Iraq MPCA Vulnerability Model Review 2021: Technical Report

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As part of the Vulnerability Model Review process, a Vulnerability Model Task Force was created to review and validate the process, the method and the models. The Task Force consisted of two types of reviewers: (1) Cash and voucher programme advisors in Iraq, current members or leaders of the Iraq Cash Working Group, who could provide insights on implementation implications of the models and contextual relevance; (2) Regional and global technical reviewers who could examine the methodology and provide feedback on the quality and integrity of the methodological approach, assumptions made and decisions taken.

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Table of Contents

Acronyms

AIC	Akaike Information Criterion
CLCI	Cash and Livelihoods Consortium for Iraq (formerly CCI)
CSI	Coping Strategy Index (WFP)
CWG	Cash Working Group
FCS	Food Consumption Score (WFP)
HH	Household
HNO	Humanitarian Needs Overview
HoHH	Head of Household
HRP	Humanitarian Response Plan
ICCG	Inter-Cluster Coordination Group
IER	Income-Expense Ratio
IDP	Internally-displaced persons
IOM	International Organisation for Migration
IQD	Iraqi Dinar
DTM	Displacement Tracking Matrix (IOM)
MCNA	Multi-Cluster Needs Assessment
MoLSA	Ministry of Labour and Social Affairs
MPCA	Multi Purpose Cash Assistance
OLS	Ordinary Least Squares Regression
PDS	Public Distribution System (Government of Iraq)
PMT	Proxy Means Test
rCSI	Reduced Coping Strategy Index (WFP)
SEVAT	Socio-economic Vulnerability Assessment Tool
SMEB	Survival Minimum Expenditure Basket
SSN	Social Safety Net
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme

Executive Summary

A new socio-economic vulnerability assessment tool (SEVAT) used to target IDP (living out-of-camp), returnee, and host community households eligible for multi-purpose cash assistance (MPCA) in Iraq was developed in 2021. Actors delivering MPCA in Iraq have used a harmonised tool to identify households since 2016 and the previous revision took place in 2019. The vulnerability model review process was led by the Cash and Livelihoods Consortium for Iraq (CLCI)[1], REACH Initiative and the Iraq Cash Working Group (CWG) with the support of a vulnerability model task force composed of programmatic and technical reviewers.

The 2021 revision of the SEVAT was prompted by the contextual shifts that have taken place in Iraq since the creation of the 2019 models and the availability of a new and fit-for-purpose dataset. The notable contextual shifts include large-scale returns of displaced households since 2019, the onset of the COVID-19 pandemic and related containment measures in early 2020 and the devaluation of the Iraqi Dinar in late 2020 with resulting macro-economic and inflationary consequences. The REACH Initiative, in coordination with OCHA and the ICCG and with the support of 20 INGO and NNGO partners, conducted a Multi-Cluster Needs Assessment (MCNA) in August 2021 to establish a comprehensive evidence base on the prevalence and type of vulnerabilities to inform Iraq's Humanitarian Needs Overview (HNO), which contained sufficient coverage and relevant variables to carry out a model review.[2]

This technical report describes all steps and considerations taken during the development of three regional vulnerability models, including data collection, variable screening, variable selection process, thresholds, and inclusion and exclusion errors. Consistent with the previous model, the 2021 vulnerability model uses a proxy-means test (PMT) method and consumption as the indicator for vulnerability.

Proxy-means testing is a method of predicting or estimating a household's consumption based on observable or accessible household characteristics and behaviours. The PMT method is employed when reliable and accessible data on socio-economic status (such as tax returns, pay slips or bank account balances) are unavailable or difficult to obtain, such is the case among conflict-affected populations in Iraq. Using detailed survey data, proxy means testing relies on multivariate regression analysis to generate a formula for estimating household consumption using proxy indicators, such as housing type or negative coping strategies. Households whose predicted consumption falls below a certain defined threshold are determined likely to be vulnerable and are therefore eligible to receive MPCA.

The 2021 SEVAT revision resulted in the creation of three regional models containing: a constant: the region's dependent variable of the consumption baseline in the form of a log10 value, variables and their coefficients; a selection of significantly correlated independent variables and corresponding coefficients, the explanatory power: R-squared and adjusted R-squared values to indicate each model's ability to account for variance in consumption on the basis of its independent variables, and error rates: inclusion and exclusion errors calculated on the basis of

[1] The CLCI is comprised of the Danish Refugee Council (DRC), the International Rescue Committee (IRC), the Norwegian Refugee Council (NRC), Oxfam and Mercy Corps as lead.
[2] Population groups in the MCNA 2021 included: IDPs (living both in and out-of-camp), returnees, and a smaller pilot of host communities. The MCNA 2021 dataset was truncated for SEVAT purposes by discarding in-camp IDP households and including all host community households to reflect the Iraq Cash Working Group's MPCA programming.

per-capita expenditure thresholds derived from the Survival Minimum Expenditure Basket (SMEB) and the Iraq National Poverty Line.

Introduction

Multi-Purpose Cash Assistance (MPCA)[3] has been used in Iraq since 2014. Initially, the assistance modality was used in response to the Syrian refugee crisis and was subsequently scaled up during the response to the internal displacement crisis triggered by the conflict with Islamic State (IS). In 2015, two cash coordination bodies were established: The Iraq Cash Working Group (CWG) was recognised as a semi-cluster within the Inter-Cluster Coordination Group (ICCG) to ensure MPCA interventions in Iraq were coordinated and followed a common rationale and approach[4] and the Cash and Livelihoods Consortium for Iraq[5] (CLCI, formerly CCI) was founded as a partnership between the largest NGO cash actors to drive the development of harmonised tools for and approaches to MPCA and implement large-scale MPCA programmes through a cost-sharing structure with strong geographic coverage to assist out-of-camp IDPs, returnees and vulnerable host community populations.[6]

From 2015, Iraq saw an uptick in the use of MPCA as an effective and efficient means of assisting socio-economically vulnerable households to meet their basic needs. The participants have consistently expressed a preference for cash over in-kind assistance, the modality enables participants the dignity of choice of which needs are most pressing and by contributing to cash flow in the community, markets are supported. The model presented in this report constitutes the third MPCA targeting model that has been developed since 2014.

Understanding Vulnerability and Targeting

The purpose of targeting assistance is to ensure that assistance is directed to the most vulnerable households. Understanding who the most vulnerable households are and determining an effective means of identifying those households are two key questions for the design of MPCA programming. This type of assistance aims to enable socio-economically vulnerable households to reach autonomous consumption for the duration of the assistance, in other words to be able to ensure the minimum household expenditure needs are met. In order to identify those in need of consumption support, the selected indicator for understanding vulnerability is consumption, proxied by per capita monthly expenditure. [7] [8] The selected indicator is the same as that which was used in the previous vulnerability model.

When assessing economic vulnerability, consumption is a standard measure in developing countries.[9] Consumption is usually considered a more accurate predictor of vulnerability or poverty than income.[10] It is considered a more direct measure of material well-being of the

[3] MPCA are cash transfers that are unrestricted and unconditional and correspond to the amount of money required to cover a household's basic needs. For more detail, see the CaLP Glossary
[4] As detailed in the Cash Working Group's ToR
[5] The CLCI is comprised of the Danish Refugee Council (DRC), the International Rescue Committee (IRC), the Norwegian Refugee Council (NRC), Oxfam and Mercy Corps as lead.
[6] Further information concerning CLCI's activities can be found here.
[7] Further information about the selection of the indicator for consumption and the PMT method can be found here.
[8] Total per capita monthly expenditure in Iraqi Dinar.
[9] Meyer, B and Sullivan, James. Measuring the Well-Being of the Poor Using Income and Consumption. University of Notre Dame, 2003.
[10] World Bank, Attacking Poverty, 2000-2001.

household[11] and the reliability of consumption data is considered higher than that of income data.[12] This is possibly due to the fact that it is more complex to leave out specific expenditures, whereas households might under-report income by concealing specific income sources completely.[13]

Proxy Means Testing

Proxy means testing (PMT) is a method of predicting or estimating a household's income or consumption based on observable or accessible household characteristics and behaviours. PMTs are especially useful when accurate income or consumption data (for example tax returns, salary slips, bank account balances) are unavailable or unreliable. Using detailed survey data, proxy means testing relies on multivariate regression analysis to generate a formula for estimating household consumption using proxy indicators, such as household characteristics or behaviours.[14] Households whose predicted consumption falls below a certain defined threshold are determined likely to be vulnerable and are therefore eligible to receive cash.

As the model estimates consumption rather than relying on reported expenditure or income, it helps practitioners to circumvent challenges associated with misreporting by potential beneficiaries. PMTs represent an effective and efficient way of maximizing impact by ensuring that limited resources are received by those who need them most. In the Iraqi context, the same methodology is also used by the Ministry of Labour and Social Affairs to identify poor households eligible for cash assistance. Utilizing a similar methodology as the government for cash targeting is important, as closer alignment between the targeting policies of the government and the humanitarian sector can help with the development of a systematic approach to referring the humanitarian caseload for government assistance.

