

**RESEARCH ARTICLE**

**LIVELIHOOD VULNERABILITY OF DROUGHT-AFFECTED AGRO-MIGRANTS IN DRY ZONE OF SRI LANKA**

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**ABSTRACT**

Climate change-driven disasters escalate vulnerabilities of rural livelihoods especially who are depending on nature. Climate induced migration is a coping strategy, seeking alternative or secondary livelihood opportunities. Despite national and international institutions having introduced alternative and secondary livelihoods for climate victims, the limitations and challenges of these programmes have not been assessed. The paper aims to address this lacuna and the importance of supportive services to strengthen secondary and/or alternative livelihoods in drought affected regions. Anuradhapura and Trincomalee districts were chosen where the drought has become the threatening climatic factor. A mixed-method approach was adopted employing a questionnaire survey with 60 paddy farmers and 15 key informant interviews including leaders in the farmer organizations (n=10) and government officers (n=5). Simple random sampling technique was adopted to draw the survey sample. Alternative livelihood vulnerability index (ALVI) was calculated over availability, accessibility, and degree of satisfaction with the supportive services. Secondary livelihoods- trading, inland fishing, daily wage labor, and self-employment are commonly adopted than a complete transformation. These options are not sustainable due to negative sentiments, resistance to change, limited support from external entities (0.3–0.5 ALVI), poor access to capacity building (0.2–0.4 ALVI), and less satisfaction with available supportive facilities (0.37 ALVI). Capacity building, skill development, and motivational sessions over alternative/secondary livelihoods are recommended with adequate supportive services for a smooth transition.

Keywords: Alternative livelihood vulnerable index; Climate change; Climate-induced migrants; Drought; Secondary livelihoods

**INTRODUCTION**

Natural resource-based communities, including land, river, ocean and forestry are most susceptible to adverse impacts of climate change that jeopardizes livelihoods and thereby the socio-economic status, well-being, and happiness (IPCC, 2022). On top of all the nature-based livelihoods, the agrarian livelihoods are frustrated due to changes in temperature, sunshine, and rainfall, which are identified as the key significant parameters of agricultural production (Salifu, 2021). Flash floods, sun scorch, drought, and salinity with sea level rises are profound adverse impacts that thwart maximum productivity of the respective sectors (Ruchir *et al.*, 2021).

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Climate change—long term changes of the climate state with unpredictable rainfall, ambient temperature rise, frequent high winds, storms, hurricanes, and prolonged dry spells adversely affects rural communities (IPCC, 2023), especially on resource-based livelihoods including agriculture, fisheries, livestock rearing, and a few others (Yamba, 2017). The climate change scenario is emerging as the most stressful issue in the globe (World Bank, 2021). Climate change impacts such as rise of ambient temperature, changing precipitation patterns and increasing drought spells are already evident across multiple sectors over the globe (UNEP, 2024) including agricultural systems (Falco *et al.*, 2018). This is evident by the rise of the annual

average earth surface temperature by 1.4 degrees Celsius that surpasses the pre-industrial baseline (1850–1900) of 13.7 °C (WMO, 2023). A higher degree of uncertainty about precipitation and rainfall patterns have been notified with 3.9 percent increment of average monsoon precipitation as predicted by 2050 (Mustofa *et al.*, 2021; IPCC, 2023).

Despite the research indicates higher photosynthesis and productivity of agricultural fields due to increasing temperature (Schneider *et al.*, 2022), the same reduces the yield of crops such as rice, maize, and wheat by 20–40% (IPCC, 2022), which are the staple foods of developing countries in the global south. Several scholars have stated that global maize and wheat yields are projected to decline by 4.1% and 1.8% respectively for every 1°C increase in temperature in the past few decades (IPCC, 2023; UNEP, 2024). Further, warmer temperatures hasten the spread of infectious diseases and other vector-borne diseases and deficiencies (Falco *et al.*, 2018) that directly affect the food security of people, which is detrimental for less developed countries with a substantial level of poverty (UNHCR, 2024). The negative impacts ramify to livestock and fisheries sectors that cause increased mortality, less recruitment, and unusual mobility (Schneider *et al.*, 2022). Similarly, a warmer atmosphere holds more moisture, increases the likelihood of extreme rainfall and directly influences the intensified flooding events. Due to these climate-related disasters, more than 32.6 million people in the globe are displaced internally (UNHCR, 2024). A higher displacement rate has been observed in the South Asian context, mainly due to water scarcity and salinization of coastal areas that lead to repeated crop failures (WMO, 2023).

