General Information

Fund	MPTF_00249: Complex Risk Analytics Fund (CRAF'd)
FMP Record	MPTF_00249_00009: CLIFDEW-GRID: Early Warning Grid-Based Risk Modelling of Climate Induced Forced Displacement
MPTFO Project Id	
Start Date	
End Date	

Applicants

Status	Contact Type	Name	e-mail	Position	Telephone	Skype
Active: 21-Feb-2023 5:08:00 AM	Project Manager	Andrea Pellandra	pellandr@unhcr.org			

Signatories

Signature Process	Role	Name of Organization	Name	User Email
Manual	Signatory	UNHCR: UNHCR (United Nations High Commissioner for Refugees)	Andrea Pellandra	pellandr@unhcr.org

Contacts

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Description

Motivation for the project

The issue of forced displacement is a pressing global challenge that has become increasingly complex in recent years. The number of forcibly displaced persons worldwide has surpassed 100 million, which includes refugees, asylum-seekers, and internally displaced persons. Moreover, slow-onset climate hazards, such as drought, sea-level rise, and other weather-related disasters, have become more frequent and intense due to climate change, leading to a rise in climate-induced displacement. By 2050, it is predicted that slow-onset climate hazards will displace another 230 million people.

In recent years, there has been growing recognition within the humanitarian sector of the need for data-driven anticipatory action. This approach involves using data and analytics to identify and anticipate displacement risks before they occur, allowing humanitarian agencies to respond more effectively and efficiently to crises. With the increasing availability of data and technological advancements in remote sensing, data-driven anticipatory action is becoming an increasingly important tool in the humanitarian toolkit.

Scope of the project

To address the issue of slow-onset climate-induced displacement, this project focuses on a grid-level approach that allows for evaluating data at the subnational level. This approach considers the variation in a country's population density, topology, microclimates, and ecosystems, allowing for more accurate predictions of displacement risks from climate change. By combining UNHCR's detailed registration data on forcibly displaced populations with grid-level-based data from remote sensing, organic data sources, and traditional country-based data sources, the project aims to develop a risk index of displacement with a predictive horizon of 6-12 months.

The project's focus on the regions of West and East Africa (covering all countries except Liberia and Equatorial Guinea, where UNHCR does not collect registration data for forcibly displaced populations) as a case study is significant because these regions are particularly vulnerable to slow-onset climate hazards (SDG indicator 13.b.1). Moreover, these regions have a history of conflict and instability, which can exacerbate the impacts of displacement. By developing a risk index of displacement, the project aims to provide early warning of displacement risks, allowing humanitarian agencies to plan and respond proactively to crises (SDG indicator 13.3.1). This approach could increase the efficiency and timeliness of operations, enabling humanitarian help to reach a broader range of people in need (SDG indicators 17.16.1 and 17.3.1).

In summary, the issue of forced displacement is a complex global challenge, which is only likely to increase in the coming years due to slow-onset climate hazards. The humanitarian sector's increasing focus on data-driven anticipatory action represents a significant step forward in addressing this challenge. This project's grid-level approach to predicting displacement risks is a promising example of how data and analytics can be used to respond proactively to crises, enabling humanitarian help to reach more people in need. By developing a risk index of displacement, this project aims to provide early warning of displacement risks, allowing humanitarian agencies to plan and respond more effectively to crises in West and East Africa.

Universal Markers

Gender Equality Marker	Risk
• GEM1 - The Key Activity contributes to GEWE in a limited way	• Low Risk

Optional Markers

Fragile Context	• Yes

Fund Specific Markers

Funding Window / Direct Cost	**Funding Windows** • Window B: Analytics that drive critical insights for crisis anticipation, prevention, and response.
Call for Proposals / Round	**2022** • Second Call for Proposals 2022 (Analytics and AI on Climate Fragility Risks)

Geographical Scope	**Geographical Scope**	**Name of the Region**		**Region(s)**	**Country**
	• Regional	• East and West-Africa (all countries except for Liberia and Equatorial Guinea, where UNHCR does not collect registration data for forcibly displaced populations)		• Africa	
Participating Organizations and their Implementing Partners	**Participating Organizations**	**Government/ Multilateral/ NGO/ Other**	**New Entities**	**Implementing Partners**	
	• UNHCR - UNHCR (United Nations High Commissioner for Refugees)			Department of Earth System Science, University of California Irvine	
Programme and Project Cost	**Participating Organization**	**Amount (in USD)**	**Comments**		
	Budget Requested				
	UNHCR	$500,071	First tranche: July 2023, Second tranche: July 2024, Milestone achieved for second tranche: Completion of Window A: Datasets		
	Total Budget Requested	**$500,071**			
	Tranches				
	Tranche 1 (50%)		Tranche 2 (50%)		
	UNHCR: Total:	$250,036 $250,036	UNHCR: Total:	$250,036 $250,036	
	Other Sources (Parallel Funding)				
	UNHCR	$80,000	Additional staff contribution: P4 Chief Data Scientist ~ 10% towards project, P3 Data Scientist ~ 10% towards project, P2 Assistant Data Scientist ~ 10% towards project.		
	Total	**$580,071**			
Thematic Keywords					
Programme Duration	**Anticipated Start Date**	01-Aug-2023			
	Duration (In months)	24			
	Anticipated End Date	01-Aug-2025			

