WHAT CAUSED LAND ABANDONMENT IN VALIGAMAM, NORTH OF JAFFNA, SRI LANKA?: A SPATIAL AND ECONOMETRIC ANALYSIS

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Abstract

This study aimed to provide a comprehensive understanding of the interplay between population density, migration, and land abandonment in the Valigamam North region, which was profoundly affected by historical events, notably the ethnic conflict in the Jaffna Peninsula from 1987 to 1995. With a randomly selected sample of 85 households, Probit and Tobit models were utilised as analytical tools. Furthermore, this study used thematic mapping methodology with ArcMap 10.4 software. The results of the probit model revealed a statistically significant impact of migration, gender, and income on land abandonment. Conversely, variables such as land size, labour, and loans did not exhibit a statistically significant influence on land abandonment. The findings from the Tobit model indicate a positive correlation between migration and the likelihood of land being abandoned. The results elucidate significant spatial variations, particularly in locales characterised by low population density, where abandonment of land is more prevalent. The outcomes of this research offer insights for the formulation of land management strategies and policy development.

JEL: *Q15, R14, C25, C21, O13, R23, Q24*

Keywords*: Valigamam North, Migration, Land abandonment, Spatial analysis, Probit model, Tobit model*

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INTRODUCTION

The 11th Global Food Security Index reveals a troubling decline in the global food environment for the third consecutive year, presenting a growing challenge to global food security. Approximately 17 per cent of the 22 million global population segment currently faces food insecurity, despite modest improvements since 2022 (FAO/WFP Crop and Food Security Assessment Mission, 2023). In this context, the effective use of land is becoming increasingly important. Land is not only a traditional factor of production alongside labour, capital, and management, but also plays a fundamental role in sustaining food security and economic stability. However, large-scale land abandonment has emerged as a global issue, with significant social, environmental, and economic consequences.

Land abandonment refers to the withdrawal of human activity and control from land, allowing land to be returned to an unmanaged natural state (Munroe et al., 2013). One of the primary drivers of land abandonment is rural-to-urban migration. Over the past fifty years, the global population has urbanised rapidly: currently, 55% of people live in urban areas, with projections estimating that this would rise to 68% by 2050. As a result, abandoned land now encompasses an estimated 400 million hectares globally (International Institute for Applied Systems Analysis, 2023).

This trend is particularly relevant in post-conflict areas such as Sri Lanka's Northern Province, where war-induced displacement and militarisation have disrupted land use. The Northern Province covers 8,290 km², with Jaffna District occupying 929 km², and Valigamam North comprising 61.80 km² (Statistical Handbook, Valigamam North, 2020). Often described as "a landscape of violence" (Alwis, 2004), Valigamam North has suffered deeply from civil conflict. After the war ended in 2009, much of the area's land remained inaccessible due to its designation as high-security zones controlled by the military (Baskaran, 2022). The initial waves of displacement began in the late 1980s, with large-scale migration taking place in 1995, when many residents fled or were forced to vacate. Although partial land releases began in 1996, by 2018, 2,847.8 acres were still withheld from civilian use (Maladevi, 2018). Despite recent releases, such as 20 acres in Naguleswaram (J/226) and 13 acres in Palali (J/254) in 2023, significant land areas, such as 794.67 acres in Myliddy North, remain unreleased.

These disruptions have contributed to complex demographic and socio-economic transformations. The population of Valigamam North, which was 61,228 in 1971, rose to 83,618 by 1992. However, following displacement in 1995, the population fell drastically to 19,967 in 2000 (Maladevi, 2018). Although numbers have since increased, reaching 45,244 in 2021, they remain well below pre-war levels. This underpopulation has resulted in vast areas of abandoned or underutilised land. In many cases, these lands are used as informal garbage dumps, increasing the risk of vector-borne diseases such as dengue and

malaria. Female-headed households, in particular, are reluctant to return due to security concerns and continued military presence.

International and local research increasingly highlights the link between migration and land abandonment. Studies by Xu et al. (2019), Bhawana and Digby (2019), Dabal et al. (2020), and Jiang and Song (2022) demonstrate a consistent relationship between labour migration and the abandonment of agricultural land. In the Sri Lankan context, Suthakar and Bui (2008) found that migration, conflict, military occupation, and economic hardship have significantly reshaped land use in Jaffna District. However, there remains a significant gap in localised, post-war studies that explore these dynamics, specifically in Valigamam North.

