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Afghanistan Mine Action Geospatial Impact Evaluation

Final Summary Report

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e-Pact is a consortium led by Oxford Policy Management and co-managed with Itad

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Disclaimer

Executive Summary

As part of Itad's provision of Monitoring, Evaluation and Learning (MEL) services to the Foreign, Commonwealth and Development Office (FCDO)'s Global Mine Action Programme 2 (GMAP2), Itad partnered with AidData from the College of William & Mary to conduct a study to **assess the local socio-economic and stabilisation impacts of extensive landmine clearance activities carried out over the past three decades in Afghanistan.** To do so the study employed a geospatial impact evaluation (GIE) approach, and was intended to both a) contribute to the pool of academic literature on the contribution of mine action to spatial development and b) test and better understand the potential for GIE and other Geographic Information System (GIS)-based approaches for understanding and assessing the impact of mine action.

This research would not have been possible without the collaboration of the Directorate for Mine Action Coordination (DMAC) in Afghanistan.

Findings

Key findings from the study include:

Strong evidence of a causal link between clearance of hazardous areas in Afghanistan and economic development, measured in increases in Nighttime Lights (NTL).

Significant differences between areas cleared prior to 2008 and those cleared from 2008 and onward, both in terms of the characteristics of areas cleared and the outcomes of clearance- likely reflecting changes in approaches to prioritisation implemented in Afghanistan around 2008.

Clearance prior to 2008 had no evident effect on economic development, but areas cleared from 2008 onward experienced a significant and substantial increase in economic activity as a result of clearance.

Areas cleared from 2008 onwards experienced lasting increases in built-up land.

Clearance was associated with increased trust in district government and satisfaction in government service provision. These effects were strongest in areas which had the lowest levels of baseline conflict

Clearance was associated with higher monetary amounts of subsequent aid investment at the district level.

Implications

The impacts of mine action

The mine action sector should draw confidence from the findings of this study which support expectations about the positive impact of clearance on economic development.

Furthermore, the study found some evidence that clearance can contribute to stabilisation-related outcomes, which although less conclusive do provide important early evidence to support another key pathway in mine action Theories of Change (ToCs).

The study also clearly indicates the mediating role that levels of conflict in the lead up to and at the time of clearance can have on subsequent outcomes. Finally, the study's findings also demonstrate that how the sector approaches prioritisation can have significant influence on long-term development and stabilisation outcomes.

The utility of GIE/GIS approaches

The study has demonstrated that the GIE methodology and other GIS-based approaches offer significant potential to the mine action sector to enhance understanding of the impact of its work. There is potential to enhance the utility of GIE/GIS methods by complementing these methods with the data collection resources that the sector has available.

1 Introduction

There has been interest in understanding and demonstrating the relationship between humanitarian mine action and its beneficial results throughout the last three decades. To date, there have been relatively few high-quality academic studies and little high quality, peer reviewed statistical analysis. Without a better understanding of how mine action operations influence social, economic and security aspects in mine and explosive remnants of war (ERW) contaminated areas, opportunities may be missed to maximise benefits. In some instances, activities may turn out to have been inappropriate, ineffective or even harmful in unexpected and unpredicted ways.

A literature review, carried out by Itad as part of its provision of Monitoring, Evaluation and Learning (MEL) services to the Foreign, Commonwealth and Development Office (FCDO)'s Global Mine Action Programme 2 (GMAP2), highlighted the very limited quantitative analysis that has been conducted into this important area of research, but it also noted the work done by Chiovelli, Michalopoulos and Papaioannou on the use of nighttime lights (NTL) analysis within a Geospatial Impact Evaluation (GIE) to investigate evidence for the influence of landmine clearance on spatial development in Mozambique[1] .

Informed by the findings of that literature review, Itad partnered with AidData from the College of William & Mary to conduct a study to **assess the local socio-economic and stabilisation impacts of extensive landmine clearance[2]** activities carried out over the past three decades in Afghanistan. In doing so it is intended to a) contribute to the pool of academic literature on the contribution of mine action to spatial development and b) build on previous NTL studies, integrating additional data sources to test and better understand the potential for GIE and other Geographic Information System (GIS)-based approaches for understanding and assessing the impact of mine action, both in Afghanistan and elsewhere.

Afghanistan is one of the countries most heavily affected by landmines, in terms of both the known number of hazards and annually recorded casualties, which presents a key challenge to human welfare and economic development in the country. Landmines are widespread geographically, affecting almost every province in the country. In addition to the evident humanitarian and economic toll of death and injury, the widespread prevalence of unexploded landmines in the country also stands to hinder economic development due to the blockages they impose. Landmines impede the flow of goods and people; this not only restricts trade and labour flows, but also hinders access to schools and medical care, with potentially long-lasting impacts on human capital accumulation. In addition, landmines block the productive use of contaminated land. The Mine Action Programme of Afghanistan (MAPA) operates one of the largest landmine removal programmes in the world, a programme which has been active since 1989. MAPA has, to date, cleared more than 15,000 hazardous areas spanning 33 Afghan provinces. Despite the significance of landmine contamination in the country and this long history of demining, little is known about the exact socio-economic impacts of clearance activities in Afghanistan and whether these effects differ depending on the characteristics of the local area.

This report presents a **summary of the study approach, key findings, limitations, implications and recommendations emerging from the study.** In doing so it draws on two more detailed reports which present the study methodology and results in greater depth[3].