Increasing frequencies of adverse impacts of climate-related risks and disasters are abandoned in traditional nature-based livelihoods in developing countries (Ruchir *et al.*, 2021; Slycan Trust, 2021). Thus, coping strategies to enhance adaptability, resilience, and transformation are much needed (CBSL, 2022; Sargani *et al.*, 2023), especially for vulnerable agrarian communities of farming and fishing (World Bank and ADB, 2020).

Vulnerability has been defined as the degree to which communities are susceptible to or unable to cope with the adverse climatic hazards in the context of exposure, sensitivity and adoptive capacity (FAO, 2018). Importantly, farmers use coping strategies such as climate-resilient crops, effective irrigation systems, and techno-based agriculture (IPCC, 2023) and internal migration to where livelihood opportunities are existing – called climate induced migration. In addition, secondary livelihoods and alternative livelihoods also have been adopted, which have been introduced either by the government, non-government, or international organizations including World Bank, UN and FAO (Slycan Trust, 2021). Climate induced migration is known as, the movement of one or more people who are forced to leave their usual place of residence, either permanently or temporarily, within a geographical border, primarily due to abrupt or progressive environmental changes brought on by climate change (IOM, 2019). Climate induced migrants adopt diverse coping strategies, including internal migration to compatible areas, searching for alternative or secondary livelihood opportunities (IOM, 2024). Secondary livelihoods are explained as, shifting for supplementary income generation sources alongside main occupation or farming such as petty trading, self-employment, fishing, and working as labors (Ellis, 2000; Chuong *et al.*, 2024). Alternative livelihoods are known as temporarily or permanently shifting to different practices in agriculture such as crop diversification using advanced irrigation systems or SMART agricultural practices (Sapkota, 2021; Wright *et al.*, 2016; Deressa, 2009). Both have been considered as adaptation strategies for climate induced migration (IPCC, 2023; Salifu, 2021). However, most of such strategies are only being practiced in patchy communities rather than being incorporated into policies, governmental advocacies and/or government supportive systems such as knowledge dissemination, vocational training, and skill development programs (UNDP, 2023). These programmes are crucial for new startups to possible alternative and secondary livelihood options, especially in low-income countries

like Sri Lanka. In the absence of well-defined sources to cope with climate-related vulnerabilities, the climate victims migrate across administrative boundaries voluntarily or involuntarily (IOM, 2019). Such migrations are intertwined with multiple social costs, including gender-based issues, drug/alcoholism-based issues, loss of families, separations, and many more (Slycan Trust, 2021; IOM, 2019). The World Bank Group estimated that more than 143 million people in sub-Saharan Africa, South Asia, and Latin America will be displaced or migrate by 2050 due to climate change (World Bank, 2021).

Sri Lanka is an island in South Asia encountering a multitude of climate vulnerabilities, where 26% of the population depends on agriculture and 18% on fisheries (CBSL, 2024). Sri Lanka is among the top ten highly vulnerable countries for natural disasters (IPCC, 2022), ranking at 13th with the highest relative risk of being displaced by disasters in South Asia (DMC, 2020). Approximately 6 in 10 people in the Sri Lankan population are experiencing multidimensional vulnerabilities, considered encompassing factors including education, health, and living standards, according to the Multidimensional Vulnerability Index (MVI) for climate change (UNDP, 2023). Disaster related victims are given in Table 1.

