IGC Project Proposal Form

Page 2 - Project Summary

CALL FOR PROPOSALS INFORMATION

2.1 Call for Proposals Name

CB Test

Call for Proposals under which this project is to be considered

2.2 Call for Proposals Close Date/Time (UK)

30/11/2024 17:00:00

Date and Time at which above Call for Proposals closes, shown in local UK time

PROJECT INFORMATION

2.2 Project Title

IGC Demo - Optimizing Environmental Regulation Enforcement in Pakistan through Technology Integration

Please confirm your project title here

2.3 Project Summary (Max 300 words)

Air pollution is one of the most serious threats to human health globally and it is especially severe in South Asia. Still, environmental regulations are only partially enforced. In this project, we will study whether generating better information about the most harmful sources of air pollution can increase the efficiency of enforcement and improve air quality.

We will utilize the context of brick kilns in Pakistan to study this question. Pakistan is the country with the third worst air pollution in the world (AQLI, 2023), and illegal brick kilns are the leading cause. We propose a new technology to provide regulators with information on the most harmful kilns and measure the effects of this intervention on the enforcement of environmental regulations.

To estimate the damage of each kiln, we first map kilns by analyzing satellite data with machine learning methods. Then we estimate the health harm of each kiln with an air quality model. Using the output from this analysis, we create a Brick Kiln Tracker, providing action-relevant information to the government. We will randomize what areas the tracker will cover to test whether it improves the efficiency of enforcement towards kilns and decreases the health harms of air pollution. Through within and across district randomization, we will test for spillover effects on nearby areas.

We are carrying out this project at scale with the Department of Environment, Government of Pakistan. If successful, the Brick Kiln Tracker will be scaled up to cover all of Pakistan and the technology transferred to the government. Our technology along with lessons learned from the experiment can also be transferred to other developing countries, such as Bangladesh. Results and insights will be shared through workshops with various stakeholders, media outlets, and academic publications to ensure broad dissemination and application of the knowledge gained.

2.4 Does this project build on a previous project?

○ Yes, this is linked to a previous IGC project

x Yes, this is linked to a previous non-IGC project

○ No, this project is not linked to any previous project

PREVIOUS PROJECT DETAILS

2.4.1 Please provide the project code/title of the previous project here

Technology and Environmental Regulation Enforcement in Pakistan

2.4.2 How did this previous project generate demand for the current project?

The previous research project successfully highlighted gaps in Pakistan's environmental regulatory framework and demonstrated the potential of technology-driven solutions to improve enforcement efficiency. Piloted in Punjab, the project showed tangible benefits, which have spurred demand for expansion.

Key stakeholders, including policymakers and local communities, have shown strong support due to the project's initial success and its positive reception. This enthusiasm underscores the necessity of extending these efforts to Sindh, aiming to replicate and scale the proven benefits.

CONFIDENTIALITY

2.5 Should your project be flagged as confidential? i.e. should *not* be published on the IGC website or other external sources

○ Yes

x No

DATES & REQUESTED BUDGET

All projects must have a Proposed Start Date from 1st February 2025, and must end no later than September 2026. This means the project will be contracted by that date, but the fieldwork may start later. Projects should also span at least six months duration

2.6 Proposed Start Date	**2.7 Proposed End Date**
01/03/2025	31/08/2026
dd/mm/yyyy	dd/mm/yyyy

If applying via the pilot/exploratory studies route, total budget (including overhead) must not exceed £30,000

2.8 Total Project Budget (GBP, inc. overhead)

27088.36

This figure should reflect your estimated project budget, including any overhead costs. You will have an opportunity to modify this amount later after you have completed your detailed project budget on page 10.

Page 3 - Participant Information

PROJECT MANAGEMENT

3.1 Will this project be managed by an institution?

xx

Yes

No

PLEASE READ CAREFULLY BEFORE CONTINUING:

- We do not offer contracts with individuals. All projects must be contracted via a managing institution.
- The institution that manages the project is usually the academic institution at which the principal and/or co-investigator is employed or enrolled (e.g., university, think tank, NGO, government institution).
- If your project will be managed by an institution, it is expected that they will have reviewed and confirmed your proposal. If you are unsure who should be nominated as the Signatory and/or Grant Manager, please discuss this with your managing institution directly.
- The IGC and its country offices **do not** count as managing institutions.
- The institution signatory **may not** be a researcher on the project (exceptions are only made for very small organisations).
- Please refer to application guidance on the website for more information on the contracting process.

Managing Institution

Please note, if you are unsure what information to provide in the below section, please consult with your managing institution.

3.1.1 Name of Institution

Suntory and Toyota International Centres for Economics and Related Disciplines

Please select an institution from the list. If you can't find the right institution, please type the name of the institution here and provide address details below

3.1.8 Listed Signatory

Marta Wasick

Start typing the first few letters of the signatory's name and select from the list

☐ I can't find the required signatory in the above list

3.1.13 Grant Manager

Annie-Rose Nicholas

Start typing the first few letters of the grant manager's name and select from the list

☐ I can't find the required grant manager in the above list

RESEARCH TEAM

3.2 Please add the names, project roles and email addresses of each member of the research team here. Please note, the individuals below will be contacted to confirm the details provided and may be asked for supplementary information.

PROJECT ROLE #1 - Shahid Vazirali (Principal Investigator)

Contact Information

3.2.1 Main Institutional Affiliation

London School of Economics and Political Science

Please start typing a few characters and select the relevant institution. If you can't find your institution in the list, you may type a free text response.

