



FACTORS DRIVING PUSH AND PULL DYNAMICS OF LIVELIHOOD DIVERSIFICATION IN THE KUTTANAD WETLAND FARMING SYSTEM

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ABSTRACT

Livelihood diversification has become a vital survival and growth strategy for farming communities worldwide, especially in regions where agricultural productivity is constrained by environmental, socio-economic, and institutional challenges. In developing economies, where agriculture remains central to rural livelihoods, diversification into non-farm and allied activities functions both as a coping mechanism and a pathway to resilience. This study examines the research identifies push and pull factors influencing diversification in the Kuttanad Wetland Farming System Employing "Structural Equation Modelling (SEM)" with "Confirmatory Factor Analysis" (CFA). Push factors, or distress-driven motives, include food insecurity, environmental threats, seasonal unemployment, and a poor asset base. These conditions compel farmers to seek alternative income sources for survival. For example, recurrent floods and salinity intrusion reduce paddy productivity, leaving households vulnerable to shortages and instability. Limited landholdings and inadequate assets further force smallholders to explore supplementary occupations. Conversely, pull factors represent opportunity-driven motives such as higher returns, employment opportunities, and additional household income. These attract farmers towards diversification into wage labour, small-scale enterprises, and allied agricultural practices. The study demonstrates that while push factors create necessity, pull factors provide incentive and aspiration. Findings reveal that food insecurity (regression coefficient 0.835) and higher returns (0.935) are the strongest drivers of diversification among Kuttanad's wetland farmers. This duality underscores the interplay between vulnerability and opportunity in shaping livelihood strategies. The research also identifies systemic constraints to both paddy farming and diversification, including inadequate institutional support, poor rural infrastructure, limited credit access, and insufficient skill development programs. These gaps hinder the sustainability of paddy cultivation and restrict diversification effectiveness. The SEM-CFA framework provides robust evidence that institutional weaknesses exacerbate dependence on precarious livelihood options, limiting long-term resilience. Policy implications emphasize strengthening institutional mechanisms, improving infrastructure, expanding credit access, and enhancing skill development. Sustainable environmental management is also critical to mitigate ecological threats undermining paddy farming. By situating livelihood diversification within the socio-ecological realities of wetland farming systems, this study contributes to rural development discourse, highlighting diversification as both an economic choice and a survival imperative shaped by structural vulnerabilities and mediated by institutional support. The findings offer valuable insights for policymakers, practitioners, and researchers designing interventions that balance agricultural sustainability with livelihood security in fragile ecosystems.

KEYWORDS: Livelihood Diversification, Farmers, Wetlands, Kuttanad Region, Pull factors, Push factors, "Confirmatory Factor Analysis (CFA)", "Structural Equation Modelling", SEM-CFA framework.

Livelihood diversification is the practice by which households engage in a variety of economic activities and build communal support networks to enhance their living conditions and safeguard against risks Sharma and Malik et al., (2024). In agrarian economies, diversification is often a response to risks associated with agricultural dependence, including fluctuating yields, market volatility, and environmental uncertainty. Rural nonfarm employment and income diversification in developing countries. Reardon and Escobar, et.al., (1998)., Sherifa, (2022) and Habib and Ariyawardana, (2023) have emphasized that diversification is both a survival strategy for the poor and an accumulation strategy for the relatively better-off.

In India, rural households increasingly rely on non-farm income sources to supplement agricultural earnings. The Kuttanad wetlands of Kerala present a unique case study: a region historically dependent on paddy cultivation, yet increasingly challenged by environmental degradation, rising costs, and socio-economic pressures. Farmers here face recurrent floods, salinity intrusion, pest outbreaks, and declining profitability of paddy farming. These conditions compel them to seek alternative livelihoods, ranging from wage labour and small-scale enterprises to migration.

