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# Determinants of employees' creativity: modeling the mediating role of organizational motivation to innovate

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## Abstract

The study aims to empirically investigate the effects of the work environment and family–work resource spillover on employees' creativity in agricultural research institutes. Additionally, this research proposes to examine the mediating role of organizational motivation to innovate in the relationships between the work environment and family–work resource spillover on employees' creativity. Using a sample of 302 researchers from agricultural research institutes in Ethiopia, the hypothesized relationships were tested through the partial least squares structural equation modeling (PLS-SEM) technique. The results reveal significantly positive direct effects of work group support and family–work resource spillover on employees' creativity. However, the results did not confirm the direct relationships of factors such as sufficient resources, reliable workload pressure, freedom, challenging work, managerial encouragement, and employees' creativity. The findings of the study contribute to our understanding of work contexts in agricultural research institutes and suggest ways in which administrators can create a conducive working environment to enhance employees' creativity.

**Keywords:** Creativity, Factors of work environment, Organizational motivation to innovate and family–work resource spillover

## Introduction

Organizational success today demands more work due to the uncertain business climate that today's firms operate in (Siyal et al., 2021). In the current dynamic and intensely competitive world, creativity is a vital source of competitive advantage and long-term success (Hughes et al., 2018). Employee creativity research was in its infancy until recently, with the majority of earlier studies concentrating on organizational innovation. In the new century, employee creativity started to draw more attention (Wang et al., 2022). Employees who are creative at workplace generate ideas that benefit the organization (El-Kassar et al., 2022). Employee creativity may effectively enhance organization development as the key driver of innovation within the organization and because creativity fosters innovation, growth, and competitiveness (Wang et al., 2022), most organizations invest heavily in finding effective ways to encourage employee creativity (Liu et al., 2020).

Research suggests that employees' creativity are influenced by many determinants including motivation (Liu et al., 2016), creative personal and role identities (Fischer et al., 2019), work contexts (Appu & Sia, 2017), and family–work resource spillover (Tang et al., 2017). Though there has been considerable research on employees' creativity via psychological, organizational, and work factors in isolation (Amabile & Pratt, 2016), the question remains: how do these determinants work collectively to contribute to employees' creativity? Despite evidence that these characteristics can all contribute to the creative process, the literature that focuses on these elements often does not take their overall influence into account. Indeed, in their review on creativity and innovation, Anderson et al. (2014) highlighted that the need to further explore employees' creativity and specifically how these determinants might work in combination towards employees' creativity. That is, by testing multiple determinants simultaneously.

This study applied the modified Amabile (1988) componential theory of creativity and innovation in organizations. Amabile (1988) demonstrated that the theory incorporates individual and organizational factors influencing employees' creativity at work and organizational innovation. However, Amabile and Pratt (2016) noted a limitation of the componential theory (Amabile, 1988), when implemented in the work context it primarily focuses on internal features within individuals and organizations, neglecting external features outside the organization. Consequently, Amabile and Pratt (2016) introduced external factors to the model. This addition addresses a gap in the creativity literature, as there is limited research investigating factors external to organizations, such as family and friends (Hong et al., 2018; Tang et al., 2017).

However, there are several studies that focus on the influence of such as political, economic and technological on creativity and organizational innovation (Serafinelli & Tabellini, 2021). Moreover, a large number of researchers have conducted research studies in exploring the relationship between culture and employees' creativity (Paletz, 2022; Parveen et al., 2015; Testad et al., 2013). As a result, this study tries to close this gap and investigate the impact of other important external variables that cover elements beyond organizational characteristics that may affect employees' creativity. It is important to determine whether social elements, such as family–work resource spillover from home to work, which are external variables of the organizational setting, affect employees' creativity. This study will solve the theoretical gap that presents direct investigation of the impact of family–work resource spillover on workers' creativity in the setting of developing nations.

Furthermore, in terms of the mediating role of organizational motivation to innovate, work motivation is described as the set of internal and external forces that initiate work-related behavior, and determine its form, direction, intensity, and duration (Fischer et al., 2019; Tan et al., 2019). As a direction for future research, Amabile and Pratt (2016) suggested the improvement and examination of organizational innovation, which includes resources, organizational motivation to innovate and management practices. The authors stated that the motif at the organizational level is the basic orientation of the organization towards creativity. Utilizing a variety of tools and ways to research employees' creative behavior has also been recommended by reviews of creativity (e.g., Lukes & Stephan, 2017). However, there is also a lack of empirical studies through which the combined influence of intrinsic and extrinsic motivation on employees' creativity should

be explored (Fischer et al., 2019). This study aims to examine the direct and mediating effects of organizational motivation to innovate for several reasons:

First, a broad collection of research demonstrating that, in a variety of contexts, intrinsic motivation generally promotes creative performance (e.g., Bodla & Naeem, 2014; de Jesus et al., 2013; Tan et al., 2019). Only intrinsic task motivation has been the subject of previous studies. In order to enhance creativity and innovation deliberately, extrinsic motivators must also be considered (Fischer et al., 2019). Understanding the impact of organizational drive to innovate as a summed variable on employees' creativity should be addressed in light of the gaps found from literature evaluations and future research directions. Second, Chen et al. (2021) argued that the frequency and intensity of employee creativity can be influenced by the social working environment. Maybe extrinsic motivation is a factor to boost creativity. For instance, (Byron & Khazanchi, 2012) pointed out that supplying incentives to encourage, motivate and can enhance individual creativity. Finally, creativity also varies greatly in their complexity or level of complication and difficulty, and this variability can affect team processes, reward expectations, and creative outcomes (Byron & Khazanchi, 2012; Malek et al., 2020; Malik & Butt, 2017). Therefore, since Ethiopia is a new context in which agricultural research institute sector adopt several practices of the developed world; creativity studies were rarely empirically examined. This study also examine whether organizational motivation to innovate, extrinsic motivator, influences employees' creativity directly or indirectly.

## Theory

### The dynamic componential model of creativity and innovation in organizations

Creativity is the development of original and practical ideas by an individual or group work by a few individuals (Amabile & Pratt, 2016; Liu et al., 2017). Organizational innovation consists of putting such original concepts into practice (Amabile, 1988). Amabile identified three important factors for the development of creativity and innovation (Amabile, 1988). Amabile's creative and innovative model consists: domain-relevant skills, creativity-relevant skills, and intrinsic-task motivation. Creativity is driven by domain-relevant skills such as technical know-how, factual information, and distinctive talent in a certain field. Domain-related knowledge can be creatively produced with the help of creativity-relevant skills. These skills include self-discipline, persistence, social abilities, risk-taking, a variety of experiences, and personal tactics that assist the person in adopting fresh views on a work. The term "intrinsic-task motivation" relates to a person's initial attitude and perceptions about completing a task.