[1] Chiovelli, G et al (2018). Landmines and Spatial Development. (National Bureau of Economic Research Working Paper No. 24758). Cambridge: NBER

[2] Throughout the report, we use the term 'landmine' or 'mine' to refer to both mines and other explosive remnants of war (ERW), and 'clearance' to refer to land released through either through clearance or survey

[3] Itad (2021). Afghanistan Mine Action Geospatial Impact Evaluation Phase 1-2, Final Report; Itad (2022). Afghanistan Mine Action Geospatial Impact Evaluation Phase 3, Final Report

2 Study approach

2.1 Purpose and objectives

The primary goal of this study was to contribute to improved understanding of the contribution of landmine clearance to development and stabilisation outcomes in Afghanistan. In addition, a second goal of the study was to explore the utility of GIE and other GIS-based approaches for understanding and assessing the results of mine action, both in Afghanistan and elsewhere.

The study set out to address the following guiding research questions:

1. **What effect have landmine clearance activities in Afghanistan had on the following outcomes?**
   - **Economic activity**
   - **Population growth**
   - **Trust in government**
   - **Reported financial well-being**
   - **Market access**
   - **Conflict levels**
2. **What effect have landmine clearance activities in Afghanistan had on land use?**
3. **At what point in the conflict cycle has clearance typically happened in Afghanistan? How do baseline conflict levels effect subsequent outcomes?**

2.2 Methodology

The study employed a geospatial impact evaluation (GIE) approach to address the research questions. GIE is an innovative approach for studying causal impacts of development interventions. To do so, it utilises spatial and temporal data about interventions (i.e. clearance activities) combined with available sources of historical outcome data, such as remotely sensed satellite data and large-scale surveys. It then employs analytical methods to mimic the conditions of a randomized control trial (RCT)[4], which enables the assessment of causal influences on intended (or unintended) impacts of the intervention. Key data sources which the study draws on are detailed in Box 1 below.

Box 1: Key data sources

Clearance data. MAPA Geo-data database of hazardous areas and clearance dates, provided by DMAC.

NTL emission data, as a proxy measure of economic activity.

Land-use data. Medium resolution daylight satellite imagery to perform an assessment of land-use and for three provinces with the largest number of landmine clearance locations in Afghanistan[5], combined with classification and change algorithms to classify and identify changes to land use types.

Data on reported financial well-being, trust in government, and market access from responses to the Measuring Impacts of Stabilization Initiatives (MISTI) survey, conducted by United States Agency for International Development (USAID).

Data on population levels and density and flows of Internally Displaced Persons (IDPs), including National Aeronautics and Space Administration (NASA) Socioeconomic Data, Applications Center (SEDAC) Gridded Population of the World Version 4 (GPWv4), and United Nations Office for the Coordination of Humanitarian Affairs (OCHA) data on IDP flows.

Data on road networks and market access, including Very High Resolution (VHR) Planet satellite imagery plus road network maps from OCHA, to assess distance to roads and market access.

Conflict data from the Uppsala Conflict Data Program (UCDP), a dataset which includes geocoded data on individual events of organised violence (categorised as state-based armed conflict, non-state conflict, and one-sided violence).

Aid Investment Management Systems (AIMS) data on all external assistance projects in Afghanistan's Development Assistance Database (DAD).

The key analytical method employed in the study is a method called difference-in-difference (DiD). DiD allows us to estimate the causal impact of landmine clearance on areas that underwent clearance at a specific time by comparing their trajectories to the trajectories of localities where clearance had not yet taken place.

[4] A randomised controlled trial (RCT) is a trial or experiment carried out on two or more groups to capture the impact of an intervention where participants are randomly assigned to receive an intervention or not

[5] Bahlan, Parwan, and Kabul

3 Findings

3.1 Changes in prioritisation approaches

Our analyses revealed significant differences between the hazardous areas cleared prior to 2008 and those cleared from 2008 and onward, both in terms of a) the characteristics of areas cleared; and b) the outcomes of clearance. This likely reflects the changes in approaches to prioritisation implemented in Afghanistan around 2008, and demonstrates the effects that approaches to prioritisation can have on long-term development outcomes.

On average, areas where clearance took place before 2008 had much higher population density, were closer to Kabul, had higher nighttime light emission, and were more likely to experience a road blockage as a result of hazards. On the other hand, on average, areas where clearance took place from 2008 onwards were affected by a greater number of, and larger, hazardous areas, were closer to roads, experienced more conflict events, and were more likely to experience a grazing or agriculture blockage as a result of hazards. Areas cleared between 2003 and 2007 also generally had more promising preceding economic development trajectories than cells cleared in 2008 or later. Finally, whilst areas cleared both before 2008 and afterwards typically exhibited a steady decrease in conflict events in the years leading up to clearance, this trend was less pronounced in areas cleared in 2008 or later – suggesting that trends in conflict may have had less of an influence on the prioritisation process from 2008 onwards.