LITERATURE REVIEW

Recent studies have continued to emphasize the importance of livelihood diversification in the context of climate change, market volatility, and socio-political instability. For instance, Singh and Sharma (2023) highlight that in South Asia, particularly in flood-prone regions, diversification into non-farm activities has become a key adaptive strategy. Similarly, Nguyen et al. (2024) examine the Mekong Delta in Vietnam, where farmers are increasingly integrating aquaculture and agroforestry to mitigate the risks posed by saline intrusion and erratic rainfall. In Bangladesh, Rahman and Akter (2022) found that access to microfinance and community-



based cooperatives significantly enhanced the capacity of rural households to diversify their income sources. These findings align with the dual nature of diversification as both a necessity and an opportunity, reinforcing the relevance of the push-pull framework in diverse agro-ecological contexts.

Moreover, the role of gender in diversification decisions has gained attention. According to Bhandari and Joshi (2023), women in Nepal's Terai region are increasingly participating in off-farm employment, driven by male outmigration and changing household dynamics. This gendered dimension of diversification is particularly relevant in Kuttanad, where women often engage in informal labour markets and self-help groups to supplement household income. The intersection of gender, environmental vulnerability, and institutional access thus warrants further exploration in the context of wetland farming systems.

A considerable body of work has investigated how farm households diversify livelihoods in the context of developing countries. Aloba Loison, (2015) highlights that diversification is often driven by necessity rather than choice, particularly among smallholders. Jansen et al. (2006) and Soltani et al. (2012) emphasize the role of demographic variables such as age, education, and household size in shaping diversification strategies. In the Indian context, diversification has been linked to structural changes in rural economies, declining profitability of agriculture, and expansion of non-farm opportunities. However, few studies have systematically analysed diversification in wetland ecosystems like Kuttanad, where environmental constraints intersect with socio-economic pressures. The dual nature of diversification distress-driven push factors and opportunity driven pull factors provides a useful analytical framework. Push factors include rising cost of living, food insecurity, and poor asset base, while pull factors include higher returns, employment opportunities, and availability of wetland resources. Understanding the relative weight of these factors is crucial for designing policies that support sustainable livelihoods.

These international cases underscore the universality of the push-pull dynamics in shaping livelihood strategies. However, the degree of institutional support and access to infrastructure significantly influences the effectiveness of diversification. For instance, while Vietnamese farmers benefit from government-backed aquaculture extension services, Kuttanad's farmers face institutional bottlenecks that limit their capacity to transition into high-return activities. This comparison highlights the critical role of enabling environments in translating diversification potential into sustainable outcomes.

Comparative insights from Bangladesh, Vietnam, and sub-Saharan Africa reinforce the relevance of the push-pull framework across diverse wetland ecosystems. However, the success of diversification strategies is contingent upon enabling environments characterized by strong institutional support, adequate infrastructure, and inclusive policies. The study underscores the need for integrated policy interventions that address both the structural vulnerabilities and the aspirational drivers of diversification.

Future research should consider longitudinal designs to capture the dynamic nature of livelihood transitions over time. Additionally, exploring the role of social capital, institutional trust, and intergenerational perspectives can provide deeper insights into the sustainability of diversification strategies. By situating livelihood diversification within the broader socio-ecological and institutional context, this study contributes to the discourse on rural resilience and sustainable development in fragile ecosystems like Kuttanad.

Livelihood diversification has been widely studied across agrarian economies, particularly in contexts where environmental vulnerability and socio-economic pressures intersect. The Kuttanad wetland farming system exemplifies this duality, but its dynamics resonate with broader global scholarship. The literature consistently frames diversification as both a **distress-driven** necessity and an opportunity-driven choice, validating the push-pull analytical framework employed in this study.

Methods (Times New Roman, bold, 12)

Data Analysis (Times New Roman, bold, 12)

Push Factors in Diversification

Several scholars emphasize that distress-driven diversification arises when farming households face acute vulnerabilities. Ellis (2000) argued that rural households diversify primarily to mitigate risks associated with agricultural dependence, including crop failure, price volatility, and climatic shocks. In the Indian context, Mishra and Reddy (2021) highlighted that recurrent floods and salinity intrusion in coastal regions compel farmers to seek supplementary occupations, echoing the findings from Kuttanad. Similarly, Loison (2015) underscored that smallholders in sub-Saharan Africa often diversify out of necessity, with food insecurity and poor asset bases being critical drivers. These parallels reinforce the finding that **food insecurity (regression coefficient 0.835)** is the most influential push factor in Kuttanad, compelling households to secure survival through alternative income streams.