Within the social protection field, PMTs are a common way to target poor people in developing countries and are widely considered to be effective.[15] However, PMTs have also invited some criticism, as statistical models often do. Typical criticism towards the PMT method pertains to its temporary utility in changing contexts, the often-high error rates, and external perception of PMT-based targeting as random or unfair.[16] These typical limitations and criticisms are accounted for in this revision in the following ways:

- This 2021 SEVAT revision is a reiteration of the 2019 models, made possible by the regular creation of large and relevant datasets in the Iraq context (at least annually). Given this, future iterations will be possible within the coming years in order to update temporal relevance of targeting models, as is the intention;
- In terms of error rates, studies have reported that other PMT-based models used for social safety nets have in the past generally resulted in exclusion errors of 30-70%.[17] Most error rates for the proposed SEVAT models are within or below the accepted range of 30-40% according to the World Bank.[18] Moreover, as is pertinent in a humanitarian context, the 2021

[11] Meyer, B and Sullivan, James. Measuring the Well-Being of the Poor Using Income and Consumption. University of Notre Dame, 2003.
[12] Ibid.
[13] World Bank, UNHCR. Improving Targeting and Welfare of the Syrian Refugees, 2015.
[14] Sikandra Kurdi, Clemens Breisinger, Hagar ElDidi, Hoda El-Enbaby, Daniel O. Gilligan, and Naureen Karachiwalla. Targeting Social Safety Nets Using Proxy Means Tests: Evidence from Egypt's Takaful and Karama Program, 2017.
[15] AusAid. Targeting the Poorest: An assessment of the proxy means test methodology, 2011.
[16] Ibid.
[17] For example, see: World Bank. Measuring income and poverty using Proxy Means Tests, 2010; and AusAid. Targeting the Poorest: An assessment of the proxy means test methodology, 2011.
[18] World Bank. Measuring income and poverty using Proxy Means Tests, 2010.

models' exclusion rates are relatively low, indicating that few eligible households will be excluded from MPCA;

- Finally, the Cash Working Group will create communications materials in order to relay detailed information on the construction of these models and the targeting process, in order to prevent perceptions of unfairness or randomness of selection on the part of the people of concern and their communities. It should also be noted that the Ministry of Labour and Social Affairs uses PMTs, which both entails that targeted populations may be accustomed to this method of targeting, and that by extension, current PMT-based humanitarian MPCA targeting is best-positioned for the eventual continuation by the Government of Iraq.

The First Model - 2016

The first harmonised vulnerability scoring model was developed by the CLCI in 2016. The model used existing CLCI household data gathered during assessments (programme intake data) and multivariate regression analysis was applied. The first model used Income-Expense Ratio (IER) as the dependent variable - or the proxy for household vulnerability - on which the effect of different household characteristics was measured to develop a proxy-means test model. In this model, the lower the IER, the more vulnerable a household was.

The model had two cut-off points, the lowest determining eligibility for a one-off transfer of MPCA, the highest for three transfers of MPCA for the most vulnerable households. The full 2016 model, with variables and the corresponding scores, is shown in **Annex 2**.

The Second Model - 2019

The vulnerability scoring model in use at the time of this review was designed by the CLCI and UNHCR in 2018/2019. It is currently employed by 13 cash transfer programming implementers in Iraq to identify eligible programme participants and to determine the level of assistance the household is eligible for. It is also employed by 8 organisations for livelihood assistance targeting and 13 for shelter assistance targeting[19]. The model was designed by CLCI and UNHCR using data from the REACH Multi-Cluster Needs Assessment (MCNA) 2018 (Round VI).

The methodological approach adopted to design the 2019 model, a proxy-means test, was the same as that used in the first model and that used by the government-led Social Safety Net (SSN) programme.[20] The model would derive a new PMT formula from recent, quality data that would reflect the changes in context and household circumstances across Iraq. This model also revised the definition of socio-economic vulnerability: as an inability to consume the goods and services needed to survive, measured through how particular household characteristics and behaviours depress monthly per capita consumption.

Developing a PMT model involves finding a set of variables that together predict household vulnerability, or the inability to consume the goods and services needed to survive. The rationale for a PMT approach was broken down further as follows:

[19] Figures obtained from Iraq Cash Working Group in November 2021.
[20] Find more information on the Government of Iraq Social Safety Net PMT here.

- MPCA is a modality that aims to enable households to meet a variety of basic needs in crisis, and the targeting methodology must be able to estimate gaps in basic needs.
- Households in need of MPCA would vary in size, with heads of households that are female and male, of varying ages, in possession of varying degrees of financial, human, and social capital and different means of accessing incomes and livelihoods.
- If robust data is available to perform regression analysis – either recent census data or methodologically robust household survey data - low inclusion and exclusion errors would be possible and thus the process would lead to an accurate poverty marker.

In brief, a PMT approach was adopted because it can address the heterogeneity, or socio-economic complexity, of the target populations for MPCA in Iraq, and indicate household vulnerability despite objectively verifiable information on household cash flow being difficult to obtain.

To better account for socio-economic variance across Iraq, regional vulnerability models would be developed rather than one national model. This also allowed for closer alignment with the Government of Iraq Social Safety Net (SSN) PMT, which also has regional models.[21] The 2019 socio-economic vulnerability targeting tool (SEVAT) model can be found in **Annex 3**.

Rationale for Revising the Model

Although the vulnerability model developed by CLCI and UNHCR in 2019 has proven to be an effective tool for targeting socio-economically vulnerable households as defined by consumption, the model itself is in need of revision. It is important that MPCA planning and programming is grounded in and informed by up-to-date information reflecting the evolving needs of conflict-affected populations. Pivotal shifts in the underlying context in Iraq over the last several years, including the significant economic disruptions and increased vulnerability caused by the COVID-19 pandemic, require the model to be updated to ensure that it remains an accurate measure of household vulnerability. The objective of this research is to update the vulnerability assessment model to ensure that MPCA programming is maximizing the amount of funding that goes directly towards addressing the most acute needs of Iraqi households.

Given the contextual socio-economic shifts in Iraq due to COVID-19, the devaluation of the Dinar and the ensuing inflationary pressures, as well as evolution in movements and returns among people in need, the 2021 Joint Analysis Team adheres to the 2019 Joint Analysis Team's recommendation of updating the model after 18-36 months. In the case that the Iraqi context changes rapidly, a new, equally suitable dataset allows for revision, and the MPCA programming is not disturbed by such a revision, an earlier revision can be considered.

The 2021 revision is based on data which takes into account COVID-19's effects on households' socio-economic status, rendering the resulting models more useful and relevant in a post-COVID context. Given that the current configuration of MPCA programming vis a vis beneficiary households in Iraq is relatively short-term (up to four months from first disbursement) at the time of writing, any effects of COVID-19 on the underlying dataset will likely only strengthen the models' utility in the medium-term, after which new data sources could be used for revisions if necessary.

[21] Find more information on the alignment of humanitarian cash and government-led social protection targeting here.

Context

Despite improvements in the security situation in Iraq over the last years, intermittent conflict continues to threaten livelihoods and contribute to widespread socio-economic vulnerability. This was exacerbated in the last two years by the arrival of COVID-19, which further limited livelihood opportunities and slowed development. In 2020, the poverty rate in Iraq nearly doubled, reaching 31.7%, while the unemployment rate hovered around 14%.[22]

The average household surveyed in the 2021 MCNA (regardless of population group) used for this analysis reported spending an average of IQD 104,802 per capita per month.[23] Most households (77%) reported having a debt, with 59% of these indebted households reporting that they took on debt to cover basic needs (including food, education, healthcare, or basic household expenditures).

Table 1. Overview (MCNA 2021)[24]

	National	KRI	Centre-South	North
Total household expenditure (within 30 days of the interview)	IQD 529,942 (USD 364)[25]	IQD 527,636 (USD 362)	IQD 510,803 (USD 351)	IQD 534,282 (USD 367)
Per capita expenditure (within 30 days of the interview)	IQD 104,802 (USD 72)	IQD 96,032 (USD 66)	IQD 132,098 (USD 91)	IQD 101,292 (USD 70)
Food expenditure (share of total household expenditure, within 30 days of the interview)	55%	62%	60%	55%
Per capita income (within 30 days of the interview)	IQD 80,926 (USD 56)	IQD 69,457 (USD 48)	IQD 117,694 (USD 81)	IQD 74,804 (USD 51)
Total household debt	IQD 7,301,423 (USD 5,015)	IQD 2,068,826 (USD 1,421)	IQD 3,487,715 (USD 2,396)	IQD 9,569,778 (USD 6,573)
Per capita debt	IQD 1,192,116 (USD 819)	IQD 341,493 (USD 235)	IQD 698,940 (USD 480)	IQD 1,533,830 (USD 1,054)
Total number of households	9,716	1,587	1,399	6,557

The average household contained six members, with 13% of all households reporting a female household head. Households with a head of household that was disabled and unemployed, or chronically ill and unemployed, or both disabled and chronically ill and unemployed made up 16% of the total sample.[26]

[22] See WFP Iraq Country Website Overview; and World Bank Iraq Unemployment Estimates.
[23] Population groups in the MCNA 2021 included: IDPs (living both in and out-of-camp), returnees, and a smaller pilot of host communities. The MCNA 2021 dataset was altered for SEVAT purposes by discarding in-camp IDP households and including all host community households to reflect the Iraq Cash Working Group's MPCA programming.
[24] Mean expenditure and income figures in Table 1 concern the averages of reported income and expenditure within the 30 days prior to the household interview.
[25] All IQD-USD conversions were made on the basis of the rate (USD 1 = IQD 1,460) per XE on November 17, 2021.
[26] The 2021 MCNA 2021 did not include explicit linkage between illness or disability being the cause of unemployment.