Figure 1: Proximity of cleared areas to roads, before and from 2008, Kabul province

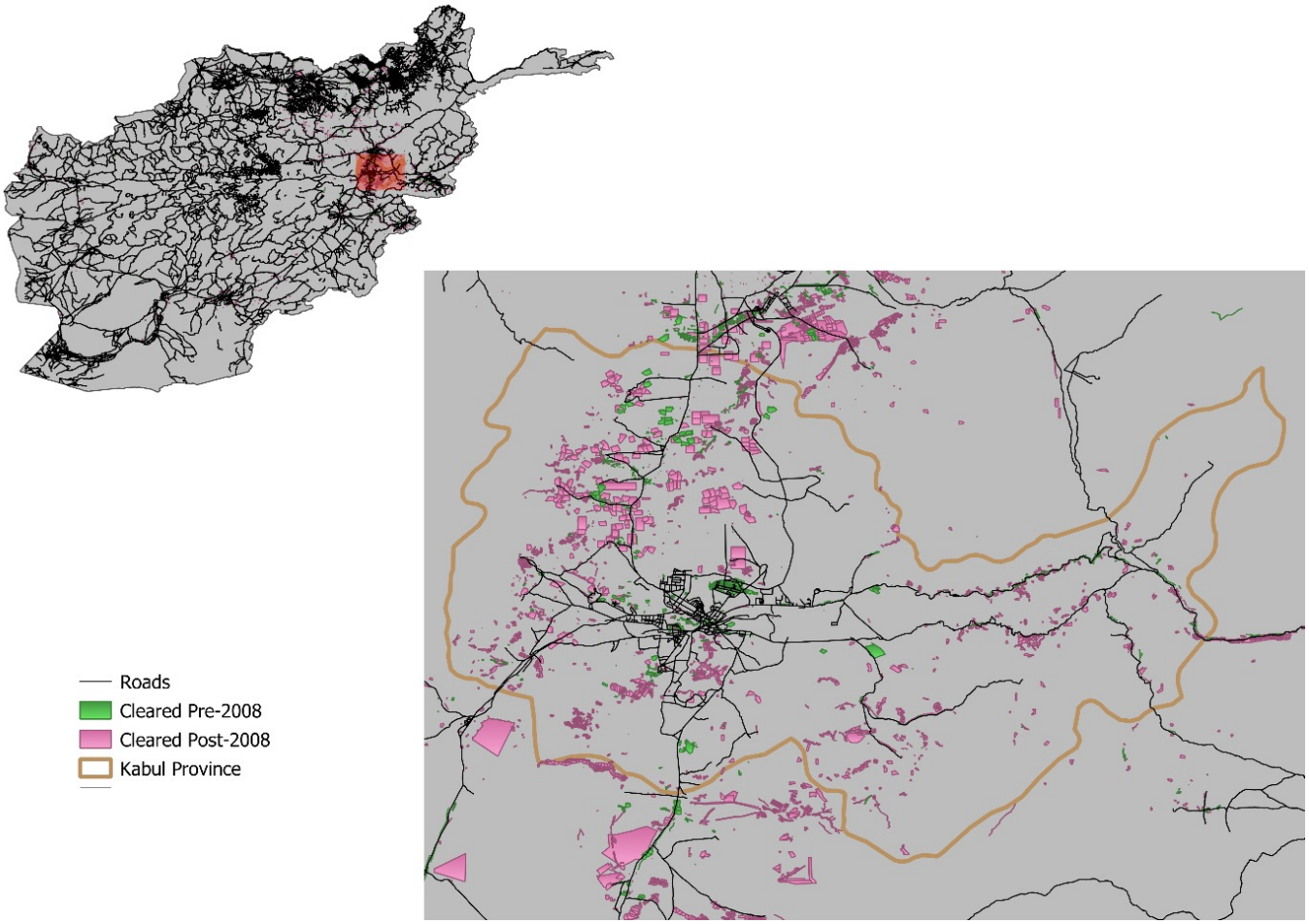
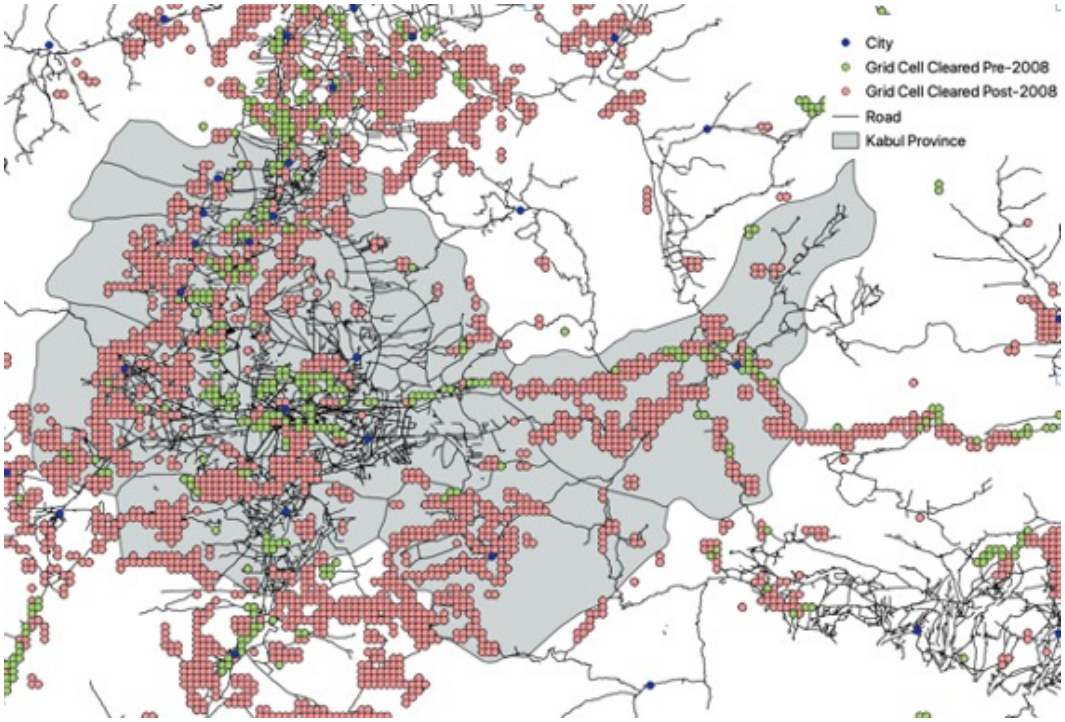