Narratives

Title	Text

Executive Summary	The focus on data-driven anticipatory action is increasingly gaining relevance due to the growing number of forcibly displaced persons and the predicted displacement of an additional 230 million people by slow-onset climate hazards by 2050, as published in the latest Groundswell report. With this in mind, humanitarian agencies are looking to increase the efficiency and timeliness of their operations to reach persons of concern faster and more targeted. Using data to predict displacement risks, agencies can plan more targeted, timely, and effective interventions. To support anticipatory action within the area of climate change induced forced displacement, the proposed project aims to develop a risk index for forced displacement due to slow-onset climate hazards, using West and East African regions (covering all countries except Liberia and Equatorial Guinea, where UNHCR does not collect registration data for forcibly displaced populations) as case studies. The project's focus on West and East Africa as a case study is particularly relevant given the high levels of displacement in these regions. Climate change is expected to exacerbate these communities' challenges, particularly those in areas with high poverty levels and limited access to resources. By developing a risk index for displacement, the project aims to provide UNHCR and other humanitarian agencies and stakeholders with a valuable tool for anticipatory action. The proposed risk index will be developed by combining data from UNHCR's detailed registration data on forcibly displaced populations, remote sensing data, other organic data sources (e.g., social media and Google Trends), and traditional country-based data sources. Using a grid-level approach at the sub-national level, the project will be able to accommodate the variation in a country's population density, topology, microclimates, and ecosystems better than traditional country-based analyses could. The use of remote sensing data is a particularly valuable tool for predicting displacement risks from slow-onset climate hazards. Remote sensing data can provide information on environmental changes that may lead to displacement, such as changes in precipitation patterns, temperature, vegetation, land use change, and soil moisture. By combining these data with socio-demographic and other environmental variables, agencies can better understand which populations are most vulnerable to displacement and can plan interventions accordingly. In addition to providing a valuable predictive tool for humanitarian agencies, the project also has broader implications for understanding the relationship between climate change and displacement. As climate change continues to accelerate, the number of people displaced by slow-onset climate hazards will likely continue to increase. By better understanding the factors contributing to displacement, agencies can better prepare for and mitigate the impacts of climate change. Overall, the project's focus on a sub-national grid-level approach to predict displacement risks from slow-onset climate hazards is an essential step towards increasing the efficiency and effectiveness of humanitarian interventions. By combining data from a range of sources, the project aims to provide a more detailed and nuanced understanding of the factors that contribute to displacement, which will help agencies to better plan and respond to climate-induced humanitarian crises.

Background and General Relevance	Slow onset hazards brought about by the rapidly warming climate are becoming a major driver of forced displacement in the world, and by 2050 are expected to add an additional 230M people to the over 100M people currently forcibly displaced in the world. The impact of climate change on forced displacement is a complex issue that requires a comprehensive and collaborative approach to address. The challenge is not just about predicting and mitigating the effects of slow-onset hazards but also about understanding the underlying factors that contribute to climate-induced forced displacement. Climate change can exacerbate poverty in rural and urban households and can compromise food security. The resulting resource scarcity can lead to local conflicts and unrest and affect the political stability of a region or country. Climate change has, therefore, the potential to, directly and indirectly, contribute to forced displacement, which probably makes it the most potent catalyst for future displacement. The scope of the challenge is vast, as climate change is a global phenomenon that affects every country and region differently. In low-lying coastal areas, salination from rising sea levels poses a significant threat to the freshwater supply and local food supply of coastal communities, while in arid regions, droughts, desertification, heat waves, and severe changes in precipitation can make it impossible for people relying on rain-fed agriculture to sustain themselves through farming or herding. The populations most affected by slow-onset hazards are often those living in poverty or in areas with limited access to resources and a robust infrastructure. Rural communities in low-income countries, for example, are particularly vulnerable to the effects of climate change, as they rely heavily on natural resources for their livelihoods and are at risk of being cut off from local food markets and trader's networks. Urban populations are also at risk, as they face shortages of food, water, and other resources due to disturbances in supply chains and rising food prices, which can lead to civil unrest. The urgency of the challenge is heightened by the fact that slow-onset hazards are already affecting millions of people worldwide, and the trend is expected to worsen in the coming decades. Given this situation, UNHCR and other humanitarian agencies are increasingly focused on data-driven anticipatory action to increase the efficiency and timeliness of their operations and reach persons of concern faster and in a more targeted fashion. The implications of a massive displacement flow raise the question of whether it can be reliably predicted and which variables primarily drive it. UNHCR is already developing an early warning model for forecasting conflict-driven forced displacement events at the national level to determine what predictors are associated with future displacement and to produce an index of the risk of displacement based on the probability the model assigns to these events. However, the link between climate change and forced displacement is complex and hard to measure, often mediated by the impact of climate change on poverty, political instability, and armed conflict. Empirical studies show that many of the triggers of forced displacement are better captured at the subnational – ideally grid – level, as this allows a more differentiated picture of variables that often are geographically confined to smaller areas and interact with varying local climates and environments. This aspect might especially hold for some indirect effects of climate hazards, like an increased likelihood of conflicts between locally confined groups and political instability due to resource shortages. The effect of temperature increases will also impact urban populations much differently from rural populations and will affect rural populations in flat, low planes consisting of farmers and herders more than in elevated and mountainous regions with rich vegetation and low population density. The key stakeholders in addressing the challenge of climate-induced forced migration include governments, NGOs, international organizations, and civil society groups. These actors must work together to develop and implement strategies that support those affected by slow-onset hazards in situations where an in-situ approach is no longer viable. Data-driven anticipatory action is critical in this effort, as it can help identify populations at risk and enable humanitarian agencies to respond quickly and efficiently. Such anticipatory action should prioritize vulnerable groups, such as women, children, the elderly, and people with disabilities, who are often disproportionately affected by climate change and are the most likely groups that are at risk of ending locked down in an untenable and worsening environment.