Environmental threats also emerge prominently in global studies. Nguyen et al. (2024) documented how saline intrusion in Vietnam's Mekong Delta has forced farmers to integrate aquaculture and agroforestry. Comparable to Kuttanad's recurrent floods, these ecological pressures destabilize traditional farming systems, necessitating diversification. Seasonal unemployment, another significant push factor in Kuttanad (coefficient 0.680), is similarly observed in Bangladesh's haor wetlands, where flash floods disrupt agricultural cycles, pushing households into wage labour and migration (Rahman & Akter, 2022). Thus, the push factors identified in this study align with broader evidence that environmental and socio-economic vulnerabilities are central to diversification decisions.



Pull Factors in Diversification

Conversely, opportunity-driven diversification reflects aspirations for improved livelihoods. Reardon et al. (1998) emphasized that rural non-farm employment often provides higher returns and stability compared to agriculture. This is consistent with the Kuttanad findings, where **higher returns (coefficient 0.935)** and **employment opportunities (0.828)** are the strongest pull factors. Habib and Ariyawardana (2023) further noted that households with better access to markets and infrastructure are more likely to diversify into profitable ventures, though in Kuttanad, poor infrastructure remains a constraint.

Studies from South Asia highlight similar opportunity-driven motives. Singh and Sharma (2023) observed that in flood-prone regions of India, households increasingly engage in small-scale enterprises and migration to urban centres, motivated by higher income prospects. In Nepal, Bhandari and Joshi (2023) found that women's participation in off-farm employment was driven by both necessity and opportunity, particularly in contexts of male outmigration. This gendered dimension is relevant to Kuttanad, where women's involvement in self-help groups and informal labour markets supplements household income, reflecting diversification as both empowerment and survival.

While push and pull factors explain household-level decisions, institutional support significantly mediates outcomes. Jansen et al. (2006) emphasized that inadequate credit access and weak extension services limit diversification effectiveness in Uganda. Similarly, Ahmed and Hossain (2022) reported that in Bangladesh's wetlands, lack of institutional support restricts households from transitioning into high-return activities. The Kuttanad study corroborates this, identifying government and institutional support (coefficient 0.238) as a weak pull factor, underscoring systemic bottlenecks. Without enabling environments, diversification remains precarious, reinforcing dependence on low-return occupations.

Comparisons with other wetland farming systems highlight both universality and divergence. Tran et al. (2023) documented how Vietnamese farmers benefit from government-backed aquaculture programs, enabling diversification into high-return activities. In contrast, Kuttanad's farmers face institutional weaknesses that restrict similar transitions. Likewise, Mwangi et al. (2024) demonstrated that mobile technology in Kenya enhances market access and income diversification, suggesting that digital infrastructure could be transformative if introduced in Kuttanad. These global insights emphasize that while push-pull dynamics are universal, institutional and infrastructural contexts determine the sustainability of diversification

Aims and Objectives: This study examines the research driving forces of push and pull factors influencing diversification in the Kuttanad Wetland Farming System.

METHODOLOGY

This study addresses that gap by employing SEM and CFA to quantify the influence of push and pull factors, while also examining constraints to paddy farming and diversification. The study was conducted among wetland paddy farmers in the Kuttanad region of Kerala, India. A total of 360 respondents were selected using stratified random sampling to ensure representation across socio-economic categories, landholding sizes, and geographic sub-regions. Data collection was carried out through structured questionnaires administered in face-to-face interviews. The questionnaire captured socio-economic characteristics, livelihood diversification patterns, constraints to paddy farming, and perceptions of diversification. Pre-testing and enumerator training ensured validity and consistency.