Amabile and Pratt (2016) updated Amabile's well-known model of creativity and innovation in organizations to include the most recent theoretical advancements on motivational factors and their effects on individual and contextual multi-level approaches. The model includes new study findings on the following topics: the significance of work, work progress, affect, work orientations, external influences, and synergistic extrinsic motivation (Amabile & Pratt, 2016). It is frequently suggested that these elements have an impact on innovation and creativity within organizations (Baer, 2012; Davis, 2009; Fūzi et al., 2022; Tanjung et al., 2022). Their dynamic componential model of creativity and innovation in organizations is a complex, multivariate theory (Amabile & Pratt, 2016).

The model is broadly clustered into organizational innovation and individual creativity which are displayed as strongly interdependent (Amabile & Pratt, 2016). In order to create something new, both clusters are described using the same three fundamental multiplicative components: motivation, resources, and processes. Taking acts for satisfaction is one of the three elements of personal creativity (intrinsic motivation), individual skills and knowledge (skills), and thinking abilities and perceptual or cognitive styles (creativity-relevant processes). The three organizational innovativeness components include the openness to take new risks (motivation to innovate), the offering of funds, time, and labor (resources), in addition to relational and transactional incentives (HRM practices). This extensively used model has a solid foundation in the literature and has been used in different circumstances (e.g., Ashford et al., 2018; Fischer et al., 2019). As a result, the study employs this model as our analytical framework.

### **Family-work enrichment theory and resource spillover**

An overview of empirical studies on the positive interconnectedness between the family and work roles of an employee, Greenhaus et al. (2006) proposed a process of family-work enrichment. The enrichment process represented “a transfer of positive experiences” from family to work (p. 73). Describing the process from the aspect of resources, Chan et al. (2020) stated that positive experiences first need to develop into the employee’s personal resource, which then spill over across the family-work boundary. Personal resources, as opposed to contextual resources, are resources that are specific to an individual and can therefore cross the line between family and job (Hobfoll, 2002). These resources include physical as well as intangible ones like mental and emotional (Tang et al., 2017). In fact, the available indicators of family-work enrichment mostly capture the transfer of personal resources such as knowledge, happy feelings, and motivation (e.g., Carlson et al., 2019; Chan et al., 2020; Hanson et al., 2006; Lin et al., 2021). Additionally, prior research has shown that family activities, such as taking care of the home and getting enough sleep, enhance employees’ personal resources, such as their capacity for problem-solving and energy, which they bring with them into their work lives (Hobfoll, 2002; Lin et al., 2021). In this study, we cast the spillover of psychological resources as the key predictor of employees’ workplace creativity. Following previous accounts of family-work positive spillover (e.g., Grzywacz & Marks, 2000; Hanson et al., 2006; Kapadia & Melwani, 2021), we define family-work resource spillover as the experience of employees with the transfer of psychological resources produced at home to the workplace. Among the transferable resources, psychological resources are the internal resources that give individuals the vigor and zeal to tackle activities (Sonnentag et al., 2020), positive moods (Du et al., 2018) and motivations (Tang et al., 2017).

### **Hypotheses**

#### **The relationship between determinants of work environment and employees’ creativity**

Houghton and Dawley (2015) in order to sustain employee creativity and foster organizational innovation, it has been asserted that firms should work to improve the stimulants and remove the barriers. Employees’ creativity is influenced by a number of factors. For example, Suifan et al. (2018) illustrated that work resources can boost creativity. Similarly, (Amabile et al., 1996) stated that human’s creativity may

be psychologically affected by perceptions of the availability of appropriate resources by encouraging attitudes toward the intrinsic worth of the work that has been done. Managerial encouragement is also considered a factor that encourages employees' creativity. Koseoglu et al. (2017) argued that effective leadership requires managers to be creative, and their creativity can influence their team members' self-perception and creativity. According to Shalley et al. (2004) leadership must actively encourage, promote, and support creativity in order to make it possible.

In terms of work group support, in today's knowledge-intensive businesses, the majority of projects are carried out by teams of professionals that strive to be both productive and creative when launching new products, services, procedures, or ways of doing business (Amabile et al., 2004). Managers must therefore take into account how employees' peers affect their creativity (Li et al., 2020). McLean (2005) emphasized that people who stand out as being very creative are frequently deserving of independence and autonomy. Additionally, Al Harbi et al. (2019) illustrated, the development of an organizational environment might be a better approach for encouraging individuals' creativity where followers might have to expend a great deal of time and effort to develop their intellectual capacity, knowledge, and creative thinking skills.

Relating to innovation management capabilities, in order for followers to attain the organization's common vision and goals, leaders are said to act as an idealized role model, inspire innovative work behavior, offer inspirational motivation, and support and mentor followers (Bednall et al., 2018; Suifan et al., 2018). It has also been noted that in order to motivate people to engage in innovative work behavior, the organizational climate must incorporate specific traits such team cohesiveness, supervisor support, and autonomy (Sönmez & Yıldırım, 2019). Individualized care and support for followers' needs and requirements on the part of leaders may have a greater impact on followers' participation in creative endeavors. These leaders continually challenge and question followers' beliefs and presumptions, which stimulates followers' intellectual thinking and ultimately motivates followers to participate in the creation and application of ideas. These leaders are skilled at connecting the organizational vision to personal objectives, inspiring followers and boosting motivation (Bednall et al., 2018). It is, therefore, anticipated that leaders in innovation management would be able to motivate employees by linking their future to the direction of the organization and to encourage them to engage in employee creative behaviors by building a strong sense of shared vision and belonging with the organization (Afsar & Umrani, 2020).

In terms of organizational motivation to innovate, this includes both organizational encouragement and lack of organizational impediments. Amabile and Pratt (2016) provided several examples of organizational encouragement of creativity: (1) clear organizational goals, (2) value placed on innovation, and (3) support for reasoned risk-taking & exploration. The key function of a vision is the "clarity of and commitment to objectives" (West & Anderson, 1996, p. 682). To unite the team, focus their efforts, and inspire them to continue their creative pursuits, a clear and motivating vision should be created and shared with them (Gordon et al., 2017). Creativity and team innovation also benefit greatly from shared purpose and accountability as well as dedication to team goals and organizational objectives (Tang, 2019).

The creative process can be risky in many ways, including motivational, emotional, cognitive, and economic risks. It is uncertain and uncomfortable activity. To develop something new, one must leave their comfort zone, go against the trend, break with social conventions, and be prepared to fail (Tang, 2019). Others who feel comfortable, trustworthy, and supported by those around them are more likely to take risks. Team members that feel strongly connected to one another and like they belong on the team are more inclined to work together, communicate, and share ideas in organizational settings (Hülsheger et al., 2009). Therefore, it's critical for team members to establish an atmosphere of mutual respect and trust (Lam et al., 2021) and to create a welcoming and cooperative work environment where team members may interact, encourage one another, and work together to solve problems (Tiwana & McLean, 2005). Therefore, it is anticipated that factors determinants of work context will help to foster employees' creativity.

