A Review of Environmental Vulnerabilities Related to Nepal's Graduation Process from Least Developed to a Developing Country Status

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Abstract
Nepal has long aspired to graduate from the Least Development Country (LDC) to Developing Country category as defined by the United Nations system. Nepal had met two of the three graduating criteria and could have technically graduated from the LDC status in 2015. However, based on the Nepal government's request to defer the review, the new 2021 assessment by the United Nations Committee for Development Policy (CDP) recommended that the country should graduate from the LDC status by 2026. The graduation requires not only meeting pre-defined development-related thresholds, but also maintaining sustained improvements in at least two consecutive assessments in two of three areas: gross national income (GNI) per capita, human assets index (HAI), and economic and environmental vulnerability index (EnVI). Nepal's economy is dependent on several environment-related factors such as agriculture, tourism, hydro-power, and natural resources. This economic development is also solidly tied to the environmental well-being of the country. The authors agree with the Nepal government's desire to graduate from the LDC status. In this paper, we review the graduation process, assess indicators of the Environmental Vulnerability (EnVI), review the current situation with respect to environmental vulnerability, and point out where it needs to develop appropriate goals, policies, and programs to help the country graduate and join the ranks of developing countries.

Keywords: *Nepal, Least Developed Country, Developing Country, landlocked, environment, climate, vulnerability, United Nations.*

"Sustainability is here to stay, or we may not be."

- Niall FitzGerald.

Introduction

The United Nations (UN) defines the Least Development Countries (LDCs) as "low-income countries confronting severe structural impediments to sustainable development" (UN DESA, 2022). The UN's Committee for Development Policy (CDP) regularly reviews the list of the LDCs to assess their progress for making any necessary changes to the categories. According to the UN, for a country to graduate from a LDC status to a developing country, it must meet

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at least two of the three criteria: gross national income (GNI) per capita, human assets index (HAI), economic and environmental vulnerability index (EVI) (UNOHRLLS, 2019). In 2021, the respective thresholds for graduation were, Minimum GNI per capita of $1,222; Minimum HAI of 66; and a maximum EVI of 32 (UnitedNations, 2021). Nepal's efforts to graduate from the LDC to developing status will need to be focused on all three criteria so that it meets at least two of the thresholds in two consecutive assessments by the UN's CDP. While we fully agree with Nepal's aspiration of graduating from the LDC status, here, we review the process of the graduation, and the current state of Nepal's economic and environmental vulnerability index (EnVI) and analyze how Nepal can do better in the EnVI arena. We examine whether despite being eligible to graduate from LDC Nepal can sustain the potentially high costs that often result in spending 2.1 to 3.7 percent of the total GDP during the year of disasters (Cavallo, Becerra, & Acevedo, 2021) to sustain the developing country status. The expenditures during the disaster years pose serious challenges to Nepal's economy because of the repetitive nature of natural disasters. To investigate this, we undertook literature survey using search engines like Academic Search Complete, Asian and European Business and References, Environmental Complete, JSTOR, ProQuest, EBSCOhost, ScienceDirect, and WorldCat and Google.com. We used environment, GNI, developing country, least developed country, Nepal, natural disasters, environmental changes, graduation, South Asia, and World Bank as keywords to search relevant sources. Since not all the disasters are the same, we focused on natural disasters in Nepal that affect people's lives and livelihoods. Also, we focused on who was affected, and how, when the disasters struck to understand how disasters cause destruction of human and physical capital that impact the economy. To analyze the local situations, we used gray literature from government and media to understand how one or more large and catastrophic disasters can impact the society.

We start our discussion with the UN sustainable development framework that divides the EVI into two areas: i) economic vulnerability index (EVI), and ii) environmental vulnerability index (EnVI). The UN Department of Social and Economic Affairs (UN, Department of Economic and Social Affairs, 2021) provides the following four indicators to measure a country's performance related to the EnVI:

1. Share of population in low elevated coastal zones
2. Share of population living on drylands
3. Instability of agricultural production
4. Victims of disasters

The first of the EnVI indicators in the list is designed to provide information pertaining to vulnerability of people due to sea level rise and storm surges resulting from climate change. The second is related to vulnerability from global warming and its effects on desertification, land degradation, wildfires, and heat stress, especially in arid, semi-arid, and dry sub-humid lands. The third indicator is concerned with instability in agricultural production. It is defined as "the standard deviation of the difference between agricultural production and its 20-year trend" (UNDESA, 2022). A high level of variability in agricultural production is indicative of high vulnerability due to natural shocks such as droughts and erratic rainfall patterns.

The fourth indicator is the share of population who are victims of disasters, defined as those killed or requiring immediate food, water, shelter, sanitation, or medical assistance. The first indicator does not apply to land-locked Nepal.

Even though Nepal has dry seasons resulting from global climate change, there are no large desert areas in the country. Thus, this second criterion applies only partially to Nepal, especially, for the western Churia (west of ~85° E longitude) range at the lower elevation and in the leeward sides of some mountainous ranges where rainfall is low. Both these areas have very thin settlements. Additionally, there has been an exodus of people from these areas to the urban areas the plains in the south. We do not focus in these areas. Thus, the second indicator related to drylands is also irrelevant to Nepal. The latter two are of utmost importance as over a third of Nepal's Gross Domestic Product (GDP) is still accounted for by the agricultural sector, and because Nepal is one of the most disaster-prone countries in the world.

As mentioned above, the purpose of this paper is to assess the EnVI, review the current situation and point out areas where Nepal needs to develop appropriate goals, policies, and location-specific programs – in view of the diverse topography where climate/weather patterns vary within a short distances – to help the country do better in these areas for graduating from the LDC status, and sustaining the position of a developing country upon graduation.

Nepal's Progress Towards Graduation from LDC Status

The UN CDP assesses a country's developmental status on whether a country meets the criteria for graduating from the LDC status and recommends graduation to other UN bodies for the final decision. Every three years, the CDP assesses the conditions of LDCs towards potential graduation. The first review of Nepal's potential towards graduating from the LDC status was done in 2015. At the time, Nepal had met two of the three graduating criteria and had technically become eligible for graduation. However, as the government of Nepal was concerned about the sustainability of the achievements, and that graduating from LDC status would make the country ineligible for certain trade-related benefits, it requested the CDP to defer its graduation until the next review in 2021. The CDP had deferred its recommendation to the second review that was done in 2021.