Normality was tested using the Kolmogorov-Smirnov (K-S) test, with results confirming normal distribution ($p > 0.05$). Reliability was assessed using Cronbach's alpha, with values exceeding 0.6 across constructs, ensuring internal consistency. SEM was employed to analyse determinants of diversification, combining regression, factor analysis, and path modelling. CFA validated the relationship between observed indicators and latent constructs. Model fit indices (GFI, CFI, RMSEA) confirmed robustness, with push factors showing excellent fit (GFI = 0.991, CFI = 0.998, RMSEA = 0.022) and pull factors showing acceptable fit (GFI = 0.981, CFI = 0.987, RMSEA = 0.051). Limitations include the geographic scope confined to Kuttanad, cross-sectional design, reliance on self-reported data, and limited disaggregation of environmental threats. Despite these, the methodology provides robust insights into determinants of diversification.

Structural Equation Modelling (SEM) using Confirmatory Factor Analysis (CFA) Approach

It is a statistical method that applies a confirmatory approach to test structural theories about phenomena. It combines two key techniques: first, the use of structural (regression) equations to represent causal relationships under study; and second, the modelling of these linkages to provide a clearer understanding of the theoretical framework. The proposed model is simultaneously evaluated against empirical data using goodness-of-fit indices to determine its adequacy. "SEM enables the analysis of multiple dependency relationships between exogenous (independent) and endogenous (dependent) variables at once". Exogenous variables are those whose variation is determined by factors outside the causal system, whereas endogenous variables are explained within the model by both exogenous and other endogenous variables. Additionally, SEM distinguishes between latent variables unobservable constructs inferred through indicators—and manifest variables, which are directly measurable and observable.

The use of Structural Equation Modelling (SEM) combined with Confirmatory Factor Analysis (CFA) is particularly suited for this study due to its ability to model complex relationships between observed and latent variables. SEM allows for simultaneous

estimation of multiple interrelated dependence relationships, which is essential for understanding the multifaceted nature of livelihood diversification. CFA, as a subset of SEM, was employed to validate the measurement model by confirming the factor structure of push and pull constructs. This approach ensures that the observed indicators reliably represent the underlying latent variables, thereby enhancing the robustness of the findings.

SEM is made up of two parts. “A measurement model specifies how latent constructs are captured through observable indicators and their measurement properties.”. Multiple regression analysis, factor analysis, and multivariate ANOVA are all combined in this method. The two-stage methodology is used to model structural equations, with the measurement model being calculated first. In the next stage, the structural model is estimated while the measurement model is kept fixed.

Both models examine the relationship between observed indicators (such as test items or scores) and latent constructs. A defining feature of “CFA” is its hypothesis-driven approach researchers specify in advance the number of factors and the expected pattern of loadings, drawing on prior theory and empirical evidence. CFA is typically employed for four purposes psychometric evaluation of instruments, validation of concepts, assessment of method effect and testing measurement invariance across groups.

Model evaluation involves assessing both statistical and substantive validity. This includes ensuring parameter estimates fall within acceptable ranges (e.g., avoiding negative variances or correlations exceeding one), verifying theoretical interpretability, confirming convergence of estimation procedures, and checking model identification and parameter significance. Goodness-of-fit is judged by comparing the model to the covariance matrix. Since complex models are rarely perfectly specified, the chi-square test of exact fit is often downplayed in favor of approximate fit indices, such as the Root Mean Square Error of Approximation (RMSEA).

In practice, CFA models are often constructed using software like AMOS. In graphical representations, rectangles denote observed variables, ovals represent latent constructs, curved double-headed arrows indicate correlations among latent variables, and straight arrows show factor loadings. Error terms or unique factors are depicted as small circles with arrows pointing to observed variables. The initial model is iteratively refined to arrive at the final specification.