Hypothesis 1: Determinants of work environment: (a) sufficient resources, (b) realistic workload pressure (c) freedom (d) challenging work (e) work group support (f) managerial encouragement (g) organizational encouragement and (h) lack of organizational impediments are positively related to employees' creativity.

#### **The relationship between family–work resource spillover and employees' creativity**

Hennessey (2018) clarified that some creativity studies have shown that external factors influence employees' creativity. However, literature was limited regarding the influence of external factors on creativity (e.g., Chua et al., 2015; Horng & Lee, 2009; Kwan et al., 2018; Li et al., 2018; Tang et al., 2017). According to earlier research, family activities like taking care of the house and getting enough sleep help employees develop their personal resources, such as their energy and problem-solving skills, which they bring with them into their work lives (Tang et al., 2017; Zhu et al., 2018).

Employees who have happy home lives are likely to develop significant psychological resources. Resource spillover between family and work is driven and motivated by the accumulation of psychological resources (Akhtar et al., 2015; Greene, 2006; Kapadia & Melwani, 2021; Lin et al., 2021). Positive psychological moods produced in family life can be transferred into work life, which can lead to the spillover of psychological resources. For example, having a high level of energy at home might boost work activities (Mauno & Ruokolainen, 2017). Positive emotional states at home might transfer to the workplace. And, the level of motivation for work can be determined at home and influenced at work (Peña-Sarrionandia et al., 2015). Therefore, it is anticipated that social factors such as family–work resource spillover and employees' creativity will be positively correlated.

Hypothesis 2: family–work resource spillover is positively related to employees' creativity.

#### **The relationship between determinants of work environment, creativity and organizational motivation to innovate**

Regarding sufficient resources, Mumford et al. (2017) stated that employees must manage their time and energy more effectively when they engage in creativity-related tasks because coming up with new ideas is a time-consuming and hard task. When there are

sufficient resources, employees do not need to expend their time and effort looking for or asking for more resources from their organization. Instead, they may focus solely on the task at hand, think deeply, and put forth creative ideas without stressing over external constraints because they lack critical resources (Caniëls & Stobbeir, 2014). Adequate resources are necessary for developing an employee's creative potential because the development of new ideas is a labor- and resource-intensive task (Zhang et al., 2018).

When it comes to realistic workload pressure, Yoo et al. (2019) argue that top management should be encouraged to foster creativity as part of the organizational motivation to innovation (Amabile, 1997), must reduce workload pressure on creative employees. Further, Tang et al. (2020) discovered that the association between employees' creativity and daily time constraint was partially mediated by challenge appraisal. Related to this, Shao et al. (2019) noticed that employee integrative complexity and workload pressure interact to affect employee creativity in such a way that paradoxical leader behavior has the strongest positive relationship with creativity when workload pressure and integrative complexity are both high.

Several researches revealed that the relationship between employee freedom and creativity was mediated by different dimensions of organizational motivation to innovate. For instance, Siregar et al. (2021) determined that the association between job autonomy and innovative work behavior, such as idea generation, was mediated by participation in the workplace. Li et al. (2018) demonstrated that job autonomy initiates the motivational-cognitive processes associated with creativity, and support for supervisory autonomy enhances this relationship by virtue of the sequential mediation effects of intrinsic motivation and cognitive flexibility. Individuals should feel free from threat and work in supportive contexts in order to foster their creative cognitions (Wong et al., 2018). Chae et al. (2015) also argued that decision-making involvement can in fact help people become more creative.

Employees' intrinsic motivation and creative output at work are thought to be significantly influenced by the design of their jobs for a long time (Amabile, 1988; Oldham & Cummings, 1996). In particular, complex, demanding tasks (i.e., those distinguished by high degrees of autonomy, skill variation, identity, significance, and feedback) are anticipated to support and encourage greater levels of motivation and creativity than are relatively basic & routine activities (Lee, 2018; Liang et al., 2021). Chae and Choi (2018) showed that creative workers look for work challenges; as a result, organizations should give them a productive environment to work in. Chae et al. (2015) conducted a study with the finding that teammate interaction mediated the relationship between job difficulty and employees' creativity.

Regarding work group support, Kim (2019) expressed that employees' creativity may be significantly and positively influenced by their relationships with others at workplace. There is evidence that such an effect exists because team collaboration will result in the generation of more task-related information than the average team member would possess (e.g., Carmeli et al., 2015). Furthermore, when several ideas come together or when creative content from one field prompts or requires original thought in another, there may be synergistic effects (Zhu et al., 2018). These cooperative structural preconditions imply that creativity is the result of a social system of actors that enhance one another's creativity as well as the effort of individuals (Shalley et al., 2004). For instance, Carmeli

et al. (2015) discovered a significant association between relational information processing and employee creative behaviors, an active degree of interpersonal conduct that actively seeks out colleagues' inputs and reacts to employees' work.

When it comes to managerial encouragement, Shalley and Gilson (2004) revealed that managers may affect their workers' work surroundings to affect the level of creativity at work. Carmeli et al. (2015) claimed that relationships with coworkers could have a considerable, favorable impact on creativity and organizational innovation. Binyamin and Carmeli (2017) study indicated that employee satisfaction, which is defined as 'a feeling that one is learning and growing personally or professionally at work'. Furthermore, Henker et al. (2015) in their study, it was found the relationship between transformational leadership and employee creativity was mediated by promotion focus, it relates to the motivation to achieve desired end goals. As a result, it is predicted that organizational motivation to innovate mediates the association between determinants of working environment and employees' creativity.

Hypothesis 3: Organizational motivation to innovate mediates the relationship between determinants of work environment: (a) sufficient resources (b) realistic workload pressure (c) freedom (d) challenging work (e) work group support (f) managerial encouragement and employees' creativity.

#### **The relationship between family–work resource spillover, creativity and organizational motivation to innovate**

Researchers have focused a lot on how social ties and other relationships affect people have access to resources (Perry-Smith, 2006) in creativity an example would be the development of original and useful ideas (Anderson et al., 2014; Li et al., 2018). This social-ties approach on creativity has mostly adopted an informational stance. For instance, weak relationships have been argued (i.e. low emotional connection, infrequent interactions, and short-lived relationships) allowing access to specific social groups and so that to different information, while close relationships (i.e. relationships with a high degree of emotional closeness, frequency of interaction, and duration) enable access to similar individuals and, thus, similar information (Perry-Smith, 2003). The accessibility of diverse information therefore promotes creativity through unique connections and cognitive recombination (Perry-Smith, 2006; Rodan & Galunic, 2004; Sosa, 2011).