Given these conditions, this research was conceived aiming at exploring the interconnected relationship between migration and land abandonment in Valigamam North. It sought to understand whether a significant correlation exists between migration patterns and the extent of land abandonment. Additionally, the study intended to examine the socio-economic and environmental factors that would most strongly influence the size of abandoned land and to investigate the patterns of population density that would be spatially related to abandoned land areas. These questions are central to understanding the underlying causes of land abandonment and resettlement reluctance and to developing informed, sustainable land management strategies for the area.

Therefore, this study was guided by the following research objectives:

(a) To evaluate the relationship between migration and land abandonment in Valigamam North;
(b) To assess the socio-economic and environmental factors that influence the scale of abandoned land; and
(c) To map the spatial relationship between population density and land abandonment.

Through addressing these objectives, the research aimed at contributing to evidence-based policy and planning for land recovery, resettlement, and sustainable development in Sri Lanka's post-conflict Northern Province.

LITERATURE REVIEW

Theoretical Framework

The perusal of previous research findings reveals a consistent and significant relationship between labour migration and farmland abandonment among rural households. Studies by Xu *et al*. (2019), Dabal *et al.* (2020), Jiang and Song (2022), and Bhawana and Digby (2019) have consistently demonstrated the substantial impact of labour migration on farmland abandonment, indicating a positive correlation between transitioning from agriculture to alternative occupations and relinquishing arable land. Furthermore, these

literature reviews support the New Labour Migration theory, which suggests that households migrate from low-income agricultural areas to pursue higher incomes, often reallocating labour resources to younger family members for employment in non-agricultural sectors. This reallocation of labour resources plays a pivotal role in shaping the behaviour associated with cropland allocation within farming households. In sum, these insights underscore the intricate dynamics between labour migration and farmland abandonment, highlighting the importance of further research to elucidate underlying mechanisms and inform effective policy interventions.

Chong Lu's (2020) research highlights an inverted U-shaped relationship between migrant labourers' average age and farmland abandonment, with both off-farm and part-time employment contributing positively to this phenomenon. Moreover, household health indirectly influences land use behaviour by affecting labour supply quality, as proposed by Jack (2011) and Fogel (2004), who describe a theoretical chain linking household health to labour supply quality and, subsequently, to cropland abandonment. These findings underscore the multifaceted nature of farmland abandonment dynamics and emphasise the importance of considering demographic, employment, and health factors in rural land use decision-making.

Marxist Rent Theory's perspective on land's role in capitalist agricultural production emphasised the concept of economic rent or "excess." Neocosmos (2008) expanded on this theory, highlighting how land ownership would enable capitalists to derive capital and wages, thus strengthening the capitalist system. Additionally, land is depicted as a key factor of production, facilitating the acquisition of other factors of production. This underscores the importance of land ownership in perpetuating capitalist economic structures.

The Push-pull Theory, Occupational Theory, and the New Labour Migration Theory propose that rural families migrate to increase their income, driven by rational economic considerations. These theories analyse the disparities in income, unemployment rates, and capital investment between agricultural and non-agricultural sectors. Migration is seen as a fundamental strategy for enhancing household income. Research by Barkly (1990), Corsi (2017), and Xu *et al.* (2018) supports these theories, highlighting the role of migration in income augmentation for rural families.

Empirical Literature Review

Valuable insights into the complex dynamics of migration and land abandonment across different contexts could be found in empirical literature. Firstly, Dine and Eklund (2023) delved into the dynamics of migration and forced migration as an adaptive response in the context of Syria's drought from 2007 to 2009 and the subsequent civil war. The study employed various research methods, including migration-focused survey methods, qualitative field studies, and the analysis of land-use activity data based on satellite images. The findings revealed that severe drought and climate change, exacerbated by the

war, were key drivers of displacement, leading to increased migration within Syria and neighbouring countries like Lebanon, Saudi Arabia, and Qatar. The study identified multiple factors contributing to migration, including war and security issues, unemployment, cultural, political, religious, ethnic, and gender-related factors. Additionally, it highlighted the decrease in land productivity as a consequence of migration and conflict, with armed conflict cited as the primary factor.

Secondly, Jiang and Song (2021) analysed the spatial distribution characteristics of abandoned land in China and examined its socio-economic impacts on cropland reuse. Using national sample data, the study investigated various indicators related to land labour quantity, agricultural labour ratio, age demographics of farmers, and cropland transfer activities. The results revealed that indicators such as land labour quantity per unit area, male agricultural labour ratio, and cropland transfer area were exhibiting significant negative effects on the increase in abandoned land. The study estimated that a substantial proportion of Chinese farmers were full-time farmers, and this proportion would be expected to increase significantly by 2030.