DATA ANALYSIS

Table 1
K-S Test for Normality

Variables	N	Mean	Standard Deviation	Kolmogorov-Smirnov Z	p value
Push Factors for livelihood diversification	360	21.38	5.38	0.656	0.256
Pull Factors for livelihood diversification	360	17.49	2.97	0.777	0.219

Table: 2
Reliability Testing Using Cronbach's Alpha

Variables	Cronbach's Alpha	N of Items
Push Factors for livelihood diversification	0.804	8
Pull Factors for livelihood diversification	0.705	9

Table: 3
Model Fit Indices for CFA – Push Factors for Livelihood Diversification

Model Fit Indics	χ^2	DF	P	Normal χ^2	GFI	AGFI	NFI	TLI	CFI	RMR	RMS EA
Push factors for livelihood diversification	14.167	12.290	.290	1.181	.991	.972	.985	.994	.998	.025	.022
Pull Factor	30.873	16	.014	1.930	.981	.947	.974	.970	.987	.042	.051
Recommended value				<5	>0.9	>0.9	>0.9	>0.9	>0.9	<1	<1

Source: CFA Results (Brown, 2006; Hu & Bentler, 1999; Kalinowski, 2006, p. 13; Thompson, 2004.

Table 4: Regression Coefficients – Push Factors for Livelihood Diversification

The latent constructs were significantly affected by all of the characteristics. The fit indices' value reflects how well the measurement model fits the data. The regression coefficients are shown in **Table.4**

Table 4
Regression Coefficients – Push Factors for Livelihood Diversification

Construct (Independent Variable)	Regression Coefficient	C.R	Variance explained (%)
PU1	0.602	13.156	36.3
PU2	0.499	10.354	24.9
PU3	0.680	15.66	46.3
PU4	0.768	19.186	59.0
PU5	0.835	22.757	69.7
PU6	0.720	17.149	51.8
PU7	0.318	6.224	10.1
PU8	0.178	3.399	3.2

Note P value < 0.001

Dependent Variable: Push factors Factors/Latent Variables (Dependent Variable)

Where

PU1 = Increase in cost of living

PU2= Non-Remunerative Paddy

PU3= Seasonal unemployment

PU4= Environmental threats

PU5= Food insecurity

PU6= Poor assets base and Skill

PU7= Low social perception to farming

PU8= Other factors

RESULTS

The analysis of push factors influencing livelihood diversification among wetland paddy farmers in Kuttanad reveals several significant determinants. **H1: Increase in cost of living (PU1)** is confirmed as a significant push factor, with a standardized direct effect of **0.602**, exceeding the recommended threshold of 0.4 (Dwyer et al., 2012). Similarly, **H2: Non-remunerative paddy (PU2)** exerts a significant influence, with a coefficient of **0.499**. **H3: Seasonal unemployment (PU3)** also emerges as a strong push factor, with a coefficient of **0.680**, while **H4: Environmental threats (PU4)** show an even higher effect at **0.768**. Among all factors, **H5: Food insecurity (PU5)** is the most influential, with a coefficient of **0.835**, underscoring its critical role in driving diversification. **H6: Poor asset base and skill (PU6)** is likewise significant, with a coefficient of **0.720**. In contrast, **H7: Low social perception of paddy farming (PU7)** and **PU8: Other factors** are not significant, with coefficients of **0.178** and **0.318** respectively, both below the recommended threshold.