Table 2. Household Demographics	
Household size	6
Female-headed households	13%
HoHH disabled/ill and unemployed	16%

When asked about household primary income sources (multiple choice), the majority of households (69%) reported that their primary income came from employment (either regular or irregular). Other common sources of income included taking on debt (25%), savings (13%), retirement (8%), and social services (8%).

Table 3. Primary sources of income within 30 days of the interview, by type of source (share of all households, may exceed 100%)	
Irregular job	50%
Debt	25%
Regular job	19%
Savings	13%
Retirement	8%
Social service (e.g., disability allowance)	8%
Family or friends	7%
Other	2%
Charity	2%
Cash assistance, Selling assets, Zakat, Remittances, Renting, Selling assistance, Illegal job	≤1%

When asked about their use of coping strategies, 43% of all households reported relying on at least one coping strategy in the 30 days prior to the survey. The most common coping strategies reported by these households included borrowing money to purchase food (64%), reducing spending on non-food items (39%), or selling assets (36%).

Table 4. Share of households who indicated using at least one strategy within 30 days of the interview, by strategy (may exceed 100%)	
Borrowing/debt to purchase food	64%
Reduced spending	39%
Selling assets	36%
Selling transport	18%
Changed place	16%
Family migrating	9%

Adult engaged in risky behaviour[27]	7%
Child forced to work	7%
Child forced marriage	3%
Child dropped out of school	3%

A households' Food Consumption Score (FCS) serves as a proxy for caloric availability in the seven days prior to the survey. Among households of all population groups covered in the MCNA, 81% were found to have an 'acceptable' food consumption score, suggesting that most household members had sufficient and adequate food intake in the previous week.[28]

Table 5. FCS Score Index	
Acceptable	81%
Borderline	12%
Poor	7%

Food consumed constituted a large portion of household expenditure, with the average household reporting 55% of all monthly expenditure was allocated towards food. For 17% of households, food expenditure reportedly exceeded 75% of total monthly expenditure. Food expenditure share can be used as a measure of household economic vulnerability based on the following premise: 'the greater the burden of food within a household's overall budget (relative to other consumed items/services), the more economically vulnerable the household. That is households that spend a large share on food are highly vulnerable to food insecurity regardless of their current consumption status.' [29]

Table 6. Food Expenditure Share	
Food expenditure exceeded 50% of total expenditure	52%
Food expenditure exceeded 65% of total expenditure	33%
Food expenditure exceeded 75% of total expenditure	17%

The Third Model - 2021

I. Approach

In developing this new model, the Joint Analysis Team relied upon a similar methodology as was used to construct the 2019 model. Using recent, quality data which reflected the changes in the context and household circumstances across Iraq, the Joint Analysis Team developed a PMT designed to estimate vulnerability defined in terms of monthly per capita consumption (proxied by

[27] WFP's CARI Index's full description of this Emergency-class coping mechanism is "Engaged in illegal income activities (theft, prostitution)." The formulation was modified in the questionnaire for the purpose of attaching less stigma to this coping mechanism vis a vis respondents.
[28] As defined by WFP's FCS Manual.
[29] Ibid.

household expenditure). Relying primarily on stepwise regression analysis, the Joint Analysis Team identified the household characteristics and behavioural indicators most significantly associated with consumption. These variables were then included in a linear regression model, yielding a formula for weighting each indicator in order to predict household vulnerability, or the inability to consume the goods and services needed to survive.

A PMT approach was again selected as the basis for the updated model. This methodology allowed for the consideration of a wide range of humanitarian-specific indicators (such as the 2022 Humanitarian Needs Overview variables and brackets) addressing and analysing the socio-economic complexity of MPCA target populations in a more systematic and evidence-based manner. As the model relies on various proxy indicators to estimate vulnerability (via expenditure) as opposed to relying on the information as it is reported, it limits instances of misreporting by potential beneficiaries. Based on targeting models built in similar contexts and population groups, it was decided that expenditure rather than income would constitute the better dependent variable to predict vulnerability given the relative specificity of expenditure reporting compared to income reporting.

Once again, the approach selected aligns with that employed by the World Bank/MoLSA in three ways: consumption is the selected indicator of vulnerability, a PMT is the method used to create the model and there are regional vulnerability models, rather than one national model, to account for socio-economic variance across Iraq (KRI, Centre-South and North).

II. Data Collection and Methodology

The dataset used for the analysis was collected by IMPACT REACH and partners for IMPACT REACH's Multi-Cluster Needs Assessment (MCNA) Round IX, conducted between June and August 2021. The MCNA is a yearly exercise with wide cooperation and buy-in among NGO partners, UN agencies and clusters, and constitutes the main data source for the Iraq Humanitarian Needs Overview (HNO) planning process and the resulting Humanitarian Response Plan (HRP). The MCNA consists of data collected as displayed in the table below. The dataset used for the vulnerability model analysis was truncated by removing the in-camp IDP household responses because MPCA programming is not typically implemented in camp settings by CWG actors.

Table 7. MCNA Data Collection Overview

Population group	Districts covered	Households interviewed
IDP out-of-camp	57	5,657
IDP in-camp	9 (27 camps)	2,373
Returnee	33	3,615
Host community[30]	4	444

[30] The MCNA 2021 uniquely included a host community pilot within the larger data collection effort. This host community data was included into the truncated dataset used for the 2021 SEVAT revision.

The MCNA 2021 samples were drawn at the district level with a 90% confidence level and 10% margin of error for each of the assessed population groups, including for the host community household samples. The stratification by population group allowed the MCNA 2021 team to draw comparative conclusions on the needs per population group per assessed district. A two-staged stratified cluster sampling approach was employed for each population group, with IOM datasets used for the sampling frames and geo-sampling and incorporating probability proportional to size (PPS) for cluster creation.

Within each sampled cluster, geo-points were randomly generated and provided to data collectors through a mapping application. An eligible household (falling within the sampled strata) nearest to the geo-point was surveyed.

The MCNA 2021 data was used primarily for its quality: as noted, the samples were drawn through the creation of geo-sampled clusters per district and samples are representative at the district-level. Except for certain districts in the Centre/South, most areas of intervention of current MPCA were included in the sample. Further, the survey tool had inputs from the Inter-Cluster Coordination Group (ICCG)[31] during the design phase and contained all necessary demographic indicators. In sum, humanitarian actors were able to support the exercise and then leverage a robust dataset for analysis by the technical task force.

Limitations of Data Collection and Methodology

Considering the purpose of SEVAT for MPCA targeting, which includes host communities, the MCNA 2021 dataset includes a low number of district-level samples for host communities compared to other population groups. They sample included offers a brief and exploratory comparison between population groups within the wider displacement-oriented MCNA 2021. Moreover, given that host communities most often (but not always) are the largest population group in any given surveyed district, this presents an additional roadblock in relativising population groups' impact on PMT results. The inclusion of more host community samples would have been preferable, and hopefully more may be included in future iterations of the MCNA. For this revision, this imbalance among population groups has been taken into account in the weighting as much as possible.

There were several variables not included in the MCNA 2021 dataset that, based on past experience in the region, the Joint Analysis Team identified as potentially relevant predictors of consumption. These variables included:

Reduced Coping Strategies Index (rCSI): The rCSI is a proxy indicator of household food insecurity which considers both the frequency and severity of five pre-selected coping strategies that the household may have used in the seven days prior to the survey.[32]

Head of Household Education: The education status of the head of household was not included in the survey. As education often impacts employment status, stability of employment, and income, it is reasonable to expect that this could be a reliable predictor of household consumption.

Head of Household Unemployed <u>because</u> of disability: Respondents were asked questions to assess if anyone in the household was disabled or chronically ill and were asked about their

[31] The ICCG and the sectoral clusters are responsible for coordinating the implementation of the Humanitarian Programme Cycle.
[32] See WFP's CARI Index.

employment status but were not specifically asked if household members (including the head of household) were unemployed as a direct result of a disability or illness. Therefore, the only recodeable binary variables possible pertained to household members or heads of households being both disabled and unemployed, but without an explicit causal linkage.

Expenditure on debt repayment and income-generating activities (IGAs): Next to being asked to report total household expenditure, respondents were not asked to specifically break down their household expenditure beyond rent, medical costs, and food expenditure, diverging from previous years. This limitation precluded further regressions on more disaggregated expenditure variables, which otherwise may have introduced different explanatory powers useful to the models. Additionally, without the additional breakdown it was not possible to remove expenditures on areas that may not directly equate to consumption, for example debt repayment or productive asset purchases.