In its 2021 review, the UN CDP recommended that Nepal be graduated from the Least Developed Country (LDC) category and a five-year preparatory period for graduating into Developing Country in 2026. This information was relayed by Nepal's Permanent Mission to the United Nations in New York on February 26, 2021 (Nepal UN Mission (a), 2021). The CDP had said that Nepal met the threshold in two areas – Human Assets Index (HAI), and Economic and Environmental Vulnerability Index (EnVI) – among three indices which are considered (FNCCI, 2021). Accordingly, Nepal was eligible to join the ranks of developing countries. Subsequently, CDP's recommendation for Nepal was endorsed by the UN's Economic and Social Council (ECOSOC) in 2021. The final decision about the graduation of a country is made by the UN General Assembly. And Nepal's case for graduation was approved by the General Assembly in October 2021 (Nepal UN Mission (b), 2021).

To meet the EnVI criteria and make incremental progress, it is important for Nepal to fulfil the EnVI criterion sustainably. It must make sustainable progress in the EnVI elements because various sustainable development goal (SDG) targets have linkages with the graduation criteria (Khatun, Pervin, & Rahman, 2018). In its report, National Review of Sustainable Development Goals dated June 2020 (Government of Nepal, 2020) the Government of Nepal said its progress on SDG goals had been uneven. The report stated that while progress in some areas such as poverty reduction and gender equality, afforestation and reforestation had been impressive, challenges remained in the areas such as climate change, biodiversity conservation, and disaster management.

In its 15th National Plan, the Government of Nepal has aligned the country's development plans with many of the SDG targets. Actions taken by governments during previous plans and their continuation in the current plan led to progress in achieving some of the SDGs. For example, Nepal's poverty rate (SDG #1) was unusually high—38 per cent in 2000, which declined to 21.6 per cent by 2015 (National Planning Commission, 2020).

In terms of the adverse impact of climate change, Nepal is considered one of the most vulnerable countries in the world. An increased frequency of extreme weather events in recent years substantiates this. According to a Government of Nepal Report (IDS_Nepal, _PAC; GCAP, 2014), 1.5 to 2 percent of Nepal's GDP is lost due to such extreme climate events. The report added that in the years with extreme events, such economic loss can rise to 5 percent of the GDP. Nonetheless, the Government has become proactive in taking climate action (SDG #13) to mitigate the adverse effects of climate change. Nepal has also made commitments to maintain and manage 45 per cent of the total area of the country under forest cover (SDG # 15), to enhance carbon sequestration through soil and forest carbon storage, and to promote green economy, among others (NPC, 2020). However, spatial circumstances suggest that Nepal's environmental conditions are also significantly influenced by the industrial activities of its northern and southern neighbors.

Graduation from a LDC to a developing country is an important milestone for Nepal because it can boost national pride and signify a global recognition of its development achievements. It also provides a rebranding opportunity to attract foreign investors. Nepal has become a unique case in 2021in that it has been recommended for graduation without meeting the GNI per capita criterion. However, meeting the criteria for being recommended to graduate only at a base level does not bring the process to finality. Maintaining the weights of the indices until graduation and sustaining them afterwards are more important. A weaker economy can have adverse consequences for building human assets and reducing economic vulnerability. Graduation also brings new economic challenges and demands full attention of policy makers to address them.

Trade-offs Related to Graduation from LDC Status

As an LDC, Nepal has been receiving concessional loans, grants, and aid from various bilateral and multilateral donors. Many of these benefits will no longer be available in concessional

terms upon graduation. Grant assistance will also be unobtainable in some cases. It will have to be replaced by loans that require both principal and interest repayment. Also, the World Bank and the Asian Development Bank, two of the major lenders, will charge a higher interest rate on loans after the country transitions from a low-income country to a lower-middle income country category, which can roughly correspond to the transition from LDC to developing country. There will also be restrictions or higher costs on accessing vertical funds such as the Global Alliance for Vaccines and Immunization (GAVI) and Fund for Climate Change. As the country will need to move away from aid and grants to investment for financing economic growth, the role of foreign direct investment (FDI) will be critical in managing the transition.

FDI comes in a package of investment capital, technical know-how and managerial competence. Thus, it is a vital resource for economic growth and employment creation. In addition, FDI is also a conduit of export promotion. For these reasons, many developing countries, including India and China, have created investment friendly environments and have provided incentives to attract FDI. Nepal however has not had an abundance of FDI as investors often perceive the country as one where corruption and a cumbersome bureaucracy can make setting up, operating businesses, and repatriating profits challenging. Nepal needs to alleviate such perceptions by making the country investment friendly.

As LDC, Nepal enjoys preferential market access for its exports under different trade regimes. After graduation to developing country status, it will lose the duty-free quota-free (DFQF) benefits. Additionally, since the reciprocal trade preference to its counterparts will come to an end upon graduation, Nepal will enter a more competitive environment in the global trading arena. Several WTO rules and requirements that Nepal is currently exempt from as an LDC will have to be observed (FNCCI, 2021). These changes may adversely impact international trade/economic growth performance, increasing the possibility for economic as well as environmental vulnerability.

However, some mechanisms and negotiated approaches are available to smoothen the path to graduation and its sustenance. We outline these mechanisms below:

i. In the export sector, the provision of DFQF access to European Union and the U.K. are generally extended for three years after graduation.
ii. China, India, and many other countries may also extend the LDC scheme to Nepal for a certain period after graduation.
iii. Nepal can also negotiate bilateral and regional free trade agreements as necessary. What is important at the beginning is to have a good transition plan to address these challenges for mitigating the adverse effects.
iv. Nepal can also learn from the experience of Bangladesh's export success in apparels in its economic transformation (Razzaque, 2018), and emulate strategies for success in exporting carpets.
    a. The U.N. has given Nepal five years (until 2026) to prepare for graduation.
    b. Even after graduation, most of the concessions are extended for another three years, giving enough time for the transition to be smooth.