The study conducted by Dahal *et al.* (2020) aimed at addressing the challenges encountered by Nepal's agriculture sector, particularly concerning land abandonment and its implications for food security. Utilising a mixed-methods approach involving focus group discussions, key informant interviews, and individual farmer meetings, both quantitative and qualitative data were gathered. The findings underscored numerous factors driving land abandonment, including rural out-migration, diminishing soil fertility, urbanisation, and inadequate government subsidies. The insights highlighted the urgent need to address these issues to sustain agricultural productivity and to ensure food security in Nepal.

Xu *et al.* (2019) analysed rural household survey data from 27 provinces in China to investigate the impact of labour migration on agricultural land abandonment. Using Probit and Tobit models, they found that a 10% increase in non-agricultural part-time employment led to a 4-5% rise in land abandonment. The outcomes of the study highlighted the significant correlation between migration and land abandonment, revealing that rural families' migration would contribute to a substantial portion of non-agricultural employment.

Deng *et al*. (2019) explored the relationship between rural household health and cropland abandonment in China using data from 8,031 households. Employing a Tobit model, they found that female health status had a more significant impact on cropland abandonment than male health. The study concluded that an increase of 1% in family health could potentially reduce land abandonment by 0.15%, suggesting a critical link between household health and decisions pertaining to agricultural land use.

Eklund *et al.* (2017) conducted a review to analyse changes in land use between 2000 and 2015 in Syria and Iraq due to armed conflicts. The study revealed that during this period,

15% of Iraq's arable land and a third of Syria's came under the control of IS. Contrary to expectations, the analysis of satellite-based time series data suggested that the effects of armed conflict on land use were not directly influenced by environmental factors. Additionally, the study noted an expansion of arable land in the area since 2015.

Suthakar and Bui (2008) conducted a study aiming to spatially map and quantify the land use pattern in Jaffna, in Northern Sri Lanka, spanning two decades from 1984 to 2004, and to assess the impacts of war. Through the analysis of secondary data using spatial analysis, digital image processing, and a classification system, their study revealed significant changes in land use over the years. Specifically, it found that agricultural land in the area had decreased, leading to an increase in non-agricultural land use following the war period. Additionally, the study highlighted a notable expansion of wetlands to 40% and 50% respectively. The identified triggers for these land use changes included ethnic conflict and its consequences, the establishment of high-security zones, economic sanctions, and large-scale migration.

While previous studies in the area have primarily explored migration, resettlement, and occupations, there is a notable absence of research specifically investigating the statistical and spatial relationship between migration and land abandonment in Valigamam North. This study, therefore, aimed to fill this gap by providing a comprehensive statistical examination and geospatial mapping of the interplay between migration and land abandonment in the area. Addressing this challenge requires a nuanced understanding of the underlying dynamics and informed policy interventions aimed at sustainable land management and livelihood development. Through rigorous empirical analysis, this study intended to contribute to the body of knowledge on this topic and to facilitate evidence-based decision-making in the region.

METHODOLOGY

The methodology employed in this study involved the utilisation of both primary and secondary data sources to comprehensively address the research objectives. Primary data collection was conducted through the distribution of a structured questionnaire to 85 heads of households who have abandoned their lands located in the Valigamam North region. The selection of households was carried out using a purposive sampling technique, ensuring adequate representation across the study area. This approach was adopted with the intention of capturing diverse perspectives and experiences related to migration and land abandonment within the community. However, since the study employed the purposive sampling technique, it could be associated with limitations in terms of statistical validity or generalisation when applying advanced econometric models such as Tobit models.

In addition to primary data collection, the study employed various econometric techniques for data analysis. Firstly, frequency analysis was conducted to explore the

distribution and prevalence of key variables related to migration and land abandonment. Subsequently, the Probit model was employed as an analytical tool to examine the relationship between migration and the occurrence of land abandonment. This statistical model facilitated the estimation of probabilities and the identification of significant factors influencing land abandonment.

Moreover, marginal effects analysis was conducted to quantify the impact of individual variables on the likelihood of land abandonment, providing insights into the relative importance of different factors. Additionally, the Tobit model was deployed to assess the socio-economic factors affecting the size of abandoned land. This model enabled the examination of censored data, where certain observations were truncated or limited, allowing for a more comprehensive understanding of the determinants of land abandonment.

By employing a combination of primary data collection methods and advanced econometric techniques, this study aimed to provide a robust analysis of the relationship between migration and land abandonment in the Valigamam North region. It was expected that this methodological approach would facilitate the generation of valuable insights and actionable recommendations for addressing land abandonment challenges and promoting sustainable land management practices in the study area and beyond.