Figure 2: Proximity of cleared areas to dense population centres, before and from 2008



Subsequent desk-based research conducted to examine possible reasons for these differences revealed that, around the 2008 period as part of early moves to transition to national ownership, the Mine Action Programme Afghanistan (MAPA) underwent significant reform and restructuring[6]. This included changes to leadership and management structures at the Mine Action Coordination Centre (MACCA) in 2007[7], a change in the lead government agency in January 2008[8], changes to tasking responsibilities and prioritisation criteria[9], the introduction of community-based demining approaches[10], and a number of other operational reforms[11]. These reforms are reported to have had significant impact, resulting in 'substantial improvements in key outputs delivered from the demining programme'[12] and leading to a 2009 strategic plan which was considered by an EU evaluation to be at the time 'the most systematically intelligent planning process and product at national programme level observed anywhere in the global mine action industry'. The evaluation reported that 'the planning pillars and prioritisation process has succeeded in linking impact information with operational taskings, allowing a far more reflective process, resulting in a more intelligent allocation of resources'[13]. According to the MAPA Integrated Work Plan for Afghanistan year 1388 (1st April 2009 - 31st March 2010) 'while operational plans have been prepared for many years in Afghanistan, the set of [prioritisation] criteria has been reworked based on thorough analysis, and the 1387 and 1388 operational plans will serve as a foundation for a much enhanced operational plans in the future'. Table 1 below details the evolution of prioritisation criteria between 2007 and 2009.

6 The Monitor (2019). Afghanistan Mine Action: 20 Year Summary, http://www.the-monitor.org/en-gb/reports/2019/afghanistan/mine-action.aspx The Monitor (2010). Afghanistan Mine Action: Contamination and Impact http://www.the-monitor.org/en-gb/reports/2010/afghanistan/mine-action.aspx; Geneva International Centre for Humanitarian Demining (GICHD) (2008). Afghan Country Mission Report, Evaluation of EC Mine Action, https://www.gichd.org/fileadmin/pdf/evaluations/database/EvaluationEC-Afghanistan-GICHD-Sep2008.pdf

7 GICHD (2012). Transitioning Mine Action Programmes to National Ownership, Afghanistan, https://www.gichd.org/fileadmin/GICHD-resources/rec-documents/Transition-Afghanistan-Case-Study-Nov2012.pdf

8 GICHD (2013). Strategic Planning in Mine Action Programmes Afghanistan, https://reliefweb.int/sites/reliefweb.int/files/resources/Afghanistan_Strategic%20Planning_2013_10_17_docx%20(1).pdf

9 The Monitor (2010). Afghanistan Mine Action: Contamination and Impact http://www.the-monitor.org/en-gb/reports/2010/afghanistan/mine-action.aspx

10 DMAC. Community Based Demining (CBD) Operations in Afghanistan, https://www.mineaction.org/sites/default/files/documents/measures_for_successful_implementation_of_cbd.pdf

11 GICHD (2012). Transitioning Mine Action Programmes to National Ownership, Afghanistan, https://www.gichd.org/fileadmin/GICHD-resources/rec-documents/Transition-Afghanistan-Case-Study-Nov2012.pdf

12 Ibid

13 EU (2009). Mid-Term Evaluation of the Mine Action Programme in Afghanistan, https://reliefweb.int/sites/reliefweb.int/files/resources/F9BF93A59A368B0F49257707001ACE4D-Full_Report.pdf

As detailed in sections 3.2-3.6 below, we also found significant differences in the outcomes of clearance happening before 2008 and later. This would indicate that these changes to prioritisation approaches had a significant impact on the development and stabilisation impacts of clearance.

Table 1: Prioritisation criteria in Afghanistan 2007 - 2009

MAPA Integrated Work Plan[14] Afghanistan year 1386 (1st April 2007 - 31st March 2008)	MAPA Integrated Work Plan[15] Afghanistan year 1387 (1st April 2008 - 31st March 2009)	MAPA Integrated Work Plan[16] Afghanistan year 1388 (1st April 2009 - 31st March 2010)
Sets out 3 levels of operational priority, based on the following factors/conditions: • **High/medium/low impact** – as defined by Afghanistan Landmine Impact Survey (ALIS) • **Casualties** – levels/risk of • **Repatriation** –how soon demining likely to be needed to support return of IDPs/refugees • **Rehabilitation/development** – any requests to support development projects and how soon they are commencing • **Social impact** – whether clearance is required to enable access to essential services	"Priority setting for the year 1387 is set based on the following planning influences/pillars in order to establish priorities at the district and individual demining task levels: MACA's top priority during 1387 will be addressing: **1. The killing zones** **2. Hazards within 500m proximity of the community** **3. High impacted communities** **4. Medium Impacted Communities** **5. Highly contaminated districts** **6. Removing small hazards** **7. Completing the "doable's" FAST** **8. Expansion of Community Based Demining Projects** **9. Areas with cultural or other benefits"**	"The operational plan is shaped by the following planning pillars criteria in this order to establish priorities at the district and individual demining task levels:" • **The 'killing zones'.** Communities that have recorded mine victims since every year since 2003 • **High impact communities.** The scoring mechanism calculates a score based on the presence of mines/ UXO, livelihood blockages and number of recent victims recorded against hazards • **SHAs with victims** • **Small hazards.** The hazards grouped into this pillar are smaller than 5,000 sqm • **Hazards proximity.** All hazards within a 500 m radius from the community centre • **Medium Impacted Communities** • **Donor Specific Priorities** • **Organization Specific Priorities** • **Non Classified Hazards** • **Hazards by Districts**

