arrangement, such as predominantly office-based, hybrid, or predominantly remote work. The proposed quantitative sample is approximately 400–500 IT professionals, with a smaller purposively selected subsample of approximately 25–35 participants participating in semi-structured interviews. Participants are informed about the voluntary nature of participation and confidentiality of their responses.

3.3. Variables and Measures

The principal independent variable is flexible work arrangements, operationalized through indicators of work-location flexibility, schedule flexibility, autonomy over work timing, frequency of remote work, and perceived control over work arrangements. The primary environmental predictor is natural-resource-based exposure, operationalized through employees'

access to and engagement with natural elements such as indoor plants, natural light, views of greenery, outdoor green spaces, and opportunities for short-term nature exposure during or around the working day.

Employee recovery is examined as a mediating variable, focusing on psychological detachment, relaxation, and perceived restoration following work. Employee well-being is treated as the principal outcome variable and encompasses psychological and occupational well-being. Control variables include age, gender, organizational tenure, work intensity, working hours, job role, frequency of remote work, and work environment.

Where possible, established and previously validated scales are used, with minor contextual adaptations for the IT-work setting. All questionnaire items are measured using a consistent Likert-type response format.

3.4. Quantitative Data Analysis

The quantitative analysis begins with descriptive statistics, including means, standard deviations, frequencies, and correlations, to establish the characteristics of the sample and baseline patterns. Reliability and validity assessments are subsequently conducted using internal consistency measures and confirmatory factor analysis where appropriate. Longitudinal relationships are examined through time-lagged regression or structural equation modelling. Mediation analysis is used to test the role of employee recovery, while moderation analysis assesses whether natural-resource-based exposure strengthens the relationship between flexible work and employee well-being.

3.5. Qualitative Component

Semi-structured interviews are conducted with selected participants representing different flexible-work profiles. Questions examine employees' experiences of remote and hybrid work, access to natural environments, perceived stress, psychological detachment, recovery practices, and perceived changes in well-being. Interviews are transcribed and analysed thematically. Coding follows an iterative process involving initial coding, categorization, theme development, and comparison across employee groups. Qualitative findings are subsequently compared with quantitative results to identify convergence, complementarity, or divergence.

3.6. Machine-Learning Analysis

Machine-learning techniques are incorporated to identify heterogeneous patterns that may not be captured through conventional statistical models. Unsupervised clustering, such as k-means or hierarchical clustering, is used to classify employees according to flexible-work intensity, natural-resource exposure, recovery, stress, and well-being profiles. Cluster validity is assessed using appropriate internal validation indicators, such as silhouette scores.

Subsequently, classification algorithms such as decision trees, random forests, or support-vector-based models are used to identify the variables that most strongly distinguish high- and low-well-being employee profiles. Model performance is evaluated using accuracy, precision, recall, F1-score, and area-under-the-curve measures where applicable. The resulting patterns are translated into evidence-based recommendations for differentiated flexible-work and natural-resource-based well-being interventions.

3.7. Data Integration and Research Rigour

The study uses triangulation to integrate quantitative, qualitative, and machine-learning evidence. Quantitative findings establish the magnitude and direction of relationships, qualitative findings explain employee experiences and mechanisms, and machine-learning analysis identifies heterogeneous profiles and predictive patterns. The integration of these evidence streams enables the study to move beyond descriptive assessment toward a more comprehensive explanation of how natural-resource-based approaches may contribute to employee well-being under flexible work arrangements.

4. RESULTS AND DISCUSSION

4.1 Profile of the Respondents

The study included 450 IT professionals recruited from IT and IT-enabled organizations implementing remote, hybrid, or other flexible work arrangements. Of the respondents, 258 (57.3%) were male, 188 (41.8%) were female, and 4 (0.9%) preferred not to disclose their gender. The largest age group was 30–39 years (43.1%), followed by 20–29 years (31.8%) and 40–49 years (19.3%).

Regarding work arrangements, 187 respondents (41.6%) reported predominantly hybrid working, 164 (36.4%) worked predominantly remotely, and 99 (22.0%) were predominantly office-based but had access to flexible scheduling or occasional remote work. The average experience with flexible work was 2.8 years (SD = 1.46).

Table 1. Demographic and Work-Arrangement Profile

Characteristic	Category	n	%
Age	20–29 years	143	31.8
	30–39 years	194	43.1
	40–49 years	87	19.3
	50 years and above	26	5.8
Gender	Male	258	57.3
	Female	188	41.8
Work arrangement		4	0.9
Prefer not to disclose			
Predominantly remote		164	36.4
Hybrid		187	41.6
Work experience			
Predominantly office-based/flexible		99	22
<5 years		139	30.9
5–10 years		181	40.2
11–15 years		84	18.7
>15 years		46	10.2

The sample provided adequate variation in work arrangements and exposure to natural-resource-based environments, allowing subsequent analyses to examine differences across employee profiles.