The Probit model, as depicted below in Equation (1), was constructed for the purpose of econometric analysis, in which the log value of the ratio between landowners who have abandoned their land and those who are actively using it was used as the dependent variable, where ABL stands for "Abandoned Land" corresponding to Pr (ABL) = 1.

$$\log\left(\frac{Pr(ABL)=1}{1-Pr(ABL)=1}\right) = \emptyset(\alpha + \beta_1 MIG_j + \beta_2 INC_j + \beta_3 GEN_j + \beta_4 LIR_j + \beta_5 LON_j + \beta_6 LBZ_j + \beta_7 OLN_j + \beta_8 LNZ_j) \text{ ---------- (1)}$$

In this model, α represents the intercept while $\beta_1 \ldots \beta_8$ are coefficients representing the impact of independent variables on the probability of the event of land abandonment occurring. These independent variables include migration (MIG) as an indicator taking the value 1 if the owner has migrated, income (INC) in Sri Lankan Rupees, gender (GEN) of the household head as an indicator taking the value 1 if the household head is male, land irrigation (LIR) as an indicator taking the value 1 if the abandoned land is irrigated, loans taken (LON) in Sri Lankan Rupees for agriculture on the land before abandonment, labour size (LBZ) representing the number of members in the household who participate in the labour force, other land (OLN) as an indicator taking the value 1 if any other lands are owned by the household head, and land size (LNZ) being the size of the abandoned land in acres.

The Tobit model, depicted in Equation (2), was employed to identify the socio-economic factors influencing the extent of land abandonment. In this model, the Land Abandonment

Score (LAS) was computed by dividing the total abandoned land size in the four selected Grama Niladhari (GN) divisions by the sampled abandoned land size and multiplying the result by 100, serving as the abandoned land metric in the model.

$$LAS_i = \beta_0 + \Sigma_{k=i}^{P} \beta_1 MIG_i + \beta_2 EDU_i + \beta_3 INC_i + \beta_4 SAV_i + \beta_5 LIR_i + \beta_6 GEN_i + \beta_7 MLC_i + \beta_8 LNZ_i + \varepsilon_i \text{ ---------- (2)}$$

where, LAS (the Land Abandonment Score) for each observation *i*, is attempted to be modelled with independent variables including migration (MIG), years of education(EDU), household income (INC) in Sri Lankan rupees, household savings (SAV) in Sri Lankan rupees, land irrigation (LIR), gender (GEN), military control (MLC) as an indicator taking the value 1 if the land is in an area under military control, and land size (LNZ). The coefficients β_1....β_8 indicate the impact of each independent variable on the Land Abandonment Score, and ε_i represents the error term.

In addition, geospatial mapping techniques were employed to generate thematic maps illustrating population density and land abandonment in Valigamam North. Secondary data on population density and abandoned land in hectares were utilised for the analysis. ArcMap 10.4 software was employed for data processing and map generation. The thematic maps were created to visualise spatial variations and identify areas with significant population density and land abandonment.

RESULT AND DISCUSSION

Socio-Economic, Demographic, and Political Drivers of Land Abandonment

The findings of this study provide robust evidence of a significant correlation between migration, agricultural, and residential land abandonment in Valigamam North. The dependent variable, ABL (Abandoned Land), is crucial for understanding land abandonment trends, while the independent variables, including MIG (Migration), AGE (Age), GEN (Gender), EDU (Education), INC (Income), SAV (Savings), LON (Loan), , LIR (Land Irrigation), OLN (Other Land), LNZ (Land Size), LBZ (Labor Size), and MLC (Military Control), providing a diverse set of factors to analyse.

The statistical analysis of the dataset offered valuable insights into the dynamics of land abandonment in the study area. As depicted in Table 1, on average, approximately 36.5% of the land is identified as abandoned (ABL), suggesting a substantial impact on land use patterns. Migration (MIG) is prevalent in the dataset, with an average occurrence of 70%, underscoring its significant influence on land abandonment. The average age (AGE) of 49.53 reflects a diverse age range, with individuals ranging from 20 to 75 years old being included. Years of Education (EDU) vary, with an average of 10.7 years, while income (INC) shows substantial diversity, ranging from LKR 10,000 to LKR 1,000,000. Savings (SAV) and loan amounts (LON) are notable variations, emphasising economic

heterogeneity. Land irrigation (LIR) is widespread, with an average occurrence of 81.1%, and the presence of other land uses (OLN) is noted in approximately 31.7% of cases. Labour size (LBZ) and military control (MLC) exhibit moderate variability, with mean values of 1.552 and 11.7%, respectively. These statistics provide a comprehensive picture of the study area, offering key insights into the interplay between migration and the complex factors influencing land abandonment.