Theory of Change	**IF** UNHCR, in partnership with UCI, develops an easily accessible risk indicator for climate-change-induced forced displacement **THROUGH** (1.1) collecting a comprehensive data set based on remote sensing, organic data, UNHCR's registration data, and other data sources, (1.2) developing and training a machine learning classification model to quantify the risk of climate-change-induced forced displacement, and (1.3) providing a well-designed and easily accessible dashboard for stakeholder; **THEN** this will provide a tool to move risk assessment from a purely qualitative process to a quantitatively supported process and additionally include climate change as a trigger of forced displacement with growing importance, **AND IF** UNHCR disseminates predictive results and methodologies with relevant stakeholders **THROUGH** (2.1) in-person workshops in the case regions, (2.2) larger online training sessions and participation in conferences to disseminate the findings and technical aspects of the work, and (2.3) reports and research articles **THEN** this information can be made available to all interested and relevant stakeholders and can potentially induce further early warning tools and the refinement of the tool itself; **THEN** planners in humanitarian organisations, NGOs and governmental institutions will be supported by a solid quantitative tool to plan anticipatory action. Overall, the impact would **THEN** be a more efficient, targeted, and speedier response to imminent displacement situations that will affect the most vulnerable parts of affected populations. In the face of a worsening displacement crisis, this means that funds will reach farther and can generate more impact. The logical sequence of events that are expected to occur as a result of this project is as follows: Step 1: Gathering Data The first step in the project involves gathering data from multiple sources. This includes UNHCR's geographically and socio-demographically detailed registration data on forcibly displaced populations, expert knowledge from field colleagues and partner organisations, grid-level based data from remote sensing and other organic data sources, and traditional country-based data sources. This step assumes that the data gathered will be of sufficient quality and quantity to allow for developing a sub-national predictive risk model. Step 2: Develop the Predictive Risk Model The second step involves developing the sub-national predictive risk model of climate-induced displacement using a grid-level approach. This step will involve combining the data gathered in Step 1 and utilizing quantitative methods from machine learning to develop the model. This step assumes that the model will accurately predict displacement risks from slow-onset climate hazards, considering variations in population density, topology, microclimates, and ecosystems. Step 3: Testing the Predictive Risk Model The third step involves testing the sub-national predictive risk model using actual data from previous periods. This step will involve comparing the predicted risks from the model with the actual displacement events that occurred in the same period. This step assumes that the model will accurately predict displacement risks from slow-onset climate hazards and perform well when tested against actual data. Step 4: Applying the Predictive Risk Model The fourth step involves applying the sub-national predictive risk model to support planning work at UNHCR and other organizations. This step will use the model to assess the risks connected with slow-onset climate events and their consequences and provide a quantitative basis to a usually more qualitative process by providing an interactive Shiny dashboard. This step will also test the dashboard's design with stakeholders until all relevant information is conveyed in a practical and easily accessible way. This step assumes that the model will support planning work and provide a stronger foundation for anticipatory action. Step 5: Incorporating the Predictive Risk Model into UNHCR's Planning Work The final step involves incorporating the sub-national predictive risk model into UNHCR's planning work. This step will involve using the model to fully incorporate slow-onset climate events and their consequences into UNHCR's planning work. Additionally, protocols will be installed together with data protection officers to share the results with partner agencies and organisations. The assumption underlying this step is that the model will effectively incorporate slow-onset climate events and their consequences into UNHCR's planning work. This step will include training workshops and dissemination activities.

Methodology	The central element in the data collection is data on the climate and ecosystem, which will be obtained from satellites. Satellites provide near-real-time observations at regular frequencies and fine spatial resolutions. E.g., satellites remotely measure vegetation properties, like greenness, at a 250-m spatial resolution across the globe every 16 days. These measurements of vegetation are frequently leveraged to forecast sub-national agricultural outcomes and food security metrics. In addition to indices of vegetation health, other relevant remotely sensed variables will be input in the model, including precipitation, surface water extent, and soil moisture, which relate to drought conditions and floods, as well as land surface temperature, which relates to human heat stress. We will select remotely sensed input data based on ground truthing efforts specific to East and West Africa. Some remotely sensed observations have been extensively evaluated in previous studies (e.g. precipitation), while others will require further evaluation (e.g. soil moisture). We will leverage available in situ observations (e.g. the International Soil Moisture Network) to quantify the uncertainties in remotely sensed observations when needed. However, since in situ observations are sparse in this region, additional efforts will be directed towards exploring the relationships between different remotely sensed variables to gain a deeper understanding of the input data. Furthermore, the predictive power of remotely sensed observations from different platforms measuring similar land surface characteristics will be assessed during model development and validation. These variables will be combined with UNHCR's registration data, organic data sources that capture sentiments and developments on the ground, conflict data, and other sub-national and national data that reflect other environmental variables, e.g., economic well-being and political variables, to form the quantitative base of the modelling work. The risk index is based on a classification model that returns the probability of a country, a region, or a grid cell producing significant displacement flows within the next 6-12 months at a monthly frequency. The definition of a significant displacement flow depends on the geographic unit and might vary depending on the population density of the geographic unit. Further input on this point will come from field colleagues until a satisfactory threshold is defined for each cell. We will test multiple machine learning algorithms, e.g., random forests, gradient boosting, XG boosting, neural networks, and ensemble techniques such as stacking to find the models with the best predictive quality. Depending on our ability to temporarily and spatially align the different data sets, we might have to focus on models that can accommodate different frequencies and granularity levels across the variables, e.g., hierarchal Bayesian models. Depending on the predictive quality of the models, several submodels might be needed to accommodate variations across the regions, rural-urban differences, and direct and indirect effects of climate-related factors on forced displacement. Models will be trained with lagged variables to remove the need to predict the feature variables. The optimal lags will be tested for each feature variable and might vary depending on the long or short-term impact of the respective feature. For variables with very immediate effects, such as conflict, we will rely on predicted conflict variables, e.g., PRIO's iViews project or the Conflict Forecast project. Models will be validated first through classical model training based on historical data. As the historical data will come in longitudinal form, training and testing data must consider the chronological structure of the data. We will use rolling windows over the entirety of the historical data. The model will be trained using k-fold cross-validation, where the number of folds will depend on the size of the training data set. Secondly, model results will be validated by testing the model on new data acquired during the project's duration to create authentic out-of-sample predictions. A specific emphasis will be laid on the detection of new situations. Metrics to be used will be: • accuracy • AUC-ROC • F1 • and others, depending on the distribution of the classes We consider it important to use metrics that measure both type 1 and 2 classification errors. We consider a 6-12 months predictive horizon to be sufficiently short to ensure high accuracy of the model predictions whilst still providing a relevant planning horizon. In quickly evolving situations, a longer predictive horizon will result in more uncertainty regarding the predictive results. However, the monthly updates of the risk index will quickly pick up on fast-evolving trends and correct eventual deviations from earlier releases of the index.