**Table 1: Disaster affected numbers in Sri Lanka in 2017**

Disaster	Affected number		Death	Injured	Missing	No of houses damaged	
	Families	Persons				Completely	Partially
<b>Drought</b>	667939	2440290	0	0	0	0	0
<b>Flood</b>	171433	666244	118	115	89	1370	10379
<b>Intense winds</b>	36148	128653	13	83	5	855	33187
<b>Animal attack</b>	15	43	10	1	0	2	7
<b>Drowning</b>			40	1	1	0	0
<b>Lightening</b>	64	268	14	21	0	2	40
<b>Landslides</b>	32905	129949	96	14	55	301	1308
<b>Slop failure</b>	1954	7748	6	2	1	24	254
<b>Total</b>	910467	3373324	297	237	151	2554	45175

Source: Annual report, Disaster Management Centre, 2017

Accordingly, floods and landslides are by far the worst of all disasters in Sri Lanka, with a startling 171,433 recorded fatalities and 666,244 injuries (DMC, 2017). A severe drought occurred in 2016 and 2017 and has led to a 50% drop in paddy and maize production, with a huge impact on more than 900,000 households in Sri Lanka (IOM, 2019).

Despite the entire country affected due to this prolonged drought spell, the small-scale farmers in the dry zone particularly Trincomalee and Anuradhapura (DMC, 2020) affected badly due to lack of resilience mechanisms, adaptability, and opportunities for recovery (World Bank, 2018). Approximately 2.4 million people were nonetheless negatively affected by the drought in the dry zone of the country (DMC,

2020). Accordingly, the government introduced secondary/alternative livelihoods yet farmers tend to migrate searching for income opportunities indicating issues and inadequacies in the coping strategies. As a result, the objectives of this study are to find out the adaptation and transformation strategies practiced by drought-affected agricultural migrants in dry zone of Sri Lanka, to calculate the efficacy index for alternative and secondary livelihoods practiced by the drought affected agricultural migrants, and to identify the constraints for the long-lasting alternative and secondary livelihoods practiced and suggest recommendations to enhance the income security of drought-affected agricultural migrants.

Thus, this paper aims to identify the most common alternative and secondary

livelihoods practiced by climate-induced migrants, while also addressing the gap in knowledge regarding the importance of supportive services that strengthen these livelihoods in drought-affected regions. Further through the ALVI, giving insights to develop climate resilience strategies and policy implications.

### Conceptual framework

This study is grounded with dynamic interrelationship in between climate change vulnerability among agricultural communities and climate induced migration. Adverse weather patterns lead by climate change (e.g. lengthy drought period and irregular rainfall patterns) stress the agricultural productivity resulting direct or indirect migration across geographical boundaries (Mustofa *et al.*, 2021; WMO, 2023; CBSL, 2022; DMC, 2020). These climate change induced migrants are eager to have alternative livelihoods or secondary livelihood opportunities (IPCC, 2023; IOM, 2019) to overcome vulnerabilities.

Absence of attractive or sufficient means of living, the climate induced migrants tend to adopt complete transformations, which are basically outside the agricultural sector thus moving to industrial or service-based employment are possible. Yet, any of these movements are associated with a sort of vulnerability depending on climate sensitivity of the region, frequency and damages due to climatic hazards, negative impacts on household economy including financial and/or human capital, strength of social capital, availability of institutional or government support and cultural and psychological factors (IOM, 2019; IPCC 2022; Slycan Trust, 2021).

In order to lessen the vulnerabilities, government, non-government organizations and international donors have introduced different supportive programs to enhance alternative and secondary livelihood options for climate-induced migrants especially in the agriculture sector (IOM, 2023; Slycan Trust, 2021). Training and knowledge dissemination programs, product development, entrepreneurship and promoting small and

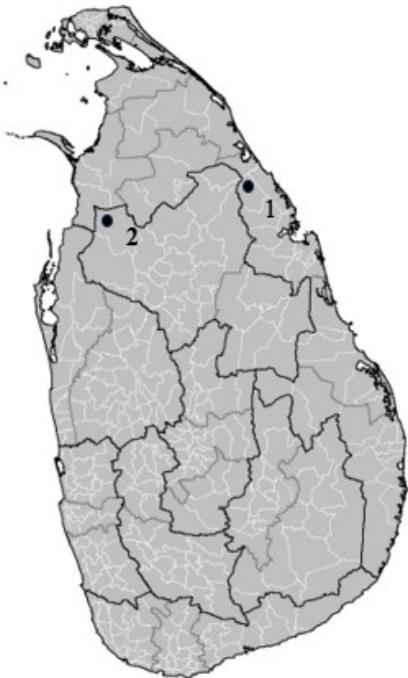
medium scale business startups are noteworthy. In addition, government focuses on providing access for real time information, extension programs and infrastructure developments (transport, electricity, water, health and education) for rural development (IPCC, 2022; IOM, 2023).