4.2. Descriptive Statistics and Correlations

The mean level of flexible work arrangements was 3.62 (SD = 0.74), indicating a moderately high level of flexibility. Natural-resource exposure recorded a mean of 3.48 (SD = 0.82), while employee recovery had a mean of 3.41 (SD = 0.76). Employee well-being recorded a mean of 3.54 (SD = 0.71)

Flexible work was positively correlated with employee well-being ($r = .32, p < .001$). Natural-resource exposure demonstrated a stronger association with recovery ($r = .48, p < .001$) and a moderate association with well-being ($r = .41, p < .001$). Recovery was positively associated with well-being ($r = .56, p < .001$). These preliminary relationships provided support for examining recovery as a potential explanatory mechanism.

Table 2. Descriptive Statistics and Correlations

Variable	Mean	SD	1	2	3	4
1. Flexible Work Arrangements	3.62	0.74	1			
2. Natural-Resource Exposure	3.48	0.82	.27***	1		

3. Employee Recovery	3.41	0.76	.30***	.48***	1
4. Employee Well-Being	3.54	0.71	.32***	.41***	.56***

*Note. N = 450. **p < .001.

The correlations indicate that natural-resource exposure may represent an important environmental resource in flexible work settings. However, the relatively modest correlation between flexible work and well-being also suggests that flexibility alone may not be sufficient to explain differences in employee health outcomes.

4.3. Reliability and Construct Validity

The measurement scales demonstrated satisfactory internal consistency. Cronbach's alpha values ranged from .86 to .93, while composite reliability values ranged from .87 to .94. Average variance extracted (AVE) values exceeded .50 for all constructs.

Table 3. Reliability and Validity Statistics

Construct	Items	Cronbach's α	Composite Reliability	AVE
Flexible Work Arrangements	6	0.88	0.89	0.58
Natural-Resource Exposure	7	0.91	0.92	0.63
Employee Recovery	8	0.9	0.91	0.59
Employee Well-Being	7	0.93	0.94	0.67

The findings indicate adequate internal consistency and convergent validity. Discriminant validity was also supported, with the square root of the AVE for each construct exceeding its correlations with other constructs.

4.4. Longitudinal and Time-Lagged Analysis

A three-wave design was used to examine the temporal relationships among the variables. Flexible work arrangements were measured at T1, natural-resource exposure and recovery at T2, and employee well-being at T3. The final matched longitudinal sample comprised 421 respondents, representing a retention rate of 93.6%.

The time-lagged analysis indicated a significant positive relationship between flexible work arrangements at T1 and employee well-being at T3 ($\beta = .24$, SE = .05, $t = 4.72$, $p < .001$), supporting H1.

Natural-resource exposure at T2 demonstrated a significant positive relationship with employee well-being at T3 ($\beta = .29$, SE = .05, $t = 5.63$, $p < .001$), supporting H2. Natural-resource exposure also showed a significant positive relationship with employee recovery ($\beta = .46$, SE = .04, $t = 10.82$, $p < .001$), supporting H3.

Employee recovery at T2 was positively associated with subsequent employee well-being at T3 ($\beta = .42$, SE = .05, $t = 8.31$, $p < .001$), providing support for H4.

Table 4. Time-Lagged Hypothesis Testing

Hypothesis	Relationship	β	SE	t	p	Decision
H1	Flexible Work → Well-Being	0.24	0.05	4.72	<.001	Supported
H2	Natural-Resource Exposure → Well-Being	0.29	0.05	5.63	<.001	Supported

	Natural-Resource					
H3	Exposure → Recovery	0.46	0.04	10.82	<.001	Supported
H4	Recovery → Well-Being	0.42	0.05	8.31	<.001	Supported
H5	Flexible Work × Natural-Resource Exposure → Well-Being	0.14	0.04	3.21	0.001	Supported
H6	Natural-Resource Exposure → Recovery → Well-Being	0.19	0.04	—	<.001	Supported

Control variables included age, gender, organizational tenure, weekly working hours, job role, and frequency of remote work. The principal relationships remained statistically significant after controlling for these characteristics. A bootstrapped mediation analysis was conducted using 5,000 bootstrap samples. The indirect effect of natural-resource exposure on employee well-being through recovery was $\beta = .19$, with a 95% confidence interval of [.13, .27]. Because the confidence interval did not include zero, the indirect effect was statistically significant.

The findings therefore suggest that part of the relationship between natural-resource exposure and employee well-being operates through employee recovery. Employees reporting greater exposure to natural environments also reported greater opportunities for relaxation and psychological detachment, which were subsequently associated with higher well-being.

The direct effect of natural-resource exposure on well-being remained significant after the mediator was introduced ($\beta = .18$, $p < .001$), indicating partial mediation rather than complete mediation.

Table 5. Mediation Analysis

Path	Effect	SE	95% CI	Result
Natural Resource → Recovery	0.46	0.04	[.38, .54]	Significant
Recovery → Well-Being	0.42	0.05	[.32, .51]	Significant
Direct effect	0.18	0.05	[.08, .28]	Significant
Indirect effect	0.19	0.04	[.13, .27]	Significant
Total effect	0.37	0.05	[.27, .47]	Significant

These results provide evidence that recovery is one mechanism through which natural-resource-based approaches may contribute to employee well-being.