Alignment with and Commitment to CRAF'd Principles	The proposed project aligns with and is committed to the CRAF'd principles in the following ways: 1. The 2030 Agenda for Sustainable Development makes an ambitious commitment to "leave no one behind" in its implementation. To ensure that this commitment is effectively met, several vulnerable population groups are identified for attention in the Agenda including migrants, refugees, and other forcibly displaced persons (FDPs). Additionally, the New York Declaration for Refugees and Migrants, the Comprehensive Refugee Response Framework (CRRF) and the Global Compact on Refugees (GCR) established a solid international commitment to supporting FDPs and the countries where they reside. Such commitment includes making forcibly displaced persons visible in the 2030 Agenda by enhancing the availability of better data and evidence. The project's primary aim is to develop a risk index for forced displacement due to slow-onset climate hazards, with a focus on West and East African regions as case studies, which directly aligns with the goal of prioritizing the interests of populations in vulnerable situations and leaving no one behind in the pursuit of the 2030 Agenda. Additionally, the project aims to increase the efficiency and timeliness of humanitarian operations by providing a valuable tool for anticipatory action, which can only be achieved with strong engagement and partnerships across a number of stakeholders, which will be greatly enhanced working under the umbrella of CRAF'd data ecosystem. 2. The project aims to use data responsibly by combining data from a range of sources, including UNHCR's detailed registration data on forcibly displaced populations, remote sensing data, and other organic data sources. The project will ensure transparency and fairness by using a grid-level approach at the sub-national level, which accommodates the variation in population density, topology, microclimates, and ecosystems. Additionally, the project will adhere to privacy principles by ensuring that personal data is anonymized and/or aggregated before being shared. UNHCR will, under the guidance of its data protection officers, develop a protocol on data sensitivity and data sharing with external partners to ensure that sensitive data will be handled with the utmost care. All sensitive data will be handled with the same security standards as UNHCR's other operational data, and requests for sharing any such data by reputable institutions will be considered after a careful comparison of benefits and risks, and only following the signature of a formal data sharing agreement. 3. Where possible, the project will provide open access to its outputs funded by CRAF'd using interoperable and open data standards. UNHCR already disseminates data openly and responsibly through a number of platforms, including the Refugee Data Finder and the Microdata Library, using international, interoperable open data standards, and a similar platform will be created to disseminate the project's outputs and integrated with the existing ones. This aligns with CRAF'd principle of providing open access to outputs to ensure that the information is available to all stakeholders who may need it. In order to minimize the risk that a third party may intentionally or unintentionally use the data differently from their legitimate purpose, individuals and organisations will have to agree on and consent to specifically established terms for data sharing and data re-use, including the purposes for which the data should be re-used. 4. The project's approach to data collection and collation, which includes using a range of sources, including UNHCR's own registration data, remote sensing data, and other organic data sources, is designed to not exclusively rely on financial support from CRAF'd, as many of these data are either proprietary to UNHCR or can be obtained through existing agreements, partnerships of licenses. By using a range of data sources, the project aims to create a sustainable approach to data collection and analysis that can be maintained beyond the project's life. Additionally, the UNHCR team is working in two directions to complement possible CRAF'd funding for the project: applying to other external sources of funding, and - in line with a model previously followed for similar projects - incorporating these activities in the UNHCR long term planning, to ensure they are mainstreamed post-2025.
CRAF'd Data Ecosystem Impact & Use Cases	The proposed project on developing a risk index for forced displacement due to slow-onset climate hazards in West and East African regions has several multiplier effects and creates synergies across the CRAF'd data ecosystem. The project's main aim is to provide a valuable tool for anticipatory action to humanitarian agencies and stakeholders to predict displacement risks more accurately, and plan a more targeted, timely, and effective intervention and response for persons of concern. The outputs of the project will have several intended use cases, including but not limited to the following: 1. Humanitarian agencies such as UNHCR will use the risk index to predict displacement risks, understand which populations are most vulnerable to displacement, and plan interventions accordingly. This tool will provide a more detailed and nuanced understanding of the factors that contribute to displacement and allow agencies to better prepare for and mitigate the impacts of climate change. It can be envisaged that the risk index could a key component feeding into one of the risk areas of the multidimensional risk used in the UN Operations and Crisis Center (UNOCC)'s Horizon Scan contributing to the Regional Monthly Review (RER) to improve situational awareness and frame the UNSG prevention agenda. The risk index could also feed into the Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness, and be used on an a case-by-case basis by field operations and other humanitarian UN agencies such as WFP and OCHA. 2. Governments and policymakers can use the risk index to develop policies that address displacement risks from slow-onset climate hazards. By better understanding the factors contributing to displacement, policymakers can create more effective strategies to mitigate the risks of displacement and ensure better adaptation. 3. Researchers and academics can use the risk index to study the relationship between climate change and displacement. The project's focus on sub-national grid-level approach to predict displacement risks from slow-onset climate hazards will provide valuable insights into the complex relationship between climate change and displacement. All these use cases are hypothetical and intended for future implementation. The project's outputs will add value to existing work in the same field by providing a more detailed and nuanced understanding of the factors that contribute to displacement from slow-onset climate hazards. The use of remote sensing data, socio-demographic data, and other environmental variables in the development of the risk index will ensure that agencies have a more accurate understanding of the risks of displacement. The sub-national grid-level approach will provide a more detailed and nuanced understanding of the factors that contribute to displacement in specific areas, allowing agencies to plan interventions more effectively. Overall, we are confident that the project will result in improved crisis response through enhanced decision-making, programming, and resource allocation. Furthermore, the synergies that will be created with key players in the area of climate crisis anticipation, prevention and response will allow us to significantly strengthen the CRAF'd data ecosystem.