[14] MAPA (2007). Integrated Work Plan, http://dmac.gov.af/wp-content/uploads/2017/03/National-Ops-Work-Plan-1386-2007-2008Integrated-Work-Plan-IWP-1386-2007-2008.pdf

[15] MAPA (2008). Integrated Work Plan, http://dmac.gov.af/wp-content/uploads/2017/03/Integrated-Work-Plan-IWP-1387-2008-2009.pdf

[16] MAPA (2009). Integrated Work Plan, http://dmac.gov.af/wp-content/uploads/2017/03/Integrated-Work-Plan-1388-1st-April-09-31st-March-2010.pdf

3.2 Clearance and economic development

The study found there is **strong evidence of a causal link between clearance of hazardous areas in Afghanistan and economic development**, measured in increase in NTL. This aligns with the findings from the Chiovelli, G et al Mozambique NTL study and provides important reinforcement for the validity of economic development pathways in mine action Theories of Change (ToCs).

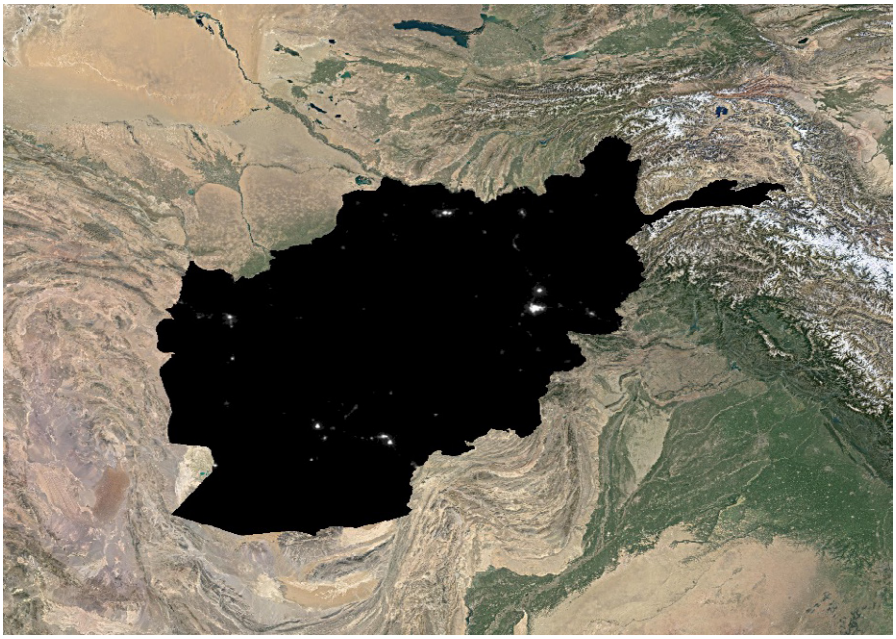
However, the study also found a marked difference in economic gains for land cleared before and after 2008, with clearance prior to 2008 having no evident effect on economic development. By contrast, areas cleared from 2008 onward experienced a significant and substantial increase in economic activity as a result of clearance. As discussed in section 3.1. above, areas cleared from 2008 onward were in general more rural, less populated and had experienced slower preceding economic growth than those areas selected prior to 2008. In other words, the greatest economic gains arose from those areas that were least developed at the time of clearance. Both before 2008 and afterwards, economic gains from clearance were disproportionately concentrated in areas closer to roads and areas with greater relative population density (even in more rural areas).

Economic effects are seen at the district as well as local level, suggesting that **clearance can contribute to increased economic activity across wide geographic areas beyond the immediate location of clearance.**

When controlling for trends in conflict levels leading up to the time of clearance, we found that **among areas cleared before 2008, increases in economic development following clearance were associated with declining levels of conflict prior to clearance, rather than being a result of clearance itself.** We also see that in areas closest to roads and with the highest baseline populations, there may have been a positive effect of clearance independent of the effects of trends in conflict. However, in less populated areas, clearance may have had a negative overall effect on economic development in this period. **From 2008 onwards, on the other hand, increases in economic development are more clearly attributable to the clearance itself.** There was no relationship between trends in conflict leading up to clearance and subsequent levels of economic development. Furthermore, **the positive effects of clearance on economic development observed in areas cleared in or after 2008 were strongest in those areas with higher baseline levels of conflict**[17]**.**

No relationship was identified between clearance and reported financial well-being or reported market access, though this was likely due to limitations of the survey data rather than indicating that no relationship exists.