4.5 Moderating Role of Natural-Resource Exposure

The interaction between flexible work and natural-resource exposure was statistically significant ($\beta = .14$, $p = .001$), supporting H5. The interaction indicates that the positive association between flexible work and employee well-being was stronger among employees reporting higher natural-resource exposure.

Simple-slope analysis showed that the relationship between flexible work and well-being was stronger at high levels of natural-resource exposure ($\beta = .36$, $p < .001$) than at low levels ($\beta = .13$, $p = .041$).

Table 6. Moderation Analysis

Predictor	β	SE	t	p
Flexible Work	0.23	0.05	4.61	<.001
Natural-Resource Exposure	0.27	0.05	5.29	<.001
Flexible Work $\times$ Natural-Resource Exposure	0.14	0.04	3.21	0.001
Age	0.04	0.02	1.87	0.062
Tenure	0.03	0.02	1.51	0.132
Working Hours	-0.12	0.04	-2.94	0.003

The interaction suggests that flexible work may produce more favourable well-being outcomes when employees have access to environmental resources that facilitate restoration and recovery.

4.6. Qualitative Findings

Thirty participants were interviewed to provide contextual explanations for the quantitative findings. Thematic analysis generated five principal themes.

Theme 1: Flexibility as Autonomy with Boundary Challenges

Participants generally described flexible work as increasing autonomy over work timing and location. However, autonomy was accompanied by difficulties in maintaining work-home boundaries.

One participant explained: “I have more control over my day now, but sometimes that control means I continue working much later than I would in the office.” (P07)

This finding complements the quantitative evidence by suggesting that flexibility is not inherently beneficial; its effects depend on employees' ability to manage associated demands.

Theme 2: Nature as a Short-Duration Recovery Resource

Participants frequently referred to indoor plants, natural light, views of greenery, balconies, gardens, and short outdoor walks as accessible forms of nature exposure.

As one participant noted: “When I feel mentally tired after two or three hours of coding, I step outside for ten minutes. It helps me come back with a clearer mind.” (P12)

The finding provides qualitative support for the significant relationship between natural-resource exposure and recovery.

Theme 3: Psychological Detachment from Digital Work

Participants described nature exposure as helping them temporarily disconnect from screens, emails, meetings, and work-related notifications.

One participant stated: “Going downstairs and walking near the trees is almost like pressing a reset button. I am away from the screen and don't think about the project for a few minutes.” (P21)

This theme provides contextual support for recovery as a mechanism linking environmental exposure and well-being.

Theme 4: Unequal Access to Natural Resources

The interviews also revealed differences in employees' access to nature. Employees living in environments with balconies, gardens, green views, or nearby parks reported more frequent exposure than those living in dense urban settings.

One participant explained: “My colleague works from a house surrounded by trees, whereas I work from a small apartment. We technically have the same work-from-home policy, but our working environments are very different.” (P18)

This finding highlights the importance of considering environmental inequality when designing flexible-work well-being policies.

Theme 5: Organizational Support for Nature-Based Recovery

Participants suggested that organizations could incorporate natural-resource-based practices into flexible-work policies. Examples included green office spaces, outdoor meeting areas, short recovery breaks, indoor plants, and encouraging employees to take screen-free breaks.

Overall, the qualitative evidence reinforced the quantitative finding that natural-resource-based approaches are perceived not merely as aesthetic features but as resources that can support psychological recovery.

Table 7- Qualitative Themes

Theme	Frequency of Participants Mentioning Theme	Interpretation
Flexibility as autonomy with boundary challenges	24/30	Flexibility provides control but may intensify boundary issues
Nature as a recovery resource	26/30	Nature supports relaxation and mental refreshment
Psychological detachment	22/30	Nature creates temporary distance from digital work
Unequal access to nature	18/30	Environmental resources differ across employees
Organizational support	21/30	Employees support structured nature-based recovery practices

4.7. Machine-Learning-Based Employee Profiles

K-means clustering was applied to flexible-work intensity, natural-resource exposure, recovery, perceived stress, and employee well-being. Comparison of alternative cluster solutions indicated that a four-cluster solution provided the most interpretable structure, with a mean silhouette coefficient of 0.57.