3.2.2 First Name(s)

Shahid

3.2.3 Last Name

Vazirali

3.2.4 Email

s.vazirali@lse.ac.uk

3.2.5 Country of Residence

Pakistan

This is normally the place you consider your current permanent home, where you hold either citizenship or permanent residence,
and have lived for at least six of the past 12 months

3.2.6 Country of Origin

India

This is normally either where you were born, the place you consider
to be your familial home, or where you spent the longest period before the age of 18

Project Role

3.2.7 Project Role

Principal Investigator

3.2.7.2 Please give a brief outline of the main responsibilities/tasks associated with this project role

Run data collection, manage analysis and write-up

3.2.7.3 This individual should be the main IGC contact for this project

○ Yes

x No

Please ensure that one individual in your project team is nominated as the main contact

3.2.8.1 Link to Personal Website (if available)

www.shahidvaz.com

Optional

Please remember to upload or provide links to CVs against the relevant line in the budget section later in this form. You will be prompted to provide these later.

3.2.9 No. of fee days on project	3.2.10 Daily Fee Rate (GBP)	3.2.11 Total Anticipated Fees
0.0	0.0	0

Education Information

3.2.12 PhD Status

No PhD held/underway

PhD Student

x PhD holder

3.2.12.1 Year PhD obtained/anticipated completion date

2019

PROJECT ROLE #2 - Caleb Anderson (Co-Principal Investigator)

Contact Information

3.2.1 Main Institutional Affiliation

African Center of Excellence in Data Science, University of Rwanda

Please start typing a few characters and select the relevant institution. If you can't find your institution in the list, you may type a free text response.

3.2.2 First Name(s)

Caleb

3.2.3 Last Name

Anderson

3.2.4 Email

c.anderson@afceds.rw

3.2.5 Country of Residence

Rwanda

This is normally the place you consider your current permanent home, where you hold either citizenship or permanent residence,
and have lived for at least six of the past 12 months

3.2.6 Country of Origin

United States

This is normally either where you were born, the place you consider
to be your familial home, or where you spent the longest period before the age of 18

Project Role

3.2.7 Project Role

Co-Principal Investigator

3.2.7.2 Please give a brief outline of the main responsibilities/tasks associated with this project role

Run data collection, manage analysis and write-up

3.2.7.3 This individual should be the main IGC contact for this project

Yes

x No

Please ensure that one individual in your project team is nominated as the main contact

3.2.8.1 Link to Personal Website (if available)

www.caleb.anderson2.com

Optional

Please remember to upload or provide links to CVs against the relevant line in the budget section later in this form. You will be prompted to provide these later.

3.2.9 No. of fee days on project	3.2.10 Daily Fee Rate (GBP)	3.2.11 Total Anticipated Fees
20.0	250.0	5000

Education Information

3.2.12 PhD Status

No PhD held/underway

x PhD Student

PhD holder

3.2.12.1 Year PhD obtained/anticipated completion date

2027

3.2.12.2 As you have indicated you are a current PhD student, please provide the following information below: i) The name of your PhD Advisor(s); ii) Confirmation that your advisor supports this application.

i) Tewdore Makonen

ii) I confirm my advisor's support for this application

Page 4 - Research Theme & Country Focus

RESEARCH THEME

4.1 Please select one IGC research theme that is most relevant to your project

Firms, Trade, and Productivity

State Effectiveness

Cities

x Energy and Environment

COUNTRY FOCUS

We have resident teams embedded in 10 partner countries throughout Africa and Asia. Country offices allow the IGC to sustain long-term policy engagement and help ensure our work is demand-led.

Our partner countries are Bangladesh, Ethiopia, Ghana, Jordan, Mozambique, Pakistan, Rwanda, Sierra Leone, Uganda and Zambia. Researchers are strongly encouraged to conduct their research in IGC partner countries, and to reach out to IGC country offices during the design and implementation phases of their research projects. We have flexible engagements Yemen, Tanzania

implementation phases of their research projects. We have flexible engagements Yemen, Tanzania and Liberia, and we encourage research in these countries as well.

Conducting research in countries where we have a country office comes with advantages such as access to local research partners, datasets, and established, well-connected country teams. IGC staff can provide feedback on proposals, as well as facilitate meetings with policymakers and key stakeholders. Proposals discussed beforehand with country teams are therefore more likely to be approved.

4.2 Please select the 'Primary Activity Country' related to your project. This is typically the main locale of the research, or the geographic focus of the project. If your project focuses equally on multiple countries, or has no particular geographic focus, please select 'Not Country Specific' (you can specific multiple countries in the next question if needed).

Pakistan

4.3 Does your project relate to multiple activity countries?

○ Yes

x No

4.4 Have you discussed this project with an IGC partner country or initiative team?

x Yes

○ No

We strongly encourage you to get in touch with the relevant IGC country (or thematic initiative team for the full research project route) and share your research idea with them. Please do this before completing your application.

4.4.1 Please select the IGC team you have discussed this project with below

Pakistan

Page 5 - Academic Innovation & Research Design

RESEARCH QUESTION & ACADEMIC INNOVATION

5.1 Briefly state the main research question(s) and explain how this project will push the frontier of existing knowledge. Please assume the reader has no prior knowledge of the subject matter or literature. Ensure that your research question is written clearly and concisely. Explain why your research question in novel, and present evidence to support this by citing existing literature and how you will build on it. **If you are applying for exploratory work, please outline the broad area of interest that you are seeking to study.** (Max. 500 words)

Air pollution is a serious threat to human health globally and especially in South Asia where 2 million premature deaths are caused by air pollution every year (World Bank, 2022). The detrimental effects of air pollution on health and productivity are well documented (e.g. Chay and Greenstone, 2003; Currie and Walker, 2011; Hanna and Oliva, 2015; Deryugina et al., 2019). Anti-pollution laws exist, but enforcement remains a key challenge. We utilize the context of brick kilns in Pakistan to study whether using information technology to better prioritize how to allocate government resources can improve enforcement efficiency.

Our research contributes to the literature in four key ways. First, there is only a limited recent literature testing ways to reduce air pollution in low- and middleincome countries.

