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Thematic Report

Night-time Light Reflectance: Potential Uses In Lebanon

September 2023

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The Lebanon Crisis Analytics Team (LCAT) provides reactive and in-depth context analysis to inform the aid community in Lebanon. The information and analysis contained in this report is therefore strictly to inform humanitarian and development actors and associated policymaking on Lebanon.

This study/report is made possible by the support of the American People through the United States Agency for International Development (USAID) and European Union Humanitarian Aid. The contents of this report are the sole responsibility of the LCAT and do not necessarily reflect the views of USAID, the United States Government, or the European Union.

Executive summary

Night-time light reflectance (NLR) data is fast becoming an accepted proxy for estimating economic activity or economic development in subnational regions of developing countries. It is especially useful when large-scale data collection is not feasible or existing vulnerability indicators are unavailable at disaggregated geographic levels. In the case of Lebanon, where centralized datasets are scant, and vulnerability assessments are typically conducted at the district or national level, NLR analysis has considerable potential. The same analytical approach may be replicated in other settings where there is a need for rapid and cost-effective data collection for humanitarian and development actors, especially where some regions are inaccessible to aid actors for security reasons.

Such a flexible, multi-faceted, and cost-effective tool is an important innovation which the LCAT hopes can support better aid implementation as Lebanon passes through a period of economic flux and aid actors attempt to navigate a changing landscape of needs. NLR has the unique added value of displaying economic activity at the local[1] level, providing granularity currently not found in standard vulnerability assessments.[2] The LCAT's NLR analysis shows granular economic development across time and space, revealing unexpected aberrations in electricity consumption, highlighting the importance of variables including access to hydroelectric power, purchasing power, and location-specific service provision. NLR satellite imagery can therefore be a way to quantitatively monitor Lebanon's local economies and service delivery inequality at multiple levels of geographic disaggregation, an important caveat to counter the misleading narrative of economic recovery.

The aid community in Lebanon can harness this information for various programmatic uses. Vulnerability assessments are often difficult to implement in regions of Lebanon where access is limited for political reasons; in these instances, NLR data can play an important role as a fill-in for geographic datagaps. Moreover, the cost-effectiveness of NLR enables organizations to obtain detailed data on vulnerability without large data collection budgets collected through conventional methods such as surveys. Given robust testing and benchmarking against other indicators, potential final uses of NLR data might include in-project monitoring, site selection, and predicting vulnerability trends for future planning. The next paper in the nightlights series builds on the present analysis to create and test a novel indicator of economic vulnerability, the economic vulnerability score (EVS) which intends to complement and enhance existing vulnerability assessments to help humanitarian and development actors better target their programming. The purpose of the following paper will be to explain how the EVS was created and provide suggestions for its application within the aid community.

Satellite imagery data sources:
NLR images were taken by the VIIRS satellite and are freely available on The Earth Observation Group website. Mercy Corps did not collect any satellite images or engage in any surveillance activities.[3]

[1] NLR data examined in this report goes down to the cadastre level. The size and makeup of a cadastre varies considerably. According to OCHA's subnational administrative boundaries, each cadastral boundary could include one or more villages or municipalities, or one or more cadastral boundaries could represent one municipality.
[2] Other datasets exist for vulnerability, such as the Multi-Sector Needs Assessment (MSNA), but only provide information only to the district level.
[3] Earth Observation Group.

Introduction

The most severe economic collapse in Lebanon's history[4] has dramatically increased multidimensional poverty – a measure of deprivation across several socioeconomic indicators – from 42% of the population in 2019 to 82% in 2021.[5] It is now estimated that 36% of the population lives in extreme poverty, up from 8% in 2019 and 23% in 2020.[6] A major drawback of these standard vulnerability assessments is that they are typically calculated at the national and district levels.[7] While the deprivation figures generated through these methods are striking, they do not fully account for important geographical nuances that could help humanitarian and development actors better target their programs.

Noting the lack of granularity in standard publicly available measurements of poverty in Lebanon and the absence of disaggregated data from national statistical offices, LCAT used open source night-time light reflectance (NLR) data collected by The Earth Observation Group to provide a more detailed analysis of economic vulnerability and deprivation at the municipal and cadastral levels. Night-time lights imply some form of human activity at the local level and are increasingly used in humanitarian contexts as an affordable proxy measure of urbanization,[8] economic growth,[9] poverty,[10] and human development and wealth.[11]

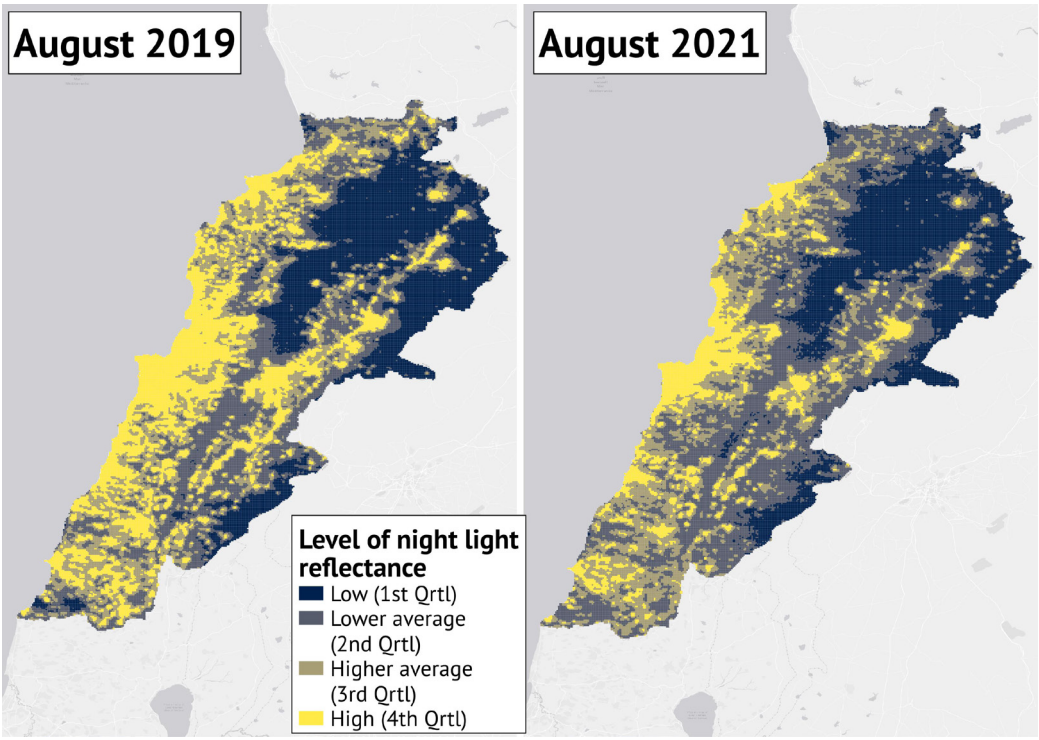

***Figure 1a**: Level of night light reflectance in August 2019 and August 2021. "Qrtl" indicates the quartile of NLR in August 2019.*