In addition, Nepal must also review the following issues related to her vulnerabilities.

i. About 2-4 million Nepalis work outside the country and sent remittances in the order of about 24 percent of GDP in 2020 (World_Bank, 2020). This dependence on remittances has contributed to low productivity growth, and triggered a muted structural transformation of the economy, where the share of agriculture in the economy has rapidly declined without a significant movement of workers out of agriculture to industries. Indeed, some 25 percent of agricultural land in the hills has been left barren due to the exodus of the able-bodied workforce (Online_Khabar, 2021). Thus, the labor released from agriculture has been transformed into migrant workers seeking employment in foreign countries. Consequently, Nepal has been suffering not only from the "hollowing out" effect as more and more skilled workers and professionals migrate, but also from the alteration of the agricultural ecosystem in the hills to the detriment of production.
ii. In the case of a normal structural transformation of the economy, low-productivity agricultural labor is absorbed by the industrial sector. The industrial sector keeps on expanding until all the surplus labor from agriculture is absorbed. Once that process is complete, productivity and wages begin to rise. This is not happening in Nepal because of the low level of industrialization.
iii. Given the situation of a large percentage of population constituting of young people with almost half a million people entering the workforce each year, Nepal should be able to take advantage of its demographic dividend (World_Bank, 2017). But the dividend is now collected by the foreign countries which employ the migrant workers.
iv. Through better policies, Nepal can develop several productive schemes for utilizing remittances and skills gained in foreign countries by returning migrants as a stop-gap measure (Sharma, 2020). Capacity enhancement, achieved through an effective use of trained human capital, with financial resources earned from remittances will help in creating, conserving, and sustainably managing the environment, and contribute towards reducing the country's environmental vulnerability.

Maintaining Progress Related to the Environmental Vulnerability Index

The CDP review in 2021 noted that Nepal had managed to make significant progress and to build resilience despite many challenges. Its heavy reliance on remittances and limited foreign direct investment (FDI) add uncertainty with regards to its recovery from the COVID-19 crisis since early 2020. The 2021 CDP review said, "For the smooth transition strategy, the Committee calls upon the Government to … build resilience to disasters, accelerate economic diversification and enhance the capacity of the central and local governments" (UNCDP, 2021).

The CDP's recommendation to Nepal for a developing economy status in 2021 are based on HAI, EnVI and GNI/Capita (Table 1; and Fig. 1).

Table 1: Criteria for graduation from LDC to Developing status economy

Criteria	Requirements	Nepal's attainment
Human Development Index (HDI)	64 or higher	74.9
Economic and Environmental Vulnerability Index (EnVI)	32 or lower	24.7
Gross national income criterion (GNI/capita)	$1,222 or higher	1,027

Economic and environmental vulnerability index(ENVI)*

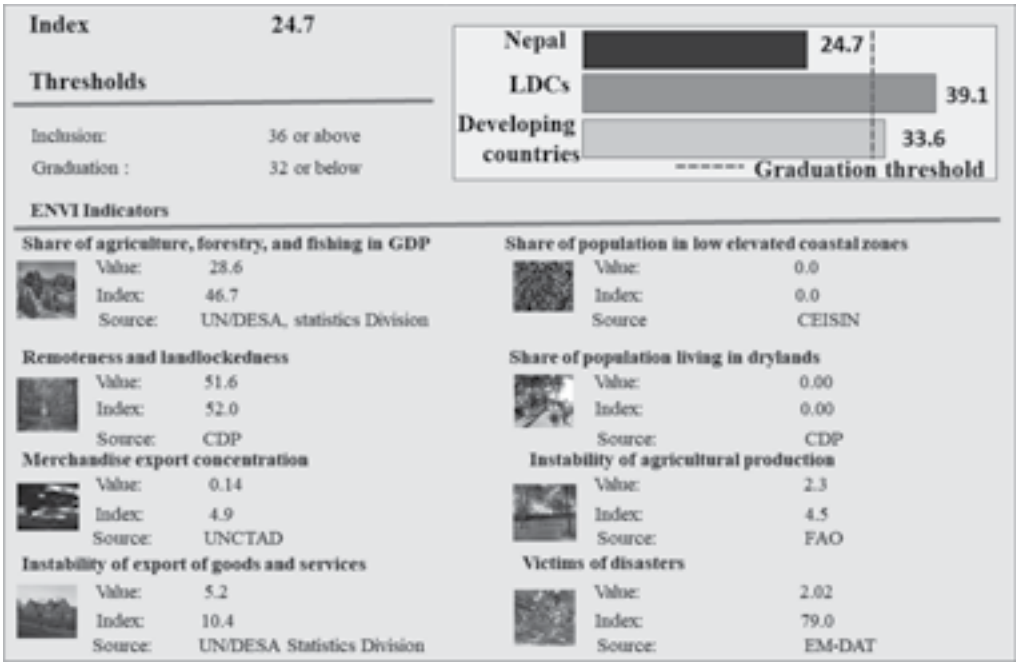

Fig.1. Nepal's Economic and environmental vulnerability situation in 2021.
Source: Redrawn from (UN, Dept. of Economic and Social Affairs, 2021)
Note: This diagram uses Economic Vulnerability Index (EVI) and EnVI abbreviations interchangeably.

The CDP report shows how Nepal has satisfied the two requirements for graduating from the LDC status. Accordingly, Nepal's Human Assets Index (HAI) is 74.9, whereas the minimum threshold needed for graduation is 64. A higher HAI number is better. Nepal's Economic and Environmental Vulnerability Index (EnVI) is 24.7. The requirement to graduate from the LDC status is an index score of 32 or below. In the case of EnVI, a lower score is better. However, Nepal had not met the income criteria (GNI per capita) because it was $1,027 in 2021 against $1,222 or higher required for graduation.

Following the review, the CDP said,
"The Committee recommends Nepal for graduation, noting that it continues to meet the human assets index and the economic and environmental vulnerability index criteria, while

approaching the threshold for graduation of the gross national income criterion. Nepal has managed to make significant development progress and build resilience despite many challenges". (UNCDP, 2021)

Nepal's development is strongly related to its efforts to conserve and enhance its natural resources and improve and maintain its agricultural production in keeping with population increase and higher income per capita. Similarly, Nepal must have plans, programs, resources, and tools to deal with disasters that people regularly encounter such as floods, earthquakes, storms, landslides, droughts, and other emerging climate-related disasters.

Although Nepal met the EnVI threshold required for graduating from the LDC status, continuous work needs to be done by the country to reduce the vulnerabilities. The following paragraphs review and discuss each of the indicators.