Figure 3: Example of NTL emissions imagery



[17]The same pattern was evident when we examined conflict levels within different radiuses of clearance sties, from 1km up to 10kms

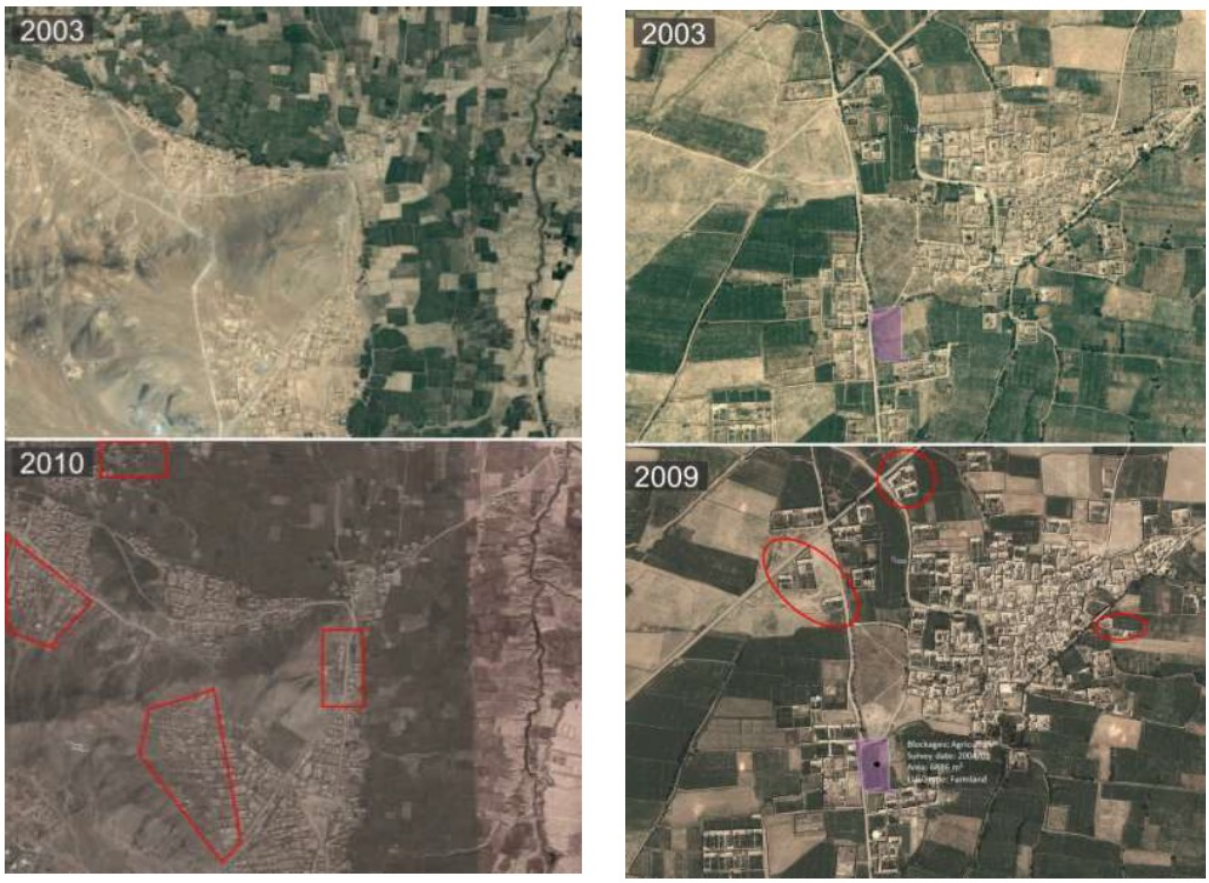
3.3 Clearance and changes in land use

As NTL as a proxy for economic development may overlook development in more rural, less electrified areas, the study also considers the effect of clearance on built-up land use, as an additional proxy for economic development. The study found that areas cleared from 2008 onwards experienced increases in built-up land. This aligns with the findings from our NTL analysis (see section 3.2), lending further support to our finding of a strong causal link between clearance and economic development for clearance from 2008 onward. Increases in built-up land were long-lasting and followed from clearance of road, infrastructure, water and agricultural blockages.

Unlike for economic development as measured by NTL, neither baseline conflict levels or trends in conflict levels leading up to clearance appear to have influenced the effect of clearance on increases in built-up land. Increases in built-up land use after clearance observed among areas cleared in 2008 and later were equally likely to occur in areas experiencing low and high levels of conflict at the time of clearance, and regardless of pre-trends in conflict levels. This suggests that those increases in built-up land use are attributable to the clearance itself rather than to any decline in conflict.

The study found no evidence of a significant expansion of farmland as a result of clearance. This is the case in areas with both the greatest and least road access, and even in areas where hazards cleared had been designated as agricultural blockages. This may not be a surprise to mine action planners and prioritisers. The general expectation is that where land previously used for farming is not in use due to landmine contamination, clearance will make that land safe to use for farming once again. The result is to take 'out of use' farmland and put it back 'into use'. The creation of new farmland is not usually a land release objective. The study reinforces that broad understanding. It was beyond the scope of the study to examine whether 'out of use' farmland and put it back 'into use', but further research could potentially explore this.