[1] W Lebanon's national currency has lost over 90% of its value since the onset of the financial crisis in late 2019. Real GDP declined from 51.6 billion US dollars (USD) in 2019, to USD 31.7 billion in 2020, and USD 23.1 billion in 2021. World Bank, Lebanon GDP (current $) Accessed August 15, 2023.
[5] UNESCWA, Multidimensional poverty in Lebanon (2019-2021): Painful reality and uncertain prospects, Sep 2021.
[6] Human Rights Watch, Lebanon: Events of 2021.
[7] Standard measures here refers to widely-used district level vulnerability assessments such as REACH's Multi-Sector Needs Assessment (MSNA), UNHCR/UNICEF/WFP's Vulnerability Assessment of Syrian Refugees in Lebanon (VASyR), WFP/FAO's IPC Classification, WFP's Household Deprivation Score, UNDP's Multidimensional Poverty Index (MPI). The Red Cross reportedly possesses cadastre level vulnerability data but does not make the information public.
[8] Zhang, Q. and K. Seto, Mapping urbanization dynamics at regional and global scales using multi-temporal DMSP/OLS nighttime data. Remote Sensing of Environment, 115(9). 2011.
[9] Henderson, V., A. Storeygard, and D. Weil, Measuring Economic Growth from Outer Space. American Economic Review, 102(2). 2012.
[10] Elvidge, C., et al., A global poverty map derived from satellite data Computers and Geoscience, 35(8). August 2009.
[11] Breuderle, A. and R. Hodler, Nighttime lights as a proxy for human development at the local level, September 5, 2018.

In other settings, NLR data has most often been used to estimate economic growth and GDP, but the peculiarities of Lebanon – notably the collapse of centralized electricity provision in favor of local generator production – allows for a more robust analytical use of the tool.

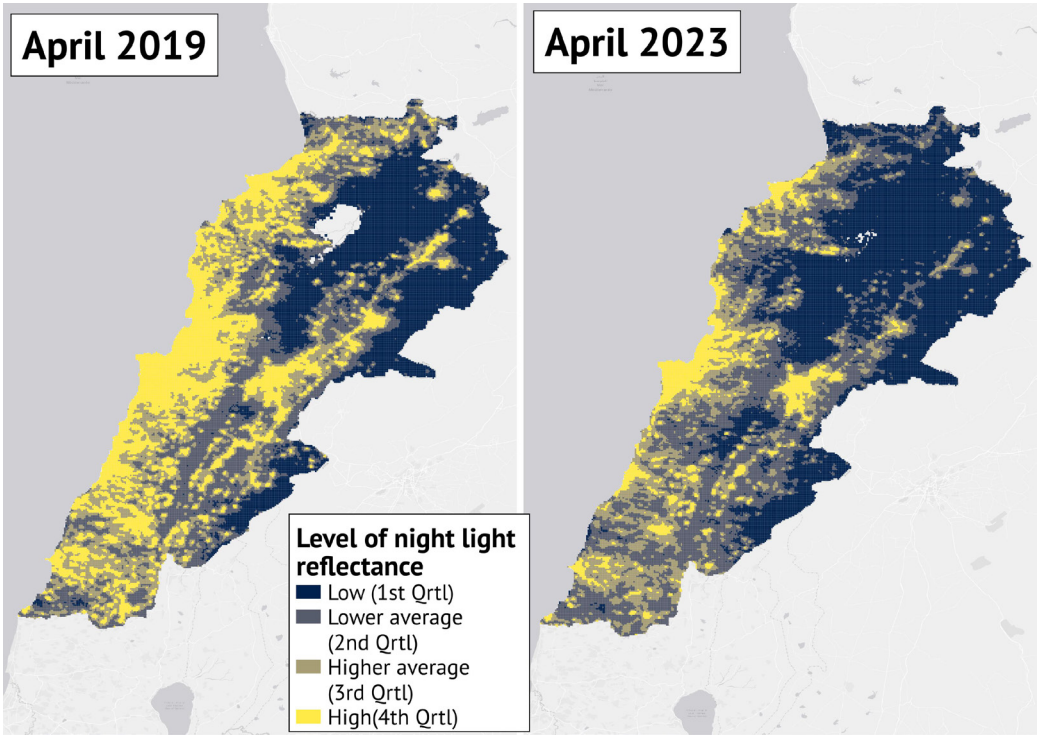

***Figure 1b**: Level of night light reflectance in April 2019 and April 2023. "Qrtl" indicates the quartile of NLR in April 2019.*

Examining post-2019 Lebanon by disaggregated geographies is crucial to determining how and why economic decline is more severe in some areas than others, and in turn can be useful in gauging how adequate humanitarian assistance has been in meeting needs across the country. Simply observing night light reflectance before the current economic crisis and at the height of fuel shortages (Figure 1a) the latest monthly satellite image (Figure 1b) highlights the dramatic economic changes that occurred as a result of the crisis. This paper aims to showcase the usefulness of NLR data in the context of Lebanon and also present an evidence base on which to build an economic vulnerability score (EVS), which will be presented in a forthcoming LCAT paper. The EVS could be used by the humanitarian and development sectors in Lebanon to complement other existing vulnerability assessments.

This first paper in the nightlights series provides a trend analysis of NLR in Lebanon from 2015 to 2023, with a focus on the recent "crisis" period (2019-present). Year-over-year measurements indicate a sharp drop in night-time light intensity since 2019. This drop reflects a combination of deteriorating socio-economic conditions, the removal of fuel subsidies, and limited fuel availability. The second section measures the relationship between social perceptions and household attributes related to electricity and night-time light intensity per-capita and year-over-year growth. Lastly, NLR dynamics are analyzed at the cadaster level and among Palestinian refugee camps. While most regions experienced a decline, some locations are doing relatively better than others. Potential explanations for these variations include regions' proximity to renewable energy sources, favorable treatment by local actors, and relative affluence. The paper concludes by summarizing its findings and proposing ways that NLF indicators can be utilized in Lebanon going forward.