Sustainability	This product will be situated at UNHCR HQ in Copenhagen and, with the support of field colleagues, will be maintained by the Statistics and Demographics section of UNHCR's Global Data Service. As the primary data source of the product is UNHCR's registration data, there is a low risk that the product cannot be sustained over a more extended period. Additionally, UNHCR has access to large quantities of remote sensing imagery and an in-house capacity to extract relevant information from these images. This means that climate variables from remote sensing can be derived in-house after project completion. Maintenance will focus on regularly updating data material, retraining the models the risk index is based on and updating and improving the dashboard. All capacities for the maintenance tasks are available in-house. It is planned to provide monthly updates on the product after project completion.
Scalability	The project will be started using grid-level areas (e.g., from PRIO-GRID) over large regions of West and East Africa. As the model relies heavily on remote sensing imagery, bottlenecks concerning scalability will mainly occur due to the roll-out of UNHCR's newest registration system (ProGres v4), which gives access to detailed micro-level data on forcibly displaced populations. As UNHCR constantly expands the usage of the ProGres v4 system, the risk index will be expanded geographically in tact with the ProGres v4 system. This means that the large areas of the global south, i.e., the least climate-resilient areas, will be covered by this risk index over time.
Innovation	The innovative aspect of this project lies in its unique way of combining novel data sources, like remote sensing imagery for environmental and economic variables and organic data sources for tracking human sentiments and decision-making during a crisis, with a grid-level approach that allows accommodating the variability in those variables across a country or region at a much higher granularity level than what would be possible with conventional country-based statistics. Combining these factors with modern machine-learning methods will create an empirically based predictive model of climate-induced forced displacement for short-range predictions at a very local level, which will give more precise information about some of the demographic aspects of the concerned population than what can be achieved by conventional approaches at the national level. To the best of our knowledge, no such predictive model exists to date. The knowledge generated through this project will additionally shed more light on the complex nexus between climate change and its direct and indirect influence on forced displacement. Although the project's primary goal is the derivation of short-range predictions with a predictive horizon of 6 -12 months, it will also contribute to detecting patterns in the data that can help explain some aspects of the climate-displacement nexus.
Cost Effectiveness	The project's work will be conducted by using UNHCR internal data and freely available data from remote sensing imagery, and other freely accessible databases (World bank database, PRIO Grid, and others). Where remote sensing data is not freely available, the project will to the extent possible use data sources that are already available in-house. The project will be conducted using cost-free open-source statistical software, as well as, using existing in-house solutions for the dashboard and in-house infrastructure. UNHCR and UCI will ensure that staff working on the project returns the highest value for the project and will run an effective project management system to ensure the timely completion of the work.

SDG Targets

Target	Description
No data available.	

SDG Indicators

Indicator Code	Description
C130301	13.3.1 Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula
C130b01	13.b.1 Number of least developed countries and small island developing States that are receiving specialized support, and amount of support, including finance, technology and capacity-building, for mechanisms for raising capacities for effective climate c
C171401	17.14.1 Number of countries with mechanisms in place to enhance policy coherence of sustainable development
C171601	17.16.1 Number of countries reporting progress in multi-stakeholder development effectiveness monitoring frameworks that support the achievement of the sustainable development goals
C170301	17.3.1 Foreign direct investment (FDI), official development assistance and South-South cooperation as a proportion of total domestic budget

Contribution to SDGs

Participating Organization	% TARGET_13.b	% TARGET_13.3	% TARGET_17.14	% TARGET_17.3	% TARGET_17.16	% Total
UNHCR	40	15	15	20	10	100
Total contribution by target	**40**	**15**	**15**	**20**	**10**	

Project contribution to SDG by target	**40**	**15**	**15**	**20**	**10**	**100**

List of documents

Document	Document Type	Document Source	Document Abstract	Document Date	Classification	Featured	Status	Modified By	Modified On
No data available.									

Project Results

Outcome	Output	Description
No outcomes available.		

Signature Indicators

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
No signature indicators available.												