Figure 4: Examples of increases in built-up land use evident in satellite imagery



3.4 Clearance and trust in government

Clearance was found to be associated with increased trust in district government and satisfaction in government service provision[18]. These effects were strongest in areas which had the lowest levels of conflict in the immediate area of clearance in the year preceding clearance.

The study found that **clearance was associated with a negative impact of landmine clearance on people's perception of how multi-level government effectiveness had changed in the past year**. However, when controlling for conflict levels in the year preceding clearance, we found that clearance likely had little to no impact on perception of multi-level government effectiveness in areas with low levels of conflict in the year preceding conflict. In areas with higher levels of baseline conflict on the other hand, clearance led to a decrease in the belief that government at all levels was effective. The negative impact on multi-level government effectiveness may reflect a different general view of district and non-district government, but it is equally possible that the way that survey questions were framed had some influence.

3.5 Clearance and conflict dynamics

Among areas that were cleared before 2008, there was no effect of clearance on subsequent levels of conflict. This may be because, as discussed in section 3.1 above, it appears that prior to 2008 sites were typically selected for clearance only after conflict decreased and stabilised to a new low level. This may have meant that there was little room for clearance activities to make a large impact on subsequent conflict levels.

However, as also discussed in section 3.1, from 2008 onwards pre-trends in conflict appear to have been less of a factor for determining selection of sites for clearance. **For those areas cleared from 2008 onwards, clearance was associated with a decrease in subsequent levels of conflict, particularly in areas with lower levels of conflict at the time of clearance.**

The study found that **clearance activities were associated with higher monetary amounts of aid investment (including bilateral, multilateral, and private aid sources) at the district level.** This relationship grows stronger as more time passes after clearance, suggesting that the effects are cumulative over time. This increase in total aid investment was driven by higher value aid investments, rather than increased numbers of aid projects.

The study did not find any evidence of links between population movements and clearance. This is most likely due to limitations of the quality and availability of data on population levels, density and IDP flows for Afghanistan, rather than indicating that no such relationship exists.

[18] As reported by respondents in the USAID MISTI survey

4 Limitations

In this section we outline several key limitations of the study.

NTL as a proxy indicator of economic development:

NTL studies are best suited to identifying changes in economic activity associated with electrification. The study additionally used daytime satellite imagery to examine some aspects of economic development (changes in land use) that would not be visible as NTL. This analysis was itself, however, limited to identifying land use that changes or stays the same. It could not assess aspects like changes in productivity in land that remains in the same use. While these are important limitations, the implication is that NTL indicators alone would most likely result in underestimation of impact on economic activity.

Productivity of farmland

Similarly, while the study did not find any impact of mine clearance on the share of land being used for farming, there may well be important improvements in the productivity of farmland which this study was not able to detect. Land already classified as farmland may have been returned to 'in use' following clearance, or, for example, farmers may have not applied substantial fertiliser to or irrigated fields near hazards until they were cleared. Further research using additional satellite data could be used to explore these issues (see section 5 below).

Lack of on-the-ground data collection

It had initially been the intention to conduct complementary on-the-ground data collection in Afghanistan as part of the study. This had been intended to serve two purposes. Firstly, we had planned to collect ground-reference data on community resilience indicators such as crop type, diversity in land use, levels of in-use farmland, and building quality, in order to then train machine learning models to examine these variables in satellite imagery. Secondly, we had planned to conduct complementary qualitative data collection to examine some of the qualitative nuances behind the findings emerging from our remote methods. However, the deteriorating security situation in Afghanistan over the period of the study meant on-the-ground data collection was not feasible.

Conflict data

For our analysis of conflict levels near hazardous areas before and after clearance, we used the UCDP dataset. Whilst the UCDP is among the most comprehensive and accurately georeferenced datasets on conflict events available, it does have some limitations. First, it focuses on conflict events in which at least one party is an organized actor, thus largely capturing political conflict, rather than, for example, inter-communal violence. Second, it is based on a combination of media-reported events and those collected from other sources, including Non-governmental organisation (NGO) publications and online databases. As a result, there are events which may be underrepresented, especially if these are unreported in media sources. Whilst similar issues are inherent in all conflict incident datasets, they are important to bear in mind when interpreting results of our analyses.

Utility of and access to other datasets

The fact that the study was unable to detect other changes relating to population movements, reported financial well-being and access to markets does not mean that such benefits did not arise, but rather may largely be a result of challenges with the availability, coverage, and quality of the data on these outcomes. Data available for the study on population levels, density and IDP flows lacked sufficient detail and duration. There were similar limitations with the satellite imagery used to measure road density and assess access to markets. The MISTI survey data was collected over a relatively short time frame making it hard to detect long term changes and narrowing our sample of clearance activity to that timeframe. The study also had no influence on the survey questions, reducing their utility. We were also unable to access a number of other potentially useful datasets such as International Organisation for Migration (IOM) data on flows of IDPs and refugees, and UNICEF data on health and education outcomes.

5 Implications and recommendations

5.1 Implications for the mine action sector

What the study tells us about the impact of mine action

The mine action sector in Afghanistan (and elsewhere) should draw confidence from the findings of this study which support expectations about the positive impact of clearance on economic development. Evidence of an increase in economic development as measured by NTL emissions, an increase in built-up land use, and of positive effects of clearance on levels of aid investment all lend weight to assumptions that clearance can contribute to positive and sustained effects on economic development. Furthermore, the study findings suggest that these effects can accrue to wider areas beyond the immediate clearance location. It is also important to note that, where no evident effects were identified (e.g. pre-2008), this could potentially be due to limitations of the study, and that in fact direct and indirect effects on economic development may be underestimated.