Key Findings

- NLR declined from late 2019 to early 2021 and accelerated after fuel subsidies were lifted in May 2021 because most of Lebanon heavily relies on diesel-powered electricity generators.
- NLR has declined in all qadas since late 2019, but qadas that receive electricity from hydroelectric power plants (Jezzine, Hasbaya, and Rachaya) declined at a slower rate than those outside of these service areas.
- NLR also declined at different rates depending on electricity provision from Syria, local political structures controlling electricity transmission, and remittance inflows.
- NLR can be a useful targeting indicator while state electricity remains minimal, although its effectiveness would diminish in general usability if electricity provision re-centralizes.
- Prospective NLR use in Lebanon is promising, as it can measure electricity consumption in less-developed areas and can be used as an indicator to monitor the effect of electricity-related development projects.


Credit: MEE/Rita Kabalan

Methodology

This paper is based on an analysis of NLR dynamics from 2019 to 2023 at different geographic levels, including a statistical analysis of household electricity-related attributes reported in the 2022 MSNA and local NLR dynamics.

I. Trend analysis between 2015 and 2023

This section provides an analysis of NLR trends at the national level, first by examining year-on-year changes from January 2015 to April 2023 and then focusing on monthly trends since August 2019, when the Lebanese pound (LBP) began depreciating on the parallel market.

From January 2015 to July 2019, NLR at the national level increased at a stable rate, with a spike in July 2017 as international fuel prices decreased and fuel and oil imports increased compared to previous months.[12] Since July 2019, growth has turned negative (NLR was -34% lower in July 2020 compared to July 2019), coinciding with the onset of the economic and financial crisis. This drop corresponds with a much lower GDP, suggesting that night lights could be a useful tool to estimate GDP in Lebanon.[13]

Another sharp decrease in NLR was observed between January 2021 and January 2022 (-50% year-on-year growth in night-time light intensity), the period when Lebanon experienced fuel shortages (summer of 2021) and the gradual removal of subsidies (starting September 2021) while the LBP rapidly depreciated.[14] Nationally, NLR reached its lowest point in August 2022, about 48% lower than one year prior and approximately 71% lower than August 2019. This suggests a substantial decrease in economic activity, lower access to electricity, and a rising level of household economic vulnerability. Our analysis suggests that NLR trends over this period are largely determined by socio-economic conditions, fuel shortages (specifically in summer 2021), the removal of fuel subsidies, and the near total collapse of electricity provision by Electricite du Liban (EDL).

[12] Lebanese Monthly Customs Data.
[13] Similar to the regional GDP estimates produced by Mercy Corps' CA-Syria team: CA-Syria, Using night lights to measure economic output in Syria May 27, 2021
[14] Reuters, Lebanese central bank effectively ends fuel subsidy, August 12, 2021

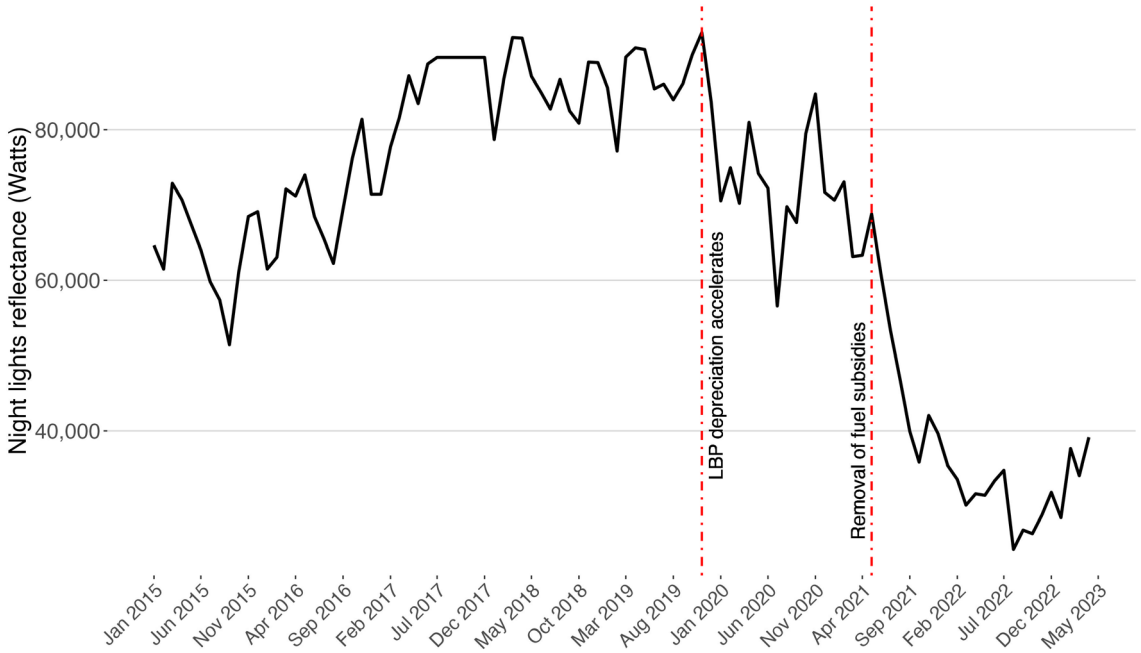

***Figure 2**: Total night light reflectance at the national level between January 2015 and April 2023.*

Accelerating deterioration of socio-economic conditions

From April 2019 to April 2023, the average district-level NLR declined by about 51%, which is indicative of decreasing economic activity and energy consumption at the district level (Figure 2). The percentage change ranged on the lower end from -71% to -66% in Aley, Kesrwane, El Meten, Jbeil, and Zgharta, and on the higher end from -25% to -31% in Jezzine, El Hermel, Hasbaya, and Sour. Lower levels of NLR decline in Jezzine and Hasbaya can be attributed to hydroelectric power, and in El Hermel and Sour to preferential treatment by politically affiliated groups with the capacity to provision electricity through preferential access to diesel generators.