Imported Fund Outcome / Output Indicators

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
People in fragile and crisis-affected settings benefitting from earlier, faster, more targeted and dignified assistance as a result of project outputs.		This indicator aims to measure the extent to which the project outputs have contributed to supporting people in fragile and crisis-affected settings earlier, faster, and in a more targeted and dignified way.	Surveys, reports, other documents, assessments, statistics etc.	Beneficiaries	Yearly	Global	Number	0	2023	TBD	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.1 In-person workshops
Stakeholders that use project outputs to support crisis action.		This indicator aims to measure the extent to which entities use project outputs for crisis action, including for programming, decision-making, and resource allocation.	Surveys, interviews, analysis of public policy documents/emergency response plans/reports, other documents.	Capacity	Yearly	Global	Number	0	2023	37	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.1 In-person workshops
	Stakeholders that use project outputs for crisis anticipation,	This indicator aims to measure the extent to which the project outputs are used by entities specifically for crisis anticipation, including for programming, decision-making, and resource allocation.	Surveys, interviews, analysis of public policy documents/emergency response plans/reports, other documents.	Capacity	Yearly	Global	Number	0	2023	37	2025	

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
Multilateral funding instruments and other entities that use project outputs to facilitate funding decisions.		This indicator aims to measure the extent to which the project results are used by multilateral funding instruments and other entities to inform funding decisions. The indicator focuses on the use of project outputs, such as data, evidence, and analysis, to support the decision-making processes of funding instruments and other entities involved in crisis action.	Surveys, interviews, analysis of public policy documents/emergency response plans/reports, other documents.	Investment	Yearly	Global	Number	0	2023	37	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.3 Dashboard for risk index
Funding allocated for crisis action with the support of project outputs.		This indicator aims to measure the extent to which the project outputs are used to facilitate funding decisions related to crisis action. The indicator focuses on the amount of funding allocated to crisis action that can be directly / indirectly attributed to the use of project outputs, such as data, evidence, and analysis, in decision-making processes.	Surveys, interviews, analysis of public policy documents/emergency response plans/reports, other documents.	Investment	Yearly	Global	Number	0	2023	TBD	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.3 Dashboard for risk index
	Funding allocated for crisis action specifically in fragile settings.	This sub-indicator aims to measure the extent to which the project outputs are used to facilitate funding decisions related to crisis action specifically in fragile contexts. The indicator focuses on the amount of funding allocated to crisis action that can be directly / indirectly attributed to the use of project outputs, such as data, evidence, and analysis, in decision-making processes.	Surveys, interviews, analysis of public policy documents/emergency response plans/reports, other documents.	Investment	Yearly	Global	Number	0	2023	32	2025	

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
Project partners involved in the implementation of the project.		This indicator aims to measure the number project partners ('participating organizations' and 'implementing partners') involved in the implementation of the project.	Internal tracking.	Capacity	Yearly	Global	Number	1	2023	1	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.1 Datasets
Datasets provided by the project.		This indicator aims to measure the provision and dissemination of datasets by the project to stakeholders.	Internal tracking.	Capacity	Yearly	Global	Number	0	2023	1	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.1 Datasets
	Datasets provided with granularity at the sub-national level or below (spatial resolution).		Internal tracking.	Capacity	Yearly	Global	Number	0	2023	1	2025	
	Datasets provided with at least monthly granularity, (temporal resolution).		Internal tracking.	Capacity	Yearly	Global	Number	0	2023	1	2025	
	Datasets provided in non-proprietary formats,	E.g., csv, json, xml, txt, sql (not dta, spss or similar proprietary file formats).	Internal tracking.	Capacity	Yearly	Global	Number	0	2023	1	2025	

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
Analytics products provided by the project.		This indicator aims to measure the provision and dissemination of analytics products by the project to stakeholders.	Internal tracking.	Capacity	Yearly	Global	Number	2023	0	1	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.2 Risk Model
	Analytics products that are leveraged for action frameworks, including for anticipatory action.	This sub-indicator aims to measure the provision of analytics products that are action frameworks or part thereof (linking analysis to policy / programming recommendations).	Surveys, interviews, analysis of public policy documents/emergency response plans/reports, other documents.	Capacity	Yearly	Global	Number	2023	0	1	2025	
	Analytics products provided with open source code.		Internal tracking.	Capacity	Yearly	Global	Number	2023	0	1	2025	
Knowledge and capacity building Initiatives conducted as part of the project.		This indicator aims to measure the provision of knowledge and capacity building initiatives by the project to stakeholders. The indicator reflects the extent to which the project has supported the development of skills, knowledge, and expertise related to the project's goals and objectives.	Internal tracking.	Beneficiaries	Yearly	Global	Number	0	2023	4	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.1 In-person workshops
Participants in knowledge and capacity initiatives as part of this project.		This indicator aims to measure the number of individuals who have participated in knowledge and capacity building initiatives provided by the project. The indicator reflects the extent to which the project has engaged stakeholders in the development of skills, knowledge, and expertise related to the project's goals and objectives.	Surveys, registration statistics.	Beneficiaries	Yearly	Global	Number	0	2023	200	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.1 In-person workshops