Evidence from studies such as this one and the Mozambique NTL study have the potential to support making a case for the value of mine action and contribute to the evidence base informing programme design and mine action objectives.

The study also found **some evidence that clearance can contribute to stabilisation-related outcomes,** including an enhanced trust in government and satisfaction in government service provision, and ultimately to a decline in levels of conflict post-clearance. Although these findings are less conclusive and further research would be required to better understand and interrogate them, they do provide important early evidence to support another key pathway in mine action ToCs.

The study also clearly indicates **the mediating role that levels of conflict in the lead up to and at the time of clearance can have on subsequent outcomes**. The effects of clearance on economic development, trust in government and subsequent levels of conflict all vary based on pre-trends and/or baseline levels of conflict. This suggests that strategic timing of mine action in the conflict cycle is important to reap the maximum benefits of mine action, and indicates the importance of high quality conflict analysis to support the appropriate timing of clearance to maximise outcomes.

Across a number of our analyses, the study found significant differences between the outcomes of clearance before 2008 and from 2008 onward. As discussed in section 3.1., sites cleared prior to 2008 had significant differences in characteristics to those cleared later – evidence of the changes to prioritisation approaches that occurred in Afghanistan around 2008. Whilst it is beyond the scope of this study to make judgements about the relative merits of pre and post 2008 clearance, the study's findings – including that greater economic benefits are associated with land released after 2008 – are important for the mine action community as they indicates that **how the sector approaches to prioritisation can have significant influence on long-term development and stabilisation outcomes.**

The utility of GIE/GIS approaches for the sector

The study has demonstrated that the GIE methodology and other GIS-based approaches offer significant potential to the mine action sector to enhance understanding of the impact of its work. This study builds on the work previously done in Mozambique demonstrating once again that the method has value in building the evidence base on mine action's results and extending understanding of some causal pathways in mine action ToCs. The availability – in Afghanistan and elsewhere – of detailed, high quality, geo-coded data on hazardous areas and clearance activities makes the sector uniquely placed to utilise GIS-methods. Although there remain limits to what can be assessed using NTL and satellite imagery, GIE and GIS allows highly cost-effective research, with the capability to look back over extended periods of time, covering wide geographical areas, and avoiding the need for physical surveys in potentially hazardous areas. Further GIE studies have the potential to further extend understanding of mine action outcomes, and could cover other geographic areas to extend our understanding of mine action outcomes across a diverse range of contexts. Further studies would also help to refine what, at present, remains an innovative and relatively untested approach.

There is potential to enhance the utility of GIE/GIS methods by complementing these methods with the data collection resources that the sector has available. The study faced limitations relating to data on the details of land use and other community resilience indicators. Mine action operations offer the opportunity to collect important data at key points in the land release process including during Non-technical Survey (NTS) before clearance and as part of post-clearance impact assessments. The effectiveness of GIE/GIS methods could be enhanced with complementary on-the-ground data collection by implementing partners, which could, by enhancing the extent and quality of available outcome data, support more insightful future studies.

5.2 Recommendations

Additional research

It is recommended that donors, individually or in partnership, support other studies, using similar approaches in other geographical areas, and using additional data sources. Further studies would contribute to building the evidence base for mine action, by further investigating links between clearance and development and stabilisation outcomes and testing the causal pathways of mine action ToCs, whilst at the time helping refine GIE-based methods to maximise their utility for the sector. This study should be viewed as the beginning of an approach, which could be extended and built upon to test other ToC pathways as well as the links between them.

Future studies could draw on addition data sets to explore additional impacts of mine action not examined in this study. For example, in order to explore changes in farmland use and productivity as a result of clearance, future research could use additional satellite data, such as the normalised difference vegetation index (NDVI), and rural land classification data. Data on health and education outcomes could also be examined.

Conducting studies in other geographic areas would enable the testing of this study's findings to understand whether they are generalisable across different contexts or whether they are specific to the Afghanistan context. Furthermore, future studies could potentially overcome some of the limitations faced by this study in terms of availability and quality of data, by selecting a context in which, for example, more complete administrative data available on IDPs and population flows and more extensive data on road networks is available.

Mine action continues in Afghanistan. **A further update to this study, carried out after five years** using the most recent NTL and other relevant data, would extend understanding of the value of this sort of analysis and could, if combined with improved data collection approaches recommended below, help refine conclusions about the impact of clearance work.

Integrating GIE/GIS methods with existing data collection methods

The sector should explore ways to better complement these methods with the data collection resources it has available. As discussed in section 5.1 above, complementary data collection by mine action implementers could potentially enhance the utility of GIE/GIS methods. It is recommended that stakeholders meet to discuss further the sort of data that implementing partners could collect to support more insightful future studies.

Qualitative, on-the-ground data collection could be used to complement this and subsequent GIE studies, to validate and explore nuances behind GIE findings. Combining GIE studies with on-the-ground, qualitative data collection would enable researchers to explore, for example, potential differences in impacts along gender or other lines, and mine action's relationship with conflict and stability, in more detail. Such data collection might take the form of, for example, household surveys and key informant interviews. The purpose of these would be to interrogate correlations uncovered by the GIE, explore the human story behind them, and to verify and better understand the extent that there are causal links, and any mediating factors associated with those.