Despite of escalating vulnerabilities and coping mechanisms by means of alternative and secondary livelihood options, vulnerability assessment is needed to evaluate the success, limitations or challenges of the introduced coping mechanisms. Thus, this study focuses on identifying viable alternative and secondary livelihoods for drought-affected agricultural migrants in the dry zone of Sri Lanka. The level of vulnerability assessed through ALVI.

The next section presents the methodology of the research conducted with a comprehensive explanation on ALVI. Then, the results and findings are elaborated with empirical evidence, followed by the conclusion drawing pragmatic policy suggestions for sustainable problem solving for climate-affected agrarian communities in the world.

### METHODOLOGY

This study was carried out in Anuradhapura (North Central Province) and Trincomalee (Eastern Province) districts in Sri Lanka, which are situated in an area noticed as the top two climate change hotspots in Sri Lanka (World Bank, 2020). The average annual temperature ranges from 22.0°C to 35.0°C, with a possibility to rise up to 36.2°C during the warmest season—from April to September (WMO, 2023). Gomarankadawala (Trincomalee) and Mahavilachchiya (Anuradhapura) Divisional Secretariat divisions (DSD) were purposively selected following the climate change hotspot map (World Bank, 2018). Despite of being the drought prone areas, Trincomalee and Anuradhapura (Figure 1) are among the high agricultural production in the country, hosting 36,385 agriculture sector employees in Trincomalee and 22,467 in Mahavilachchiya (DCS, 2020).



**Figure 1: Research areas in Anuradhapura and Trincomalee districts in Sri Lanka**

Source: Department of Census and Statistics, 2023

1: Gomarankadawala DSD in Trincomalee district, 2: Mahawilachchiya DSD in Anuradhapura district

A mixed-method approach was adopted by employing both quantitative and qualitative data collection methods for better interpretations. Five village administrative divisions (Grama Niladhari/ GN divisions) from each Divisional Secretariat Divisions (DSDs) were selected randomly. Accordingly, Thanthirimale, Pemaduwa, Randuwa, Mannaramhandiya and oyamaduwa GN divisions were selected from Mahawilachchiya DSD and Gomarankadawala, Galkadawala, Kandamalawa, Mailawewa and Kalyanapura GN divisions were selected from Gomarankadawala DSD. Thirty paddy farmers were selected from each district randomly (total  $n = 60$ ). Key informant discussions were held with office bearers of farmer organizations and well-experienced farmers ( $n = 10$ ) and ground-level government officials/ extension officers ( $n=5$ ). Village level administrative records were gathered from each GN division as the sampling frame. Both descriptive and inferential statistics were used for data

analysis. The vulnerability index was developed (see the next section). ALVI ranges from 0 to 1, which indicates the most to least vulnerability for alternative and secondary livelihood opportunities where 0.5 is considered as the benchmark of vulnerability (less than 0.5 is considered the vulnerable condition, and higher than 0.5 is taken as the less vulnerable situation) (Hahn *et al.*, 2009). This scale has been used by other vulnerability indices including Socioeconomic and livelihood vulnerability index (Chowdhury *et al.*, 2025), Climate Vulnerability index-measure of climate change vulnerability (Pandey and Jha, 2012), Flood Vulnerability Index (Balica *et al.*, 2012), and Climate change vulnerable index (Edmonds *et al.*, 2020).