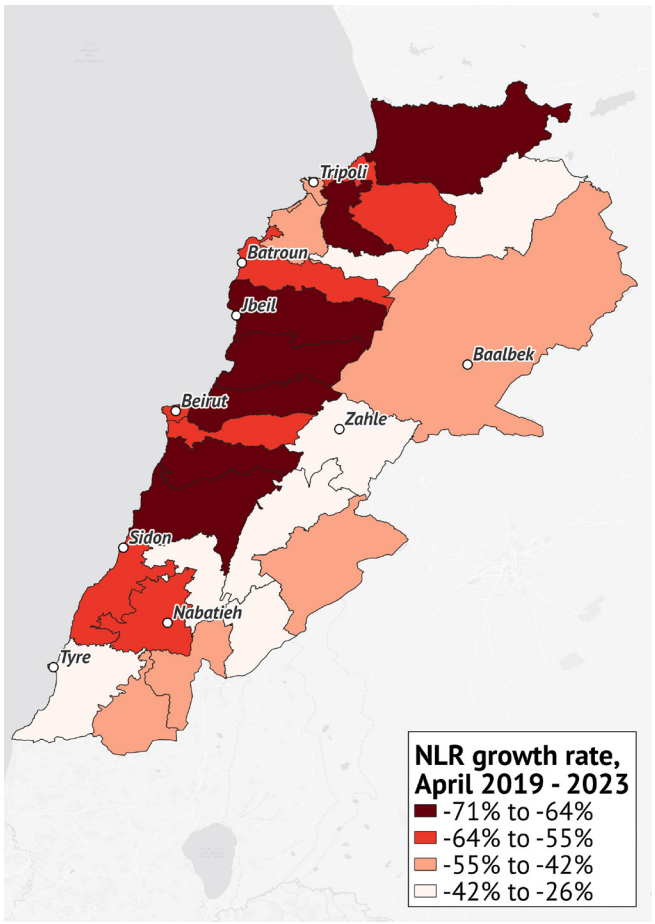

***Figure 3**: Growth rate of night-time light intensity at the district level from April 2019 to April 2023.*

Fuel prices and the removal of subsidies

Electricity consumption in Lebanon is heavily dependent on the price of diesel because electricity provision in Lebanon is largely decentralized and most residents rely on diesel-powered generators as their main source of electricity.[15] A spike in international fuel prices – from less than USD 60 per barrel throughout most of 2019 and 2020 to over USD 100 per barrel from March to July 2022[16] – was one driver of higher fuel prices in Lebanon. The decrease in NLR also coincided with a decrease in mineral fuel and oil imports, which declined from 11.8 million tons in 2019 to 7.8 million tons in 2020, 6.2 million tons in 2021, and only 5.1 million tons in 2022.[17]

Fuel shortages and the lifting of subsidies also contributed to changes in NLR, which sharply decreased from May 2021 to September 2021, when Lebanon experienced acute fuel shortages – particularly in July and August 2021 – and diesel prices in the country began to rapidly increase (see Figure 3). NLR growth declined by 44% from August 2019 to August 2020, while NLR declined by 33% from August 2020 to August 2021 and by 48% from August 2021 to August 2022. The year-over-year growth rate was lower between August 2021 and August 2022 than it was between August 2020 and August 2021 during the "summer fuel crisis". This suggests that, while the 2021 fuel shortages set Lebanon's NLR on a downward trend, deteriorating socioeconomic conditions had a more adverse effect on economic and human activity, and the decrease in night-time lights accelerated even after fuel shortages were resolved. This is also reflected in GDP decline, from USD 51.6 billion in 2019, to USD 31.7 billion in 2020, and USD 23.1 billion in 2021.[18]

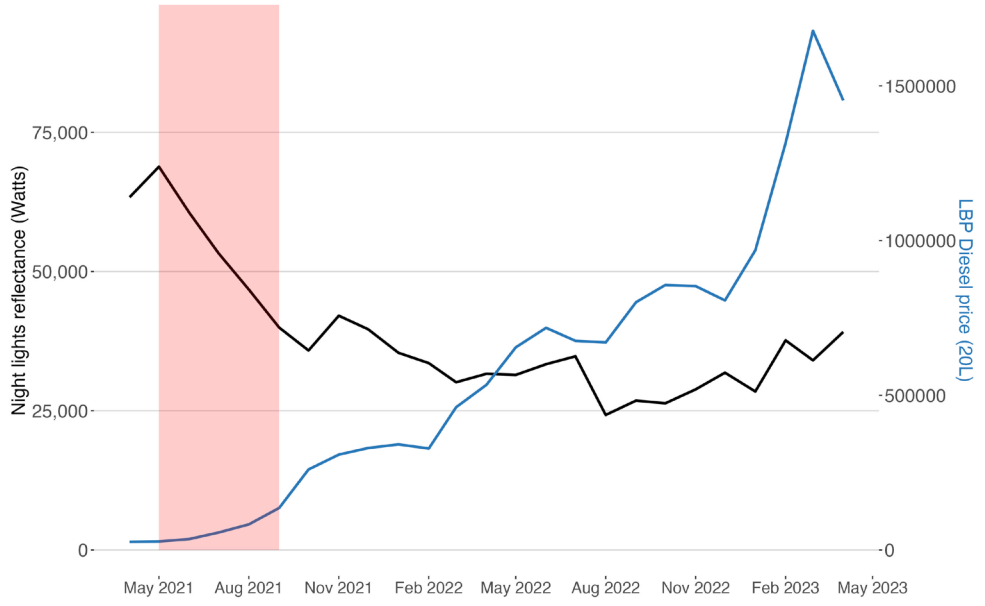

***Figure 4**: Monthly national-level NLR and diesel prices between April 2021 and April 2023. The red shaded period represents the summer 2021 fuel crisis.*

NLR has recovered at multiple points since late 2019 and now is on an upward trend. NLR slightly increased from September 2021 to November 2021, when fuel shortages eased, but the removal of fuel subsidies and contemporaneous rapid LBP parallel market depreciation led to exponential growth in local diesel prices, which then accelerated NLR decline. NLR has been slightly recovering since August 2022, reflecting the small increase in EDL electricity provision and the decreasing cost of crude oil beginning in May 2022,[19] an important component in the retail price of diesel fuel leading to a decrease in the USD price of diesel beginning in July 2022.[20]

[15] According to the 2022 REACH MSNA, about 73% of Lebanese households rely on a neighborhood or private generator as an electricity source, compared to about 15% reporting solar panels as an electricity source.
[16] Index Mundi, Crude Oil (petroleum) Monthly Price - US Dollars per Barrel.
[17] Lebanese Monthly Customs Data.
[18] World Bank. Lebanon GDP (current $) Accessed August 15, 2023.
[19] Trading Economics - Crude Oil Price.
[20] Largely motivated by lower average global oil prices from July 2022 to March 2023 compared to the year before.