It is important that work family researchers start relating their studies to strategically aimed constructs that are of interest to organizational stakeholders (Kossek et al., 2018). Essentially, organizational stakeholders will be more willing to support work family solutions if researchers can show that these "family-focused" activities relate to and encourage characteristics that generate organizational effectiveness and success (Chua et al., 2015; Kossek et al., 2018; Xu et al., 2018), organizations can benefit from family-supportive research in terms of both employee well-being and organizational outcomes (Bagger & Li, 2014). Findings from a recent study that are consistent with this objective (Tang et al., 2017) imply that, under some circumstances, family factors (such as marital satisfaction) can enhance creativity at work through positive spillover. Further, another study Rofcanin et al. (2017) offers positive preliminary support for the association between family supportive influence and job performance. Therefore, it is expected that organizational motivation to innovate mediates the relationship between social factors



(family-work resource spillover) and employees’ creativity. The conceptual framework depicted in (Fig. 1) illustrates the relationships among the study variables..

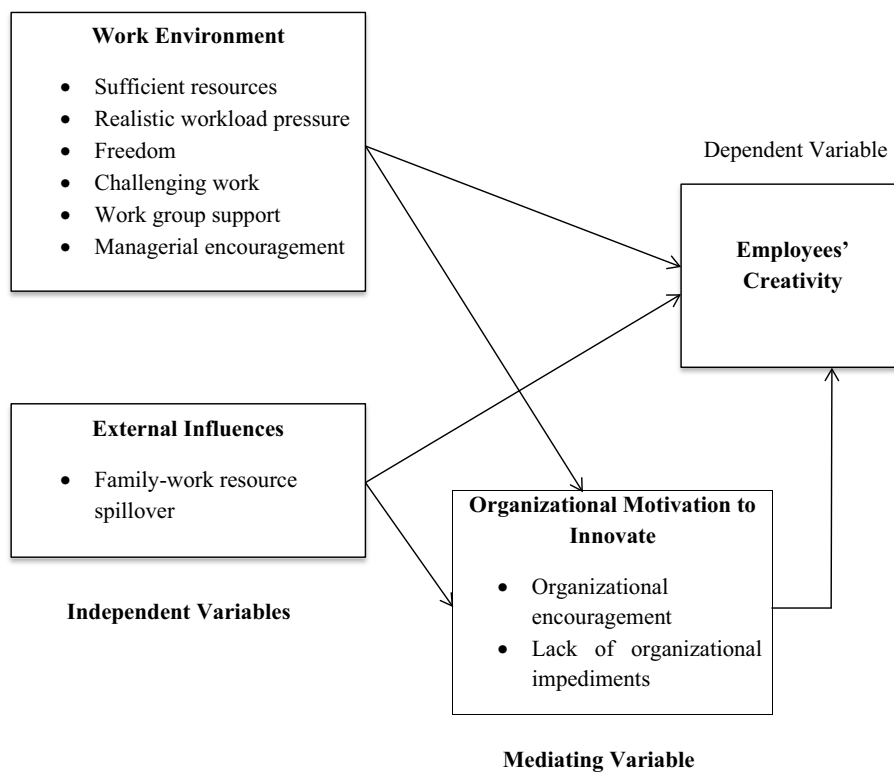
Hypothesis 4: Organizational motivation to innovate mediates the relationship between family–work resource spillover and employees’ creativity.

**Methods**

**Sample and data**

Yamane’s formula (1967, as cited in Israel, 1992) was utilized to determine the sample size for this study, resulting in a calculated size of 306.814. While this suggests a need for 306.814 replies, it is common practice to raise the sample size by 30% to account for potential nonresponses (Israel, 1992). Therefore, the sample size was adjusted to 400 to ensure accurate data collection. The study ultimately included 1317 researchers, with educational backgrounds distributed as follows: 378 with a BSc, 797 with an MSc, 6 with a DVM, and 136 with a PhD.

The study included all 17 research centers in the EIAR as the target population. These facilities were chosen because they collectively represent the diverse range of agricultural institutions within the Ethiopian economy. Following the approach outlined by Ragab and Arisha (2017), a three-stage multi-proportionate systematic random sampling method was employed to identify suitable respondents within each of the EIARs. In the first stage, purposive sampling was used to select EIAR researchers. The second stage involved stratified sampling to categorize respondents into four strata based on their degree levels: BSc, MSc, DVM, and PhD. In the third stage, proportionate



**Fig. 1** Conceptual framework of the study

systematic random sampling was applied, taking into account the years of experience of the employees.

In the sample majority 64.6 percent of the respondents were 'Men' while 35.4 percent were 'Female'. In terms of age, majority 67.6 percent of the respondents were less than 35 years, 14.9 percent were 36–40 years, 14.2 percent were 41–45 years and least 3.3 percent were above 45 years respectively. Regarding the highest level of education of the respondent, 59.3 percent of participants had a master's degree, followed by 28.1 percent were bachelor's degree, 11.9 percent PhD, 0.7 percent were DVM. In terms of experience, majority 38.8 percent of the respondents were above 7 to 9 years followed by 30.1 percent were 4 to 6 years, 21.2 percent were above 10 years and least 9.9 percent were less than 3 years, respectively.

### **Instruments and measures**

The survey strategy is popular in social sciences and associated with deductive research approach (Rahi, 2017). According to Jenny Rowley (2014) when a researcher wants to profile a sample in terms of statistics or determine the frequency of beliefs, attitudes, processes, behaviors, experience, or forecast, a questionnaire is utilized. Questionnaire should not only suit with the research and the researcher but also to respondents (Rahi, 2017; Rowley, 2014). Extending to this, Khalid et al. (2012) stated that in the data collection process, the most efficient technique is to use a questionnaire, especially when the researcher knows exactly what questions should be asked and how to quantify the elements. As the research method is quantitative it seems perfect to use survey questionnaire for inquiry mode (Khalid et al., 2012; Rahi, 2017; Rahi et al., 2019) (detailed in Additional file 1).

### **Statistical procedure**

The study employed Smart PLS (4.0.7.8), a statistical tool to examine the data through partial least squares structural equation modeling (PLS-SEM), a variance-based structural equation modeling technique. PLS-SEM is based on maximizing the explained variance of the endogenous latent variables. In particular, it is appropriate for exploratory and predictive studies (Manley et al., 2021). This study followed the standard evaluation guidelines on reporting PLS-SEM results (e.g., Hair et al., 2017, 2021; Henseler et al., 2016). Many management disciplines are recognized the case for PLS-SEM as a viable methodology. For example, PLS-SEM differs from CB-SEM in that it does not impose minimal criteria or constrictive assumptions on measurement scales, distributional assumptions or sample sizes (Hair et al., 2017; Sarstedt et al., 2021). The following rationales support the use of PLS-SEM in this study:

First, the study modeled work environment and family–work resource spillover with the Ethiopia institute agricultural research employees' creativity as composites estimated in conceptual model (Henseler et al., 2016). Second, the study used work environment, and family–work resource spillover to predict employees' creativity, responding to the call to use PLS-SEM as a prediction-oriented approach to SEM (Manley et al., 2021; Purwanto & Sudargini, 2021). Third, the study model shows a relatively complicated structure with a number of manifest and latent variables and the presence of multi-dimensionality in the constructs included in the model (Hair et al., 2017; Sarstedt et al.,

2021). Fourth, it is believed that the model's structural relationships are still in the early stages of theory development or extension, enabling the exploration and development of new phenomena (Richter et al., 2015). Finally, the benefits of PLS-SEM in terms of less rigorous standards or restricted assumptions allowed us to develop and estimate our model without adding extra restrictions (Hair et al., 2019; Purwanto & Sudargini, 2021).