### Calculation

Balanced weighted average approach (Sullivan *et al.*, 2002; Pandey and Jha, 2012; Balica *et al.*, 2012; Edmonds *et al.*, 2020) was used to develop the ALVI. ALVI uses three major components (UNDP, 2007) - availability, accessibility and satisfaction on government supportive programs designed for small-scale businesses (*Supplementary table 2*). Supportive services were explored over vocational training, extension, financial support, knowledge dissemination (market, weather, technology, finance, logistic, value chain, networking, financing and insurance) and infrastructure facilities like transport, market facilities, health and education. Furthermore, family wealth, household savings and debts were also taken as variables (Hahn *et al.*, 2009; UNDP, 2007; Sullivan *et al.*, 2002). These indicators have been used to assess the level of vulnerability and adaptive capacities in disaster-affected communities before and after the disaster (Hahn *et al.*, 2009). Standardization of sub-components is a prerequisite because each and every sub-component has different measurement levels. The ALVI value is calculated by averaging each major component index values (Eckstein *et al.*, 2020; Edmonds *et al.*, 2020), which reflects the vulnerability level of alternative and secondary livelihood options among climate-induced migrants in selected DSDs.

$$\text{Index Sd} = \frac{Sd - S_{\min}}{S_{\max} - S_{\min}}$$

Where;  $S_{\min}$ : Preselected minimum,  $S_{\max}$ : Preselected maximum, and  $Sd$ : Original subcomponent for district

Sub-component average by,

$$Md = \frac{\sum_{i=1}^n \text{indexSdi}}{n}$$

Where;  $Md$ : Major component in district d,

Sub-component:  $= \sum_{i=1}^n \text{indexSdi}$ , and  $n$ : Number of sub-components in major components

Final index value calculated by,

$$\text{ALVI}_d = \frac{\sum_{i=1}^x Wmi * Mdi}{\sum_{i=1}^x Wmi}$$

Where;  $\text{ALVI}_d$ : Alternative Livelihood index in district d, Major component average:

$\sum_{i=1}^x Wmi * Mdi$ , Total sub-components:  $\sum_{i=1}^x Wmi$ , and  $X$ : Number of major components

## RESULTS AND DISCUSSION

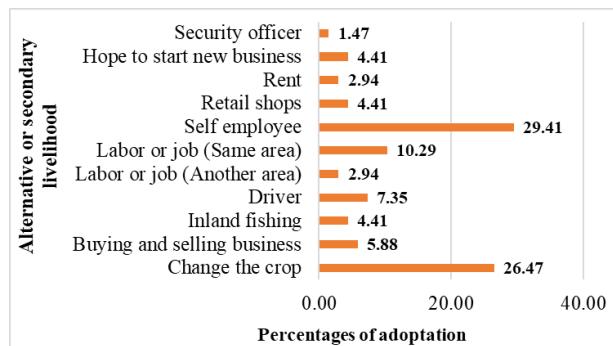
The socio-demographic profiles of the samples in Gomarankadawala and Mahawilachchiya DS Divisions reflect predominantly middle-aged (between 41–50 years) and male-headed households. The total sample consists of 31.67% women and 68.33% men where as 73.33% of respondents in Gomarankadawala were male and 26.67% were female. Similarly, 63.33% in Mahawilachchiya were male and 36.37% were female (Table 2). There was a notable difference in education levels between two demographic areas: while 60% of respondents in Gomarankadawala had studied up to Ordinary Level (O/L), 46.67% in Mahawilachchiya had completed education only up to Grade 8, suggesting relatively lower educational attainment among the agricultural communities in two selected areas. In average over 70% of the households consist with more than 4 family members in both two DSDs. Hence, community-specific adaptive programmes are paramount importance for these vulnerable households. Overall, both Mahawilachchiya and Gomarankadawala DS divisions exhibit similar demographic and rural characteristics, yet with distinct variations in gender composition, educational background, and household size.