This made fuel more affordable in Lebanon's increasingly dollarized economy. Additional electricity provision from EDL[21] may also contribute to higher levels of aggregate NLR.

Household economic indicators related to district-level NLR dynamics

The level and growth of district-level NLR is strongly related to multiple household economic indicators. This was determined by measuring the correlation between indicators related to electricity consumption reported in the 2022 multi-sector needs assessment (MSNA) published by REACH[22] and the NLR growth rate from August 2019 to August 2022, and the August 2022 NLR per-capita of the district.[23] [24] The indicators include a household's source of electricity, coping strategies used to pay for electricity, proportion of income spent on electricity, hours of electricity per-day, and the income-expenditure ratio. The results support the assertion that income levels are closely linked to electricity consumption in Lebanon (Annex 1).

MSNA indicators that produce the strongest positive correlation with NLR indicators are the income/expenditure ratio,[25] the proportion of households that do not report coping with a lack of electricity, the proportion of households that use solar panels or batteries as an electricity source,[26] and the proportion of households that use loans to pay for electricity. These correlations link high household incomes[27] [28] to better NLR outcomes.

The use of neighborhood generators as an electricity source, difficulty meeting electricity needs, and requesting more information about electricity services from humanitarian actors were negatively related to NLR indicators. The substantial negative relationship between the use of neighborhood generators and NLR per-capita suggests that the adoption of neighborhood electricity generators is a sign that electricity provision from EDL is limited, necessitating – for those who can afford it – a dependence on local generator operators and their prices. Unsurprisingly, districts with a higher concentration of households that reported difficulty meeting basic electricity needs tended to have lower NLR growth rates (August 2019 to August 2022). Importantly, the proportion of households that want information about electricity services from humanitarian actors suggests that Lebanese households are seeking external support to maintain or expand their level of electricity consumption.

NLR dynamics and social perceptions

The social perception that electricity is a serious community problem[29] is statistically related to changes in NLR[30] and the correlation between diesel and NLR growth rates.[31]

[21] L'Orient Today, EDL: Power supply to reach 4 hours per day, starting Friday, February 8, 2023.
[22] Reach Resource Center. Available at: reachresourcecentre.
[23] Population data in Lebanon obtained from Kontur.
[24] The growth rate between August 2019 to August 2022 was used because 72% of the REACH MSNA household data was collected in August 2022; therefore, August 2019 to August 2022 NLR growth rates best represent the reported electricity consumption dynamics at the time the data was collected.
[25] The district average of households' monthly income divided by expenditure.
[26] Using the available district-level data, it is difficult to precisely measure the extent that solar and battery-powered electricity sources affect NLR.
[27] According to the 2022 MSNA, the average monthly income of Lebanese households that reported using solar panels as an electricity source was 52% higher than households that did not report using solar panels as an electricity source. This difference is statistically significant, according to a t-test (t= -10.44, p <0.000).
[28] The average monthly income of Lebanese households that reported using batteries as an electricity source and those that did not were not statistically significantly different. Batteries are cheaper than solar panels, therefore, batteries appear to be a cost-effective approach to increasing electricity consumption.
[29] UNDP/ARK, Regular Perception Survey Wave XIV, August 2022.
[30] The change in NLR from August 2019 to August 2022.
[31] The correlation between NLR and diesel price growth rates from June 2021 to August 2022. This statistic essentially measures the district's price elasticity of generator costs and, later in this report, proves useful as a proxy indicator for a location's level of economic vulnerability.

The proportion of respondents who reported a lack of electricity as one of the top two most serious problems facing their household was the only indicator that produced a moderate correlation with any NLR-related indicator; specifically, the correlation between diesel prices and NLR growth rates (r = -0.55; p = 0.004). The correlation was negative, indicating that districts where households struggled to maintain their level of electricity consumption as diesel prices increased more often reported electricity as a serious household problem (Figure 4).

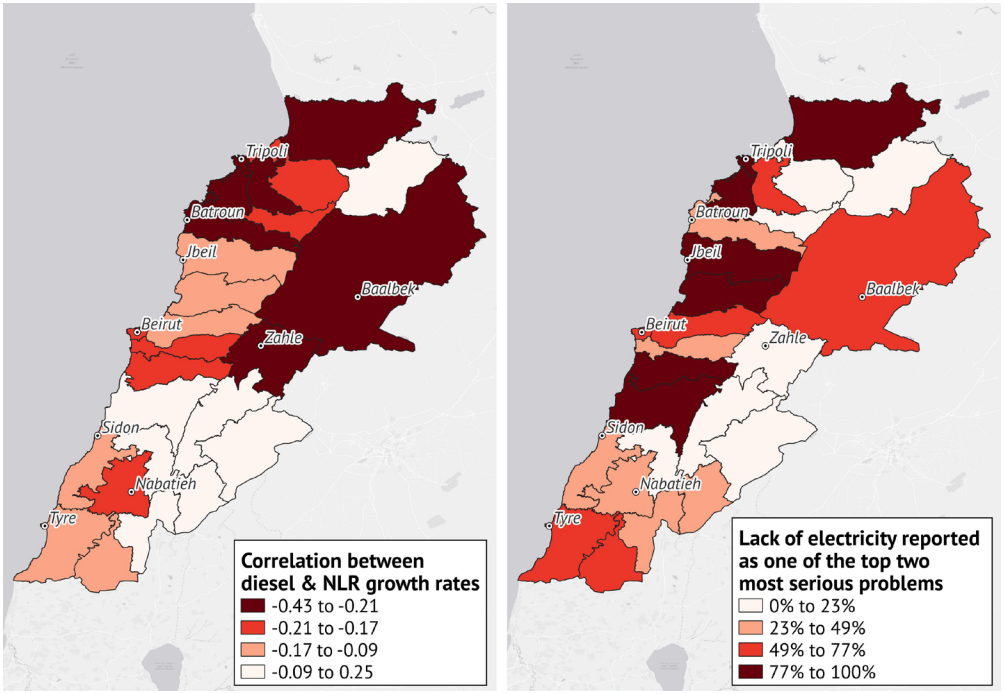

***Figure 5**: District-level correlations between NLR and diesel price growth rates (left), and the proportion of respondents that reported the lack of electricity is one of the top two most serious problems facing their household. These indicators are moderately negatively correlated (r = -0.55; p = 0.004).*

NLR dynamics in Palestinian refugee camps

The social perception that electricity is a serious community problem is statistically related to changes in NLR and the correlation between diesel and NLR growth rates. The proportion of respondents who reported a lack of electricity as one of the top two most serious problems facing their household was the only indicator that produced a moderate correlation with any NLR-related indicator; specifically, the correlation between diesel prices and NLR growth rates (r = -0.55; p = 0.004). The correlation was negative, indicating that districts where households struggled to maintain their level of electricity consumption as diesel prices increased more often reported electricity as a serious household problem (Figure 4).