Table 1: Results of descriptive analysis

Variable	Observation	Mean	Std. Dev	Minimum	Maximum
ABL	85	0.365	0.484	0.00	1
LAS	85	0.549	1.240	0.00	7
MIG	85	0.700	0.463	0.00	1
GEN	85	0.800	0.402	0.00	1
AGE	85	49.530	12.300	20.00	75
EDU	85	10.700	4.296	2.00	18
INC	85	113,600.000	167,650.000	10,000.00	1,000,000
SAV	85	13,837.000	36,706.800	300.00	250,000
LON	85	21,389.000	50,733.550	200.00	350,000
LIR	85	0.811	0.393	0.00	1
OLN	85	0.317	0.468	0.00	1
LNZ	85	5.000	5.578	1.45	38
LBZ	85	1.552	0.780	1.00	4
MLC	85	0.117	0.324	0.00	1

Source: Author's calculations

Impact of Migration on Land Abandonment

The Probit model analysis unveiled noteworthy insights into the dynamics of land abandonment concerning various socio-economic factors. Results indicated that Migration (MIG), Income (INC), and Other Land (OLN) exhibit a positive and statistically significant impact on the likelihood of land abandonment. Specifically, an increase in migration, higher income levels and the availability of alternative land options were found associated with heightened probabilities of land abandonment, which finding is consistent with the finding of Xu *et al*. (2019); Dabal *et al*. (2020); Jiang and Song (2022) and Bhawana and Digby (2019) who identified migration as a key factor influencing land use changes in rural regions. Conversely, household head being male (GEN) and the abandoned land being irrigated (LIR) emerged as influential factors with significantly negative effects on land abandonment, implying that the household head being male (compared to being female) and the abandoned land being irrigated (compared to being unirrigated) would tend to reduce the probability of abandoning agricultural land.

Interpretation of the model coefficients in Table 2 indicates the change in the underlying likelihood of land abandonment, not a direct change in probability, for a one-unit change in the independent variables. The positive coefficient for migration and income suggests an increase in these variables is associated with a higher likelihood of land abandonment, while the negative coefficients for male household heads (GEN) and irrigated land (LIR)

indicate these factors are associated with a lower likelihood of land abandonment. On the other hand, ownership of other land (OLN) by the household head has shown a significant positive impact on land abandonment. However, variables like the size of the land concerned (LNZ), loan amount (LON) taken for agricultural purposes on the land concerned, and the number of members in the household participating in the labour force (LBZ) did not show statistically significant effects on land abandonment, as their coefficients were not significantly different from zero. The intercept (cons) represents the baseline probability of land abandonment when all other variables are zero.

Table 2: The impact of migration on land abandonment

Number of Observation = 85 Log likelihood = -12.8157					LR chi2 (8) = 85.90 Prob > chi2 = 0.0000 Pseudo R2 = 0.7702	
ABL	**Coef.**	**Std. Err.**	**Z**	**P>[Z]**	**[95% Conf. Interval]**	
MIG	1.83	0.84	2.18	0.03 **	0.18	3.46
GEN	-2.05	0.91	-2.27	0.02**	-3.81	-0.28
INC	0.02	0.01	2.20	0.03**	0.00	0.01
OLN	2.12	0.88	2.40	0.017**	0.38	3.85
LIR	-4.12	1.29	-3.19	0.001***	-6.65	-1.59
LNZ	0.05	0.05	1.00	0.315	-0.05	0.15
LON	-0.02	0.02	0.30	0.766	-0.01	0.01
LBZ	-0.33	0.52	-0.64	0.525	-1.35	0.68
-cons	1.27	1.31	0.97	0.33	-1.29	3.84

Note: ** and *** represent 5% and 1% significance levels, respectively.

Source: Author's calculations

The marginal effects after analysis using the Probit model, depicted in Table 3, shed light on the dynamic relationship between various factors and the likelihood of land abandonment (ABL).

Table 3: Marginal Effect after Probit Model (MFX)

Y= Pr(ABL) (Predict) = 0.29273114

Variable	**dy/dx**	**Std. Err**	**Z**	**P>[z]**	**[95% C.I]**		**x**
MIG	0.47	0.22	2.12	0.03**	0.03	0.91	0.69
GEN	-0.69	0.21	-3.27	0.00***	-1.11	-0.28	0.8
INC	0.000	0.00	2.32	0.02**	0.00	0.00	113.1
OLN	0.71	0.19	3.62	0.00***	1.08	1.08	0.32
LIR	-0.91	0.13	-7.12	0.00***	-0.66	-0.65	0.81
LNZ	0.02	0.02	1.01	0.31	-0.02	0.05	4.99
LON	-0.01	0.01	-0.33	0.74	-0.00	0.00	21389.4
LBZ	-0.11	0.19	-0.59	0.55	0.55	0.26	1.55294

Note: ** and *** represent 5% and 1% significance levels, respectively.