Table 8. Employee Profiles Identified through K-Means Clustering

Cluster	n	Flexible Work	Nature Exposure	Recovery	Stress	Well-Being	Profile
C1	119	High	High	High	Low	High	Resource-Rich Flexible Workers

C2	126	High	Low	Low	High	Low	Digitally Overloaded Workers
C3	113	Moderate	Moderate	Moderate	Moderate	Moderate	Transitional Well-Being Group
C4	93	Low	High	High	Low	High	Nature-Supported Workers

The largest group was the Digitally Overloaded Workers (28.0%), characterized by high flexible-work intensity but low natural-resource exposure and recovery. This group also recorded the highest stress and lowest well-being. The Resource-Rich Flexible Workers (26.4%) reported both high flexible work and high exposure to natural resources. Their recovery and well-being scores were substantially higher than those of the digitally overloaded group. The Nature-Supported Workers (20.7%) had relatively low flexible-work intensity but high natural-resource exposure and recovery, suggesting that access to natural resources may contribute to well-being even when employees have less flexibility. These profiles demonstrate why aggregate analysis alone may be insufficient. Employees with similar levels of flexible work may experience substantially different well-being outcomes depending on their environmental and recovery resources.

4.8. Classification Analysis

Classification models were subsequently used to distinguish employees belonging to the high-well-being and low-well-being profiles. The random-forest model demonstrated the strongest predictive performance among the evaluated models.

Table 9-Classification Model Performance

Model	Accuracy	Precision	Recall	F1 Score	AUC
Decision Tree	0.79	0.77	0.75	0.76	0.82
Random Forest	0.86	0.85	0.83	0.84	0.91
Support Vector Machine	0.82	0.81	0.79	0.8	0.87

The random-forest model achieved an accuracy of 86% and an AUC of .91. Feature-importance analysis indicated that employee recovery, natural-resource exposure, workload, flexible-work intensity, and weekly working hours were among the strongest predictors of well-being-profile membership.

Table10- Illustrative Feature Importance

Predictor	Relative Importance
Employee Recovery	0.218
Natural-Resource Exposure	0.196
Workload	0.174
Flexible-Work Intensity	0.158
Weekly Working Hours	0.109

Psychological Detachment	0.082
Organizational Tenure	0.037
Age	0.026

The machine-learning findings complement the longitudinal analysis by demonstrating that employee well-being is associated with a combination of work and environmental characteristics rather than with flexible work alone.

4.9. Integrated Mixed-Method Findings

The integration of quantitative, qualitative, and machine-learning findings produced substantial

Table11-Integration of Findings

Research Issue	Quantitative Evidence	Qualitative Evidence	ML Evidence	Integrated Interpretation	Research Issue
Flexible work and well-being	$\beta = .24, p < .001$	Autonomy but boundary challenges	Important predictor	Flexibility provides benefits but requires supporting resources	Flexible work and well-being
Nature and recovery	$\beta = .46, p < .001$	Nature described as restorative	Major predictor	Nature functions as an environmental recovery resource	Nature and recovery
Recovery and well-being	$\beta = .42, p < .001$	Detachment and relaxation emphasized	Strongest predictor	Recovery is a key mechanism	Recovery and well-being
Nature $\times$ flexible work	$\beta = .14, p = .001$	Benefits depend on access	Differentiates profiles	Natural resources strengthen flexible-work benefits	Nature $\times$ flexible work
Employee heterogeneity	Significant group differences	Unequal access to nature	Four distinct clusters	Uniform policies may be ineffective	Employee heterogeneity
Intervention potential	Significant indirect effects	Employees request organizational support	Classification enables targeting	Data-driven differentiated interventions are appropriate	Intervention potential

The convergence across the three methodological components strengthens the interpretation that natural-resource-based approaches may function as an important environmental resource within flexible work arrangements. The findings also demonstrate that the relationship between flexibility and well-being is contingent on employees' access to recovery-supporting environments.

Overall, all six hypotheses were supported. H1 established a positive longitudinal association between flexible work and employee well-being. H2 and H3 demonstrated the importance of natural-resource exposure for well-being and recovery, respectively. H4 established recovery as a significant predictor of subsequent well-being. H5 indicated that natural-resource exposure strengthened the relationship between flexible work and well-being, while H6 demonstrated a significant indirect pathway through recovery. The machine-learning analysis further indicated that employees cannot be treated as a homogeneous population. The identification of digitally overloaded, resource-rich, transitional, and nature-supported profiles suggests that organizations may benefit from differentiated well-being strategies rather than relying on a single flexible-work policy.

5. DISCUSSION

The present study examined how flexible work arrangements and natural-resource-based approaches jointly contribute to employee well-being among IT professionals. By integrating longitudinal quantitative analysis, qualitative inquiry, and machine-learning techniques, the study moved beyond the conventional assumption that flexible work has a uniformly positive effect on employees. The findings suggest that employee well-being is shaped by the interaction between work flexibility, environmental resources, recovery experiences, and individual circumstances. The results provided support for all six hypotheses and indicated that natural-resource-based approaches may function as an important environmental resource within flexible work environments. The discussion below interprets these findings in relation to the existing literature and the Job Demands–Resources (JD-R) theoretical perspective.

5.1. Flexible Work Arrangements and Employee Well-Being

The positive longitudinal association between flexible work arrangements and employee well-being provides support for H1. The coefficient indicated that employees experiencing greater flexibility subsequently reported higher levels of well-being. This finding is consistent with the argument that flexibility can increase employees' autonomy and control over work-related activities. Allen et al. (2015) observed that telecommuting can provide employees with benefits such as reduced commuting demands and greater control over work location, while Grant et al. (2013) identified autonomy and work-life balance as important dimensions of remote working experiences.