EnVI Graduation Criteria in the Nepali Context

Share of population in low elevated coastal zones

This indicator implies that the population living in low elevated coastal zones is subject to the damages and losses brought about by the impending climate change that causes sea level to rise. As Nepal is landlocked and does not have any coastal areas this criterion does not apply. Hence, the UN CDP report of 2021 shows the value and indicator for this element is zero.

However, Nepal does have low lying lands that are on the flood plains of various rivers that are prone to annual flooding. The damages caused by floods, including loss of human life and property, are significant. Climate change has worsened the situation. It is important that Nepal minimizes the loss and damage from floods, which are likely to continue as climate change increases both the frequency and magnitude of floods and storms in the flood plains. This issue is discussed further in Section 5.4.

Share of population living on drylands

According to Greenfacts (Greenfacts.org, 2022), drylands are the land areas where the mean annual precipitation is less than two thirds of potential evapotranspiration from soils and plants. The UN CDP report of 2021 shows the value and indicator for this for Nepal to be zero. This implies that Nepal does not have any permanent population living in the areas defined as drylands.

There are no hot deserts in Nepal. Landless squatters are settled in some areas without irrigation facilities, such as Churia and Bhabar regions. However, technologies like rain harvesting, storing rainwater in ponds, and piped water supply have helped the settlers to grow kitchen gardens and backyard crops that do not need regular external irrigation. These regions have small populations, which has been further reduced by migration to urban areas, to the plains/ Terai and for work abroad.

Instability of agricultural production

According to Sustainable Competitiveness Observatory, instability of agricultural production "reflects … the vulnerability of countries to natural shocks, in particular impacts of droughts and disturbances in rainfall patterns" (SCO, 2018). For this indicator, the CDP report has allotted a value of 2.3 for Nepal against the index of maximum 4.5 (a lower value is better) as graduation threshold.

In its 2018 report, UN CDP (UNCDP, 2018) said that agriculture is a significant component of Nepal's economy contributing some 33 percent to the GDP. Further, agriculture employs many individuals and provides regular income to most rural households. As many able-bodied young Nepalis are now leaving the hinterlands, agricultural production has been experiencing an adverse impact caused unavailability of workers.

In 2010, only 29.7 percent of agricultural land in Nepal had access to perennial irrigation facilities (World Bank, 2010). Rest of the farming depended on monsoon rainfall that also made the production unpredictable. Since production fluctuates based on too much or too little rain annually, the Nepalis often joke about the economy being more dependent on the monsoon rains and less on economic policy.

Global climate change and climate-induced disasters affect agricultural production in Nepal. Since global temperature is likely to increase by at least 2°C from preindustrial levels before 2100 (IPCC, 2018), this will have multiple, far-reaching consequences for ecosystems, their services, and human populations in Nepal. As the mountain ecosystem deteriorates, communities living within the watershed areas face food insecurity because of crop losses due to phenological changes (Fig. 2) from droughts, floods, and soil erosion (Mills, D., & Manji, 2020).

Climate change leads to instability of agricultural productivity due to dry spells, delayed monsoon, and more frequent extreme climate events such as droughts, floods, hurricanes, wildfire, heat waves, hailstorm, and cloudbursts. Household food insecurity is experienced differently by different socio-economic groups. For example, poor and disadvantaged groups will suffer more than the well-off groups. Even though many disadvantaged groups have been able to improve their living conditions through remittance in recent years, this is not sustainable in the long run. Policies need to target how to harness the temporary benefits obtained from the remittance through proper investments and long-term productivity gains. Climate policies should on promoting sustainable livelihoods for the vulnerable groups.

Unexpected levels of precipitation, floods, storms and changing temperatures have impacted the general stability of weather that many farmers had experienced. Evidence suggests that inter-annual and intra-annual climatic fluctuations negatively impact agricultural productivity. For example, an increase in temperature reduces crop yields and encourages pest proliferation (Nelson, et al., 2009). Further, the changes in precipitation patterns increase the chances of short-run crop failure and long-run production decline. Table 2 shows the estimated quantity of rice crop destroyed in Nepal by the October 2021 floods.

Table 2: Destruction of rice crop in October 2021 due to the torrential rain

Province	Flooded rice area (ha)	Area under rice crop destroyed by October 2021 flood (area in hectares)				Estimated quantity of rice destroyed (metric tons)	Total cost of destruction in million US Dollars
		Total destruction	Partial destruction	Slightly damaged	Relief Able Area		
Province 1	49,945	6,722	16,806	26,554	13,092	49,748	13.93
Province 2	48,684	5,355	30,500	12,829	15,146	57,557	16.11
Bagmati (3)	530	530	0	0	530	2,014	0.61
Gandaki (4)	1,192	1,192	0	0	1,192	4,530	1.26
Lumbini (5)	42,427	42,427	0	0	42,427	161,223	45.24
Karnali (6)	2,767	2,767	0	0	2,767	10,515	2.95
Sudur Pakshim (7)	46,849	32,000	0	0	36,455	138,528	38.79
	192,394	90,993	47,306	39,383	111,609	424,115	118.89

Source: (Adhikari A. , 2021)

Because of the undulated topography, fragile, and sandy soils in the plain and some parts of the hills, Nepal is hypersensitive to natural calamities such as landslide and floods in the monsoon season. Similarly, due to unscientific cropping systems, inappropriate infrastructure and poor technology, Nepal's agriculture is equally sensitive to the long dry spells and high temperature during spring season and impacts of climate change (Fig. 2).

Generally, heavy rainfall occurs in Nepal during the monsoon season, but in 2021, Nepal witnessed unseasonal heavy rainfall shortly after the monsoon season. This unprecedented rainfall damaged an estimated 35 percent of the crops at the time of harvest (UN Nepal,