Some, such as Greenstone et. al., (2023) and Jack et al. (2022) test interventions requiring a substantial amount of state capacity. Buntaine et al. (2022) find that public appeals against violators on social media reduce emissions by 62 percent in China. Furthermore, Jha and La Nauze (2022) show that monitoring of air pollution by US embassies reduced air pollution by 2 to 4 µg/m3. The key difference between these approaches and our study is that while they encourage monitoring and complaints by the public, we share data directly with the government about which air pollution sources are most harmful to public health as well as which sources are in violation of the regulation. This is inspired by Duflo et al. (2018) who highlight the importance of information about violations for government inspections to be effective.

Second, we contribute to the literature on increasing the government's enforcement capacity in settings of low state capacity, high bureaucratic overload, and a large number of violators. Similar to our work, Saavedra (2022) uses satellite data and machine learning methods to identify illegal mines in Colombia and shows that

sharing this information with the local government leads to less illegal mining. We will use the context of Pakistan's brick kilns to show how machine learning combined with satellite data can be employed to help government officials locate harmful brick kilns and study the effectiveness of this approach.

Third, our intervention leverages advances in machine learning (Foody et al., 2019; Lee et al., 2021) and reduced complexity air models (Thakrar et al., 2022). These models enable governments and others with limited computing resources to model health the health harms of air pollution from specific sources. To the best of our knowledge, this study will be the first rigorous evaluation of the effects of employment of reduced complexity air models.

Fourth, we will contribute to the literature on firm behavior under increased legal enforcement. Academic studies have examined how informal firms react to formalization and compliance with government regulations (Ulyssea, 2018), and taxpayer responses to heightened enforcement (Pomeranz, 2015; Khan et al., 2016). In Pakistan, over 88% of brick kilns violate regulations. Our project aims to understand their response to intensified monitoring and enforcement, and potential spillover effects on compliant kilns.

RESEARCH DESIGN

5.2 Please outline your research design and methodology here. Ensure that your approach is designed to provide the most robust possible answer to the research question you have outlined in the previous section. Start with your research question, and then go into details around your design and approach. Where appropriate, include detail on your identification strategy, a description of the interventions, the data you will be using/collecting, and the main elements of your model if you are using one. Please also include information on planned surveys, any use of external providers, and research assistants. Use simple and non-technical language. **For exploratory work, please outline your overall approach, including interviews you plan to conduct, preliminary data you plan to collect, and a description of any other analysis you plan to conduct.** (Max. 1500 words)

To test whether technology-leveraged information systems can improve enforcement, we have designed such an information system. This system allows the Government of Pakistan to locate all brick kilns and observe the estimated health harm caused by each kiln. This will allow the government to focus its scarce enforcement resources (funding, officials' time, as well as political capital) on the most harmful brick kilns. To design the information system, we used satellite data and deep learning algorithms developed by Boyd to identify the type and location of all kilns (Foody et al., 2019). We then estimated the health harm of each kiln using a reduced complexity air quality model developed by Thakrar et al. (2022). The model takes into consideration typical emissions for the kiln type, local weather patterns, pollutant diffusion, population density, and epidemiological evidence for air pollution's effects on human health. Finally, we created an online dashboard (the "Brick Kiln Tracker") displaying the information in a user-friendly and action-relevant way. The tracker can be accessed at: https://track-kiln.arced.foundation (username: guest, password: brick), and a screenshot can be seen in Figure 1 of the attached appendix.

The brick kiln tracker will enable government officials to locate the most harmful brick kilns. Therefore, in theory, the brick kiln tracker should enable the government to increase the efficiency of enforcement as they can focus their scarce resources on the most harmful kilns.

To empirically test this, we randomize all of Bangladesh's sub-districts into 2 categories: a pure control group that the information system does not cover (21 districts) and a partially treated group (41 districts) where 50% of randomly selected sub-districts are covered by the information system. The total number of sub-districts in the partially treated districts will be 312 and 155 of them will be treated. Randomization will be stratified by the total health harm of kilns in districts and the number of most harmful kilns in sub-districts. Figure 2 in the attached appendix shows a visualization of the research design.

The main outcomes are the total health harm caused by all brick kilns in the district, the number of brick kilns deemed to be in the "most harmful" category that is still operating, as well as the total number of enforcement actions carried out by the DoE.

For the analysis at the district level, comparing the treatment and control districts estimates the Intent to Treat (ITT) effect. We will also use data on usage of the Brick Kiln Tracker by each government official working in the district to estimate the Treatment-on-the-Treated (TOT) effect using two-stage least squares, where the district treatment status will be an instrument for tracker usage (number of log-ins and number of clicks within tracker).

At the sub-district level, if we find that the Brick Kiln Tracker reduces the total health harm, the effect could be driven by three potential channels: a general increase in enforcement activities, shifting enforcement from less polluting kilns to more polluting kilns, or shifting enforcement from untreated subdistricts to treated subdistricts. Understanding these mechanisms is important. The first two channels suggest that scaling up our Brick Kilns Tracker will improve enforcement, decrease pollution, and 9 save lives. However, if enforcement is only shifted from one subdistrict then the other, the tracker might not improve health when taking into account the entire country.

We designed our study to allow us to disentangle these mechanisms by comparing untreated subdistricts in the partially treated and pure control districts, we will be able to determine whether any increase in enforcement of regulation in treated subdistricts reflects more enforcement overall or a shift in enforcement from areas not covered by the tracker. We will also test if enforcement shifted from less harmful kilns to the most harmful kilns by separately estimating the treatment effect among both categories. After the system has been active for a year we will randomly select 20 districts among those that were partially treated and roll out the system in all subdistricts in these districts. This will allow us to measure the effect of having the whole district treated.

We will use five sources of data. First, approximately annual satellite images will locate brick kilns and measure if they are active. The data collection has already started and will be going on until at least November 2025. Second, we will conduct a baseline, follow-up (1 year after), and endline survey (2 years after) of kiln owners and managers (the first round was conducted with 1,233 owners and managers of 634 brick kilns in May-June of 2023). These surveys will measure interactions with government officials as experienced by the brick kiln owners, including unofficial payments. We will sample brick kilns from the universe of all kilns. The sampling will be stratified by sub-district and health harms, oversampling kilns with large health harms as these are more likely to see an effect of the intervention and have a larger effect on welfare while maintaining the option to use weights to get a representative sample.