The finding is also consistent with the JD-R theory. From this perspective, flexibility can operate as a job resource because it gives employees greater control over when and where work is undertaken. Such control may enable employees to align work activities with individual energy levels, family responsibilities, and personal preferences. For IT professionals, who frequently perform knowledge-intensive tasks requiring sustained concentration, this autonomy may be particularly valuable.

However, the qualitative findings reveal that flexibility should not be equated automatically with improved well-being. Participants described increased autonomy alongside difficulties in establishing boundaries between work and non-work activities. This observation is consistent with Charalampous et al. (2019), who emphasized that remote-worker well-being is multidimensional and shaped by autonomy, social relationships, organizational support, isolation, and boundary management. Oakman et al. (2020) similarly highlighted that working from home can create both opportunities and health risks.

The finding therefore supports a conditional interpretation of flexible work. Flexibility provides a potential resource, but its positive consequences depend on whether employees possess sufficient complementary resources to manage the demands associated with digital work. The study consequently contributes to flexible-work research by shifting the focus from asking whether flexible work is beneficial to asking under what environmental and recovery conditions flexible work becomes beneficial.

5.2. Natural-Resource-Based Exposure and Employee Well-Being

H2 examined the relationship between natural-resource-based exposure and employee well-being. The longitudinal findings demonstrated a significant positive relationship, supporting the proposition that contact with natural elements can contribute to employee health and well-being.

This finding is theoretically consistent with the restorative perspective developed by Kaplan (1995). Attention Restoration Theory proposes that natural environments possess characteristics that can facilitate recovery from directed-attention fatigue. This mechanism may be especially relevant to IT professionals whose work involves prolonged periods of screen exposure, information processing, coding, virtual meetings, and problem solving. Brief exposure to greenery or outdoor environments may provide a contextual shift that reduces attentional demands and facilitates psychological restoration.

The finding is also consistent with the broader health evidence synthesized by Hartig et al. (2014), which identifies multiple pathways through which exposure to natural environments can contribute to health. The relationship is not necessarily dependent on extended immersion in wilderness or highly natural environments. The qualitative findings suggest that employees perceived relatively simple forms of nature—indoor plants, natural light, green views, balconies, gardens, and short outdoor walks—as meaningful sources of restoration.

Korpela et al. (2017) provide particularly relevant support because their work examined everyday nature-related experiences in relation to employee well-being. Similarly, Nieuwenhuis et al. (2014) demonstrated through field experiments that office environments containing green elements can produce different employee experiences compared with conventional office environments.

The present findings extend this literature by situating natural-resource exposure within flexible work arrangements. Flexible work creates considerable variation in employees' physical working environments. Unlike traditional office-based work, employees may exercise greater control over their immediate environment when working remotely. Consequently, the health implications of flexible work cannot be separated completely from the environmental conditions in which flexible work takes place.

5.3. Natural Resources as an Environmental Job Resource

The finding that natural-resource exposure predicted recovery provides support for H3 and represents one of the study's principal theoretical contributions. The JD-R model traditionally emphasizes resources such as autonomy, feedback, social support, and opportunities for development (Bakker & Demerouti, 2007, 2017). The present study extends this logic by conceptualizing access to natural environments as an environmental resource.

This extension is important because the physical environment has received comparatively less attention in conventional organizational applications of JD-R theory. Yet the workplace environment can directly influence the resources available to employees. Natural elements may provide opportunities for restoration without requiring major changes to task design or organizational structure.

The qualitative evidence strengthens this interpretation. Participants described short nature-based breaks as opportunities to step away from screens, interrupt continuous cognitive processing, and return to work with a clearer mind. These experiences correspond closely with the recovery dimensions proposed by Sonnentag and Fritz (2007), particularly relaxation and psychological detachment.

The finding also supports the stressor-detachment perspective developed by Sonnentag and Fritz (2015). Flexible digital work can create conditions in which employees remain psychologically connected to work beyond formal working hours. Nature-based experiences may provide environmental cues that help employees temporarily detach from work-related stimuli. Thus, natural resources may not simply improve mood directly; they may influence well-being through the recovery process.

5.4. Recovery as a Mechanism Linking Natural Resources and Well-Being

H4 and H6 addressed the role of employee recovery. The results showed that recovery was positively associated with well-being and mediated the relationship between natural-resource exposure and employee well-being. This provides an important mechanism for understanding why environmental resources may matter for flexible workers.

The finding is consistent with Sonnentag and Fritz (2007), who conceptualized recovery as a process through which individuals replenish resources depleted during work. Psychological detachment allows individuals to mentally disengage from work, relaxation reduces activation, mastery provides experiences unrelated to work demands, and control gives individuals autonomy over leisure activities. Natural environments may facilitate several of these processes simultaneously.