### Analysis and results

According to the standard evaluation guidelines on reporting PLS-SEM results (Hair et al., 2017), three stages are involved in PLS-SEM analysis and interpretation: (1) assess the reliability and validity of the measurement model, (2) assessment of the structural model, and (3) structural equation modeling/global model fit assessment.

#### Measurement model

The evaluation of the measurement model in PLS-SEM was based on the individual indicator reliability, composite reliability (CR), average variance extracted (AVE) and discriminant validity of the constructs.

The reliability of all reflective constructs was evaluated by analyzing two types of reliability of indicators: Cronbach's alpha (CA) and composite reliability (CR). The recommended value is  $\geq 0.70$  for all types of reliability (Hair et al., 2011). The values of Cronbach's alpha, and composite reliability exceeded 0.70, confirming the convergence or internal consistency of all constructs (Additional file 2).

The average variance extracted (AVE) provides an indication of convergent validity. Fornell and Larcker (1981) recommend an AVE value  $\geq 0.50$ , which means that  $\geq 50\%$  of the indicator variance should be accounted for. Consistent with this recommendation, all constructs had AVE values that exceeded this value (Additional file 2). Moreover, we assessed the discriminant validity based on (Hair et al., 2017) guidelines. We employed Fornell and Larcker criterion. As per the Fornell and Larcker (1981) criterion, the square root of the construct was greater than the absolute value of their respective correlations. Table 1 shows that the results for the cross loadings of all indicators or dimensions loaded higher on their respective constructs than on the other constructs, and the cross-loading differences were much higher than the suggested threshold of 0.10 (Gefen & Straub, 2005).

**Table 1** Discriminant validity (Fornell-Larcker criterion)

	ChallW	Creativity	FaWoSpi	Freedom	ManagEnc	OrgMoln	RealWLP	SuffrR	WorkGSu
ChallW	0.856								
Creativity	0.113	0.81							
FaWoSpi	0.122	0.739	0.818						
Freedom	0.193	0.089	0.028	0.803					
ManagEnc	0.172	0.343	0.361	0.111	0.86				
OrgMoln	0.173	0.757	0.686	0.163	0.29	0.867			
RealWLP	0.277	0.135	0.126	0.159	0.16	0.15	0.845		
SuffrR	-0.031	0.155	0.107	0.094	0.025	0.152	0.207	0.811	
WorkGSu	0.177	0.684	0.782	0.084	0.456	0.622	0.131	0.081	0.827

**Table 2** Collinearity statistics (outer VIF values)

	VIF		VIF		VIF		VIF
ChallW1	3.72	LacOrglm1	2.832	OrgEnc1	4.163	SuffiR1	3.088
ChallW2	2.597	LacOrglm10	4.123	OrgEnc10	5.708	SuffiR2	2.591
ChallW3	2.314	LacOrglm4	3.553	OrgEnc11	8.673	SuffiR3	3.511
ChallW4	3.869	LacOrglm6	6.563	OrgEnc2	4.272	SuffiR4	2.934
Creativity1	1.646	LacOrglm7	4.004	OrgEnc3	5.65	SuffiR5	3.162
Creativity2	4.011	LacOrglm9	4.522	OrgEnc4	3.728	SuffiR6	3.639
Creativity3	2.585	ManagEnc1	3.483	OrgEnc5	3.12	WorkGSu1	2.255
Creativity4	4.117	ManagEnc2	7.775	OrgEnc6	3.923	WorkGSu2	2.18
Creativity5	2.278	ManagEnc4	2.109	OrgEnc8	5.291	WorkGSu4	2.136
Creativity6	1.836	ManagEnc6	3.289	OrgEnc9	3.561	WorkGSu5	2.532
FaWoSpi1	1.698	ManagEnc7	5.408	RealWLP1	1.964	WorkGSu6	1.95
FaWoSpi2	1.68	ManagEnc8	5.078	RealWLP2	4.235		
FaWoSpi3	1.334	ManagEnc9	2.684	RealWLP3	2.692		
Freedom1	4.891			RealWLP4	2.012		
Freedom2	3.383						
Freedom3	4.852						
Freedom4	3.199						

VIF: variance inflation factor

**Table 3** Collinearity statistics (inner VIF values)

	ChallW	Creativity	FaWoSpi	Freedom	ManagEnc	OrgMoIn	RealWLP	SuffiR	WorkGSu
ChallW		1.159				1.153			
Creativity									
FaWoSpi		3.164				2.606			
Freedom		1.096				1.068			
ManagEnc		1.293				1.293			
OrgMoIn		2.06							
RealWLP		1.167				1.166			
SuffiR		1.081				1.072			
WorkGSu		2.943				2.865			