III. Preparing the Dataset

In order to prepare the dataset for the purpose of selecting variables suitable for regression and ultimate inclusion into the models, several steps were taken to optimise variables' elucidation of predictability. The dataset was truncated by removing in-camp IDP households and district samples that were not representative due to insufficient sample size. The individual-level data (asked per member of the household in a repetitive loop) was collapsed and merged with household-level data, each household was assigned a region, and the new set of weights were applied. Following this, the team screened all available variables for relevance.

Variable Screening

Before beginning the analysis, it was necessary to review all 232 questions (each with multiple answers) included in the MCNA 2021 dataset and identify a selection of plausible explanatory variables to be tested for inclusion in the model.

Selecting variables, the Joint Analysis Team identified those which were:

1. Logically relevant to a household's socio-economic vulnerability. Variables were excluded if they were deemed too distant from socio-economic vulnerability. This served to reduce the likelihood of 'nuisance variables,' or variables that may only be coincidentally significant, being included in the model. *For example, 'Have you or any member of your household received any information, education, or training about the risk of explosive ordnance?'*
2. Plausible questions to ask during a household assessment. Variables deemed too sensitive for staff or enumerators to ask households during a vulnerability assessment were removed. *For example, whether adults use disciplinary measures to address behaviour problems among their children.* The MCNA 2021 questionnaire was constructed using input from ICCG clusters based on sectoral needs. The revision of the SEVAT and the implications of its purpose as a vulnerability targeting tool, however, requires included questions to be answered as truthfully and completely as possible, which led the team to exclude overly sensitive questions.

3. Answered by an acceptable proportion of households. Questions with a low response rate (less than circa 5%, decided on a case-by-case basis) or with pre-conditions (those only asked if a respondent selected a particular answer to a previous question) were excluded, where possible. *For example, when asked about top three priority needs in the previous year, only 0.66 percent of respondents selected Child Protection., which led the team to exclude this answer as its own variable for consideration of inclusion.*

One important difference between the 2021 model and the 2019 model is that the updated model includes a variable capturing household income. Including income in the model helps to limit the number of high-income households which are incorrectly identified as vulnerable. Addressing inclusion error was identified as a priority due to tensions that can arise within communities when households see their wealthier neighbours receiving cash. As household income can be difficult to accurately measure due to the fact that it is generally self-reported, the income variable included in this model represents only the top income quintile a household falls under (not penalising any household below the 80th percentile), relative to the collected and scored dataset. This broader definition helps account for slight errors in reporting while still controlling for a household's overall level of income. The inclusion of income improved the predictive power of the models substantially as household income is closely correlated with household expenditure.

Weights

The purpose of the MCNA 2021 sampling was to ascertain levels of vulnerability among IDP and Returnee households, in districts where these population groups were most concentrated. The host communities segment served as an exploratory benchmark, and therefore was only surveyed in four districts in the MCNA 2021. Despite any variation in samples per population group, the MCNA 2021 dataset constitutes the most suitable dataset for the creation of the SEVAT because MPCA also targets the same population groups and profiles in similar areas as those sampled in the MCNA 2021, and because it is the most thematically comprehensive and recent dataset available.

In order to allow for regression among all samples across population groups, at both the regional and national level for PMT modelling, all samples were treated as individual strata as a sample of population group within a given district (e.g., returnee households in Al-Falluja). Each stratum was subsequently weighted at the district level per population group. The below formula was used at the district-level to create one uniform set of weights for all strata.

$$\frac{Population / \sum Population}{Sample / \sum Sample}$$

Several factors led us to apply this type of weighting. For instance, relying on only four districts' samples for the host communities segment, despite the typically large size of host communities as a population group, meant that we had to consider these samples' relative importance among the other samples. Conversely, some surveyed districts actually have higher population sizes for non-host community populations than host communities, such as Returnee households in Mosul and Al-Falluja, which also required elucidation through appropriate weights. Lastly, some districts saw samples from multiple population groups, while others did not because the MCNA 2021 sampling method only included a population group once at least 200 households of the population group were recorded in the IOM-DTM data, which required balancing. The analysis team decided

that in order to keep in accordance with district-level granularity, district-level weighing provides the highest degree of meaning in terms of representativeness and balance, given that MPCA actors using SEVAT will continue to target all of these population groups. Weights for each stratum surveyed can be found in **Annex 11**.

IV. Analysis

As described above, the purpose of conducting this research was to update the PMT used to construct the 2019 vulnerability model to accurately reflect shifts in the socio-economic context within Iraq. In this context, vulnerability is defined in relation to households' level of consumption, with those households which are not able to consume the basic goods and services required for survival considered to be the most vulnerable. In Iraq, like many other countries, precise measurements of household income or consumption are unavailable or difficult to obtain, so it is impossible to know precisely how much a household earns or spends every month. It is for this reason that it is necessary to estimate household consumption based on observable household characteristics using a PMT.

Variable Selection Process

After defining a list of plausible potential variables for inclusion in the model, the Joint Analysis Team constructed three distinct national PMT models designed to predict household consumption to evaluate each type of model as a step in the process of developing the regional models. These models were developed using three distinct methodologies: Stepwise regression, best subsets variable selection, and the least absolute shrinkage and selection operator (lasso). The outcome variable of all models was the log10 of monthly household per capita consumption.[33]

Stepwise Regressions

Stepwise regression is a method of fitting regression models which uses statistical significance to select the explanatory variables to be used in a multiple-regression model.[34] The Joint Analysis Team utilized a bi-directional stepwise regression model, which relies on a combination of forward-selection and backward elimination to identify the variables that are the best fit based on their significance level. Similar to a purely forward-selection model, the bi-directional model starts with no variables and adds variables one at a time. At every step, however, the model also accounts for the statistical consequences of adding each additional variable on the predictive power of previously included variables. Previously included variables no longer determined to be reliable predictors of consumption will be simultaneously removed from the model.[35] This process will continue until no more predictors can be justifiably entered or removed from the model. The variables remaining will be considered the 'final model,' or those which, taken together, were found to be the strongest predictors of household consumption.

Variables are included or excluded from the model based on a specified p-value threshold. A p-value, or probability value, represents the level of statistical significance of each variable in the

[33] Log10 form variables are used because they have a normal distribution, a necessary condition to apply OLS regression.
[34] Proceedings of BS2013. 13th Conference of International Building Performance Simulation Association, 2013.
[35] See Penn State. Applied Regression Analysis.

model. In other words, this is the likelihood that any observed change in consumption is attributable to the variable in question and not a product of random chance.[36]

The stepwise regressions used in this analysis were non-hierarchical, meaning the order in which the variables should be tested was not specified by the Joint Analysis Team. The model selected the most significant variable at each stage, stopping when no additional terms were found to have a p-value ≤ the threshold (either 0.05 or 0.15, depending on the model specification) when added to the model.

The Joint Analysis Team ran two stepwise regressions with differing p-value thresholds, defined as follows:

1. The first model used a p-value threshold of $p \leq 0.05$ for inclusion in the model. To be removed from the model, a variable's p-value must have exceeded 0.05. A p-value of 0.05 is a standard significance threshold, offering strong evidence that the null hypothesis (that observed differences occurred as a result of chance) is false.
2. The second model will use a p-value threshold of $p \leq 0.15$ for inclusion in the model (with a p-value above 0.15 required for removal from the model). This is often cited as a standard threshold for the inclusion of variables using a stepwise regression process because a p-value of 0.05 can be too restrictive in this context.[37]

Upon running each stepwise model on the original list of pre-selected variables, the Joint Analysis Team identified a high degree of multicollinearity amongst the predictors (many predictors were found to be highly correlated with each other). If two variables are found to be collinear after running the regression, one is automatically and arbitrarily removed from the model, leading to the exclusion of potentially valuable predictors. To address this issue, the Joint Analysis Team shortened the long list of variables by regressing each variable on per capita consumption individually, including only those variables with a p-value smaller than 0.05 in the final short list of potential variables. Each of the above stepwise regressions was then run on this short list of variables to produce two additional models for comparison. This substantially reduced multicollinearity among the predictors, ensuring that all variables were fully assessed for inclusion in the model.

The fact that the stepwise regression model estimates the p-values and coefficients of each variable as they are added to the model and not within the final model as a whole has the potential to introduce bias and is one of the shortcomings of this methodology (described in more detail in the limitations section below). To account for this, the Joint Analysis Team estimated the final coefficients and p-values of the model by regressing all of the covariates identified through the stepwise procedure on the log10 of per capita consumption using a standard OLS regression. In some cases, this resulted in the p-values increasing above the 0.05 or 0.15 threshold, as some variables were less statistically significant within the final model than at the stage in which they were added via the stepwise procedure. These variables are included in the final model, as removing them would violate the underlying assumptions of the model.

[36] See Dr. Saul Mcleod. Simply Psychology: P-values, 2019.
[37] Kuhn, Max and Johnson, Kjell. Feature Engineering and Selection: A Practical Approach for Predictive Models, 2021.