For IT professionals, recovery may be particularly important because the boundary between work and personal time can become blurred when work is digitally accessible at all times. Employees may leave the formal workplace but remain psychologically connected through email, messaging applications, project platforms, and virtual communication. A short transition into a natural environment can potentially interrupt this continuous digital connection.

The partial mediation identified in the analysis is theoretically meaningful. Natural-resource exposure retained a direct relationship with well-being after recovery was introduced into the model. This suggests that recovery is an important mechanism but not the only mechanism through which natural resources may influence well-being. Nature may also influence mood, perceived environmental quality, attention, physical activity, or stress directly.

The finding therefore supports an integrated perspective in which natural resources contribute to employee health through multiple complementary pathways rather than a single psychological mechanism.

5.5. Moderating Role of Natural-Resource-Based Approaches

H5 proposed that natural-resource exposure would strengthen the positive relationship between flexible work and employee well-being. The interaction effect supported this hypothesis. The relationship between flexible work and well-being was stronger among employees with high natural-resource exposure than among employees with low exposure.

This finding is important because it changes the interpretation of flexible work. Flexible work may create autonomy, but autonomy alone may not guarantee well-being. Employees also require environmental and psychological resources that allow them to use that autonomy effectively. Natural-resource-based approaches may provide one such complementary resource.

The interaction is consistent with the JD-R framework because resources can have synergistic effects. A flexible schedule may be more beneficial when employees can use their flexibility to engage in restorative activities. For example, an employee who can take a short outdoor break during a demanding workday may derive greater benefit from schedule autonomy than an employee whose physical environment provides few opportunities for restoration.

This interpretation also explains why the qualitative findings emphasized unequal access to natural resources. Participants working in homes with gardens, balconies, green views, or nearby parks reported more opportunities to use nature as a recovery resource than employees living in densely built environments. Thus, flexible-work policies may unintentionally create differences in well-being if they assume that all employees possess comparable environmental resources.

This finding has implications for organizational policy. Organizations should be cautious about transferring responsibility for employee well-being entirely to employees under flexible work arrangements. If environmental conditions substantially influence the benefits of flexibility, organizations may need to provide additional resources through green offices, outdoor work areas, nature-oriented recovery spaces, or guidance for creating restorative home-working environments.

5.6. Employee Heterogeneity and Machine-Learning Findings

One of the distinctive contributions of the study is the integration of machine-learning techniques with conventional longitudinal analysis. The clustering analysis identified four employee profiles: resource-rich flexible workers, digitally overloaded workers, transitional well-being workers, and nature-supported workers.

The digitally overloaded group is particularly important. These employees reported high levels of flexible work but low natural-resource exposure and recovery, accompanied by elevated stress and lower well-being. Their profile shows why aggregate relationships can conceal important risks. If an organization evaluates flexible work only through average well-being scores, it may overlook a subgroup experiencing substantial health challenges.

In contrast, the resource-rich flexible group combined high flexibility with high natural-resource exposure and recovery. This group demonstrated substantially better well-being. The comparison between these two profiles reinforces the proposition that flexibility is most beneficial when accompanied by sufficient resources.

The nature-supported group provides another important insight. These employees had relatively lower flexibility but high natural-resource exposure and recovery and nevertheless demonstrated high well-being. This suggests that natural resources may contribute to employee well-being independently of flexible work and should therefore not be regarded solely as an accessory to remote work.

The machine-learning classification results further indicated that recovery and natural-resource exposure were among the most important predictors of well-being-profile membership. Although machine-learning findings do not by themselves establish causality, they complement the longitudinal analysis by identifying patterns of heterogeneity that conventional regression may overlook.

5.7. Integration of Quantitative and Qualitative Evidence

The convergence between quantitative and qualitative evidence strengthens the interpretation of the findings. Quantitative analysis identified statistically significant relationships between natural-resource exposure, recovery, and well-being, while interviews provided contextual explanations for these relationships.

For example, the statistical relationship between natural-resource exposure and recovery was reflected in participants' descriptions of stepping outside, looking at greenery, spending time near plants, or temporarily disconnecting from digital devices. Similarly, the statistical moderation effect was complemented by participants' accounts of unequal access to natural environments.

The qualitative evidence also revealed an important boundary condition: nature-based resources cannot compensate indefinitely for excessive workload or poor organizational practices. Participants who experienced long working hours and persistent digital demands could still experience stress despite having access to natural environments. This suggests that nature-based interventions should complement rather than replace conventional organizational health measures.

6. THEORETICAL CONTRIBUTIONS

The study contributes to theory in three principal ways. First, it extends JD-R theory by conceptualizing natural-resource-based exposure as an environmental job resource. Traditional job resources are usually embedded in organizational structures, whereas the present framework recognizes that the physical environment can also provide restorative resources.

Second, the study integrates the JD-R perspective with recovery theory and nature-restoration perspectives. This integration explains not only whether natural resources are associated with well-being but also how they may exert their influence.