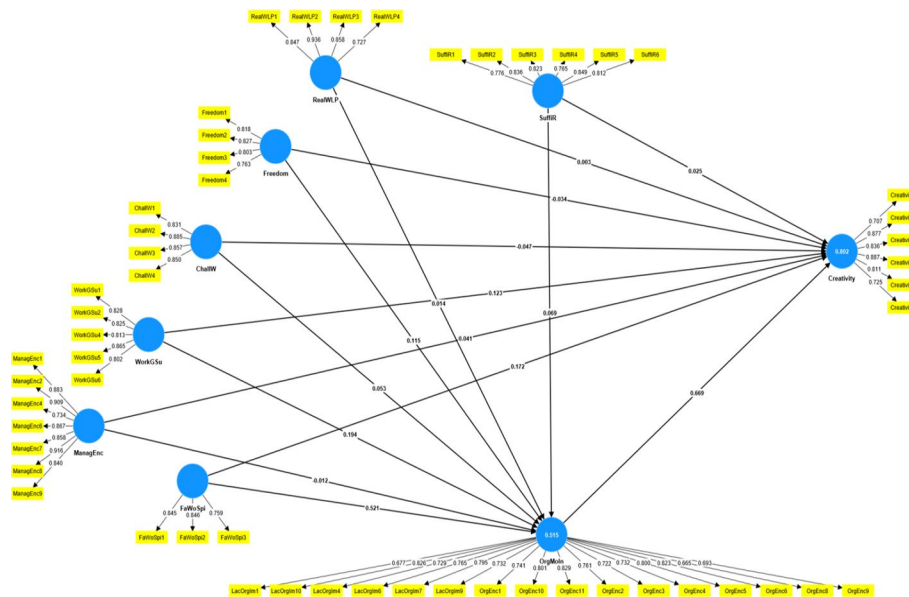
**Assessment of structural model**

The study addressed the concern of multicollinearity in the dataset by employing the variance inflation factor (VIF). Aiken et al. (1991) recommended that the values of VIF must be < 10, and this study found VIF values within the suggested range, depicting no issue of multicollinearity in the data set (see Tables 2 and 3). Next, the structural model was evaluated using the standardized root mean square residual (SRMR) values should be lower than 0.08 for a sample size greater than 100 (Henseler et al., 2016). As a result, we found a significant model fit for this study (0.066). The values of coefficient of determination ( $R^2$ ) 0.75 or 0.5 for endogenous latent variables can as a rough rule of thumb, be respectively described as substantial or moderate. (Hair et al., 2010, 2019). Table 4 shows that  $R^2_{(Creativity)} = 0.802$  and  $R^2_{(Organizational Motivation to Innovate)} = 0.515$ , the structural model had satisfactory in-sample predictive power, consistent with prior research in this area (Ali et al., 2019; Fischer et al., 2019). Moreover, the value of  $Q^2$  should be higher

**Table 4** Saturated model results

Construct	R2	R2 Adjusted	Q <sup>2</sup> predict	SRMR
Creativity	0.802	0.797	0.560	0.066
OrgMoln	0.515	0.503	0.482	

SRMR: Standardized root mean square residual; R2: determination of coefficient; Q<sup>2</sup>: cross-validated redundancy



**Fig. 2** PLS-SEM showing relationships in variables (Ringle et al., 2022)

than zero. Hence, this study’s results were both within the significance level, and the study model’s predictive relevance was achieved (see Table 4) (Falk & Miller, 1992).

**Structural equation modeling**

The modified model and hypotheses exclusively considered indirect relationships. This approach was chosen as testing the mediating effects requires the preliminary examination of direct relationships. The following hypotheses were assessed using PLS-SEM.

H1: Organizational motivation to innovate mediates the relationship between determinants of work environment: (a) sufficient resources (b) realistic workload pressure (c) freedom (d) challenging work (e) work group support (f) managerial encouragement and employees’ creativity.

H2: Organizational motivation to innovate mediates the relationship between family–work resource spillover and employees’ creativity.

The sizes and significance of the path coefficients that reflect the hypotheses were examined. Bootstrap resampling method with 5000 resamples (Hair et al., 2013) was used to determine the significance of the path coefficients. Figure 2 provides structural model results and Table 5 provides the path coefficients, standard deviation, *t*-statistics, and *p*-values.

**Table 5** Hypothesis constructs (path coefficients, Mean, STDEV, *T* values, *p* values)

Effects	Relationships	Beta	Sample mean (M)	STDEV	<i>t</i> -vales	<i>p</i> values	Decision
H1a	SuffiR—>Org-MoIn->Creativity	0.046	0.05	0.026	2.013	0.044	H1a; supported
H1b	RealWLP->Org-MoIn->Creativity	0.009	0.011	0.029	0.329	0.743	H1b; not supported
H1c	Freedom->Org-MoIn->Creativity	0.077	0.078	0.031	2.485	0.013	H1c; supported
H1d	ChallW->Org-MoIn->Creativity	0.053	0.039	0.028	2.028	0.043	H1d; supported
H1e	WorkGSu->Org-MoIn->Creativity	0.13	0.132	0.043	3.048	0.002	H1e; supported
H1f	ManagEnc->Org-MoIn->Creativity	-0.008	-0.008	0.027	0.306	0.759	H1f; not supported
H2	FaWoSpi->Org-MoIn->Creativity	0.349	0.345	0.043	8.131	0	H2; supported

The PLS-SEM findings show that (H1<sub>a</sub>) testing the direct effects between availability of sufficient resources and employee creativity, showed a non-significant relationship ( $\beta=0.071$ ,  $t=1.778$ ,  $p=0.076$ ). While, the indirect effects of organizational motivation to innovate between the relationship of sufficient resources and employees’ creativity were significant with ( $\beta=0.046$ ,  $t=2.013$ ,  $p=0.044$ ). Thus, it was concluded that organizational motivation to innovate fully mediated the relationships between sufficient resources and employees’ creativity. Thus, H1<sub>a</sub> was supported. Nevertheless, the results show that (H1<sub>b</sub>) realistic work load pressure has non-significant relationship on employees’ creativity ( $\beta=0.013$ ,  $t=0.320$ ,  $p=0.749$ ). In terms of the mediating effects, the result showed no indirect effects of realistic work load pressure, via organizational motivation to innovate on creativity ( $\beta=0.009$ ,  $t=0.329$ ,  $p=0.743$ ). Thus, H1<sub>b</sub> was not supported.

(H1<sub>c</sub>) testing the direct effects between freedom and employee creativity showed non-significant relationship on employees’ creativity ( $\beta=0.043$ ,  $t=1.133$ ,  $p=0.257$ ). While, the indirect effects of organizational motivation to innovate between the relationship of freedom and employees’ creativity were significant with ( $\beta=0.077$ ,  $t=2.485$ ,  $p=0.013$ ). Thus, it was concluded that organizational motivation to innovate fully mediated the relationships between freedom and employees’ creativity. Similarly, there is non-significant direct effect of challenging work on employees’ creativity ( $\beta=-0.011$ ,  $t=0.283$ ,  $p=0.777$ ). Whereas, the indirect effects of organizational motivation to innovate between the relationship of challenging work and employees’ creativity were significant with ( $\beta=0.053$ ,  $t=2.028$ ,  $p=0.043$ ). Thus, it was concluded that organizational motivation to innovate fully mediated the relationships between challenging work and employees’ creativity (H1<sub>d</sub> was supported).

The results show that (H1<sub>e</sub>) work group support has a significant and positive effects on employees’ creativity ( $\beta=0.253$ ,  $t=3.874$ ,  $p=0.000$ ), and the indirect effects of organizational motivation to innovate between work group support and employees’ creativity were significant with ( $\beta=0.13$ ,  $t=3.048$ ,  $p=0.002$ ) which shows partial mediation in the model. However, the results show that (H1<sub>f</sub>) managerial encouragement has non-significant relationship on employees’ creativity ( $\beta=0.033$ ,  $t=0.760$ ,  $p=0.447$ ).

In terms of the mediating effects, the result showed no indirect effects of managerial encouragement, via organizational motivation to innovate on creativity ( $\beta = -0.008$ ,  $t = 0.306$ ,  $p = 0.759$ ). Thus, H1<sub>f</sub> was not supported.

Moreover, (H2) family–work resource spillover has significant and positive effects on employees' creativity ( $\beta = 0.0521$ ,  $t = 7.654$ ,  $p = 0.000$ ), and the indirect effects of organizational motivation to innovate on creativity between family–work resource spillover and employees' creativity were significant with ( $\beta = 0.349$ ,  $t = 8.131$ ,  $p = 0.000$ ) which shows partial mediation in the model. Thus, H2 were supported.