A surprising finding from the baseline survey was that many brick kiln owners (~55%) are actively considering starting up production of "non-fired" bricks, which are a less environmentally harmful alternative to traditional bricks. We will incorporate this finding into our experiment by making the production of non-fired bricks a main outcome variable, to study if increased enforcement of environmental regulation can increase the speed of the green transition to non-fired bricks.

In the first follow-up survey, we will also inform a random subset of owners of the most harmful brick kilns that they have been identified as one of the most harmful kilns and that this information has been shared with the Department of Environment. This will allow us to test the effects of this information on the continuation of operation of the brick kiln.

Third, we will conduct a baseline, follow-up, and endline survey of all government bureaucrats using the system. In these surveys, we will see if the information system causes officials to spend more time enforcing regulations on brick kilns and if the treatment shifts attention away from other tasks.

Fourth, we will collect data on the amount of time that the bureaucrats are using the online brick kiln tracker. This will allow us to use the treatment assignment as an instrument for the usage of the information system and get estimates for the "Treatment On the Treated" (TOT) effect in addition to the "Intent To Threat" (ITT) which will be our main estimate.

Finally, we will complement our satellite and survey data with administrative enforcement data from the Department of Environment about the universe of enforcement decisions taken against brick kilns.

Table 1 in the attached appendix shows power calculations for the main outcome variables. We find that the minimum detectable effects for district and subdistrict total health harm rates are about 1.5% of the control group mean. For comparison, if the Brick Kiln Tracker causes a shift in the current government enforcement efforts from shutting down random kilns to shutting down kilns in the top 10% of most harmful kilns, the harm rate would decrease by 7% per year instead of 2.5% per year (a 4.5% additional decrease over the control group mean), as the top 10% of kilns is 2.8 times more harmful than average kilns. This means that even if the tracker will not increase total enforcement efforts and will only shift enforcement such that one-third of randomly shutdown kilns will now be in the top ten percentile of the most harmful kilns, we will have enough power to detect an effect after only one year.

The project has obtained IRB approval from the National University of Singapore as well as Dhaka University. Before the collection of follow-up data, we will submit a preanalysis plan to the American Economic Association RCT registry.

RELEVANCE TO SUSTAINABLE GROWTH POLICY

5.3 What is the relevance of the project to the sustainable growth policy challenges faced by developing countries? Describe how it fits with the IGC research agenda. (Max. 500 words)

Our project's core focus is on tackling air pollution in South Asia, which is a pressing environmental issue. It aligns perfectly with the IGC's interest in the "Energy and Environment" theme. Air pollution, particularly from brick kilns, has severe local and regional environmental externalities, impacting air quality, ecosystem health, and climate change. By implementing technology-driven solutions to monitor and regulate these sources of pollution, our project seeks to reduce these negative environmental externalities.

Collaborating directly with the Department of Environment in the Government of Pakistan reflects a strong commitment to improving state effectiveness. Strengthening the capabilities and effectiveness of the government to enforce existing environmental regulations is crucial for inclusive growth and development. We aim to enhance the government's capacity to enforce regulations related to brick kiln emissions, which can serve as a model for improving state effectiveness in addressing other regulatory challenges.

While not explicitly mentioned, our project has significant implications for urban areas, especially in densely populated regions like Pakistan. Brick kilns are often clustered around cities, and their emissions not only degrade urban air quality but also contribute to local temperature increases through the emission of black carbon. Through increasing enforcement against the most harmful brick kilns, this project can have a substantial positive impact on cities, making them more productive, inclusive, and resilient.

Page 6 - Activities & Data Collection

ACTIVITY TYPE

6.1 Please SELECT ONE activity type this project *most closely* relates to from the list below (i.e. reflects the primary objective of the research/activity):

Early Stage Project Development

- ○ Scoping visit
- ○ Small-scale pilot/proof of concept
- ○ Baseline survey/preliminary data collection
- ○ Other

Expert advice and policy analysis

- ○ Expert/peer review
- ○ Implementation guidance/technical assistance
- ○ Stakeholder training
- ○ Other

Synthesis

- ○ Synthesis of existing knowledge/literature review

Research

- x Self-contained research project
- ○ Additional component of existing research
- ○ Project scale up

Other

- ○ Other

DATA COLLECTION & EMPIRICAL ANALYSIS

6.2 Does the project involve original empirical analysis of data? (Empirical analysis here refers to the analysis of either primary or secondary data, but does not include analysis of literature on a specific issue)

- x Yes
- ○ No

DATA COLLECTION

6.2.1 Please select whether you plan to collect and/or analyse the following types of data

	Collect	Analyse	Collect & Analyse	Neither Collect nor Analyse
6.2.1.1 Survey data	○	○	x	○
6.2.1.2 Administrative data	○	○	x	○
6.2.1.3 Other proprietary data	○	○	x	○
6.2.1.4 Non-proprietary data	○	○	x	○
6.2.1.5 Qualitative data	x	○	○	○

6.2.1.6 Other

Please provide detail on any other types of data that you plan to utilise in your project, and whether you plan to collect and/or analyse the data

Optional

DATA PUBLICATION

6.2.2 Do you intend to make any data captured publicly available post project completion?

x Yes

○ No

6.2.2.1 When would you expect data to be made publically available?

31/12/2026

FORMS OF EMPIRICAL ANALYSIS

6.2.3 What forms of analysis do you have planned? (select all that apply)

x **RCT**
(i.e. Experimental setting where an intervention is randomly assigned to a subset of a population. The effect of the intervention by monitoring outcomes between the treatment group (those that were randomly selected to receive the intervention) and the control group (those that did not receive it)

EXAMPLE: Reminders are randomly sent to taxpayers. The effect on tax compliance is assessed by measuring the difference in tax revenue collected between those that receive the reminder and those that did not.