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
	Non-male participants in knowledge and capacity initiatives as part of this project.	This sub-indicator aims to measure the number of non-male individuals who have participated in knowledge and capacity building initiatives provided by the project.	Surveys, registration statistics.	Beneficiaries	Yearly	Global	Number	0	2023	TBD	2025	
	Participants from fragile and crisis-affected settings in knowledge and capacity initiatives as part of this project.	This sub-indicator aims to measure the number of individuals from fragile and crisis affected settings who have participated in knowledge and capacity building initiatives provided by the project.	Surveys, registration statistics.	Beneficiaries	Yearly	Global	Number	0	2023	TBD	2025	
	Non-male participants from fragile and crisis-affected settings in knowledge and capacity initiatives as part of this project.	This sub-indicator aims to measure the number of non-male individuals from fragile and crisis affected settings who have participated in knowledge and capacity building initiatives provided by the project.	Surveys, registration statistics.	Beneficiaries	Yearly	Global	Number	0	2023	TBD	2025	
Downloads and/or users of project outputs.		This indicator aims to measure the use and dissemination of project outputs by tracking the number of downloads and/or users of the project outputs.	Surveys, interviews, internal statistics.	Capacity	Yearly	Global	Number	0	2023	500	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.3 Dashboard for risk index
	Downloads and/or users of project outputs from stakeholders in fragile and/or crisis-affected settings.	This sub-indicator aims to measure the use and dissemination of project outputs by tracking the number of downloads and/or users specifically in fragile and/or crisis-affected settings.	Surveys, interviews, internal statistics.	Capacity	Yearly	Global	Number	0	2023	TBD	2025	

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
Publications produced as part of this project.		This indicator aims to measure the number and quality of publications produced by the project, which may include scientific reports, best practices, guidelines, and other types of knowledge products. The indicator reflects the extent to which the project has generated new knowledge, shared best practices, and disseminated findings related to the project's goals and objectives.	Internal tracking.	Capacity	Yearly	Global	Number	1	2023	4	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.3 Reports and articles
Understanding of the datasets / analytical tools by the key stakeholders.		This indicator aims to measure the level of comfortability and technical understanding of the datasets or analytical tool provided as part of the project.	Surveys, interviews, internal statistics.	Capacity	Yearly	Global	Percentage	0	2023	100	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.2 On-line workshops and conferences
External reports and other tangible products that feature data or analytics from the project.		This indicator aims to measure external reports and other tangible products that feature data or analytics from the project.	Internal tracking.	Other	Yearly	Global	Number	0	2023	1	2025	**Outcome:** 2. Dissemination of results and incorporation of the tool into anticipatory decision-making. **Output:** 2.3 Reports and articles

Project Indicators

Indicator Title	Component Title	Description	Means of Verification	Category	Cycle	Scope	Value Type	Baseline Value	Baseline Year	Target Value	Target Year	Linked Outcome / Output
Data quality		This indicator aims at measuring the quality of the collected data and its applicability for the analyses.	Data quality sets the basis for a successful predictive model and a further incorporation of the results in the decision-making process.	Other	Yearly	Others	Yes/No	No	2023	Yes	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.1 Datasets
	No components available.											
Model quality		This indicator aims at measuring the predictive quality of the risk model(s).	The risk model stands at the center of this work and will determine whether or not this quantitative tool can be incorporated into planning processes.	Other	At closure	Others	Percentage	100	2023	10	2025	**Outcome:** 1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa. **Output:** 1.2 Risk Model
	No components available.											

Risks

Event	Category	Level	Likelihood	Impact	Mitigating Measures	Risk Owner
Delayed starting point of the project due to the needed recruitment of a new data scientist.	• Organizational	High	Possible	Moderate	UNHCR will do its utmost to ensure a speedy recruitment process, relying on a well-established recruitment protocol. If it becomes apparent that the recruitment of the staff will be significantly delayed, UNHCR has enough in-house capacity within the areas of data science, climate change, and forced displacement to begin the project within a reasonable time frame.	UNHCR
Risks regarding data availability for the chosen regions.	• Operational	Very High	Unlikely	Major	UNHCR and their partner UCI have already made a thorough investigation of the data availability within the chosen case regions. Furthermore, both institutions have long-standing experience working with real-world data that always include some missingness.	UNHCR, UCI

Risk of being unable to develop a satisfactory early warning model within the project's time frame.	• Operational	Very High	Unlikely	Major	UNHCR and UCI both have strong teams within quantitative and predictive analyses. UNHCR will additionally ensure to recruit a strong data science lead for the project and will put up a detailed project management plan to ensure that the work is kept on track.	UNHCR, UCI
Risk of not being able to conduct the dissemination and capacity-building plan.	• Strategic • Political • Operational	Medium	Unlikely	Moderate	UNHCR has set up a detailed project management plan that from the on-set plans those activities for the second year of the project. If in-person training should not be possible, for example due to travel restrictions, UNHCR will ensure that qualitatively equivalent online training options will be available to and through field offices.	UNHCR
Data security risk	• Strategic • Political	Very High	Rare	Major	The final results for the early warning risk indicator will be treated as highly sensitive data in the same way as UNHCR's registration data. Data security protocols will be discussed with our data protection officers and information will only be shared with external stakeholders, e.g., other UN agencies, NGOs, or governments after thorough consideration and consultation with data protection officers.	UNHCR

Budget by UNSDG Categories: Over all

Budget Lines	UNHCR (6.5%) *	Total
1. Staff and other personnel	$352,000	$352,000
2. Supplies, Commodities, Materials	$4,000	$4,000
3. Equipment, Vehicles, and Furniture, incl. Depreciation		$0
4. Contractual services	$0	$0
5. Travel	$35,000	$35,000
6. Transfers and Grants to Counterparts	$78,550	$78,550
7. General Operating and other Direct Costs		$0
Project Costs Sub Total	**$469,550**	**$469,550**
8. Indirect Support Costs	$30,521	$30,521
Total	**$500,071**	**$500,071**