**Table 2: Descriptive statistics for socio-demographic factors of the respondents**

Socio demographic factor	Category	Percentage of respondents in DS division		
		Gomarankadawala	Mahavilachchiya	Overall
Gender	Male	73.33	63.33	68.33
	Female	26.67	36.67	31.67
Age of the respondent	21-30	13.33	10	11.67
	31-40	16.67	20	18.33
	41-50	33.33	40	36.67
	51-60	26.67	23.33	25
	Above 60	10	6.67	8.33
Education	No schooling	0	0	0
	Primary education	10	10	10
	Passed grade 8	16.67	46.67	31.67
	Up to O/L	60	30	45
	Up to A/L	10	13.33	11.67
	Higher education	3.33	0	1.67
Number of family members	1	0	0	0
	2	20	3.33	11.67
	3	13.33	36.67	25
	4	40	23.33	31.67
	More than 5	26.67	36.67	31.67

### Alternative livelihoods adopted by climate migrants

Climate induced agricultural migrants in selected DS divisions in dry zone of the Sri Lanka use broad alternative options to strengthen their income generating sources (Figure 2).

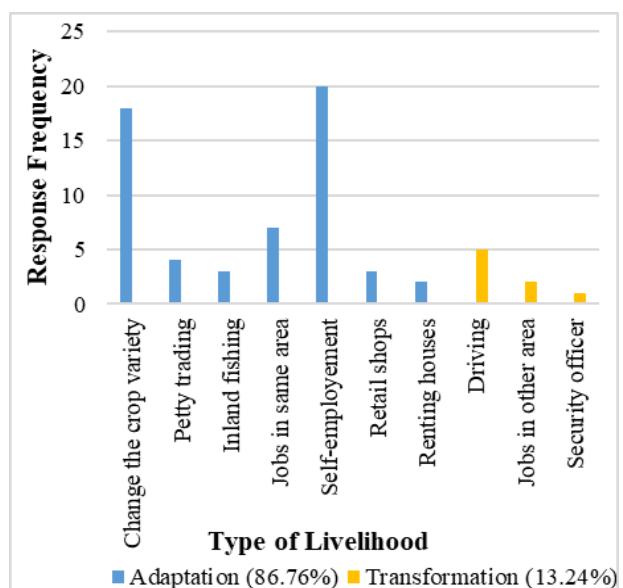


**Figure 2: Alternative livelihood and secondary livelihood options**

Figure 2 shows the alternative and secondary livelihood options followed by the climate induced agricultural migrants in the sample. Of them, inland fishing, petty trading, jobs in same area, self-employment, retail shops, changing of cultivated crop variety and renting houses are used as secondary livelihoods. Moving as laborers for other areas, security officer and driving jobs have been used as major alternative livelihood options. The most prominent secondary livelihood selected by 29.41% of respondents is self-employment related to producing dairy-related products and snacks, which indicates a considerable propensity for entrepreneurship amidst the difficulties caused by climate change in the agriculture sector. Their main market is village fairs or local retail shops in proximity (95%). Cultivation of drought-tolerant crop varieties is a coping strategy for 26.47%. Those who are reluctant to migrate due to personal reasons engage with petty jobs including daily paid labor (10.29%), driving (7.35%), inland fishing (4.41%), and petty trading (4.41%). Figure 3 shows different livelihood options adopted by the respondents in two DSAs.

As per Figure 3, majority of respondents are

using secondary livelihood options as adaptation strategy for climate changes, specifically for the drought (86.76%) and are not willing to move away from agriculture completely. In contrast, a fewer number of respondents (13.24%) are using alternative livelihoods as a transformation strategy, and they are not willing to return for agriculture when the climatic conditions get normal. This information indicates that there is a very high preference for incremental changes for livelihood transitions among vulnerable communities.



**Figure 3: Livelihood options**

Table 3, shows the Alternative Livelihood Vulnerable levels at each districts. Same level of vulnerability (~0.44 index value) was recorded from Anuradhapura and Trincomalee districts, which is less than the benchmark of vulnerability (0.5) (Sullivan *et al.*, 2002; Pandey and Jha, 2012; Balica *et al.*, 2012; Edmonds *et al.*, 2020). The availability component shows a significant improvement-shifting from 0.35459 to 0.60451 due to migration in Anuradhapura; whereas from 0.32576 to 0.5876 in Trincomalee. This implies that the availability of resources and programs linked to alternative livelihoods has increased notably. The major component of accessibility shows a slight improvement-shifting from 0.2153 to 0.41723 in

Anuradhapura due to migration and from 0.21417 to 0.4175 in Trincomalee. This confirms the accessibility of the resources and programs to the target communities. However, the vulnerability has increased due

to limited accessibility for supportive services (0.2-0.4) and capacity-building programs compared to their availability (0.3-0.5). Yet, there is a noticeable difference on accessibility in both locations.