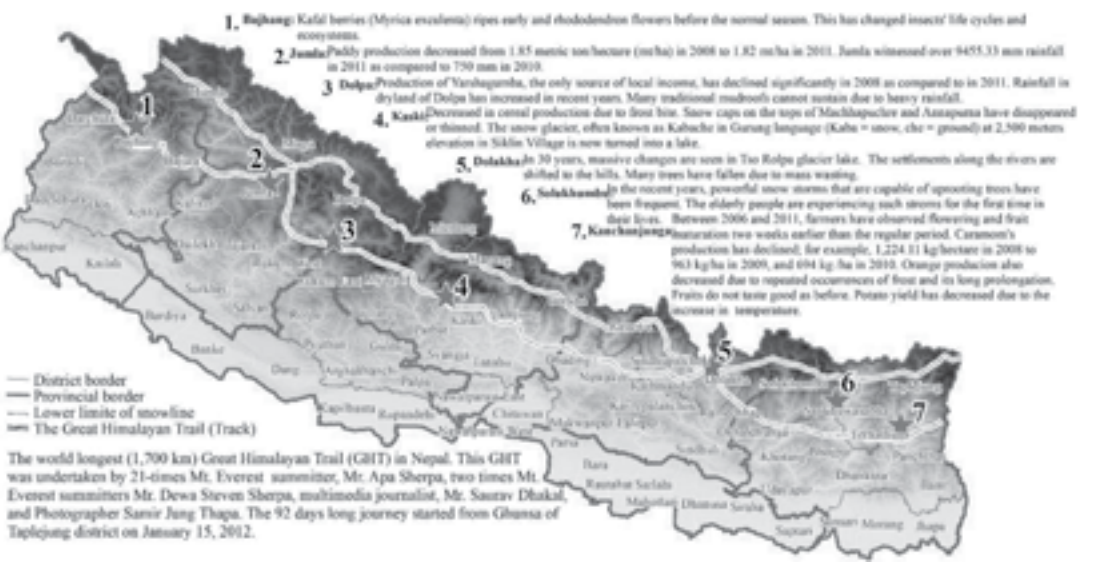

Fig. 2. Climate change has changed livelihood patters of people all over Nepal
Source: Adapted from (Bhattarai & Conway, 2021)

2022). A recent survey by UN Nepal has revealed the damages caused by unprecedented floods, landslides, and heavy rainfall cause most damage in Nepal (Table 3).

Table 3: Disaggregated hazard incidences (percentages) in Nepal

Incidence	House damaged/ destroyed	Damage to land	Damage to assets	Loss of crops	Loss of livestock	People displaced
Flood	57	42	44	86	30	26
Landslide	72	84	54	75	32	44
Heavy rains	53	56	33	83	21	25

Redrawn from source: (UN Nepal, 2022).

The same survey also revealed that of the 77 administrative districts of Nepal, in 12 districts[4] , school going children faced problems of residence (52%), health care (42%), food aid (34%), access to clean water (32%), child protection (27%), and lack of child friendly spaces (21%) due to infrastructure damages caused by unprecedented climatic events. Further, over 70 percent of the households were concerned about their food security followed by financial problems (62%), safety of family (43%), and shelter (21%). This had compelled may family members to borrow money (52%) from various sources for expenses , while some household members (47%) who were affected by the unprecedented rainfall, were planning to leave home for employment. Yet, some households (20%) were unsure where to go and how to sustain their livings (UN Nepal, 2022). These 12 districts are merely examples; similar situations have been reoccurring in various parts of the country due to unexpected weather and climatic conditions triggered by global warming.

Due to frequent and often consecutive drought years, food production and yield have been negatively impacted. For example, in the western region of the country, food production decreased by 12.5 percent, and in the eastern sector, it decreased by six percent between 2002 and 2005 (Regmi, 2007). In the tropical regions of Nepal, higher temperatures adversely affect rice yield. For every 40C increase in average ambient temperature, the average crop yield is reduced by 3.4 percent (roughly 0.8 per cent average crop yield decrease for every 1◦C increase in temperature). Every 10 C rise in temperature has reduced rice yield by 0.15 percent (Joshi, Maharjan, & Luni, 2008). Without CO2 fertilization , effective adaptation, and genetic improvement, each degree-Celsius increase in temperature means a decrease in yield of these crops. In another observation, wheat crop production has decreased by six percent, rice by 3.2 percent, maize by 7.4 percent, and soybean by 3.1 percent between the period of 2007 and 2013 (Zhao, et al., 2017) mainly due to the increase in temperature, holding other variables constant.

Victims of Disasters

Nepal has been experiencing an increased brunt of disasters in the past several years. This is due to the combination of many factors including climate change, rapid urbanization often on vulnerable lands including flood plains, construction of roads on unstable slopes,

4 Bajhang, Banke, Bardiya, Dang, Darchula, Doti, Ilam, Kailali, Kanchanput, Morang, Panchthar, and Saptari.

and regular, but increasing frequency of natural calamities such as earthquakes, floods, landslides, and unprecedented storms/rains. The UN CDP 2018 report noted that "Nepal's geographical location exposes it to extreme precipitation, seismic activities and landslides." This has contributed to increasing incidents of human death, loss of livestock and agricultural products, and destruction of infrastructure.

In an environmentally vulnerable country like Nepal, multiple environmental shocks can often occur in close succession. A case in point is the 2015 earthquake with epicenter in Gorkha, which was followed by above-normal rainfall in the monsoon season. The 7.8 magnitude (Richter Scale) earthquake killed some 9,000 individuals, and destroyed many houses that were not earthquake resistant. It took several years for Nepal to bounce back from the tragedy, and even today, many of the displaced families remain without permanent homes and away from their farming lands.

The unprecedented rainfall after the earthquake led to severe landslides as water percolated into cracks created by the earthquakes. As the country was already shaken by the earthquake, the above-normal rainfall led to increased incidences of landslides, destruction of agricultural land and assets, disruption in distribution of food aid, and damage of roads and communications infrastructures (Randell, Jiang, Liang, Murtugudde, & Sapkota, 2021).

Environmental vulnerability can adversely affect year-round access to safe and enough food. This will become an impediment for attaining one the SDGs related to ending global hunger by 2030. A better understanding of the effects of the intertwined, location-specific climate and disaster events will be necessary to design appropriate response to these vulnerabilities.

Nepal has more than 6,000 rivers and rivulets with a total cumulative length of 45,000 km. Many rivers flood during the monsoon season impacting families, livestock, and agriculture near the rivers and in the flood-plains. Torrential rains can also cause landslides that cause loss of lives and property. Nepal does not have strong flood-plain related regulations, specifically restricting construction and human habitation on areas that could be flooded in intervals of 50 or 100 years. Nepal needs to enhance its survey, mapping, and identification of the flood plain types where human settlements and construction activities need to be restricted through appropriate regulations.