Source: Author's calculations

Controlling for other variables at their mean values, the above results reveal that increased migration (MIG) would positively influence the probability of land abandonment, with a significant marginal effect of 0.47 (p=0.034). Conversely, the household head being male (GEN) has a negative and significant impact, reducing the probability of land abandonment by 0.693 (p=0.001). Higher-income (INC) is associated with a slight increase in the likelihood of land abandonment, with a significant marginal effect of 0.000 (p=0.020). The presence of ownership of other land (OLN) significantly raises the probability of land abandonment by 0.705 (p=0.000). Notably, land irrigation (LIR) has a substantial negative impact, decreasing the probability of land abandonment by 0.904 (p=0.000). Land size (LNZ), loan amount (LON) and the number of members in the household participating in the labour force (LBZ) exhibit negligible effects that are not statistically significant, and therefore cannot be inferred as significantly influencing the likelihood of agricultural land abandonment. This evidence is consistent with the findings of Jiang and Song (2021) and Suthakar and Bui (2008), who underscored numerous factors driving land abandonment.

Impact of Socio-Economic and Demographic Factors on the Size of Abandoned Land

The Tobit model analysis provides valuable insights into the relationship between various factors influencing the size of land abandonment. Firstly, migration (MIG), the number of years of education of the household head (EDU), household income (INC), and military control (MLC) could be identified as factors positively influencing the size of land abandonment, while the land concerned being irrigated (LIR) appears to have a negative impact. This suggests that factors such as migration, education, income, and military control would contribute towards increasing land abandonment, while access to irrigation facilities would mitigate it.

Table 4: Socio-economic factors that influence the size of abandoned land

Number of observation = 85 Log likelihood = -69.799698					LR chi2 (8) = 64.44 Prob > chi2 = 0.0000 Pseudo R2 = 0.3158	
LAS	**Coef.**	**Robust Std. Err**	**t**	**P > [t]**	**[95% conf. Interval]**	
MIG	1.99	0.78	2.53	0.01**	0.42	3.56
EDU	0.18	0.08	2.24	0.03**	0.02	0.33
INC	8.24	0.00	3.99	0.00***	0.00	0.01
LIR	-1.73	0.54	-3.18	0.00***	-2.81	-0.64
MLC	1.13	0.60	1.88	0.06*	-0.07	2.34
LNZ	0.05	0.04	1.16	0.24	-0.03	0.14
GEN	0.42	0.41	1.04	0.30	-0.39	1.25
_cons	-4.21	1.86	-2.26	0.03	-7.93	-0.49
/sigma	1.51	0.19			1.12	1.90

Note: *, **, and *** represent 10%, 5% and 1% significance levels, respectively.

Source: Author's calculations

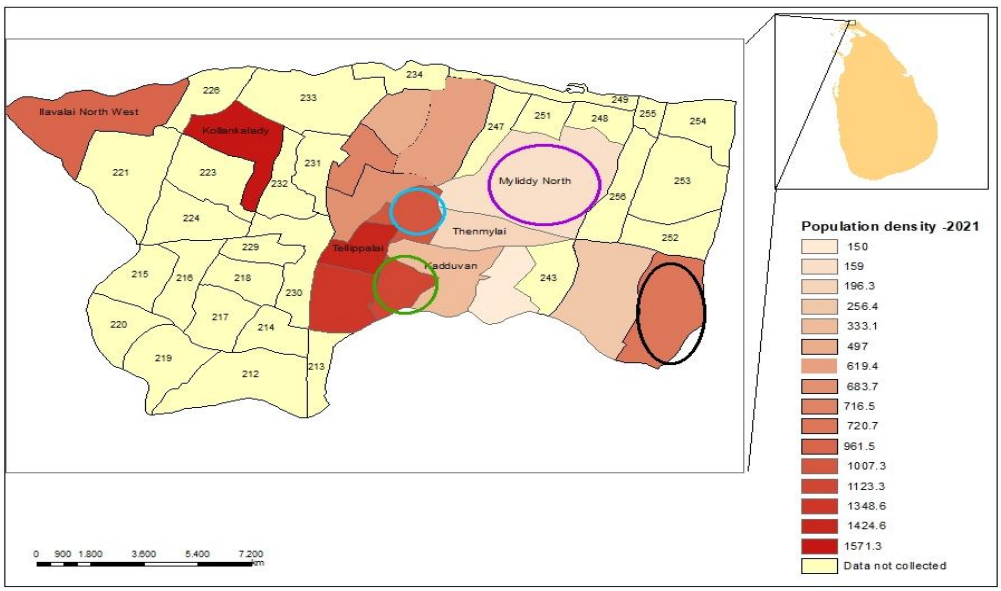
The interpretation of the coefficients in Table 4 (above) reveals specific effects of these factors on the size of abandoned land. For instance, the migration of a household head would lead to an increase in the size of abandoned land by 1.996 units. Similarly, for each additional year of education of the household head, the size of abandoned land increases by 0.178 units. This suggests that as educational attainment levels rise, individuals may be more inclined to migrate to urban areas, leading to increased land abandonment in rural areas. Furthermore, the model estimates revealed that land under military control could be associated with an increase in abandoned land size by 1.14 units, but, only with a weak significance at the 10% level. This weak significance suggests that, while military policies may have played a role in land abandonment dynamics, the statistical evidence for a strong, direct impact is limited.