Best Subset Variable Selection

As described above, one of the limitations of the stepwise methodology is that variables are evaluated for inclusion in or exclusion from the model one by one rather than assessed based on their fit within the final model as a whole. Because of this, there is an increased risk of either overfitting the model or mistakenly excluding variables that are relevant within the final model but do not appear to be relevant at the moment they are considered within the procedure. Stepwise selection remains a useful tool for narrowing down relevant predictors (particularly when the original list of variables is hand-selected based on strong theoretical justification, as was the case here); however, to ensure that the final model selected was as accurate and efficient as possible, the Joint Analysis Team choose to develop a third model using a different methodology to present for comparison.

This third model was developed using best subset variable selection, a methodology that examines all possible permutations of the input predictors to identify the model with the most explanatory power. Explanatory power was assessed based on the Akaike Information Criterion (AIC), a statistic which captures how well the model fits the data it was generated from (compared to all other possible models).[38] The AIC penalizes models which include a greater number of predictors, which helps prevent model overfitting while maintaining a similar degree of explanatory power.

As the best subsets variable selection requires that the program run every possible combination of variables, it is extremely computationally intensive, and the length of time required to run the model increases exponentially with each additional variable added. As a result, the original list of variables was too long for this type of analysis. To allow for AIC analysis, the Joint Analysis Team selected 19 variables deemed particularly relevant based on the results of preliminary individual regression analysis, the 2019 vulnerability model, and experience working closely with Iraqi households in the field. Variables were selected such that the final pre-AIC analysis list included variables belonging to each of the 10 key thematic categories (highlighted in **Annex 4**), with the exception of education.

Least Absolute Shrinkage and Selection Operator (Lasso)

Lasso is a regression analysis method designed to estimate model coefficients, which can then be used to select the covariates most relevant to include in a model. It is most useful in situations where there are a lot of potential covariates, but it is important to identify and include only the small number of covariates which actually have an effect on the outcome of interest (in this case, consumption).

Similar to using best subsets variable selection, lasso fits all variables into the model at once, but requires substantially less computing power to do so, allowing for a greater number of input variables. This also addresses some of the limitations associated with stepwise regression, including that individually fitting variable within the model does not always lead to identification of the best overall model (described in more detail below).

Following suggestions from several independent reviewers, the Joint Analysis Team used lasso to construct both a national model as well as three individual regional models and compared the

[38] ScienceDirect. The Akaike Information Criterion, 2011.

results to the existing models. The models constructed using lasso were found to have a comparable degree of explanatory power (based on both their R-Squared and Adjusted R-Squared values) but included considerably more variables than the previous models (although there was a significant amount of overlap between the models constructed using lasso and the previously designed models). Considering that the quality of the models appeared to be comparable, the Joint Analysis Team ultimately decided to proceed with the models constructed using the stepwise methodology as these models were practically easier to implement in the field and were consistent with the methodology used to construct previous versions of the PMT.

Reviewing the Models

The above analysis yielded a total of six potential models, summarized in the table below:

Table 8. Potential Models (Overall)

Methodology	Threshold/Selection Criterion	Variables Included
Stepwise Regression	$p \leq 0.15$	All variables selected by the Joint Analysis Team prior to beginning analysis
		Shortlist of variables created by individually regressing all variables on per capita consumption and retaining only those with a p-value ≤ 0.05
	$p \leq 0.05$	All variables selected by the Joint Analysis Team prior to beginning analysis
		Shortlist of variables created by individually regressing all variables on per capita consumption and retaining only those with a p-value ≤ 0.05
Best Subset Variable Selection	AIC	Refined shortlist of 19 variables selected by the Joint Analysis Team based on performance in preliminary individual regression analysis, appearance in the 2019 model, and their relevance in the field.
Lasso		All variables selected by the Joint Analysis Team prior to beginning analysis

In order to select the final national models for comparison, the Joint Analysis Team first reviewed each model with respect to three primary criteria:

1. **R-squared value**: The r-squared value, also known as the coefficient of determination, represents the percentage of variance in per capita consumption which could be explained by each model. The models had r-squared values ranging from 50% to 62%. When

screening the models, the Joint Analysis Team first looked for those models found to have the highest r-squared values, suggesting greater explanatory power.[39]

2. **Number of variables**: The Joint Analysis Team also reviewed the number of variables included in each model. Larger models containing many variables would be difficult to practically implement in the field, while models with too few variables run the risk of being too specific and thereby eliminating eligible households.
3. **Relevance of variables**: In reviewing the variables included in the model, the Joint Analysis Team also considered their relevance. This included ensuring that there was a theoretical justification for including each variable in the model (the variable seemed relevant based on past research, experience in the field, etc.) as well as the number of households affected.

After reviewing each of the models, the Joint Analysis Team selected two primary models with high explanatory power and a reasonable number of predictors that seemed logically relevant to the Iraqi context. Before finalizing the models, variables determined to be irrelevant either due to a lack of theoretical justification and/or their limited applicability were removed from the models. The two final models selected for consideration included:

1. Stepwise regression model (p-value threshold of 0.05): All variables
2. Best subsets variable selection model

These national models were constructed for exploratory purposes and will ultimately not be used programmatically.

V. Regional Models:

Similar to the 2019 PMT model, the Joint Analysis Team constructed a series of unique regional models (KRI, Centre-South, and North) in addition to the national model presented above.

For each region, three distinct models were generated using the same methodology described above.

Table 9. Potential Models (Regional Models)

Methodology	Threshold/Selection Criterion	Variables Included
Stepwise Regression	$p \leq 0.15$ $p \leq 0.05$	Shortlist of variables created by individually regressing all variables on per capita consumption and retaining only those with an individual p-value ≤ 0.05
Best Subsets Variable Selection	AIC	

After running each regional model using the original shortlist of variables, the Joint Analysis Team identified several variables that were included as predictors of consumption but were programmatically problematic. For example, taking out debt for essential needs was found to be a predictor of increased consumption in several models. This makes sense, as taking out debt would allow households to consume more in the short term but including this term in the model would

[39] The Joint Analysis Team also looked at adjusted r-squared, which was found to be very similar in all cases.

mean that households taking out debt just to survive would be less likely to qualify for aid. This is problematic, as these households are likely very vulnerable, so this term was removed from the model.

After these problematic variables were identified, they were removed from the broader variable pool and the stepwise process was repeated to generate updated versions of each model. A full list of the variables that were removed are included in **Annex 7**.

Limitations of Analysis

Stepwise regression methodologies have been criticized in academic literature due to their potential to produce biased results.[40] This criticism arises from how the stepwise methodology fits many models, adding variables one at a time until a statistically significant relationship is identified, the likelihood that a coincidental statistical relationship will be discovered increases. P-values (the basis for which variables are selected for inclusion or exclusion) are biased towards 0, increasing the risk that variables will appear significant even if the relationship is only coincidental. This can result in "overfitting" of the model, or the inclusion of too many independent variables.

Because the model selects variables by adding them to the model one by one and evaluating their individual impact (avoiding the computational burden of trying all possible combinations of explanatory variables), there is also the possibility that the model erroneously excludes variables that are not independently significant but have explanatory power within the broader model.[41]

The Joint Analysis Team took several steps to mitigate these limitations, including:

- Manually discarding irrelevant or theoretically redundant variables tested by the stepwise model to include only variables predicted to have an impact on consumption. Limiting the variable pool using a theoretical justification reduces the risk that the model will erroneously identify correlations.
- Running a linear regression on the list of variables identified as significant through the stepwise procedure to reduce the bias in the r-squared values and the values of the coefficients.
- Reviewing each potential model to determine whether all the variables were theoretically justifiable, applied to a sufficient proportion of the population, and were feasible to accurately measure in the field. Variables that did not meet these criteria were removed from the model.
- Testing a model that did not rely on the stepwise methodology. To do this, the Joint Analysis Team hand-selected a shortlist of 19 variables perceived and agreed to be especially relevant based on experience working in the region and/or inclusion in previous models. Best-subsets variable selection, which analysed all possible combinations of these variables, was performed on this shortlist to identify the combination of variables found to be the best and most efficient predictor of consumption. The model obtained using this method is presented as a potential final model, offering an alternative to models selected based on a stepwise procedure.

[40] Flom, Peter. Stopping stepwise: Why stepwise selection is bad and what you should use instead, 2018.
[41] Smith, Gary. Step away from stepwise, 2018.

VI. Results

Regional Models

The regional models with the significant variables and coefficients are presented in the tables below (the governorates contained within each model are noted in **Annex 5**). For each region, the model was constructed using a stepwise regression model with a p-value threshold of 0.15. This threshold helps maximize the r-squared value of the model and include an adequate number of predictors.

KRI: Stepwise Regression (P-Value Threshold: 0.15)

R-Squared: 50%

Adjusted R-Squared: 50%

Table 10. Regional Model: KR-I		
Variables	**Coefficient**	**P-Value**
Coping - Child Working	-0.0636112	0.025
Food Expenditure Share	-0.1917827	0.000
Highest Income Quintile	0.2417639	0.000
Household Food Consumption Score (FCS) Index	0.00010782	0.026
Number of HH Members	-0.027957	0.000
Primary Income - Retirement	0.1080621	0.003
Primary Income - Regular Job	0.0474559	0.053
Priority Need - Healthcare	0.0367101	0.054
Shelter Type - Good	0.0791048	0.000
Constant	**5.0076**	

Centre-South: Stepwise Regression (P-Value Threshold: 0.15)[42]

R-Squared: 73%

Adjusted R-Squared: 73%

Table 11. Regional Model: Centre-South		
Variables	**Coefficient**	**P-Value**

[42] Two variables (Nationality Certificate - Adults and Number of Crisis Coping Strategies Used) were removed as they were found to have programmatically problematic coefficients. These variables were directly removed from the final model, and OLS regression was run on the remaining variables to update the coefficients and p-values. This adjustment had a minimal impact on the R-Squared value of the model (dropping it from 74% to 73%).