### Robustness test of model specification

Creating methods to assess the robustness of the structural model results is a crucial task. This includes examining nonlinear effects and endogeneity, which are considered essential in PLS-SEM analyses (Hair et al., 2016). Sarstedt et al. (2020) have suggested a method for discovering and treating nonlinear effects and endogeneity that relies on an assortment of latent class processes after reviewing the existing methodologies. The PLS-SEM bootstrap The findings reveal that all factors have a quadratic effect and the Gaussian copula p values are  $> 0.05$ . Thus, nonlinear effects and endogeneity test results have strengthened the robustness of the methodology (detailed in Additional file 3).

### Discussion and conclusions

The primary objectives of this study were to examine: (a) the direct influence of the work environment and family–work resource spillover on employees' creativity, and (b) the mediating effect of organizational motivation to innovate in the relationship between the work environment, family–work resource spillover, and employees' creativity within agricultural research institutes. The hypothesized relationships were tested using the PLS-SEM technique. To assess the mediating effects of organizational motivation to innovate, direct relationships between determinants of the work environment and employees' creativity were examined. The statistical analysis of this study revealed a direct relationship between organizational motivation to innovate and employees' creativity. As organizational motivation to innovate acts as the mediator, the direct relationship between organizational motivation to innovate and employees' creativity led to full, partial, or no mediation effects.

According to Fischer et al. (2019) organizations should make an effort to improve the working environment and remove the barriers to maintain employee creativity and foster organizational innovation. Moreover, ElMelegy et al. (2016) stated that leaders should do is create an environment that encourages creativity by removing organizational barriers and putting in place well-organized systems for recognizing and rewarding creative behavior. As a result, the outcome was consistent with prior studies showed positive relationships between employees' creativity and dimensions of organizational motivation to innovate, for instance reward (e.g., Eisenberger & Rhoades, 2001; Eisenberger et al., 2020; Fischer et al., 2019; Yoon et al., 2015), incentives (e.g., Malik & Butt, 2017; Malik et al., 2019).

The statistical analysis of this study showed a non-significant direct relationship between sufficient resources and employees' creativity. Interestingly, these results contradict findings of Dul and Ceylan (2011), Rasulzada and Dackert (2009) and Sonenshein

(2014) a positive relationship between both variables. However, findings of this research validate no-significant relationship (Mueller & Kamdar, 2011; Ramos et al., 2018; Yeh & Huan, 2017). The findings addressing mediating effects, which demonstrated positive indirect impacts of sufficient resources through organizational motivation to innovate on employee creativity, support the prior argument that sufficient resources alone are insufficient for creativity. In a similar vein, access to resources and entrepreneurial creativity did not seem to be directly associated instead, having an access to resources is just a subdued way to encourage creativity at workplace (Zhou et al., 2008). The findings of this study make it clear that sufficient resources by itself do not foster employee creativity. The availability of organizational motivation to innovate, however, contributes to indirectly improve creativity.

The study found that a non-significant direct relationship between realistic work load pressure and employees' creativity. Moreover, the result of mediating effects showed no indirect effects of realistic work load pressure via organizational motivation to innovate on employee creativity. Thus, H1<sub>b</sub> hypothesis was not supported. In the literature, various types of work pressure have been examined in relation to employees' creativity: workload pressure (e.g., ElMelegy et al., 2016; Mumford et al., 2013), time pressure (e.g., Baer & Oldham, 2006), and with both workload and time pressure (Shao et al., 2019). High workload pressure will force employees' to use simple and ineffective methods that are less creative. As a result of the lack of time for creativity, excessive workload pressure has a detrimental effect (Mumford et al., 2010). On the other hand, Aleksić et al. (2017) has been discovered that there is a positive, negative, or no relationship between creativity and time pressure. There are a few research indicates that when the work's domain shifts, for instance in high-pressure jobs requiring high creativity, concentrating on important activities enhances employee creativity. Thus, the domain's nature could be used to explain the present study's inconsistent results. This may require further investigation.

Results of the study demonstrate that direct relationship between freedom and employees' creativity is a non-significant. These results are consistent with the findings of recent research conducted by (e.g., Naranjo-Valencia et al., 2011; Zhang et al., 2020). However, these results contradict findings of Wheatley (2011). Moreover, the result of mediating effects showed an indirect effect of freedom via organizational motivation to innovate on employees' creativity. Several researches revealed that the relationship between employee freedom and creativity was mediated by different dimensions of organizational motivation to innovate. For instance, Siregar et al. (2021) determined that the association between job autonomy and innovative work behavior, such as idea generation, was mediated by participation in the workplace. Li et al. (2018) demonstrated that job autonomy initiates the motivational-cognitive processes associated with creativity, and support for supervisory autonomy enhances this relationship by virtue of the sequential mediation effects of intrinsic motivation and cognitive flexibility. Individuals should feel free from threat and work in supportive contexts in order to foster their creative cognitions (Wong et al., 2018). Chae et al. (2015) also argued that decision-making involvement can in fact help people become more creative.

The present study found that a non-significant direct relationship between challenging work and employees' creativity. On the other hand, the result of mediating effects



showed positive indirect effects of challenging work through organizational motivation to innovate on employee creativity. Thus, H1<sub>d</sub> hypothesis was supported. Several empirical researches have looked at how challenging work affects employees' creativity, but the results were inconsistent and inconclusive. For example, while some studies have found a positive relationship between challenging work and employees' creativity (e.g., Carmeli et al., 2007; Ramos et al., 2018; Zhang et al., 2015), others indicated that challenging work was not associated with employee creativity directly (e.g., Rasulzada & Dackert, 2009; Zhou et al., 2012). The full mediation effects of organizational motivation to innovate on the relationship between challenging work and employees' creativity, as the findings of the present study, which support the case for assessing the context in which challenging work within the institutes exists. Employees' intrinsic motivation and creative output at work are thought to be significantly influenced by the design of their jobs for a long time (Amabile, 1988; Oldham & Cummings, 1996). In particular, complex, demanding tasks (i.e., those distinguished by high degrees of autonomy, skill variation, identity, significance, and feedback) are anticipated to support and encourage greater levels of motivation and creativity than are relatively basic & routine activities (Lee, 2018; Liang et al., 2021). Chae and Choi (2018) showed that creative workers look for work challenges; as a result, organizations should give them a productive environment to work in.