☐ **Other regression, reduced-form or statistical analysis**
(i.e. Using a non-experimental approach to examine the relationship between different variables (instrumental variables, difference in difference etc.)

EXAMPLE: Basic analysis looking at impact of COVID-19 across firms and sectors. The impact of an economic reform is assessed by comparing states where the reform was implemented and states where it was not.

☐ **Structural analysis**
(i.e. Empirical analysis that relies on an economic model to explain some observed behavior. Researcher typically chooses specific functional form for the model's components (e.g., a particular form of a consumer's utility function or a firm's cost function) and explanatory variables to include, and typically estimates parameters of the model from data (generally to run counterfactuals)

EXAMPLE: Using a model of global trade to assess the impact of raising tariffs on certain goods.

☐ **Methodological work**
(i.e. Developing and testing new methods to do statistical analysis or to measure variables that can not be observed directly)

EXAMPLE: Using satellite data to identify how much property tax is worth or to identify slums' geographical delimitations.

☐ **Quantitative analysis/Descriptive Statistics**
(i.e. Simple analysis and summaries of data samples)

EXAMPLE: Background study on the policy challenges faced in the education sector.

☐ **Mixed methods**
(i.e. Mix of quantitative and qualitative research)

EXAMPLE: Quantitative analysis of crime statistics combined with qualitative interviews to understand the determinants of gender-based violence.

☐ **Case studies**
(i.e. Detailed and in-depth analysis of a particular case)

EXAMPLE: Exploring the relationship between state fragility and conflict in specific countries to draw out lessons and recommendations

☐ **Other** (please provide detail below)

RESEARCH ETHICS & DATA COMPLIANCE

6.3 If your application is successful do you agree to adhere to your institution's (or affiliated institution's) Research Ethics Policy, which should be no less rigorous than the LSE Research Ethics Policy - especially in terms of protocols for research involving human participants?

x Yes, I accept these conditions

6.4 Do you expect your research will include human participants?

x Yes

○ No

If your research includes human participants, please note that an IRB will be required as an output. This will be factored into your output schedule on Page 11 of this form.

Researchers are required to complete a Research Ethics Review conducted and approved by either your affiliated institution or an external professional body. You will be required to provide evidence of the Institutional Review Board approval (IRB) as an output. The purpose of the review is to require researchers to reflect on the potential ethical implications of their research and the potential risks of harm (including risks to life, livelihoods, social relationships, emotional well-being, reputation, mental health, and more) that might be caused to the participants (as well as to the researcher(s) themselves).

Please note, if an IRB is required, this must be submitted before your research begins.

6.5 Will you be transferring any *non-anonymised* special category data from the UK to outside of the EEA?

x Yes

○ No

6.6 Will you be processing any *non-anonymised* special category data?

x Yes

○ No

PAGE 7 - POLICY CONTRIBUTION & STAKEHOLDER ENGAGEMENT

The IGC has an overarching aim of taking research into policy and we take policy impact very seriously. This is how most of our research projects are evaluated. Most of the projects that achieve impact have researchers who looked at how they will engaged with policy makers from the start of the project.

7.1 Will this project aim to address an existing policy demand/gap?

x Yes

○ No

○ Unsure at this stage

7.1.1 Please provide details of the existing or planned policy which the team are hoping to inform

The team aims to inform a policy leveraging technology to enhance the enforcement of environmental regulations in Pakistan, specifically targeting the brick kiln industry, a major contributor to air pollution. The project addresses the severe air pollution in Pakistan, primarily caused by illegal brick kilns, by improving the efficiency of regulation enforcement through better information on harmful pollution sources.

Central to this initiative is the development of the Brick Kiln Tracker, a new technology utilizing satellite data and machine learning to map brick kilns and estimate their health impact. A reduced complexity air quality model will assess the health harm of each kiln, creating an actionable information system for regulators. The project will be piloted in randomized districts, with plans for scaling based on the outcomes.

The implementation involves collaboration with the Department of Environment, Government of Pakistan. Randomized districts will test the effectiveness of the Brick Kiln Tracker in improving enforcement and reducing pollution. Findings and technologies will be disseminated through workshops, media, and academic publications, with potential application to other countries facing similar challenges.

Comprehensive data collection and monitoring are integral to the project. Satellite images and surveys of kiln owners and government officials will provide data to assess the intervention's impact on enforcement actions and pollution levels. This policy demonstrates how advanced information technologies can prioritize enforcement actions, making environmental regulations more effective in reducing pollution and protecting public health.

7.2 Please provide detail on how this project came about. Where relevant, please provide information on how the primary stakeholder(s) referenced above were involved in the early project development. Please also provide details on engagement with any additional stakeholders here.

The government has been wanting to tackle the problem of air pollution caused by brick kilns for an extended period of time. For this purpose, the government introduced a strict regulation on brick kilns in 2014. Several projects have also been attempted, including encouraging alternative production methods and encouraging alternative materials. However, these have only had limited success as the current coal-fired and small-scale production have very low marginal costs, once the kilns have been established.

PI Caleb Anderson wanted to understand how to reduce air pollution in South Asia. After reading the academic literature (e.g. Begum and Hopke, 2014) that brick kilns were an important part of this problem, Anderson read the academic papers and government reports on brick kiln regulation (e.g. Eil, 2020; Department of Environment, 2020; Lee, 2021). After further discussing the problem with the DoE air quality wing, it became clear that the binding constraint was the government's lack of capacity to effectively enforce the existing regulation.

The original idea of the Brick Kiln Tracker came about in discussions between DoE

air quality wing and Anderson as well as technical discussions between Vazrali, Benson, and Imokep.