According to World Bank data, 28.68 percent of the total land in Nepal was arable in 2015 (World Bank, 1961-2018). Of this, less than 30 percent had perennial irrigation facilities. Agricultural production is reasonably stable (with little fluctuations due to extreme temperature) in the lands that are irrigated throughout the year. However, it is difficult to forecast production for lands that fully depend on rainfall, and which can often be affected by landslides and flooding.

Nepal has prepared various disaster mitigation plans and policies at the national, provincial, and local levels. But there are major gaps in disaster risk preparedness. Mitigation plans for accidental floods and landslides that destroy thousands of lives and expensive infrastructure (Vij, et al., 2020) are not well laid out despite claims about policy makers working for enhancing

the resilience of vulnerable communities (Djalante, Holley, & Thomalla, 2011). There is a lack of financial and human resources government departments at all three levels in Nepal for building community resilience and adaptive capacity to mitigate disasters. Despite having limited capacities, governments provide rhetorical encouragement to enhance response and recovery programs in the disaster policies and plans (Vij, et al., 2020).

The Government of Nepal had prepared the National Adaptation Program of Action (NAPA) in 2010 to mitigate climate change through a consultative process. NAPA has become a strategic tool to assess climate vulnerability and systematically respond to climate change by developing appropriate adaptation measures. It hopes to attract funds from international donor agencies for its work. Additionally, Nepal also prepared climate change policy (2011), Local Adaptation Plans for Action (LAPA) framework to mitigate climate related incidences and to offer services to local communities. Recently, Nepal has developed a new national climate change policy, aligning its goals with the new federal structure of Nepal (Vij, et al., 2020).

Though Nepal spreads across 4° in latitude in the northern hemisphere and 8° in longitude in the eastern hemisphere, within this narrow range the elevation ranges from 65 m in the south to 8,848 m in the north. Elevation variations create different aspects, slopes, and orientation, where solar irradiance varies and impacts vegetation growth. Global climate change has brought several crop phenological anomalies. For example, citrus, and rhododendron have been flowering in the month of December instead of late February and early March (Sharma B. , 2020). These aspects and slopes also bring significant variations in rainfall patterns. Seasonal variations in rainfall patterns significantly impact agricultural practices and living conditions.

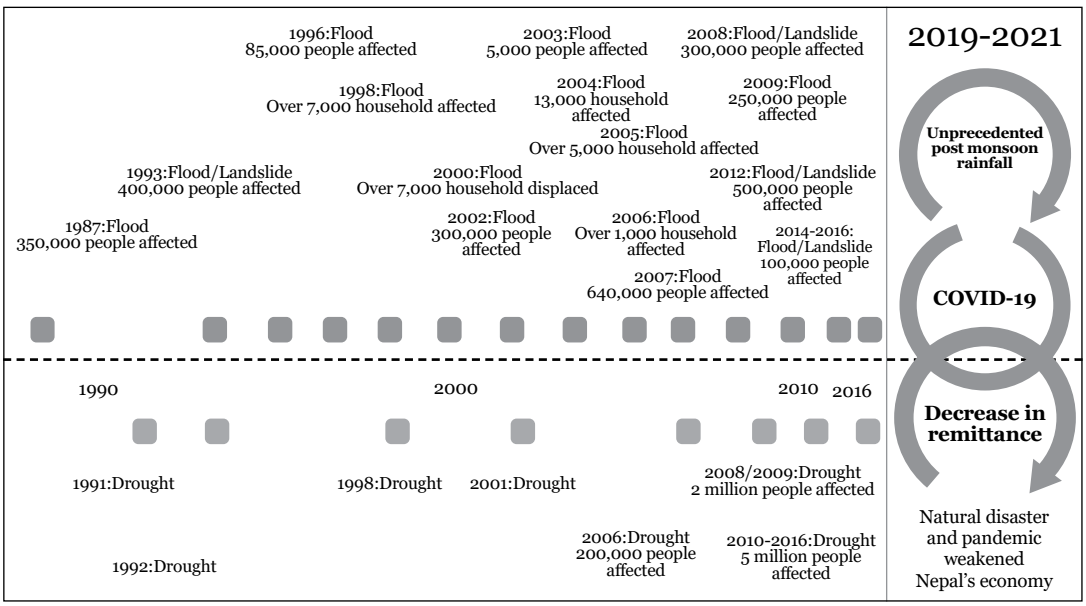

Fig. 3. Natural disasters in Nepal

Source: Modified from (Bhattarai & Conway, 2021)

In addition, planners and policy makers also need to take into account different microclimatic conditions. For example, in the third week of October 2021, the torrential rainfall caused a loss of $119 million worth of rice (Table 2).

Nepal receives rainfall from monsoonal winds that are caused by the low-pressure systems in the Bay of Bengal, which move north making the westerly winds active. That brings orographic precipitations in Nepal starting from the east and ending in the west. Since the late 1990s, intense rainfalls have caused several flood events. Rainfall is intense when more than 100 mm of rain occurs within 24 hours.

Further, the rainfall patterns have been erratic. For example, in 2004, Rampur, Chitwan witnessed 405-millimeter rainfall within 24 hours, and in 2005, 311 mm, but in 2021, the same place witnessed maximum rainfall of only 125 mm (Sharma K. , 2021). In late October 2021, , western Nepal received 211 mm of rainfall within 24 hours. Some areas such as Dipayal (Doti district) received 166 mm, Ghorahi (Dang district) 133 mm, and Bhairahwa (Rupandehi district) received 112 mm (Nepali Times, 2021). Rainfall varies widely across Nepal (Fig. 4). This has implications for food production and household food security (Gautam & Anderson, 2017).

Torrential rainfall in general, and late monsoon rains, cause floods and landslides and significant damages. Additionally, global climate change coupled with the unexpected COVID-19 pandemic, has added to the woes of many communities. Glacial lake outburst floods (GLOFs), an incidence that is exacerbated by climate change at the regional and global levels, damage infrastructure and cause loss of lives and property in the downstream catchment areas (Fig. 3).