**Table 3: Values of Alternative Livelihood Vulnerable Index for Anuradhpura**

Components	Anuradhapura			Trincomalee			
	Wm	Md*Wm	Index	Wm	Md*Wm	Index	
<b>Availability</b>	Before*	2892	1034.3575	0.35459	2713	890.3768	0.32576
	After*	4444	2691.1981	0.60451	4339	2554.580	0.58760
<b>Accessibility</b>	Before	2027	441.7198	0.2153	2020	440.5990	0.21417
	After	3281	1375.4010	0.41723	3345	1436.522	0.42754
<b>Satisfaction with supportive services</b>		1936	726.5192	0.37051	1881	673.1058	0.35288
<b>Family wealth</b>	Before	128	67.5556	0.36296	103	44.8889	0.27037
	After	75	24.2222	0.16667	97	46.8889	0.24815
<b>Savings</b>	Before	128	67.5556	0.36296	103	44.8889	0.27037
	After	75	24.2222	0.16667	97	46.8889	0.24815
<b>Debts</b>	Before	260	222.2222	0.85185	253	210.8889	0.82593
	After	176	114.2222	0.54074	217	173.7778	0.69259
<b>Satisfaction for income</b>	Before	118	94.0000	0.73333	113	84.5000	0.69167
	After	92	53.5000	0.51667	97	62.0000	0.55833
<b>Life satisfaction</b>	Before	118	94.0000	0.73333	113	84.5000	0.69167
	After	119	92.0000	0.74167	119	92.5000	0.74167
<b>Final ALVI value</b>				<b>0.4488</b>		<b>0.4412</b>	

Before\*: Values before the drought, After\*: Values after the drought

(Source: Field work in Anuradhapura and Trincomalee, 2023)

Having a lower value lesser than 0.5 indicates lower accessibility to adopt/follow alternative strategies although the communities are willing for. This coincides with the trust in the services offered by the government. In contrast, the respondents are not satisfied with the existing services within the area (satisfaction = 0.3). Key informant discussions held with government officers confirm poor coordination between institutions, lack of data on slow-onset disasters like drought, and absence of unified plans to tackle problems related to climate-related job loss and migration as drawbacks and limitations in the process (Government officials, Gomarankadawala, 2023).

The respondents are not satisfied about the government's supportive services. This has been mentioned in the Roadmap on Climate Mobility for Sri Lanka (IOM, 2024). It states, knowledge dissemination, vocational training programs for potential entrepreneurs, capacity-building programs, infrastructure development, financial assistance services,

technology adaptation for agriculture, and extension services for climate-induced migrants are inadequately provided, which is in line with the study findings.

Family wealth, savings, and debt are the determinants of choosing alternative and secondary livelihoods. Family wealth and savings have decreased in both pre- and post-event scenarios (ALVI = 0.3), which shows the financial barriers existing on alternative and secondary options. Although savings and permanent income sources improve ALVI, it has declined mainly due to the drop in family wealth and satisfaction-related metrics. In fact, financial stability can be considered as a key attribute for long-term availability of alternative options chosen by climate-induced migrants.

#### Constraints on alternative options

According to the major component values of ALVI, climate-induced migrants in both Anuradhapura and Trincomalee demonstrate a significant resistance to change for alternative

options (accessibility component less than 0.5 in both districts). Majority of farmers (95%) opt to retain in their usual traditional agricultural practices. This has been mainly due to lack of trust on government-supported services and programs available for alternative/secondary livelihoods, which is evident by lower satisfaction scores (Anuradhapura: 0.370513; Trincomalee: 0.352885). Besides, these communities have limited awareness on skill development and capacity-building programs, which restricts the communities' ability to leverage improved accessibility indices (Anuradhapura: 0.2153 to 0.41723; Trincomalee: 0.21417 to 0.42754) that would enhance their alternative options. Inadequacy of initial capital for investments (high debt value ~0.8 and lower savings ~0.2), poor infrastructure facilities such as transport and storage facilities and limited market access and solely depends on the local market (~0.3 satisfaction for services and facilities) are the main constraints for adopting alternative options. Vulnerability is also depicted by the sub-components that varies between 0.2-0.4 ALVI. Lack of accessibility to modern technological practices hinders the adoption of alternative livelihood options.