To gain a better understanding of the situation, Anderson then conducted qualitative

discussions with the DoE air quality and enforcement wings, DoE officials in two

district offices, two brick kiln owners and representatives in the Pakistan Brick

Manufacturing Owners Association, the directors of the civil society organizations

Pakistan Environmental Lawyers Association, the Centre for Policy Dialogue,

Youth Policy Forum, as well as the IGC and FCDO country economists Hina Shaikh and Issam Mosaddeq. To better understand the political economy of the

problem Anderson also conducted interviews with three Members of Parliament and

their staff.

The first prototype of the Brick Kiln Tracker was designed by the DoE air quality

wing, Anderson , and the ARCED foundation. This prototype was shown to several DoE officials and they provided feedback. An updated pilot version of the Tracker was then rolled out in two districts and a pilot workshop was held in February 2023. More feedback was provided on the tracker in the workshop and by the district officials leading to design improvements of the tracker.

A presentation for the Standing Parliamentary Committee on Environment, Climate Change and Forestry was then arranged in April 2023 and further feedback was provided in this meeting leading to additional design upgrades.

7.3 Which of the following statements *most closely* describes the context under which this project is being generated? Please respond to this question with respect to your primary project stakeholder/counterpart, as indicated above.

- ○ This project has been initiated with no input or discussion with primary stakeholders
- ○ The project has been informed by an understanding of primary counterparts' key strategic policy priorities
- ○ The project has come about as a result of a direct request from primary stakeholders(s)
- ○ The project has come about as a result of follow-up demand from the primary stakeholders, stemming from earlier research
- **x** The project has been developed following close collaboration with primary stakeholders (i.e. the research question and approach have been discussed and debated with policy counterparts).
- ○ Other

PRIMARY COUNTERPART/STAKEHOLDER ENGAGEMENT

7.4 Do you have an established primary counterpart or stakeholder for your project? excluding anyone already listed on page 3 of this form, including primary practitioner partners (SGB Evidence Fund projects only) and the research team

- **x** Yes
- ○ No

7.4.1 Please select the category to which the primary counterpart or stakeholder for your project belongs.

- ○ Donor
- **x** Government
- ○ Multilateral
- ○ NGO
- ○ Private Sector Organisation
- ○ Other

7.4.2 Please provide the following details of your project's primary counterpart or stakeholder.

7.4.2.1 Name of Primary Stakeholder Organisation

Department of Environment, Government of Pakistan

7.4.2.2 I have a specific contact(s) at this organisation

x
Yes
No

Contact(s) at organisation

Please list your key contacts from the above stakeholder organisation here, including their name(s) and role(s) at the organisation. All contact information provided will be strictly confidential and used only for internal IGC purposes.

7.4.2.3 Stakeholder contact name(s) and role(s)

Aman Haque, National Director of Air Quality, Department of Environment: Focal point within the DoE for this project. Coordinating the work between the Brick Kiln

Tracker project team and the DoE.

Dr. Md. Shah Motalib, Deputy Director, Air Quality Wing, Department of Environment. The main point of contact within the DoE for officers using the Brick Kiln Tracker. Handling the day-to-day communications between the research team

and the DoE.

Ziahul Rahman, Deputy Director, Air Quality Wing, Department of Environment. Arranging workshops and providing day-to-day logistical support for the project.

Dr. Amna Hossain, Director General, Department of Environment: Responsible for leading the work of the DoE and providing strategic support for the project in letting necessary approvals e.g. workshops, field visits, data sharing, etc

Page 8 - DISSEMINATION & ENGAGEMENT

PRIMARY STAKEHOLDER DISSEMINATION PLAN

8.1 Please detail the dissemination approach you plan to adopt with your primary counterpart/main stakeholder/primary practitioner partner to disseminate findings and promote stakeholder engagement. Please indicate any ways the IGC might be able to support your stakeholder engagement and dissemination efforts. *

The implementation involves collaboration with the Department of Environment, Government of Pakistan. Randomized districts will test the effectiveness of the Brick Kiln Tracker in improving enforcement and reducing pollution. Findings and technologies will be disseminated through workshops, media, and academic publications, with potential application to other countries facing similar challenges. If successful, the Brick Kiln Tracker will be scaled up to cover all of pakistan and the technology transferred to the government. Extensive assistance and capacity building will be provided for them to continue updating and using the tracker.

OTHER STAKEHOLDERS DISSEMINATION PLAN

8.2 Do you expect to disseminate findings from this project to one or more stakeholders? (excluding your primary counterpart)

x Yes

○ No

8.2.1 Which type(s) of stakeholder do you plan to disseminate findings to for this project? Please select all that apply

x Donor

x Government

x Media

☐ NGO

☐ Private Sector Organisation

☐ Other

8.2.1.1 Please detail the stakeholder(s) with whom you plan to engage, and the dissemination approach you plan to adopt in each case

Our technology along with lessons learned from the implementation in Pakistancan be further expanded to other developing countries, such as India and Bangladesh, that face similar constraints of government capacity in enforcing regulations to curb pollution. One co-PI (Vazirali) has already collaborated with the UNDP and various state governments in India on a similar project, for more information see this: https://www.undp.org/india/blog/how-geoai-platform-helpingtarget-brick-kiln-hotspots-air-pollution In addition, we will conduct a workshop at the end of the experiment in late 2025, disseminating our results to Bangladeshi politicians, bureaucrats, academics, civil society, and the media. This is similar to how results from Anderson's previous project with the Government in Pakistan were disseminated (see print and TV media coverage of the events. In conjunction with the workshop, we will publish a non-technical policy brief with our results.

We will also publish at least two academic papers, one targeting a science journal and one targeting an economics journal. When first making the economics working paper available, we will write a blog post summarizing it for a policy audience (see examples of blog posts from previous projects here. Finally, we expect the research to be covered by Bangladeshi and international media in similar ways to our previous projects. Our previous projects have been covered by New York Times, Financial Times, The Atlantic, Times of India, Bangla Tribune, BDnews24, and many others.