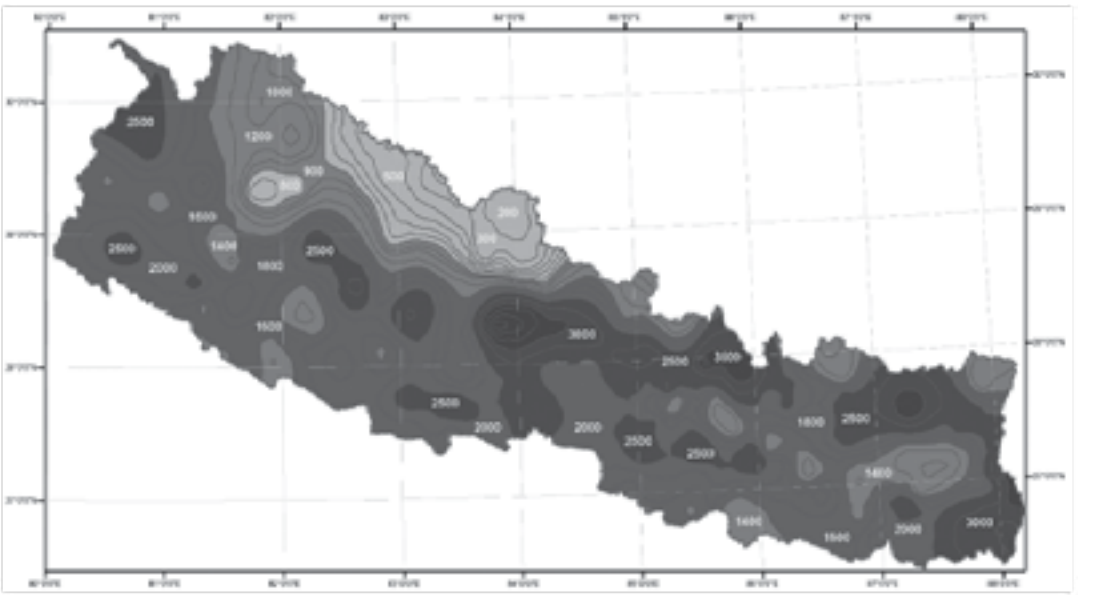

Fig. 4. Non-uniform precipitation in Nepal (mm/yr.). Isohyets.
Source: Adapted from Department of Hydrology and Meteorology (Nepal) data 2021(DHM, 2021).

Fig. 5: Location of glacial lakes in Nepal.
Source: Adapted and modified from (Bhattarai & Conway, 2021)

In addition to the risks from GLOFs, high intensity rainfall has increased the risk of slop failures and landslides. Landslides sweep away homes, bridges and roads after heavy rain and flash floods (Hearth, 2021). In 2020, disasters caused by continuous rainfall killed 360 people and affected 23,478 families (117,390 individuals). In 2020, 5,125 houses were destroyed, and 7,457 houses were partially damaged, displacing around 7,000 families mostly by landslides. Various hazards have led to loss of lives and damage of infrastructure (Tables 3, 4, &5). Further, local governments in Nepal routinely resort to build unplanned or badly planned roads on unstable slopes (sometimes colloquially known as "bulldozer engineering"), which often results in slope failures and the complete destruction of the roads during the rains.

Table 4: Disaster types and impact in Nepal

Types of disasters	Events			Human and livestock losses (Head counts)				Property			
								Houses		Farmland (lost from landslides/ floods)	Estimated values (Million in rupees)
	Total	Loss with monetary values	Loss without monetary values	Deaths	Missing	Injuries	Livestock	Perished (Lost)	Damaged		
Accident	2375	15	2360	2395	330	1051	35	66	648	61	94
Anthropogenic causes	1450	1019	431	266	0	462	108285	6269	583	167	5062
Others	124	3	121	255	81	285	0	59	5	0	1
Subtotal Manmade disasters	3949	1036	2913	2917	411	1798	108320	6394	1236	228	5157
Biological	3950	18	3932	16839	0	43115	79643	0	0	47865	25
Climate related	6016	3650	2366	1346	18	1336	22340	77265	2420	514422	27170
Geophysical	316	16	300	9719	0	29361	516353	639817	343647	0	7060580

Types of disasters	Events			Human and livestock losses (Head counts)				Property			
	Total	Loss with monetary values	Loss without monetary values	Deaths	Missing	Injuries	Livestock	Houses		Farmland (lost from landslides/ floods)	Estimated values (Million in rupees)
								Perished (Lost)	Damaged		
Hydrological	7828	1572	6256	9475	1927	2666	554945	118856	157643	297950	17208
Meteorological	4531	547	3984	3174	40	4386	12901	4607	18685	264063	5323
Others	884	78	806	937	552	1064	183	1851	632	30055	78
Subtotal Natural disasters	23525	5881	17644	41490	2537	81928	1186365	842396	523027	1154355	7110386
Grand total	**27474**	**6917**	**20557**	**44407**	**2948**	**83726**	**1294685**	**848790**	**524263**	**1154583**	**7115543**

Source: (MoHA, 2019)

According to the UCN CDP report (2018), "Overall, about 37 percent of the country's population is considered exposed to climate-related factors, particularly in the areas such as agriculture, forestry, water and energy, health, infrastructure, and tourism" (UNCDP, 2018).

Table 5: Number of victims of natural disasters in Nepal (1971-2017)

Period	Disaster Events	Human (Death & Missing)	Human Injuries	Livestock Lost	Farmland (ha)	Educational Center	Medical Center	Other lost	Other Damaged	Reported loss (Million RS)
1971-75	757	1573	1302	4538	20940.34	8	0	6943	1271	24.81
1976-80	1088	1926	959	14217	61247.3	68	1	24926	14678	59.17
1981-85	1020	2971	1241	11939	18055.71	33	0	7303	2795	166.15
1986-90	1044	2580	13722	3392	13408.69	2401	0	31376	50048	462
1991-95	2512	6470	3240	28835	351338.9	22	1	41299	38352	3604.66
1996-00	2437	5912	3583	32666	131093.4	25	3	46965	17937	2489.74
2001-05	4573	5533	19307	38073	174629.2	86	4	24576	12413	4238.33
2006-10	4820	3897	13164	519178	217883.3	2076	17673	25516.94	40527.04	4129.79
2011-17	5274	13165	25410	533527	165758.7	27900	3627	628638	329203.5	7093648

Source: EM-DAT: The Emergency Event Database- Universite Catholique de Louvain (UCL)- CRED, D. Guha-Sapir- www.emdat.be, Brussels, Belgium. (EM-DAT, 2017)

Some Policy Considerations

Centralized and decentralized systems have implications for administrative capacity and efficiency in environmental management. Nepal became a federal republic in 2015, but the federal structure is still evolving and therefore it may take some for the country set its priorities particularly in terms of the new climate-induced natural disasters. Several coordination bodies have been set up, but these agencies lack capacity, knowledge, and resources to design mechanisms of successful disaster governance. There have been frequent changes in the government in the recent past. For example, 23 governments were formed between 1990 and 2017 (Shrestha & Bhattarai, 2017), and two governments were formed between 2017 and 2021. Such changes in government leadership have created unstable work environments and weakened institutions. In theory, federalism has decentralized the power structure, but clear mandates and division of power to delineate the authority of the different levels of governments remain to be finalized. Nepal can improve its management of natural resources and can minimize the impacts of future disasters through coordinated policies of federal, provincial, and local governments.