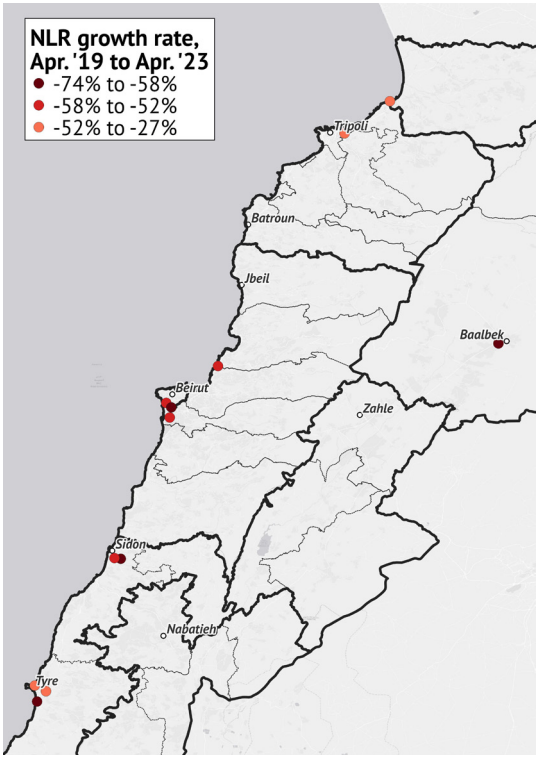

***Figure 6**: NLR growth rate from April 2019 to April 2023 in the twelve formal Palestinian camps.*

II. Geographic trends at the cadaster level since late 2019

While trends at the national level are indicative of deteriorating conditions, a geographic analysis of NLR dynamics can be used to identify rising vulnerabilities at the local level, as the negative effects of Lebanon's economic downturn may have been relatively weaker in some regions compared to others. This section analyzes changes in NLR intensity at the cadaster level since late 2019 and is divided into two parts. The first entails an examination of local trends between August 2019 (at the outset of LBP depreciation) and August 2021 (during the period of acute fuel shortages). The second part focuses on the post-fuel crisis period, from August 2021 to August 2022. As the partial lifting of subsidies began, fuel became accessible on the market, although almost exclusively to households able to afford it. This implies that changes in electricity consumption during this period were largely determined by income.

a) Cadaster level trends during the fuel crisis period

This sub-section analyzes variations in NLR at the cadaster-level from August 2019 to August 2021 (Figure 6). As Lebanon experienced fuel shortages, NLR and electricity consumption decreased in most of the country, although in some regions the decrease was not as pronounced and in some cases actually increased. Since access to fuel was limited during this period, even for affluent households, relatively higher electricity consumption (or slower decline) in these areas may have been due to their geography or preferential treatment by local actors.

From August 2019 to August 2021, NLR decreased in 94% of cadasters (1,491 cadasters), with an average growth rate of -39% (-44% being the median; -86% the minimum, and 98% the maximum). NLR increased in only 99 cadasters from August 2019 to August 2021, with most located in the Baalbek-Hermel region extending to eastern Bekaa, South Lebanon, and Nabatiyeh. These regions are spread around the Litani river, where hydroelectric power plants are the main source of local energy production. Relative increases in supply and electricity coverage in these regions can potentially be explained by local actors' control over the state energy supply from these hydroelectric power plants.

Prominent families and politically affiliated groups in Baalbek-Hermel have long controlled power plants and electricity transmission,[32] and have also reached agreements with private electricity providers to ensure electricity coverage in the region.[33]

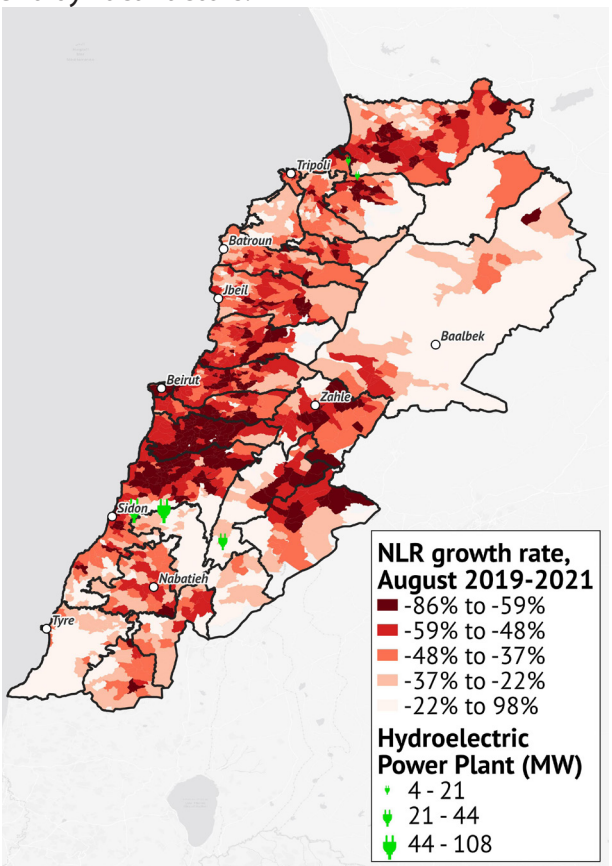

***Figure 7**: Growth rate of night-time light intensity at the cadaster level from August 2019 to August 2021.*

[32] Al-Dad Press, بالتفصيل : عصابات الكهرباء والمحروقات تتحكم بالبقاع August 28, 2021
Yazbek, B. يعليك-الهرمل: العشائر تحتكر الكهرباء والخبز يؤجج العنصرية ضد اللاجئين Al-Modon, June 29, 2022
[33] Masry, A. كهرباء يعليك: 22 على 24 بقوة الأمر الواقع و"الطقّار Grand LB, April 29, 2021

Local media reported in 2017 that the eastern Bekaa region has benefited from energy supply from Syria, following an agreement in 1995 between Lebanon and Syria that established a Syrian-fed power line through the Baalbek-Hermel and Bekaa governorates.[34]