Coping - Child Working	-0.0507738	0.180
Food Expenditure Share	-0.1558639	0.007
Highest Income Quintile	0.1618074	0.000
Household Food Consumption Score (FCS) Index	0.0032847	0.000
Needs Met - Some	-0.1161377	0.000
Number of HH Members	-0.0588231	0.000
Primary Income - Retirement	0.0848814	0.011
Priority Need - Healthcare	0.0534873	0.009
Priority Need - Livelihoods	-0.0473875	0.016
Priority Need - None	0.0825092	0.004
Constant	**5.118463**	

North: Stepwise Regression (P-Value Threshold: 0.15)

R-Squared: 51%

Adjusted R-Squared: 51%

Table 12. Regional Model: North

Variables	Coefficient	P-Value
Coping - Child Dropped Out of School	-0.0556815	0.110
Decision Making	0.0253836	0.027
Dependency Ratio	0.1458218	0.001
Food Expenditure Share	-0.3179392	0.000
Highest Income Quintile	0.2350054	0.000
Household Food Consumption Score (FCS) Index	0.0009158	0.004
Nationality Certificate - Adults	0.0485267	0.094
Needs Met - All	0.0701775	0.003
Number of HH Members	-0.0301807	0.000
Primary Income - Irregular Job	-0.0348703	0.010
Primary Income - Regular Job	0.0299593	0.038
Primary Income - Retirement	0.0700564	0.000
Priority Need - Healthcare	-0.020704	0.085
Priority Need - Livelihoods	-0.0587495	0.000

Shelter Condition	-0.0161102	0.011
Water Quality - No Problems	0.0298257	0.006
Constant	**5.115584**	

VII. Thresholds

Thresholds for assistance determine whether households are considered eligible for assistance and, in the case of MPCA in Iraq, the frequency of assistance received. Thresholds are used during the development of the PMT in order to calculate inclusion and exclusion error and validate the model. In updating the PMT model, this research also seeks to reconsider the thresholds (or level of per capita consumption) below which households are defined as vulnerable.

In the previous SEVAT model, there were three thresholds for assistance (see Table 10). Households below the threshold of 110,000 IQD per capita per month were considered eligible for MPCA and either 1, 2 or 3 months of assistance depending on the level of consumption below 110,000 IQD.

Table 13. 2019 Thresholds

Category	Threshold
R1	110,000
R2	92,000
R3	70,000

A range of thresholds were considered when identifying the 2021 proposed thresholds in Table 11, including international poverty markers, national poverty markers, Survival Minimum Expenditure Baskets and previous thresholds. For a full list of considered thresholds, see **Annex 6**. After consultation with the World Bank, the Iraq National Poverty Line, which was initially calculated in 2018 using household expenditure data, was updated using 2021 inflation data. This threshold was selected as the upper threshold for assistance. After consultation with the Cash Working Group, the 2021 Survival Minimum Expenditure Basket (SMEB) was selected and converted into per capita consumption.

Table 14. 2021 Thresholds (Proposed)

Category	Justification	Threshold	Rounded Threshold
R2: Vulnerable	2021 Iraq National Poverty Line	117,104	115,000
R3: Highly Vulnerable	2022 SMEB	66,667	70,000

The proposed thresholds were primarily devised in order to calculate inclusion and exclusion errors in order to validate the model. The final thresholds are decided on by Cash Working Group members in line with the design of MPCA for 2022.

VIII. Inclusion and Exclusion Errors

Both national models and all three regional models were tested for inclusion and exclusion errors. Inclusion errors (also referred to as 'leakage') refer to households identified as eligible based on their predicted consumption in the model, but who would not be eligible according to their actual consumption level reported in the survey data. Exclusion errors (also referred to as 'undercoverage') refer to households found ineligible by the model, but who should be eligible according to their actual consumption. Testing for inclusion and exclusion requires first identifying a vulnerability threshold in actual consumption, then calculating the proportion of households below that threshold who would be included or excluded according to predicted consumption.

Inclusion and exclusion errors were tested at both proposed vulnerability thresholds (Primary: 117,104 IQD and Secondary: 66,667 IQD) for all models with a focus on the Primary Threshold for the purposes of validation. When using a PMT model, the distribution of the predicted and actual outcome variable (consumption) will always differ slightly due to the error or unexplained part of the model. In some cases, the model's predictions are truncated on one end of the distribution or even shifted in one direction. To accommodate this, all thresholds were calculated by first identifying the share of households that would be considered socio-economically vulnerable based on their *actual* (reported) consumption. The percentage was then applied to households' predicted consumption, with the adjusted poverty line defined as the level of predicted consumption below which the same share of households would be defined as 'socio-economically vulnerable.' This threshold was uniquely calculated for each region to account for regional variations in poverty. These updated thresholds are displayed in **Annex 10**.

The error rates were first calculated in-sample using the entire dataset. Across all models, error rates calculated were found to be comparatively low, on average. Inclusion error at the Primary Threshold ranged from 6.4% to 17.6%, slightly higher than the 2.9% to 4.4% calculated in 2019 but still substantially lower than those generally found for other PMT targeting mechanisms.[43] Ranging from 2.4% to 17.5%, the exclusion errors of the updated models were lower than those of the 2019 models (at the Primary Threshold). Conceptually, there is a trade-off between inclusion and exclusion errors; minimizing the number of vulnerable households mistakenly deemed ineligible (lower exclusion error) often simultaneously increases the number of non-vulnerable households erroneously included in the model (higher inclusion error).

When testing for inclusion and exclusion errors, it is preferable to use a separate dataset from that which was used to develop the model. Due to the limited availability of robust, representative, and up-to-date datasets with variables similar to the MCNA 2021 data, this was not possible.

To account for this, and based on suggestions from reviewers, the Joint Analysis Team adopted an additional method for calculating the inclusion and exclusion errors within the same MCNA 2021 dataset by using a K-fold cross-validation technique (Table 12 and 13). This method splits the dataset into 10 equal subsamples (or "folds"). The model is used to generate predictions across 9 out of the 10 folds and is then validated in the 10th fold. This process is repeated across all 10 folds, with the average of all 10 inclusion or exclusion errors representing an estimate of the overall error of the model. In effect, this method allows the entire dataset to be used to both construct the model and test for inclusion/exclusion error, but because these errors are calculated multiple times across different subsections of the data, the resulting estimates are thought to be more accurate

[43] Freeland, Nicholas. Proxy Means Testing: it's Official, 2017.

than in-sample testing, which was the method of calculation for the pre-review models' errors (**Annex 9**) and the 2019 models' errors.

Table 12 and 13 show the updated K-fold method generated relatively low exclusion errors, which was the primary goal in creating models which is to effectively identify and include vulnerable households, with the secondary goal of minimising erroneous inclusion.

Table 15. Inclusion Error Updated Models		
	Primary Threshold: 117,104 IQD per capita	Secondary Threshold: 66,667 IQD per capita
KRI	6.4%	24.8%
Centre-South	17.6%	41.1%
North	8.1%	20.8%

Table 16. Exclusion Error Updated Models		
	Primary Threshold: 117,104 IQD per capita	Secondary Threshold: 66,667 IQD per capita
KRI	17.5%	30.6%
Centre-South	2.4%	60.6%
North	4.9%	26.9%

The inclusion and exclusion errors for the Centre-South region at the secondary threshold are markedly higher than those in the other regions. While both of the rates (48.5% and 64.7%) can still be considered within generally acceptable ranges of PMTs, caution should be taken when implementing the secondary threshold within programmes in the Centre-South (see **Annex 5** for list of governorates). Reasons for the Centre-South model's higher error rates compared to those of the other regional models could potentially be attributed to the fact that the Centre-South samples were fewer than those in the North, and more diversified than in KR-I, both in terms of population groups covered as well as the rural/urban divide given the high number of samples in Baghdad. Furthermore, samples in Centre-South also reported higher income and expenditure per capita, on average, rendering the lower Secondary threshold less useful than in the North and KR-I models. However, it should be noted that Centre-South's model's exclusion error at the primary threshold is the lowest of all, which is ultimately the most important and positive validation given that the model should strive to eradicate exclusion error as much as possible in order to not exclude otherwise eligible households. In sum, additional consideration to the sampling of future Multi-Cluster Needs Assessments to increase the sample size and representative nature for this region would further improve future vulnerability models.

Conclusion

In summary, the vulnerability model review has led to the development of updated targeting models for Multi-Purpose Cash Assistance (MPCA) in Iraq. The Proxy-Means Test model remains

relevant and effective at identifying households in need of consumption support to meet their basic needs.