Hence, climate change resilience programs need to be focused on short-term and long-term alternative options for climate-induced migrants. Such programs need to be enriched with well-defined criteria to establish proper supportive and capacity-building programs at the right time for the climate-induced migrants (KII from Anuradhapura, 2023). Government, non-government organizations, and private sector supportive services are supposed to be vigilant and prepared for any circumstances even though the climate-induced migration is seasonal and temporal (SlycanTrust, 2021; CBSL, 2022).

Furthermore, this study suggests developing transparent information dissemination programs through effective extension facilities that would enhance long-lived alternative and secondary livelihood options for local communities. Since market accessibility and infrastructure facilities have

become a serious issue on expanding self-employment and small-scale businesses, improvements in market places and linkages are suggested. Financial instabilities can be overcome by structured credit schemes with proper credit management systems. Finally, this study suggests strong bottom-up feedback mechanisms as critical initiatives for the long-term success of each alternative option, especially for small-scale businesses and entrepreneurs among climate-induced migrants.

## CONCLUSIONS

This research aims to assess the difficulties in gaining alternative and secondary livelihoods and the success of the supportive services available for drought affected climate induced agricultural migrants in Sri Lanka, particularly in Anuradhapura and Trincomalee districts-the most drought affected areas in Sri Lanka. Self-employment (29.41%), cultivation of climate-resilient crop varieties (26.47%) and temporary jobs (13.2%) are the main adaptation strategies adopted by climate-induced migrants in Anuradhapura and Trincomalee. Comparatively a higher level of vulnerability for climate induced alternative and secondary livelihoods (0.44 ALVI) is reported for both Trincomalee and Anuradhapura. However, availability and accessibility to supportive services are inadequate (satisfaction is 0.5). Importantly, the rural agrarian communities are less reluctant to abandon their conventional ways in favor of more modern and sustainable alternatives that are closely knitted with their identity-based cultural practices. Besides, lack of awareness, insufficient capital, poor infrastructure, and limited market access hinder the progress of alternative livelihoods. Transparent information dissemination through effective extension facilities, improved market linkages, structured credit schemes and bottom-up feedback mechanisms are identified as critical initiatives for the long-term success of each alternative option. Hence, this study highlights the requirement of a strong policy focus to emphasize the sustainable alternative options for climate-induced migrants, especially in drought affected areas in Sri Lanka.

## AUTHOR CONTRIBUTION

MWKKD and DNK jointly conceptualized the study. MWKKD conducted the fieldwork. Both authors contributed to data analysis and manuscript preparation, discussed the results, and approved the final version of the paper.

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**Supplementary Table 1: Major components and subcomponents of the ALVI**

Major component	Subcomponents	Scale
<b>Availability of supportive services (Before the migration)</b>	Market Marketing Irrigation technology Land preparation technology Harvest and post-harvest technology Information and communication technology Finance support Knowledge dissemination and training programs Vocational training Motivational and capacity building programs Supply chain Value chain Networking Bank support Digital banking Insurance facilities and support Extension services Access to information Government support to new business startup Rural development programs Subsidies and loan facilities Infrastructure (Roads, water, electricity)	1-10
<b>Availability of supportive services (After the migration)</b>		
<b>Accessibility for supportive services (Before the migration)</b>		1-10
<b>Accessibility of supportive services (After the migration)</b>		
<b>Satisfaction with available Supportive services</b>		1-5
<b>Family wealth</b>		1-5
<b>Savings</b>		1-5
<b>Debts</b>		1-5
<b>Satisfaction level for income</b>		1-5
<b>Satisfaction level of life</b>		1-5