Budget by UNSDG Categories: 2023

Budget Lines	Fiscal Year *	Description	UNHCR (6.5%) *	Total
1. Staff and other personnel	2023	P2 TA Data Scientist ~ 100% to project	$88,000	$88,000
2. Supplies, Commodities, Materials	2023	ICT and software licences	$1,000	$1,000
3. Equipment, Vehicles, and Furniture, incl. Depreciation	2023			$0
4. Contractual services	2023		$0	$0
5. Travel	2023			$0
6. Transfers and Grants to Counterparts	2023	Grants for partner UC Irvine for producing climate data from satellite imagery for case regions.	$30,000	$30,000
7. General Operating and other Direct Costs	2023			$0
Project Costs Sub Total			**$119,000**	**$119,000**
8. Indirect Support Costs			$7,735	$7,735
Total			**$126,735**	**$126,735**

Budget by UNSDG Categories: 2024

Budget Lines	Fiscal Year *	Description	UNHCR (6.5%) *	Total
1. Staff and other personnel	2024	P2 TA Data Scientist ~ 100% towards project	$176,000	$176,000
2. Supplies, Commodities, Materials	2024	Software licences	$2,000	$2,000
3. Equipment, Vehicles, and Furniture, incl. Depreciation	2024			$0

Budget Lines	Fiscal Year *	Description	UNHCR (6.5%) *	Total
4. Contractual services	2024		$0	$0
5. Travel	2024	1 number of trips for 1 person	$5,000	$5,000
6. Transfers and Grants to Counterparts	2024	Grants for partner UC Irvine for producing climate data from satellite imagery for case regions.	$32,500	$32,500
7. General Operating and other Direct Costs	2024			$0
Project Costs Sub Total			**$215,500**	**$215,500**
8. Indirect Support Costs			$14,008	$14,008
Total			**$229,508**	**$229,508**

Budget by UNSDG Categories: 2025

Budget Lines	Fiscal Year *	Description	UNHCR (6.5%) *	Total
1. Staff and other personnel	2025	P2 TA Data Scientist ~ 100% towards project	$88,000	$88,000
2. Supplies, Commodities, Materials	2025	Software licences, access to satellite imagery	$1,000	$1,000
3. Equipment, Vehicles, and Furniture, incl. Depreciation	2025			$0
4. Contractual services	2025		$0	$0
5. Travel	2025	2 trips for 3 people	$30,000	$30,000
6. Transfers and Grants to Counterparts	2025	Grants for Partner UC Irvine to produce climate data from satellite imagery and knowledge transfer to UNHCR.	$16,050	$16,050
7. General Operating and other Direct Costs	2025			$0
Project Costs Sub Total			**$135,050**	**$135,050**
8. Indirect Support Costs			$8,778	$8,778
Total			**$143,828**	**$143,828**

Performance-based Tranches Breakdown

Tranche	Tranche %	UNHCR	Total
Tranche 1	50%	$250,036	$250,036
Tranche 2	50%	$250,036	$250,036
Total		**$500,071**	**$500,071**

Programme Outcome Costs

Outcome	Output	Activity	Implementing Agent	Time Frame								
				2023		2024				2025		
				3	4	1	2	3	4	1	2	3
1. A composite and machine-learning-based risk index of climate-induced forced displacement at the grid level for the regions of study East and West Africa.												
	1.1 Datasets											
		1.1.1 Data curation										
			UNHCR	☑	☑	☑	☑	☐	☐	☐	☐	☐
		1.1.2 Knowledge transfer from UCI to UNHCR										
			UNHCR	☐	☐	☐	☐	☐	☐	☑	☑	☑
		1.1.3 Evaluation of data sets										
			UNHCR	☑	☑	☑	☐	☐	☐	☐	☐	☐
		1.1.4 Data cleaning										
			UNHCR	☐	☐	☑	☐	☐	☐	☐	☐	☐
		1.1.5 Temporal and spatial alignment of all data sources										
			UNHCR	☐	☐	☑	☐	☐	☐	☐	☐	☐
	1.2 Risk Model											
		1.2.1 Model training										
			UNHCR	☐	☐	☐	☑	☑	☑	☐	☐	☐
		1.2.2 Model testing										
			UNHCR	☐	☐	☐	☑	☑	☑	☐	☐	☐

Outcome	Output	Activity	Implementing Agent	Time Frame								
				2023		2024				2025		
				3	4	1	2	3	4	1	2	3
		1.2.3 Checking scalability of models										
			UNHCR	☐	☐	☐	☐	☐	☑	☑	☐	☐
	1.3 Dashboard for risk index											
		1.3.1 Relational data base										
			UNHCR	☐	☐	☑	☑	☑	☑	☑	☑	☐
		1.3.2 Setting up of data pipelines										
			UNHCR	☐	☐	☐	☐	☐	☑	☑	☐	☐
		1.3.3 Upgrade of an existing dashboard										
			UNHCR	☐	☐	☐	☐	☐	☐	☑	☑	☐
2. Dissemination of results and incorporation of the tool into anticipatory decision-making.												
	2.1 In-person workshops											
		2.1.1 Organisation of workshops										
			UNHCR	☐	☐	☐	☐	☐	☐	☑	☑	☑
	2.2 On-line workshops and conferences											
		2.2.3 Organisation of online workshops and participation in conferences.										
			UNHCR	☐	☐	☐	☐	☐	☐	☑	☑	☑
	2.3 Reports and articles											
		2.3.3 Writing reports and articles.										
			UNHCR	☐	☐	☐	☐	☐	☑	☑	☑	☑

SIGNATURES

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Title:	**Senior Data Scientist**	**Fund Manager, CRAF'd**
Date:	**17-Jul-2023**	**14-Jul-2023**
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