As it is clear from the data and discussion presented above, that there are issues related to both the instability of agricultural production and victims of disasters that will need to be addressed. Addressing these issues strategically and on time is the way forward towards graduation to a Developing Country. Continued progress in the human and economic development depends heavily on the Government's ability to manage natural resources (for example, greenery for carbon sequestration) and minimize disaster losses by carefully using location-specific environmental variables in development planning. Towards these objectives, Nepal needs to devise several environment, agriculture, and disaster related policies to sustain the gains made in these areas and be able to maintain progress after graduation. For example, Nepal can consider schemes for using the currently bare and fallow lands and adopt measures to conserve its natural resources and protect the environment. Food security for the people is an important component of the goal to reduce environmental and economic vulnerability. The government also needs to consider how the disadvantaged groups in the country are protected from food-insecurity and environment-induced disasters.

While Nepal has made progress in many of these fronts while working towards attaining the SDG goals and the country's own policy priorities, increased focus is required for attaining the EnVI goals to support Nepal's graduation from the LDC status.

Nepal needs to establish sound earthquake safety policies, programs, and standards for all types of infrastructure to minimize and eliminate the loss from the future earthquake events. Earthquake safety can be achieved by following disaster resilient urban planning and design guidelines (Malla, 2015). For example, buildings that have symmetrical plans and elevations, and include minimal cantilevered floors, slabs, and projections from walls, have low height, lower center of gravity, equal floor height, and short room spans are more earthquake resilient. Likewise, planning for safe settlements by mapping possible vulnerable areas can help ameliorate the impact of natural disasters.

Providing adequate and evenly distributed open spaces in urban areas is important for earthquake-resilient planning. Open spaces provide spots for people to gather during earthquakes and emergencies. Further, provision of adequate right-of-way for roads is critical in urban areas to offer sufficient access to emergency vehicles following earthquakes and other disasters.

Several programs are in operation to alleviate climate related disasters. The Ministry of Home Affairs (MoHA) in coordination with the Office for the Coordination of Humanitarian Affairs (OCHA) provides rescue operation services to people during disasters. Civil society organizations and donor agencies also offer services to help communities cope with various natural disasters. Such efforts are important for reducing vulnerability of the people.

It is also important to note that a weak economy cannot build human assets and mitigate or reduce environmental vulnerability. Thus, a failure to achieve a high, or at least a moderate level of economic growth may create obstacles in the path to graduation. Hence economic growth should become a top priority for graduation. A corollary to this will be resource mobilization both externally and internally.

Externally, Nepal should develop policies to attract foreign direct investment. Internally, it should promote entrepreneurship and improve the governance system, alongside other reforms. Another important success factor for graduation and its aftermath will be a proper preparation during the transition. Since Nepal will lose a lot of benefits now available, especially in trade, the government should begin to negotiate bilaterally and regionally for extension of DFQF-type trading preferences after graduation. This can help to offset/ minimize the effects of end of preference after graduation. Nepal must also seek the support of international agencies and trading nations to maintain trade-related concessions and facilities for some time after its graduation.

As many other countries have created effective programs in climate change, disaster management, enhancing agricultural productivity, and water resources management, Nepal can review the lessons learned and create suitable policies and programs. Since Nepal has already experienced good results in micro-hydro, community forestry, mobilization of non-governmental organizations (NGOs) for development, and in biodiversity conservation, it can formulate effective policies and programs in other areas related to the environmental conservation and improvements to sustain the momentum.

Conclusion

After many years of work towards the goal of graduating from the LDC status, and after two deferrals in the graduation process, Nepal is now close to becoming a member of the developing countries group. Despite several challenges, including its land-locked situation, a difficult terrain, and dramatic climatic variations within a small geographic area, Nepal has made progress in several areas to be able to now consider leaving behind its underdeveloped status. As the UN CDP, has rated Nepal's performance as satisfactory, the country is now poised to officially graduate from the LDC category in 2026.

There will be some trade-offs once Nepal graduates to join the developing countries group. While Nepal will benefit from its new stature, image, and success, the country will also lose some trade, foreign aid, and investment-related benefits and concessions. However, Nepal can negotiate bilaterally and multilaterally to make its transition easier. We have articulated some policy pathways for this in sections three and six above.

For sustaining its status as a developing country, Nepal should strictly regulate activities that harm the environment and biodiversity. Examples areas for policy and program improvements include conservation of natural resources, afforestation, disaster-resilient planning, flood control, flood plain management, and checking the uncontrolled road construction on unstable slopes. In addition, disaster management programs designed to mitigate the effects of floods, landslides, earthquake, GLOF, epidemics, and heat and cold waves should be continually tested and improved. Engaging the services of environmental and community-based NGOs can also help the country progress towards these goals.

Nepal needs to create and implement earthquake-resilient planning, policies, and zoning regulations through detailed land use mapping. Planning capacities should be enhanced and

delegated across the different levels of government. In the areas related to climate change adaption, disaster prevention, and management, Nepal needs to learn from best practices elsewhere in countries such as Costa Rica, Chile, USA, and Japan, and craft appropriate policies.

Our objective in writing this paper was to examine aspects of EnVI for Nepal's graduation from a least developed country. We have assessed achievements and identified problems for sustaining and improving on the EnVI measures required for graduation. We have identified key areas of concern and articulated some policy-measures required for addressing these issues. Proper policies and their timely implementation are necessary to rectify the problems for making the graduation possible, meaningful, and sustainable. In closing, we would like to reiterate that good transition strategies are the key to a successful graduation of Nepal from the LDC status. Developing sound strategies and mobilizing resources, and building capability to implement them, will largely determine how easily Nepal can cross the LDC finish line to join the group of developing countries.

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