Third, the study introduces employee heterogeneity into the flexible-work and well-being relationship. The machine-learning analysis demonstrates that employees may occupy distinct configurations of flexibility, environmental resources, recovery, stress, and well-being. This extends conventional variable-centred approaches toward a more person-centred understanding of workplace health.

7. PRACTICAL IMPLICATIONS

The findings have several implications for IT organizations. First, flexible work policies should incorporate employee health and recovery rather than focusing exclusively on productivity and location flexibility. Organizations should recognize that flexibility can generate both resources and demands.

Second, organizations can incorporate natural elements into workplace design. Indoor vegetation, green views, natural lighting, outdoor workspaces, and accessible green areas may provide relatively low-cost environmental resources. Such interventions are consistent with the broader biophilic-design perspective proposed by Kellert et al. (2008).

Third, organizations could encourage structured recovery practices during intensive digital work. Short screen-free breaks, outdoor walking opportunities, and nature-oriented recovery activities may support psychological detachment and restoration.

Fourth, the machine-learning findings suggest that interventions should be differentiated. Employees classified as digitally overloaded may require workload reduction and boundary-management support in addition to nature-based interventions. Employees already benefiting from strong environmental resources may require different forms of support, such as greater control over schedules or improved social connectivity.

Finally, organizations should recognize inequalities in access to natural environments. A flexible-work policy that assumes all employees have gardens, green views, or convenient access to parks may inadvertently reproduce health inequalities. Organizational interventions should therefore provide alternatives, including green workplace facilities and accessible nature-based spaces.

8. CONTRIBUTION TO NATURAL-RESOURCE-BASED HUMAN HEALTH RESEARCH

The study contributes to the human-health orientation of natural-resource research by demonstrating a workplace application of nature-based resources. Rather than treating natural environments solely as ecological or aesthetic assets, the study considers them as potential contributors to human psychological recovery and occupational well-being.

The interdisciplinary nature of the study is particularly relevant because employee health is influenced by the interaction of biological, psychological, social, and environmental conditions. The findings suggest that natural-resource-based approaches can complement organizational interventions designed to manage the health consequences of flexible digital work.

Nevertheless, the study should avoid overstating the evidence. Natural-resource exposure should not be presented as a substitute for clinical treatment or as a universal solution to occupational stress. Its potential contribution lies in functioning as a complementary environmental resource within a broader employee-health strategy.

9. LIMITATIONS AND FUTURE RESEARCH

Several limitations should be acknowledged. First, even a longitudinal time-lagged design does not establish causality as strongly as a randomized experimental intervention. Future research could employ randomized or quasi-experimental designs comparing different nature-based interventions.

Second, several variables rely on self-reported assessments, which may introduce response bias. Future studies could incorporate objective indicators such as wearable-device measures, physiological stress indicators, activity levels, or validated sleep measures.

Third, access to natural resources may be strongly influenced by residential environment and socioeconomic conditions. Future research should examine environmental inequality explicitly.

Fourth, the machine-learning analysis is dependent on the quality and size of the dataset. Larger multisite samples would permit external validation of employee profiles and predictive models. Future studies could also employ explainable artificial intelligence to ensure that recommendations remain transparent and interpretable.

Finally, future research could investigate specific natural resources separately rather than treating natural-resource exposure as a broad construct. Comparisons between indoor plants, green views, outdoor exposure, natural light, and plant-derived interventions could identify which resources produce the strongest health-related effects.

Overall, the study suggests that the future of flexible work should not be conceptualized solely in terms of where employees work. A more comprehensive perspective should consider the environmental resources available to employees, their capacity to recover from digital work demands, and the conditions under which flexibility promotes rather than undermines health.

10. CONCLUSION

This study examined the relationship between flexible work arrangements, natural-resource-based approaches, employee recovery, and employee well-being among IT professionals, adopting an integrated longitudinal mixed-method and machine-learning approach. The findings indicate that flexible work can contribute positively to employee well-being, but its benefits are not uniform and depend substantially on the environmental and psychological resources available to employees. Natural-resource-based exposure emerged as an important environmental resource, demonstrating positive associations with employee recovery and well-being and strengthening the relationship between flexible work and well-being. Recovery further emerged as a significant mechanism through which natural-resource exposure may contribute to improved employee health, suggesting that opportunities for relaxation and psychological detachment are particularly important in digitally intensive work environments. The qualitative findings reinforced these relationships by demonstrating that employees perceive natural elements such as greenery, outdoor spaces, natural views, and short nature-based breaks as opportunities to reduce cognitive fatigue and temporarily disconnect from digital work. The machine-learning analysis further demonstrated considerable heterogeneity among employees, identifying distinct profiles characterized by different combinations of flexibility, natural-resource exposure, recovery, stress, and well-being. These findings extend the Job Demands–Resources perspective by conceptualizing access to natural environments as an additional environmental resource that can complement organizational resources such as autonomy and flexibility. The study therefore suggests that organizations should move beyond conventional flexible-work policies and consider the physical and environmental context in which flexible work is experienced. Nature-based workplace features, accessible green spaces, restorative breaks, and organizational support for recovery can be incorporated

into broader employee-health strategies, particularly for digitally intensive occupations. At the same time, natural-resource-based approaches should be viewed as complementary rather than substitutes for workload management, healthy work design, psychological support, and effective boundary management. By integrating flexible work research with environmental and human-health perspectives, the study highlights the potential of natural-resource-based approaches to contribute to healthier and more sustainable models of flexible work. Future research should validate these findings through experimental and physiological measures and examine specific types of natural resources to determine their differential effects on employee health and well-being.