In South Lebanon and Nabatiyeh, politically affiliated groups compete over hydroelectric power resources in order to supply their supporters' villages with electricity in light of the fuel crisis,[35] which led to preferential treatment of some villages at the expense of others. In August 2021, Electricite du Liban – the state electricity supplier – reportedly lost control of several power stations in the areas of Sour, Zahrani, and Nabatiyeh. In the absence of centralized management of these power plants, individuals associated with local political parties reportedly took control of plants and used them to generate power in a preferential manner, leading to increased supply in neighboring villages and decreases in others.[36] One other potential explanation for relatively better coverage in South Lebanon and Nabatiyeh could be that a high share of households in these regions receive remittances from abroad. These regions have the most recipients of foreign remittances (%14 of households and South Lebanon and %10 in Nabatiyeh as of 2018),[37] which could partially explain their ability to pay for electricity in contemporary Lebanon.

b) Cadaster-level trends since the removal of subsidies

This sub-section analyzes cadaster-level trends in night-time light intensity from August 2021 to August 2022, as fuel subsidies were gradually lifted (Figure 7). In contrast to the previous two years, the removal of subsidies made fuel readily accessible on the market,[38] although at ever-increasing prices. This meant that in 2022, access to electricity was almost exclusively limited to households in higher-income brackets. Night-time light intensity decreased across most of the country, with large cadaster-level variations.

In line with changes at the district and national levels, night-time light intensity further decreased in nearly all cadasters from August 2021 to August 2022, with the NLR of the average cadaster declining by 49%. By comparison, there was an average growth rate per cadaster of 29% in August 2020 to August 2021, while the growth rate was 14% from August 2019 to August 2020.

From August 2021 to August 2022, when fuel shortages eased as subsidies were lifted, NLR only increased in 11 cadasters[39] (with a maximum year-over-year growth of 20%, and a minimum of –86%).

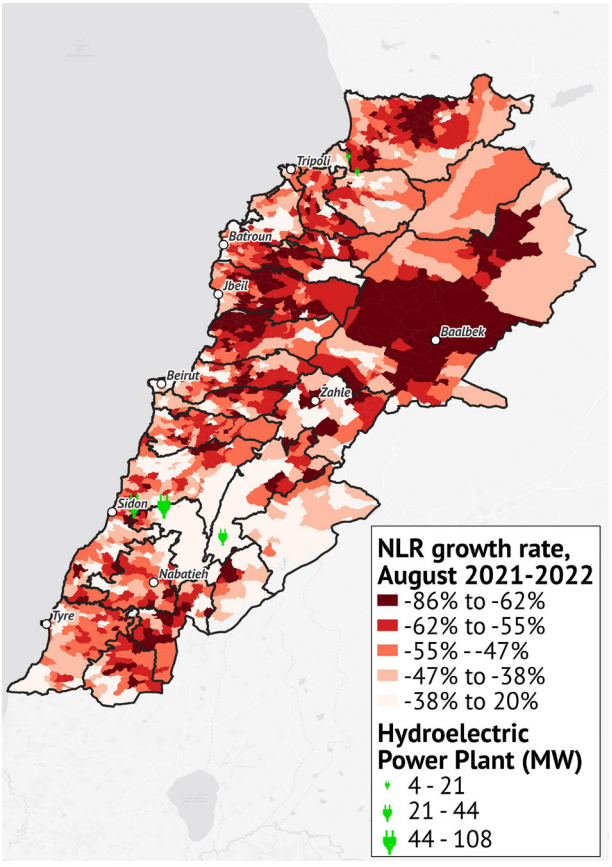

***Figure 8**: Growth rate of night-time light intensity at the cadaster level from August 2021 to August 2022.*

[34] Barkhissian, L. الكهرباء السورية إلى بعلبك.. مغشوشة Al-Modon, October 20, 2017
Abedl-Razaq, A. نظام سورية يصدّر الكهرباء إلى لبنان ويقطعها عن دمشق Al-Arabi, July 30, 2020
[35] Fakhreddine, L. معامل الليطاني»... كهرباء للطوائف فوق قدرة الإنتاج Al-Akhbar, June 11, 2022
[36] Saarati, R. 2021. برسم الحكومة: قوى الأمر الواقع تحتل محطات تحويل الكهرباء وتديرها! Al-Joumhouria, October 5, 2021
[37] Central Administration of Statistics. "Labour Forces and Household Living Conditions Survey 2018-2019."
[38] This stemmed from a greater amount of imports and less fuel smuggling to Syria, largely due to lower profit margins on unsubsidized fuel.
[39] From highest to lowest positive NLR growth: Qabaa Jezzine (Jezzine); Qaraaoun (West Bekaa); Aain Bou Souar (El Nabatieh); Deir Aain Ej-Jaouzeh (West Bekaa) Tcheflik Eddé Haouch (Zahle); Aatchaneh (El Meten); Saydoun (Jezzine); Qatnaaoun (El Batroun); Qaytouleh (Jezzine); Aain Qana (El Nabatieh); Chmaarine (Chouf)

The same cadasters in which NLR increased from August 2019 to August 2021 also experienced a year-over-year decrease from August 2021 to August 2022. These changes suggest that even as fuel became more widely available following the removal of subsidies, additional economic hardship (via LBP depreciation, inflation, and continued economic decline) limited households' access to electricity.

Regional changes generally exhibited similar patterns to those at the cadestar level from August 2019 to August 2021, except in Baalbek governorate. The West Bekaa-Rachaya, Jezzine, Sour, and Nabatiyeh regions experienced a relatively smaller decrease in NLR compared to others, likely due to their connectivity to hydroelectric power plants. However, many more cadasters in Baalbek governorate experienced a sharp decline, suggesting local municipalities could not afford to subsidize electricity costs and therefore residents could not afford to maintain their previous level of electricity consumption. The Greater Beirut region, which extends to some cadasters in Baabda, Metn, and Keserwan experienced relatively smaller decreases in their night-time light intensity. Although energy consumption decreased in these regions during the fuel crisis period, the availability of fuel since the removal of subsidies suggests residents in these areas were able to consume relatively more electricity due to higher income levels.

Photo by AFP

Conclusion

National NLR dynamics reflect macroeconomic trends in Lebanon, most notably the decline in NLR at the beginning of the economic crisis and accelerated decline when fuel subsidies were removed. NLR analysis in districts and cadasters reveal that some locations have managed to consume more electricity than others since late 2019, likely due to access to hydroelectric power, greater purchasing power, and location-specific service provision. Furthermore, NLR data has demonstrated the potential to cast light on variations in economic development in vulnerable places like refugee camps. Household attributes related to electricity were also related to NLR growth rates and NLR per-capita. Most notably, NLR growth rates were negatively correlated with the percentage of households that reported difficulty meeting electricity needs, and NLR per-capita was higher in districts with higher income-to-expenditure ratios and a higher percentage of households that use solar and batteries as a main electricity source.