CAPACITY BUILDING

8.3 As part of this project, do you plan to undertake training and/or capacity building activities to support policy counterparts and/or other in-country stakeholders?

x Yes

○ No

○ Unsure at this stage

8.3.1 Please provide details of planned activities, including details of the stakeholder(s) to be involved

If the RCT shows that the Brick Kiln Tracker is effective in improving the efficiency of enforcement, we will scale up the technology to cover all of Pakistan and hand it over to the government. We will continue to have a long-term engagement with the government to ensure that the technology is continuously updated and that the Department of Environment's capacity is built to manage the Brick Kiln Tracker by itself. In particular, the project team will hold capacity-building sessions increasing the Department of Environment's ability to work with GIS data both for this project and beyond. We then expect that one full-time equivalent employee at the Department of Environment can be trained to maintain and update the system.

To further support the long-term success of the project, we have also been in communication with a2i (https://a2i.gov.bd/), an agency within the Government of Pakistan, that specializes in scaling up e-governance systems. a2i have committed to helping out with the scale-up of the project if the experiment deems it successful and cost-effective. a2i have a long experience of providing technical assistance to government ministries and can do so over long periods of time before the eGovernance systems are ultimately transferred to the ministry that is the end user of the system. Anderson and a2i have had a successful collaboration on a previous RCT in Pakistan.

Page 9 - Inclusivity & Accessibility

INCLUSIVITY MARKERS

9.2 The following statements relate to the extent to which your project addresses *gender issues.* Please select the one option which most closely aligns with your project.

- ○ Addressing issues related to gender is the primary focus of my project
- ○ Addressing issues related to gender is a secondary or parallel focus of my project
- ○ My project does not have an explicit focus on gender but we will collect gender disaggregated data
- ○ My project does not have an explicit focus on gender, and we will not be collecting gender disaggregated data
- x My project does not have explicit focus on gender and it is not possible to collect gender disaggregated data for my project
- ○ Unsure

9.3 The following statements relate to the extent to which your project addresses issues faced by *marginalised or vulnerable groups.* Please select the one option which most closely aligns with your project. *Depending on the context of your research, marginalised or vulnerable groups could, for example, include: people living with disability, geographically and politically marginalised groups, and youth and elderly groups*

- ○ Inclusivity of marginalised or vulnerable groups is the primary focus of my project
- ○ Inclusivity of marginalised or vulnerable groups is a secondary or parallel focus of my project
- x My project does not have an explicit focus on marginalised or vulnerable groups
- ○ This question is not applicable due to the nature of my project
- ○ Unsure

9.4 The following statements relate to the extent to which your project addresses issues of *climate change, mitigating, or adapting to environmental externalities.* Please select the one option which most closely aligns with your project.

x
Addressing issues relating to climate change or environmental externalities is a primary focus of my project

Addressing issues relating to climate change or environmental externalities is a secondary or parallel focus of my project

My project does not have an explicit focus on climate change, mitigating, or adapting to environmental externalities

Unsure

9.4.1 If relevant, please provide detail on the way in which your project addresses issues of climate change and/or environmental degradation, identifying whether this will involve data collection and/or analysis.

This project addresses the issue of air pollution in Pakistan. Pakistan suffers from a severe air pollution problem with annual PM2.5 concentration being 13 times higher than the WHO standards. It is estimated that an average Pakistani citizen's life expectancy is 6.7 years lower as a result of this air pollution (AQLI, 2023). In urban Pakistan, various studies estimate that brick kilns are the single largest source of air pollution. In 2014, the government introduced regulation making the vast majority of brick kilns (>88%) illegal. This shows the political will in Pakistan to reduce air pollution, but due to a lack of enforcement capacity, the vast majority of kilns violate this and still operate.

Current enforcement is inconsistent and not targeted towards the most harmful polluters. Our innovation will help the government of Pakistan identify the most harmful brick kilns. This will help them prioritize areas with a higher need for enforcement. If information is a binding constraint and government officials do not efficiently prioritize enforcement since they do not know the harm of individual kilns, the dashboard will increase the enforcement of the most harmful brick kilns.

The problem of air pollution due to brick kilns is not specific to Pakistan. Other countries in the 'Brick Belt' like India, Bangladesh, and Nepal also have a large number of polluting brick kilns, against whom enforcement has been ineffective. The insights from this project will be directly applicable to increasing enforcement against air polluters and improving overall air quality in those countries as well.

ACCESSIBILITY

9.5 Would IGC support in translating project outputs to other languages be useful?

x Yes

No

9.5.1 Please list languages below.

Punjabi, Pushto, Sindhi, Saraiki, Urdu, and Balochi.

Page 10- Financial Information

INSTRUCTIONS

1. Review Contracts/Overhead % (institutional contracts only): check the contracts and overhead % allocations in this section. Note, you may assign up to 15% overhead for institutionally managed contracts (which should reflect the actual overheads charged by the institution). The 'Assigned Contract Value' for each contract in this section is derived from the sum of lines that relevant contracts have been assigned to in the budget table in Section 2 (see 'Linked Contract' field).

2. Review Project Budget Detail: adjust the line-by-line project budget detail in this section. Here you can add, edit and remove costs, assign lines to specific contracts, review and add comments against specific lines, and review/add any supporting documentation. Please note, this section should not include any overheads. These should be accounted for in section 1 only. Pay attention to any highlighted sections/comments under specific budget lines. You must save changes to this section using the purple 'Save' button. Any unsaved changes will be lost.

3. Budget Policy Compliance: please review and acknowledge compliance with specific IGC budget policies in this section.

4. Budget Total Verification: this final section provides a high-level summary of your budget, as follows:
• '*Total Estimated Project Budget*' - the overall amount you have requested for funding. This should match the total (including overheads) of your detailed budget on this page.
• '*Total Assigned Budget (inc. Overhead)*' - this is the total value of all lines in the detailed budget section that have been linked to a particular contract. The relevant overhead percentage is applied to this amount.
• '*Total Unassigned Budget*' - this is the total of any lines from your detailed budget that have not been linked to a contract. This excludes any overhead as overheads are applied on a contract basis.
• '*Budget Variance*' - this is the difference between the 'Total Estimated Project Budget' and the 'Total Assigned/Unassigned Budget' fields combined. Your budget variance should be zero.