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AUTHOR CONTRIBUTIONS

Shelley Shikhar: Conceptualization, Investigation, Writing & Editing.

Dr. Anant Deogaokar: Supervision, Methodology, ML Analysis, Review & Editing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was taken for this study.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

- [1] Allen, T. D., Golden, T. D., & Shockley, K. M. (2015). How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest*, 16(2), 40–68. <https://doi.org/10.1177/1529100615593273>
- [2] Bakker, A. B., & Demerouti, E. (2007). The job demands–resources model: State of the art. *Journal of Managerial Psychology*, 22(3), 309–328. <https://doi.org/10.1108/02683940710733115>
- [3] Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: Taking stock and looking forward. *Journal of Occupational Health Psychology*, 22(3), 273–285. <https://doi.org/10.1037/ocp0000056>
- [4] Bloom, N., Liang, J., Roberts, J., & Ying, Z. J. (2015). Does working from home work? Evidence from a Chinese experiment. *The Quarterly Journal of Economics*, 130(1), 165–218. <https://doi.org/10.1093/qje/qju032>
- [5] Charalampous, M., Grant, C. A., Tramontano, C., & Michailidis, E. (2019). Systematically reviewing remote e-workers' well-being at work: A multidimensional approach. *European Journal of Work and Organizational Psychology*, 28(1), 51–73. <https://doi.org/10.1080/1359432X.2018.1541886>
- [6] Grant, C. A., Wallace, L. M., & Spurgeon, P. C. (2013). An exploration of the psychological factors affecting remote e-worker's job effectiveness, well-being and work-life balance. *Employee Relations*, 35(5), 527–546. <https://doi.org/10.1108/ER-08-2012-0059>
- [7] Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, 35, 207–228. <https://doi.org/10.1146/annurev-publhealth-032013-182443>
- [8] Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, 15(3), 169–182. [https://doi.org/10.1016/0272-4944\(95\)90001-2](https://doi.org/10.1016/0272-4944(95)90001-2)
- [9] Kellert, S. R., Heerwagen, J., & Mador, M. (Eds.). (2008). *Biophilic design: The theory, science and practice of bringing buildings to life*. Wiley.
- [10] Korpela, K., De Bloom, J., Sianoja, M., Pasanen, T., & Kinnunen, U. (2017). Nature at home and at work: Naturally good? Links between window views, indoor plants, outdoor activities and employee well-being over one year. *Landscape and Urban Planning*, 160, 38–47. <https://doi.org/10.1016/j.landurbplan.2016.12.005>

- [11] Mouratidis, K., & Papagiannakis, A. (2021). COVID-19, internet, and teleworking: Lessons from the pandemic and the future of work. *Cities*, 110, 103106. <https://doi.org/10.1016/j.cities.2020.103106>
- [12] Nieuwenhuis, M., Knight, C., Postmes, T., & Haslam, S. A. (2014). The relative benefits of green versus lean office space: Three field experiments. *Journal of Experimental Psychology: Applied*, 20(3), 199–214. <https://doi.org/10.1037/xap0000024>
- [13] Oakman, J., Kinsman, N., Stuckey, R., Graham, M., & Weale, V. (2020). A rapid review of mental and physical health effects of working at home: How do we optimise health? *BMC Public Health*, 20, 1825. <https://doi.org/10.1186/s12889-020-09875-z>
- [14] Sonnentag, S., & Fritz, C. (2007). The Recovery Experience Questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. *Journal of Occupational Health Psychology*, 12(3), 204–221. <https://doi.org/10.1037/1076-8998.12.3.204>
- [15] Sonnentag, S., & Fritz, C. (2015). Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of Organizational Behavior*, 36(S1), S72–S103. <https://doi.org/10.1002/job.1924>
- [16] Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224(4647), 420–421. <https://doi.org/10.1126/science.6143402>
- [17] Van den Berg, A. E., Maas, J., Verheij, R. A., & Groenewegen, P. P. (2007). Green space as a buffer between stressful life events and health. *Social Science & Medicine*, 65(7), 1349–1359. <https://doi.org/10.1016/j.socscimed.2007.05.048>
- [18] White, M. P., Alcock, I., Grellier, J., Wheeler, B. W., Hartig, T., Warber, S. L., Bone, A., Depledge, M. H., & Fleming, L. E. (2019). Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Scientific Reports*, 9, Article 7730. <https://doi.org/10.1038/s41598-019-44097-3>