Overall, these findings underscore the complex interplay between socio-economic factors, government policies, and land use decisions, providing valuable insights for policymakers and stakeholders in addressing land abandonment issues effectively.

Spatial and Temporal Distribution of Population Density and Land Abandonment

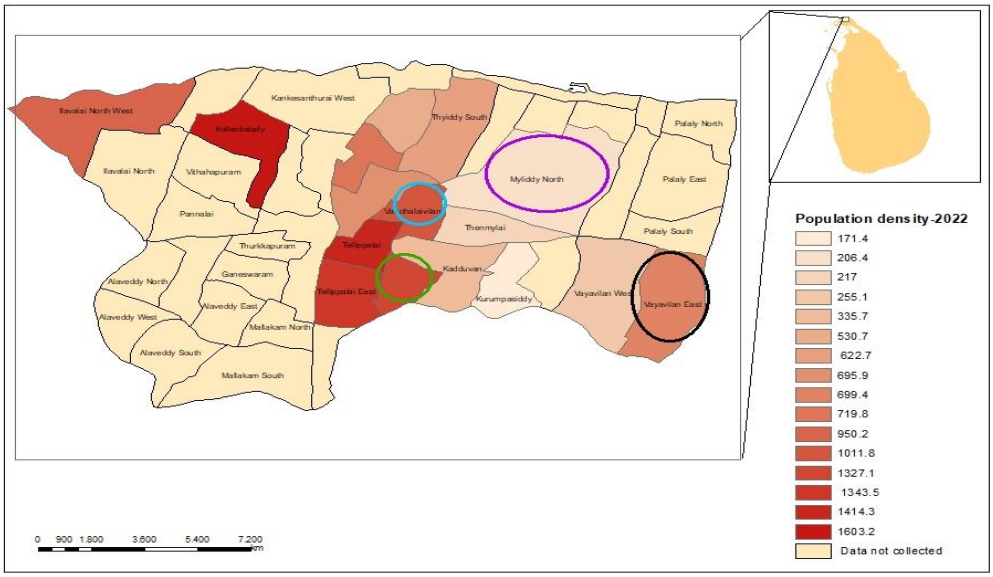
In addition to the statistical model, the spatial thematic maps revealed similar results. Figures 1 and 2, depicting the spatial and temporal analysis of population density and land abandonment in Valigamam North, further validate the econometric findings regarding the drivers of land abandonment, demonstrating that land abandonment gives rise to lesser population density as individuals and households move away from unutilized land to seek new opportunities.

Figure 1: Map showing population density in 2021 in the Valigamam area



Source: Jaffna District Secretariat, 2023

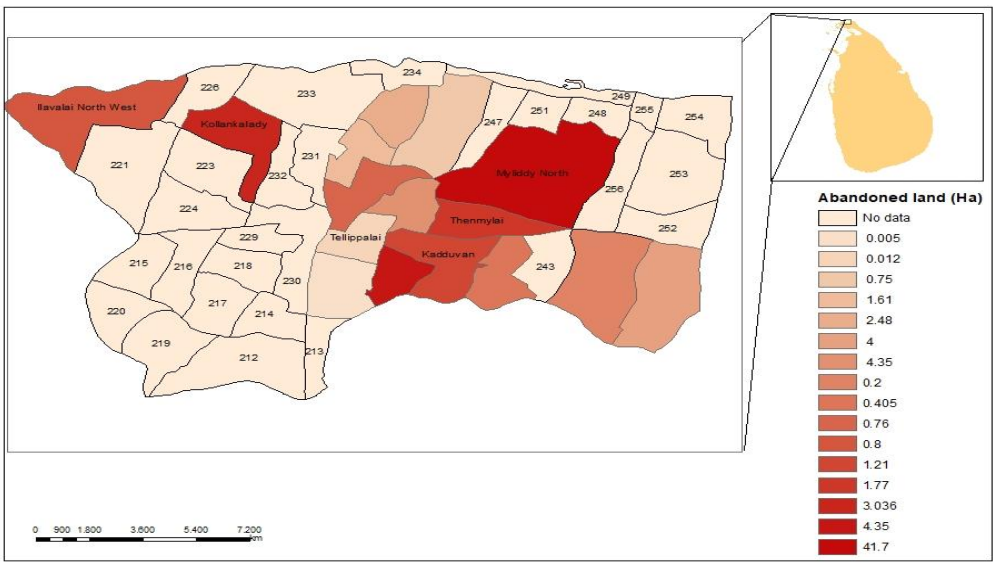
Figure 2: Map showing population density in 2022 in the Valigamam area