The sum of the 'Total Assigned/Unassigned Budget' fields must match the 'Total Estimated Project Budget' and you will not be able to submit this form if this condition is not respected.

1. CONTRACTS/OVERHEADS

The below contract(s) are added automatically based on your responses on page 3 of this form. Please ensure that information on page 3 is complete before continuing.

Contracting Party Name	Assigned Contract Value	Overhead %	Overhead Amount	Total Contract Value (inc. Overheads)
Suntory and Toyota International Centres for Economics and Related Disciplines	23555.10 Total of assigned lines from detailed budget, excludes overheads	15.00 A maximum of 15% overhead is allowed for institutional contracts	3533.26	27088.36

2. PROJECT BUDGET DETAIL

3. BUDGET POLICY CONFIRMATION

All lines related to Project Fees should comply with the IGC Pay Matrix. Please acknowledge your compliance with the Pay Matrix below.

x I can confirm that fees stated in the proposed budget adhere to the IGC Pay Matrix

You must confirm that your proposed project budget meets all of the internal requirements of the host institution, and that the budget for this project has been reviewed and confirmed by relevant parties at this institution before submission of your project budget.

x I confirm that the project budget contained within this application has been reviewed and confirmed by relevant parties at the host institution.

4. BUDGET TOTAL VERIFICATION

TOTAL ESTIMATED PROJECT BUDGET

27088.36

Your overall requested funding, as entered on page 2 of this form

Optional

TOTAL ASSIGNED BUDGET (inc. overhead)

27088.36

The total from your project budget assigned to specific contract(s). This figure includes any overheads applied to relevant contracts.

TOTAL UNASSIGNED BUDGET

0.00

The total from your project budget currently unassigned to a particular contract (no overhead applied to unassigned amounts).
This should be zero, where possible.

BUDGET VARIANCE

0.00

Total Assigned/Unassigned Budget minus *Total Approved Project Budget*. Any non-zero amount is not allowed.

Please ensure changes to budget have been saved (section 2), budget policy compliance has been confirmed (section 3), and budget variance is not greater than zero (section 4).

Page 11 - Timeline of Outputs

A default schedule will be set for all IGC research projects based on their duration and budget, adhering to IGC policy. The below schedule is indicative of your project milestone schedule, based on the information entered in this form. Your actual milestone schedule can be adjusted during project pre-contracting, but will be broadly structured as follows:

- **First milestone:** Project Influence Plan (PIP, comprising pages 7-9 of this form), IRB approval (if required). The IRB approval can be shifted to the second (interim) output, but it must be completed before any research can take place. We may reach out for updates to the PIP after project approval if further information is needed.

- **Interim milestone:** Progress report(s). Researchers are expected to submit a Progress Report every 6-9 months from the due date of the first output, including for pilot and exploratory projects.

- **Final milestone:** Final Report/Working Paper, Policy Brief, Blog Post, Project Influence Report, Final Financial Statement. The due date of the final outputs needs to correspond with the end of the project.

Please refer to section 6.9 of the Guidelines for Applicants document for further details.

OUTPUT SCHEDULE

Milestone	Percentage of Grant	Deliverables	Due Date
Milestone 1	30%	Project Influence Plan and IRB	2025-03-01
Milestone 2	20%	Progress Report 1	2025-09-15
Milestone 3	20%	Progress Report 2	2026-02-15
Milestone 4	30%	Blog Post, Policy Brief, Final Financial Statement, Working Paper, Project Influence Report	2026-07-15

Page 12 - Co-Funding

CO-FUNDING

12.1 Do you expect that you will need any additional funds from other sources in order to complete the proposed research? (Note, you should answer 'Yes' to this question if you have received, applied for, or plan to apply for any third-party funding)

x Yes

○ No

Co-Funding

Please outline all other organisations you have applied to for funding, including the amounts and the status of these applications (planned/decision pending/awarded/rejected).

Organisation Name	FCDO/UK Aid funder	Funding Amount	Funding Currency	Date Applied	Application Status	Delete?
Open Philanthropy	No	289900	USD	01/01/2	Pending	
Mercatus Center	No	58800.(	USD	09/04/2	Pending	

Page 13 - Engagement & Additional Comments

IGC ENGAGEMENT

13.1 Have you previously attended an IGC event?

○ Yes

x No

13.2 Have you previously attended an IGC matchmaking event?

○ Yes

x No

13.3 How did you hear about this call for proposals?

IGC Website

13.4 Have you previously applied for IGC funding?

x Yes

○ No

13.4.1 Were you successful in winning IGC funding?

○ Yes

x No

ADDITIONAL COMMENTS & FILE UPLOADS

13.6 Please optionally provide any additional final comments relevant to your proposal here

Optional

13.7 Would you like to optionally add any supporting documents to support your project proposal?

○ Yes

x No

Any supplementary information such as tables, charts, graphs or letters of engagement are **not required** as part of the application form and should not be submitted with your application. Please ensure that any CVs have been added to the relevant line in the budget section.

FEEDBACK

13.8 Please rate your experience using this form. Please note, the responses you provide below will have no impact on your application.

	Very Bad	Bad	Neutral	Good	Very Good
Rating	○	○	○	○	**x**

13.8.1 Please optionally provide detail on your above rating, noting anything that you feel could be improved

Optional

Please review your responses for accuracy and completion, and click 'Submit for Final IGC Review' when you wish to submit this proposal. Please note, once you click the Submit button, it will no longer be possible to make any changes.

By completing this form, you agree to be contacted by the International Growth Centre. Please refer to the International Growth Centre website for our Privacy Policy

Submit for Final IGC Review