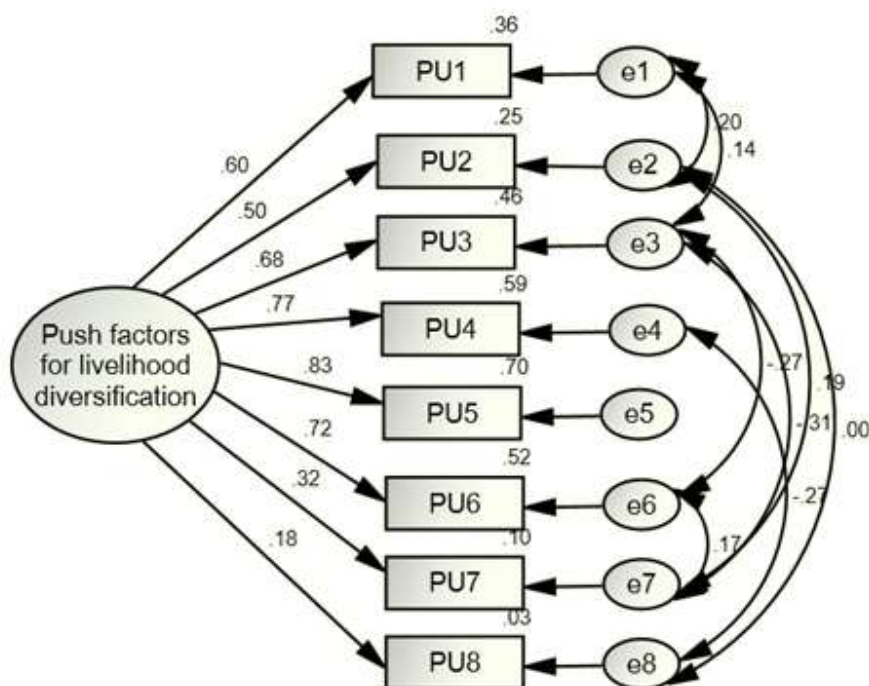


Fig. 1: AMOS-18 Graphics showing Push Factors for Livelihood Diversification

After running the CFA measurement model, we test whether the regression coefficient is zero or non-zero and found that all independent variables have non zero values. However, the recommended value for this study is greater than 0.4 (Dwyer et al., 2012). It is found from the CFA model that increases in the cost of living (0.602), non-remunerative paddy (0.499), seasonal unemployment (0.680), environmental threats (0.768), food insecurity (0.835), and poor asset base and skills (0.720) are considered under study have regression coefficient greater than 0.4. For all other variables viz, low social perception to paddy farming (0.318) and other factors (0.318) have regression coefficient less than 0.4.

Therefore, we conclude that those variables whose regression coefficient value greater than 0.4 are the significant distress push factors that compel the Kuttanad wetland paddy farming community to diversify their livelihood. The Push factors whose regression coefficient is less than 0.4 do not influence livelihood diversification among the Kuttanad wetland paddy farming community.

Table 5
Regression Coefficients – Pull Factors for Livelihood Diversification

Construct (Independent Variable)	Regression Coefficient	C.R.	Variance explained (%)
PL1	0.935	32.059	87.3
PL2	0.828	22.328	68.6
PL3	0.776	19.560	60.2
PL4	0.433	8.756	18.7
PL5	0.211	4.048	4.4
PL6	0.238	4.585	5.6
PL7	0.333	6.541	11.1
PL8	0.165	3.146	2.7
PL9	0.008	0.151	0.0

Note: P value < 0.01

PL1 = High return / income

PL2 =Higher employment

PL3= Additional cash to meet household expenditure

PL4 = Availability of wetland resources

PL5= Better rural infrastructure

PL6 = Govt./Institutional support

PL7=Support from Social Networks

PL8= Lower risk

PL9= Other factors

The analysis of pull factors influencing livelihood diversification among wetland paddy farmers in Kuttanad highlights several significant determinants. **H1: Higher returns/income (PL1)** is confirmed as the strongest pull factor, with a standardized direct effect of **0.935**, well above the recommended threshold of 0.4 (Dwyer et al., 2012). **H2: Higher employment opportunities (PL2)** also exert a strong influence, with a coefficient of **0.828**, while **H3: Additional cash to meet household expenditure (PL3)** is similarly significant, with a coefficient of **0.776**. **H4: Availability of wetland resources (PL4)** is another significant pull factor, though with a relatively lower coefficient of **0.433**.

In contrast, several factors do not meet the threshold for significance. **H5: Better rural infrastructure (PL5)**, with a coefficient of **0.211**, and **H6: Government or institutional support (PL6)**, with a coefficient of **0.238**, are not significant pull factors. Likewise, **H7: Support from social networks (PL7)**, **H8: Lower risk (PL8)**, and **H9: Other factors (PL9)**, with coefficients of **0.333**, **0.165**, and **0.008** respectively, fall below the recommended value of 0.4 and are therefore not considered significant.