The statistical analysis of the study showed a significant direct relationship between work group support and employees' creativity. In addition, the results indicate that organizational motivation to innovate has a partial mediating effect between the relationships of work group support and employees' creativity. Empirical studies showed direct positive relationship outcomes (e.g., Farmer & Kung-mcintyre, 2003; Foss et al., 2013; Kremer et al., 2019; Lin & Liu, 2012; Ramos et al., 2018; Tierney & Farmer, 2011) in alignment with findings reported in this study and some showed non-significant associations between work group support and employee creativity (e.g., Foss et al., 2013; Rasulzada & Dackert, 2009). The findings of the partial mediating effect, which demonstrated a positive indirect effect of work group support via organizational motivation to innovate on employees' creativity, support the argument of some researchers for instance, Carmeli et al. (2015) discovered a significant association between relational information processing and employee creative behaviors, an active degree of interpersonal conduct that actively seeks out colleagues' inputs and reacts to employees' work. In conclusion this study finding highlights the need for additional research to examine the conditions in which work group support might foster employees' creativity, particularly in diverse contexts and by assessing diverse constructs.

The present study found that a non-significant direct relationship between managerial encouragement and employees' creativity. Moreover, the result of mediating effects showed no indirect effects of managerial encouragement via organizational motivation to innovate on employee creativity. The empirical evidence regarding the relationship between the two variables is mixed. For instance, managerial encouragement has drawn significant research attention as a critical element that could positively influence employees' creativity in contemporary creativity literature (e.g., Chang & Teng, 2017; Chen & Hou, 2016; Khalili, 2016; Kim & Yoon, 2015; Kremer et al., 2019). According to other studies, managers do not significantly impact their employees' creativity (e.g., Binnewies et al., 2008; Foss et al., 2013). These

inconsistent findings highlight the need for additional study to clarify the nature of this relationship between managerial encouragement and employees' creativity and offer conclusive evidence.

The statistical analysis of this study showed a significant direct relationship between family–work resource spillover and employees' creativity. The result of mediating effects showed positive indirect effects of family–work resource spillover via organizational motivation to innovate on employees' creativity. Examining the impact of family–work resource spillover as an external variable on employees' creativity supports Tang et al. (2017) argument, the psychological resources that an employee brings to work can enhance their creativity. An individual's momentary thinking and thought-action repertoire are expanded by psychological resources, allowing them to recognize a wide range of alternatives (Fredrickson, 2001). Therefore, the findings provide evidence of family–work resource spillover on the relationship between, not only individual or/ and organizational factors, but also external factors such as family–work resource spillover and employees' creativity is characterized by the EIAR.

In conclusion, the results revealed that family–work resource spillover is an important source of psychological resources that facilitate employees' creativity at work. According to Amabile and Pratt (2016) suggestion, variables outside of the organizations may have an impact on employees' creativity, the current study examined the direct and indirect relationship between family–work resource spillover and employees' creativity. Although no research have yet looked at the association between family–work resource spillover and employees' creativity, other relevant evidence can help in explaining this finding.

### **Theoretical contributions**

The study enhances the dynamic componential model of creativity and innovation within organizations by examining the influence of a novel external variable, namely family–work resource spillover, on employees' creativity. While existing research extensively explores the impact of determinants such as political, economic, and technological factors on creativity and organizational innovation, and numerous studies delve into the relationship between culture and employees' creativity, there remains a gap in understanding how other significant external variables, beyond organizational characteristics, may influence creative outcomes. This study aims to address this gap by investigating the impact of crucial external variables that extend beyond typical organizational parameters. Specifically, it explores whether social elements, such as family–work resource spillover from home to work, as external variables in the organizational setting, have a discernible effect on employees' creativity. By examining these dynamics, we contribute to a more comprehensive understanding of the factors shaping creative processes within the organizational context.

Moreover, the study expands on the examination of both the direct and indirect effects of organizational motivation to innovate, treated as a summated variable. Concerning the mediating role of organizational motivation to innovate, work motivation is defined as the amalgamation of internal and external forces that instigate work-related behaviors.

### Practical contributions

The empirical results from the PLS-SEM analysis have significant practical and managerial implications for organizations based on how work environment and family–work resource spillover impacts the development of employees' creativity. First, regarding the relationship between various factors and employees' creativity, the existing literature has provided inconsistent outcomes. The findings of the present study are relevant because they offer additional evidence of the nature of the relationship in the EIAR context. Second, when considering employees' creativity, managers must take the required changes into account. Individual preferences, fundamental concerns, and problem-solving approaches can change over time, demanding improvements to ensure the right fit between individuals' creative potential and their work environment.

### Limitations and future research directions

In addition to its contribution to the literature, the present study includes some limitations that expand future research directions. First, because we only collected data through self-reporting in our study, we were unable to get an "outside" or "independent" viewpoint on the opinions of the participants. Participants may describe themselves differently for a variety of conscious and unconscious reasons, making self-reported data susceptible to inaccuracies (Roth et al., 2022). Second, in the current study, the idea of creativity as a single construct relating to idea generation was covered (Amabile et al., 1996, p. 1), while some studies have analyzed and compared various forms of creativity and their affecting elements, such as radical and incremental creativity (Madjar et al., 2011). Thus, there is a need for future studies that examine such types of creativity and their influencing factors. Third, the current study focused only on the individual level Amabile (1997) stated that the model can be applied to individuals and small teams. According to Nijstad and De Dreu (2002) understanding what impedes or encourages creativity and group innovation is crucial since groups are important organizational building blocks in the workplace. It is therefore necessary to analyze the same model using a different unit of analysis, such as a team, in order to better understand the variables that affect group creativity. Finally, the current study contributed to the literature by investigating the impact of family–work resource spillover as an external factor to organizations. However, there remains a need to examine other external factors, such as government rules and regulations, customers, public opinion and globalization.

### Abbreviations

AVE	Average variance extracted
CA	Cronbach's alpha
CR	Composite reliability
ChallW	Challenging Work
FaWoSpi	Family–work resource spillover
ManagEnc	Managerial encouragement
OrgMoln	Organizational motivation to innovate
PLS-SEM	Partial list square structural equation modeling
RealWLP	Realistic work load pressure
SuffIR	Sufficient resources
UoG	University of Gondar

WorkGSu Work group supports

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13731-024-00364-w>.

**Additional file 1.** Survey questions.

**Additional file 2.** Measurement model.

**Additional file 3.** Quadratic effect & Gaussian copula results.

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### Study Location

The study was carried out in Ethiopia; the data were collected from researchers working in the Ethiopian Institute of Agricultural Research (EIAR).

### Author contributions

YMY was responsible for the theoretical background, research design, survey implementation, data evaluation, and discussion. The first draught of the manuscript was written by YMY. DAG and ATD performed the critical assessment and manuscript edits. The submitted version was read and approved by all writers. DAG and ATD have given their formal permission for the manuscript to be submitted in this format. YMY has taken on the role of informing DAG and ATD on the progress of the editorial review process, the content of reviews, and any revisions made.

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### Availability of data and materials

Datasets for the study are available, and the same can be obtained from the corresponding author on reasonable request.

### Declarations

#### Competing interests

The authors declare that they have no competing interests.

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