As this updated model was constructed using recent, reliable, and comprehensive data, it more accurately reflects the current context in Iraq and accounts for recent shocks, including the COVID-19 pandemic, the devaluation of the currency and other climate and conflict related shocks. In comparison to the 2019 model, the updated models were found to be more accurate predictors of consumption (as reflected by the higher r-squared values).

Once the model is finalised, the Iraq Cash Working Group will be responsible for validating the thresholds for assistance and determining the frequency of assistance for the coming years. Additionally, re-entry criteria could be determined to mitigate the risks associated with exclusion error of the model. Setting re-entry criteria would mean that households could be re-assessed using a second set of criteria, often protection-related and categorical, that can be applied on a case-by-case basis.[44]

[44] An example of exclusion re-assessment can be found from a case study in Jordan here.

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Annex 2: First Vulnerability Model (2016)

Indicator	Score
No household members working	10
Toilet shared with other relatives	9
Missing civil documents	8
Female-headed household	7
Standard house	6
Temporary job/daily labour	5
Disability OR chronic illness prevents working	4
Coping strategy index score	3/2/1

Annex 3: Second Vulnerability Model (2019)

North (R Squared = 18%)	
Variable	**Coefficient**
Forced marriage (NCS)	0.3006
Without standard dwelling/shelter	0.2304
Food from social events (NCS)	0.1748
Child labour (NCS)	0.073
Without secure water source	0.0713
Shared latrine	0.0567
Reduce non-food spending (NCS)	0.0447
Household hosting PLW	0.0392
Household size	0.0391
Head of household has difficulty working	0.0313
Spend savings (NCS)	0.0311
CSI score is 'Medium' or 'High'	0.0159
Employment rate	-0.002

KRI (R Squared = 29%)	
Variable	**Coefficient**
Food from social events (NCS)	0.1634
Child dropout from school (NCS)	0.1004
Without standard dwelling/shelter	0.0887
Household hosting PLW	0.0579
Reduce non-food spending (NCS)	0.041
Household size	0.0362
Employment rate	-0.002

Centre-South (R Squared = 37%)	
Variable	**Coefficient**
FCS category 'Poor' or 'Borderline'	0.1035
Without standard dwelling/shelter	0.1031
Without regular income	0.0553
Household size	0.0595
Employment rate	-0.002

Annex 4: Independent Variables

Demographics
Household composition • Gender of HoHH and BHA category: F&M, FNM, MNF, CNA • 'Large households' (above 6 members)
Disabilities and chronic illnesses • Head of household with disability • Head of household with disability prevented to work/self-care/attend school • Head of household with chronic illness • Head of household with chronic illness prevented to work/self-care/attend school • Household hosting person with disability
Food Intake
Food expenditure • As a share of total expenditure • Food expenditure which exceeds 50%, 65%, or 75% of total consumption
Food source
Food consumption • Food consumption score • Food consumption categories (poor, borderline, acceptable)
Lack of food
Household not eating
Hunger
Use of Negative Coping Strategies
Use of individual coping strategies: • Selling household property • Buying food on credit • Selling means of transport • Child dropout • Reduce spending on NFI • Changing place of residence • Engaging in high-risk behaviour • Child working • Family migration • Forced marriage
Severity of coping strategies used: • Number of emergencies, crisis, or stress coping strategies used • Use of at least one emergency, crisis, or stress coping strategy • Total number of coping strategies used • Coping severity
Shelter
Risk of eviction

Shelter type: • HLP document • Formal vs informal shelter • Critical shelter condition • Whether improvements to shelter are required
Access to water
Availability of water
Quality: • Quality of water source • Quality of water
Water use: HNO categorical brackets on the basis of sufficiency of access to water for diverse purposes (drinking, cooking, personal hygiene, other domestic purposes).
Latrine access
Type of latrine: • Flush vs no flush • Quality of latrine • Private vs shared latrine • Number of households latrine is shared with
Handwashing
Type of sink: • Sink with tap water • No sink with tap water
Access to soap
Children/Education
Formal school enrolment: • Primary • Intermediate • Secondary • Total
Regular school attendance: • Primary • Intermediate • Secondary • Total
Livelihoods
Dependency ratio:
Income: • Source of primary income • Amount of income from employment/pensions • Amount of income per capita • Income/expenditure ratio • Income quartiles/quintiles (one additional coefficient's value added per quart/quintile)

Debt: • Whether household has debt • Debt per capita • Reasons for taking on debt (basic needs vs other reasons)
Protection
At least one child not residing in the household: • Due to marriage • Due to seeking employment • Due to studying • Due to armed actors
Possession of documentation: • PDS card (food ration card) • ID card • Certification of nationality or unified ID
Feeling unsafe: Women
Priority needs: • Whether priority needs are material • Whether all of the household's needs are met

Annex 5: Regional Model Governorates

Centre-South	KRI	North
Babil	Dohuk	Al-Anbar
Baghdad	Erbil	Diyala
Kerbala	Al-Sulaymaniyah	Kirkuk
Al-Najaf		Ninewa
Wassit		Salah Al-Din
Maysan		
Al-Qadissiya		
Thi Qar		

Annex 6: Potential Thresholds

Potential Threshold	pccons (per-capita consumption constant, IQD) range *per capita per month*	Values	Proportion of Eligible caseload under MCNA 2021
International Poverty Markers			
International Poverty Line (USD1.90 per day per capita (2011 PPP))	56,778	1,892.60 (2012) per day	27.31%
Lower Middle Income Class Poverty Line (USD3.20 per day per capita (2011 PPP))	95,625	3,187.50 (2012) per day	58.61%
Upper Middle Income Class Poverty Line (USD5.50 per day per capita (2011 PPP))	164,355	5,478.50 (2012) per day	86.33%
National Poverty Markers (2017-2018)			
Food Poverty Line	53,300		24.88%
National Poverty Line	110,881		68.64%
National Poverty Markers (adjusted for 2021)			
Food Poverty Line	55,416	2021 until Sept	25.96%
National Poverty Line (using food+non-food CPI)	117,104	2021 until Sept	72.23%
National Poverty Line (using headline CPI)	117,821	2021 until Sept	72.28%
2019 Model Thresholds			
R1	110,000		68.62%
R2	92,000		57.53%
R3	70,000		39.85%
2019 Model Thresholds with devaluation (/1200 *1460)			
R1	133,833		79.43%
R2	111,933		68.85%
R3	85,167		52.24%
2019 Model Thresholds with inflation (+6 percentage points - CPI)			
R1	116,600		70.93%
R2	97,520		58.90%
R3	74,200		41.85%
Survival Minimum Expenditure Basket (SMEB) (2022)			

Household Basket divided by per capita - rent med	63,333.33	380,000	33.69%
Household Basket divided by per capita - rent high	66,666.67	400,000	37.87%
Food Basket SMEB (2022)			
Food Basket Poverty Line	15,206.50	91,239 per household	1.39%
Daily Wage Income			
20 USD per day 20 days	97,333	400 USD = 584,000 IQD per HH	58.82%
Proposed Thresholds			
Vulnerable/R2 (2021 IQ National Poverty Line)	70,000 - 120,000		35.26%
Highly Vulnerable/R3 (2022 SMEB)	<70000		38.51%

Annex 7: Problematic Variables Removed from Models

Variables Removed Due to Programmatically Problematic Coefficients
Debt Reason - Education
High Income Household
Difficulty Accessing Services
Shelter Issues
Latrine HNO
Eviction Risk
Debt - Essential Needs
Priority Need - Shelter
Hungry
Primary Income - Family and Friends
HLP Document
Shared Sanitation
HH Member Distressed
Handwashing - Sink/Tap
Private Latrine
Not Eating
Debt Reason - Other
Debt Per Capita
Shelter - No Improvements Necessary
Priority Need - Psychosocial
Priority Need - Sanitation
Coping - Selling Transport
Coping - Change Place
Coping - Borrow Debt
Primary Income - Renting

Primary Income - Remittances

Formal School

Dependency Ratio - Binary

Shelter Type - Good

Coping - Family Migrating

Birth Certificate - All HH Members <18

Debt Reason - Clothing

Priority Need - Food

HH Food Consumption Level

The variables below were removed prior to running the North model only. They were not found to be problematic in any other models.