This first part of the LCAT's nightlights series highlights the utility of NLR as a way to quantitatively monitor Lebanon's economy at multiple levels of geographic disaggregation, and as an alternative source of evidence to identify pockets of vulnerabilities at local levels, particularly when there are data and information gaps. Proxy data analysis options in the absence of reliable local level datasets are especially relevant in contexts like Lebanon, where geographic access for aid actors is limited and national government data is lacking. NLR is a proxy dataset which, in Lebanon, can go far beyond estimating economic activity; it can also be used to validate other conventional datasets such as surveys and estimate differentiation in service delivery across areas, populations, and political affiliations.

This dataset can help fill gaps where on-the-ground access is difficult. Vulnerability assessments are often unable to capture data from certain regions of Lebanon where access is complicated due to local political affiliations; in these instances, NLR data can be used as a fill in to complete the picture for aid actors. NLR is also cost-effective, allowing organizations to obtain detailed data on vulnerability without the lengthy and costly process of hiring enumerators to carry out surveys. Potential uses will be elaborated on in the second part of the series, but could include assisting the monitoring of electricity-related development projects, informing beneficiary site selection, and even predicting vulnerability trends for future planning. Such a flexible, multi-faceted, and cost-effective tool is an important innovation which the LCAT hopes can support better aid implementation as Lebanon passes through a period of economic flux and aid actors attempt to navigate a changing economic landscape.

MSNA Indicator	NLR indicator	Correlation (p-value)
Income/expenditure ratio	NLR per-capita	r = 0.60 (0.002)
Percent of HHs reporting using private or neighborhood generators as an electricity source, and did not use the main network	NLR per-capita	r = -0.46 (0.02)
Percent of HHs reporting using neighborhood generators as an electricity source	NLR per-capita	r = -0.61 (0.001)
Percent of HHs reporting using private or neighborhood generators as an electricity source	NLR per-capita	r = -0.54 (0.002)
Percent of HHs reporting using the main network as an electricity source	NLR per-capita	r = -0.42 (0.038)
Percent of HHs reporting using solar panels as an electricity source	NLR per-capita	r = 0.74 (0.00003)
Percent of HHs reporting using batteries as an electricity source	NLR per-capita	r = 0.75 (0.00002)
Percent of HHs reporting paying for electricity by loan or debt	NLR per-capita	r = 0.57 (0.003)
Percent of HHs reporting paying for electricity by selling assets	NLR per-capita	r = 0.62 (0.0009)
Percent of HHs reporting they would like receive information on electricity services from humanitarian actors	NLR growth rate	r = -0.45 (0.026)
Percent of HHs reporting trouble meeting electricity needs	NLR growth rate	r = -0.47 (0.019)
Average hours of electricity per-day	NLR growth rate	r = 0.42 (0.038)
Percent of HHs that use batteries as an electricity source	NLR growth rate	r = 0.43 (0.032)
Percent of HHs that use that cope with a lack of electricity by sharing the electricity bill with neighbors	NLR growth rate	r = 0.42 (0.039)
Percent of HHs that did not need to cope with a lack of electricity	NLR growth rate	r = 0.52 (0.007)

***Annex 1**: Statistically significant correlations between NLR and electricity-related indicators in the 2022 MSNA.*

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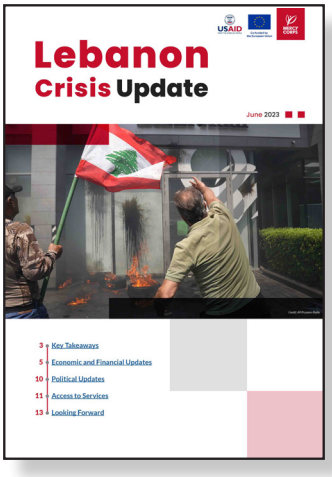

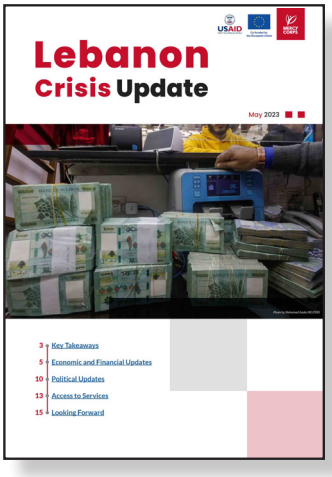

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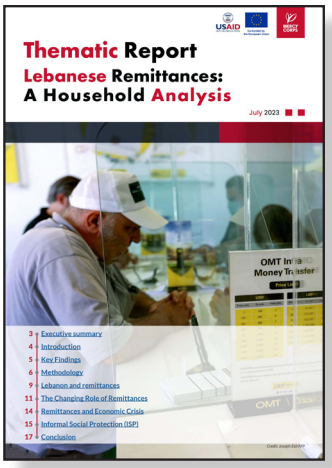

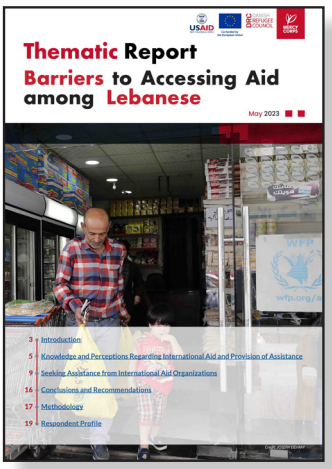

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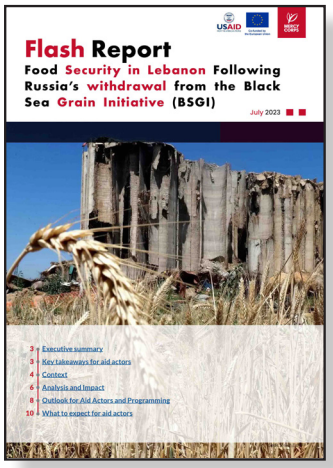

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Mercy Corps is a leading global organization powered by the belief that a better world is possible. In disaster, in hardship, in more than 40 countries around the world, we partner to put bold solutions into action — helping people triumph over adversity and build stronger communities from within. Now, and for the future.