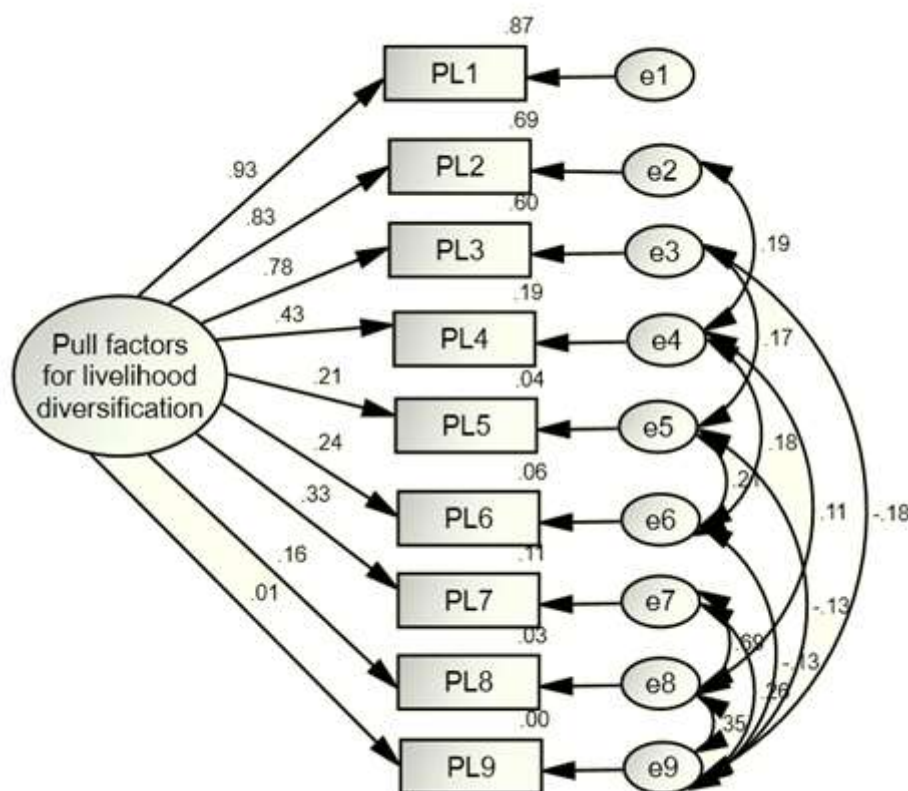


Figure 2: AMOS-18 Graphics showing Pull Factors for Livelihood Diversification

CONCLUSIONS

This study provides a comprehensive analysis of the push and pull factors influencing livelihood diversification in the Kuttanad wetland farming system. The findings reveal that distress-driven push factors such as food insecurity, environmental threats, and seasonal unemployment significantly compel farmers to seek alternative livelihoods. Simultaneously, opportunity-driven pull factors like higher income potential and employment opportunities attract farmers toward diversified economic activities. The SEM-CFA framework effectively captures the complex interplay between these factors, offering robust empirical evidence to inform policy and practice.

In short, to test the hypothesis, the socio-economic and environmental factors are grouped under push factors and pull factors. Hypothesis is framed based on the influence of each of these independent variables on livelihood diversification, and the test results are as follows.

An increase in cost of living, non-remunerative paddy, seasonal unemployment, environmental threats, food insecurity, poor asset base and skills are the significant push factors for livelihood diversification among the Kuttanad wetland farming community. However, low social perception of paddy farming and other factors are not significant push factors for livelihood diversification among the Kuttanad wetland farming community.

Moreover, higher return/income, higher employment, additional cash to meet household expenditure, availability of wetland resources are the significant pull factors for livelihood diversification among the Kuttanad wetland farming community. However, better rural infrastructure, govt./Institutional support, social networks support, Lower risk and other factors are not significant pull factors for livelihood diversification among the Kuttanad wetland farming community.

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