Source: Jaffna District Secretariat, 2023

Several Grama Niladhari (GN) divisions, including Vajavilan East, Myliddy North, Varuththaraivilaan, and Kadduvan West, emerge as critical zones exhibiting both low population density and substantial areas of abandoned land. Notably, Myliddy North, highlighted with a purple circle in the spatial map, stands out as the region with the lowest population density and one of the highest levels of land abandonment in hectares.

Figure 3: Spatial variation in abandoned land areas in hectares



Source: Jaffna District Secretariat, 2023

Figure 3 (above) presents the spatial distribution of abandoned land, further emphasising that peripheral regions, especially those lacking sufficient infrastructure and market access, are disproportionately affected.

These findings indicate that increasing land abandonment contributes to a decrease in population density. Specifically, areas such as Kadduvan West, Kollankaladdy, Thenmylai, and Varuththaraivilaan show high proportions of uncultivated land, reinforcing the notion that declining population density, largely driven by migration, has a direct impact on agricultural land use. These spatial disparities support earlier research by Jiang and Song (2021), who identified population structure, cropland transfer dynamics, and ageing rural demographics as major determinants of land abandonment. Moreover, the results are consistent with the findings of Suthakar and Bui (2008), who documented similar spatial transformations in Jaffna District following conflict-induced migration and resettlement. The peripheral nature of the most affected GN divisions, characterised by inadequate road networks, reduced public service provision, and limited economic opportunity, suggests that logistical and economic marginalisation are key contributing factors. These spatial patterns underscore the interconnectedness of demographic shifts and land use decisions, particularly in post-conflict rural areas. As households migrate out of these economically disadvantaged zones, the reduced labour force and declining population density contribute to the gradual disuse and abandonment of land.

Overall, the spatial analysis reveals that land abandonment in Valigamam North is not random but closely linked to population distribution and accessibility. This spatial relationship affirms broader theoretical and empirical understandings of land abandonment, demonstrating how demographic decline and marginalisation converge to shape rural land use patterns.

CONCLUSION AND RECOMMENDATIONS

This study has revealed a comprehensive analysis of the factors influencing land abandonment in Valigamam North, with a particular focus on the role of migration. The results demonstrate that migration, years of education, income, ownership of other land and gender being male significantly contribute to land abandonment, while access to irrigation would reduce its likelihood and extent.

The Probit model identifies migration, income, gender, ownership of other land, and irrigation as significant determinants of land abandonment. Migration, in particular, indicated a strong positive association with abandonment probability, underlining the need for policies that address the impact of migration on agricultural sustainability. Interestingly, the effect of income is statistically significant, but its marginal effect on the probability of land abandonment is so negligibly small that it holds no meaningful real-world impact. This finding highlights a crucial distinction between statistical

significance and practical relevance. Yet, this effect could be a subject for further research.

The Tobit model further confirms that increases in migration, education, and military presence are associated with larger abandoned land areas, while irrigation access mitigates these effects. These findings emphasise the socio-economic complexity behind land abandonment, which could be critical vis-à-vis livelihood stability.

The spatial analysis appeared further validating the econometric findings by revealing a clear link between low population density and higher rates of land abandonment. This is a critical outcome of the long-term impact of conflict-driven migration on land use patterns. The post-conflict displacement and resettlement of communities have led to a demographic decline in certain rural areas. As households migrate out of these areas, the resulting reduced labour force and low population density contribute directly to the gradual disuse and abandonment of land.

These findings underscore how demographic shifts converge to shape rural land use, highlighting that land abandonment may not be a random occurrence but possibly a predictable consequence of specific socio-political and migration-related factors. Addressing these issues would require integrated, region-specific strategies that combine resettlement support, agricultural investment, and migration-sensitive planning. Future research should further investigate the drivers of migration and their long-term implications on land use, to support more effective and sustainable land management in post-conflict areas like Valigamam North in Jaffna, Sri Lanka.

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