Number of Crisis Coping Strategies

Primary Income - Savings

Regular/Irregular Income

Debt

Priority Need - None

Annex 8: Model Variables Explained

Regional Model Variable List	Variable explanation
Number of Household Members	Number of persons living in and reliant on the household, regardless of family ties
Highest Income Quartile	Household income fell in the highest quintile of the income distribution.
Shelter Type - Good	HNO categorisation of shelter type (good_rental and good_habitual)
Food Expenditure Share	Food expenditure divided by total household expenditure within 30 days before the interview
Coping Strategies - Child Working	Household-applied coping strategies within 30 days before the interview
Coping Strategies - Child Dropped Out of School	Household-applied coping strategies within 30 days before the interview
Primary Income - Regular Job	Primary reported (potentially multiple) sources of income within 30 days before the interview
Primary Income - Irregular Job	Primary reported (potentially multiple) sources of income within 30 days before the interview
Primary Income - Retirement	Primary reported (potentially multiple) sources of income within 30 days before the interview
Primary Income - Regular Job (private or public sector, NOT temporary or daily wage work)	Primary reported (potentially multiple) sources of income within 30 days before the interview
Priority Need - Healthcare	Household-indicated priority need (maximum 3 options) within a year of the interview
Priority Need - Livelihoods	Household-indicated priority need (maximum 3 options) within a year of the interview
Priority Need - None	Household-indicated priority need (maximum 3 options) within a year of the interview
Household Food Consumption Score (FCS) Index	Calculated FCS Index Score - Continuous Variable
Needs Met - Some	Household reports that some but not all of their priority needs were met in the past year
Needs Met - All	Household reports that all their priority needs were met in the past year
Water Quality - No Problems	Household experienced no problems related to

	water quality
Dependency Ratio	Number of working adults as a share of total number of household members
Shelter Condition	HNO categorisation of shelter condition
Decision Making	Household feels that they are able to play a role in local decision making
Nationality Certificate - Adults	Possession for all household members over 18: Nationality certificate (binary)

Annex 9: Pre-review in-sample inclusion and exclusion errors

		Threshold: 117,104 IQD per capita	Threshold: 66,667 IQD per capita
National	Model 1: Stepwise	5.2%	8.4%
	Model 2: Best Subsets	4.7%	7.4%
Regional	KRI	7.5%	15.9%
	Centre-South	39.1%	9.3%
	North	4.6%	9.2%

Annex 10: Calculated regional thresholds

Calculated Regional Thresholds		
Region	Updated Primary Threshold	Updated Secondary Threshold
KRI	107,994.84 IQD	74,571.59 IQD
Centre South	115,447.62 IQD	72,745.98 IQD
North	100,373.72 IQD	64,411.14 IQD

Annex 11: Weights

Region	Governorate	District_mcna	Population_group	Weight	N_survey	Pop
Centre-South	al.basrah	abu.al.khaseeb	host	1.622604	105	23340
Centre-South	al.basrah	al.basrah	idp_out_camp	0.13438	22	405
Centre-South	al.basrah	al.zubair	idp_out_camp	0.033324	46	210
Centre-South	al.najaf	al.kufa	idp_out_camp	0.04601	66	416
Centre-South	al.najaf	al.najaf	idp_out_camp	0.082021	110	1236
Centre-South	al.qadissiya	al.diwaniya	host	11.88445	140	166065
Centre-South	al.qadissiya	al.diwaniya	idp_out_camp	0.072996	140	380
Centre-South	babil	al.hilla	idp_out_camp	0.031967	58	254
Centre-South	babil	al.mussyab	idp_out_camp	0.18271	100	2503
Centre-South	baghdad	al.adhamiya	idp_out_camp	0.017891	51	125
Centre-South	baghdad	al.kadhmiyah	idp_out_camp	0.112341	202	1539
Centre-South	baghdad	al.kadhmiyah	returnee	0.361761	202	5055
Centre-South	baghdad	al.karkh	idp_out_camp	0.055093	95	717
Centre-South	baghdad	al.mahmoudiya	idp_out_camp	0.067687	253	1122
Centre-South	baghdad	al.mahmoudiya	returnee	0.484485	253	8761
Centre-South	baghdad	al.risafa	idp_out_camp	0.066244	40	363

Centre-South	kerbala	kerbela	idp_out_camp	0.146223	95	1903
Centre-South	maysan	al.kahla	idp_out_camp	0.041024	50	281
Centre-South	thi.qar	al.nasiriya	idp_out_camp	0.050268	44	303
Centre-South	wassit	al.kut	idp_out_camp	0.040417	95	526
KRI	al.sulaymaniyah	al.sulaymaniyah	idp_out_camp	1.103	87	13146
KRI	al.sulaymaniyah	chamchamal	idp_out_camp	0.108231	104	1542
KRI	al.sulaymaniyah	derbendikhan	idp_out_camp	0.074343	103	1049
KRI	al.sulaymaniyah	dokan	idp_out_camp	0.055558	108	822
KRI	al.sulaymaniyah	halabcha	idp_out_camp	0.046114	104	657
KRI	al.sulaymaniyah	kalar	idp_out_camp	0.151364	106	2198
KRI	al.sulaymaniyah	rania	idp_out_camp	0.045753	56	351
KRI	duhok	al.amadiya	idp_out_camp	0.017573	81	195
KRI	duhok	duhok	idp_out_camp	0.319793	105	4600
KRI	duhok	sumail	idp_out_camp	0.700947	120	11523
KRI	duhok	zakho	idp_out_camp	0.502593	108	7436
KRI	erbil	erbil	idp_out_camp	2.260212	101	31273
KRI	erbil	koysinjaq	idp_out_camp	0.029259	120	481
KRI	erbil	makhmour	returnee	0.251722	95	3276
KRI	erbil	rawanduz	idp_out_camp	0.033298	73	333

KRI	erbil	shaqlawa	idp_out_camp	0.050224	117	805
North	al.anbar	al.falluja	host	1.080581	310	13767
North	al.anbar	al.falluja	idp_out_camp	0.160275	310	2525
North	al.anbar	al.falluja	returnee	6.2341	310	87111
North	al.anbar	al.kaim	idp_out_camp	0.029862	214	270
North	al.anbar	al.kaim	returnee	0.818693	214	16599
North	al.anbar	al.ramadi	idp_out_camp	0.067324	247	1365
North	al.anbar	al.ramadi	returnee	7.659452	247	103880
North	al.anbar	al.rutba	idp_out_camp	0.025715	301	465
North	al.anbar	al.rutba	returnee	0.198602	301	4598
North	al.anbar	ana	idp_out_camp	0.033536	168	317
North	al.anbar	ana	returnee	0.398235	168	5401
North	al.anbar	haditha	returnee	0.34947	96	4596
North	al.anbar	heet	idp_out_camp	0.025549	157	210
North	al.anbar	heet	returnee	2.254382	157	29957
North	diyala	al.khalis	idp_out_camp	0.05056	204	658
North	diyala	al.khalis	returnee	0.900132	204	13441
North	diyala	al.muqdadiya	returnee	0.567002	114	8855
North	diyala	baquba	idp_out_camp	0.231178	106	3357

North	diyala	khanaqin	idp_out_camp	0.155213	185	2020
North	diyala	khanaqin	returnee	1.372331	185	16920
North	diyala	kifri	idp_out_camp	0.137167	170	2067
North	diyala	kifri	returnee	0.028955	170	238
North	kirkuk	al.hawiga	returnee	1.857825	106	26978
North	kirkuk	daquq	idp_out_camp	0.040314	243	729
North	kirkuk	daquq	returnee	0.067998	243	1034
North	kirkuk	dibis	idp_out_camp	0.027688	206	330
North	kirkuk	dibis	returnee	0.073978	206	1206
North	kirkuk	kirkuk	idp_out_camp	0.824384	272	13891
North	kirkuk	kirkuk	returnee	1.328778	272	27123
North	ninewa	al.baaj	idp_out_camp	0.063367	246	1224
North	ninewa	al.baaj	returnee	0.596276	246	8577
North	ninewa	al.hamdaniya	idp_out_camp	0.223513	275	4348
North	ninewa	al.hamdaniya	returnee	1.679684	275	30604
North	ninewa	al.hatra	idp_out_camp	0.052577	179	533
North	ninewa	al.hatra	returnee	0.558457	179	8033
North	ninewa	al.mosul	host	8.095038	329	159691
North	ninewa	al.mosul	idp_out_camp	1.13298	329	14745

North	ninewa	al.mosul	returnee	13.94716	329	171960
North	ninewa	al.shikhan	idp_out_camp	0.167539	208	3328
North	ninewa	al.shikhan	returnee	0.037309	208	322
North	ninewa	aqra	idp_out_camp	0.126916	225	3912
North	ninewa	sinjar	idp_out_camp	0.376586	212	6036
North	ninewa	sinjar	returnee	1.538225	212	20019
North	ninewa	telafar	idp_out_camp	0.084545	230	1552
North	ninewa	telafar	returnee	4.516875	230	59403
North	ninewa	tilkaef	idp_out_camp	0.159024	231	2941
North	ninewa	tilkaef	returnee	1.618389	231	21284
North	salah.al.din	al.daur	returnee	0.585882	126	10113
North	salah.al.din	al.shirqat	returnee	1.706362	100	23376
North	salah.al.din	balad	idp_out_camp	0.084238	208	1154
North	salah.al.din	balad	returnee	0.92266	208	13651
North	salah.al.din	beygee	returnee	1.72486	102	24102
North	salah.al.din	samarra	idp_out_camp	0.160706	284	2818
North	salah.al.din	samarra	returnee	0.357027	284	7630
North	salah.al.din	tikrit	idp_out_camp	0.176314	205	2512
North	salah.al.din	tikrit	returnee	2.134383	205	29532

North	salah.al.din	tooz.khurmato	idp_out_camp	0.166432	297	3534
North	salah.al.din	tooz.khurmato	returnee	0.462293	297	8993