Global Fire Use Survey Methods Summary

1. Survey design and participant recruitment

The Global Fire Use Survey was initially conceived of and designed over a year of monthly meetings by an interdisciplinary, international, team of 9 researchers working for universities and state agencies. In 2022, the draft survey was piloted with 6 researchers with expertise in human fire use. The pilot participants were asked to provide feedback for each individual survey question and broader comments on survey design, structure and language. The pilot participants were then invited to online meetings to discuss their feedback in more detail. After editing to reflect their feedback, the pilot participants were invited to comment on another survey draft. They were subsequently invited to co-author this paper in recognition of their contribution to the survey design.

We aimed to recruit survey participants who had researched and/or worked in a capacity related to human fire use in the region for which they responded for a period since 1990. Respondents were asked to confirm this at the start of the survey. People with the knowledge required to complete the survey were wide-ranging in background and experience and could include researchers, land managers, or people using fire as part of their livelihoods. They might be employed by universities, state agencies, NGOs, or businesses, or be self-employed. Questions at the end of the survey were designed to capture which of these categories a given respondent fell into.

Potential participants were initially identified via the literature. We emailed invitations to participate in the survey to the authors of sources in two databases of literature on human-fire interactions, the Livelihood Fire Database (LIFE) [], and the Database of Anthropogenic Fire Impacts (DAFI) []. The research team, including those that piloted the survey, also shared the survey within their networks, and it was advertised on social media via the Leverhulme Centre for Wildfires, Environment and Society. All those invited to participate were asked to provide recommendations of other possible participants. Once the survey had been open for a month, additional searches for participants were targeted at regions with no existing responses, through literature searches using Google Scholar, and by searching online for agencies and NGOs working with fire in the region.

The survey was open to responses from December 2022 to June 2023. Participation was voluntary, and respondents were offered the opportunity to enter a prize draw with the potential to win a blanket designed by an Indigenous artist. The survey took approximately 30 minutes to complete.

2. Survey content

Survey respondents completed the survey for a region that they knew well. The survey regions (<https://firemap.terraces.hku.hk/>) were determined by combining country boundaries with biomes []. We delimited the regions on this basis because fire governance and land use can be expected to vary by country, while fire behaviour and land use vary strongly by biome. We also expected that respondents might find it difficult to generalise across multiple countries, given that expert knowledge is often country specific. Where biomes are not geographically continuous within a country, fragments of the same biome type combined into one region. For tropical savannas, we further subdivided the regions into arid savannas where precipitation constrains woody cover, and mesic savannas, where fire and other disturbances are responsible for the co-existence of trees and grasses, using 650mm as a cutoff in precipitation for African savannas [], and 1000mm for savannas elsewhere globally []. For boreal forests, in Europe and Asia, we subdivided the (initially very large) regions further to the level of ecoregions [Olson et al. 2001], and in Canada, into two regions – East and West. For Australia we subdivided all regions further by State/Territory.

The survey was designed and administered using the Qualtrics online survey software. The survey had four blocks of questions (full details in Tables 1 and 2). The first block focused on the stakeholder groups using fire, reasons for burning, and months in which specific fire uses occur. Here, we considered three stakeholder groups separately: 1) small-scale livelihood and/or cultural (hereafter SSLC) fire users – Indigenous peoples and others whose livelihoods rely on family labour or labour exchange with other households; 2) commercial fire users – large landowners and companies employing workers; 3) state/NGO fire users – government agency or non-governmental organisation land managers. The second block focused on describing the human fire regime, including fire use by all stakeholder groups. This included questions about seasonal variation in burned area, fire ignitions, and risk of escaped fire, and about trends in burned area and ignitions since 1990. The third block focused on fire governance, with questions about the amount of fire suppression by agencies, policy interventions affecting fire use, and the effectiveness of these. The fourth block focused on the expertise of the respondents, with questions about their professional background, research methods (if applicable), and the specific years and locations for which their knowledge was deepest.

For all survey questions, bar those about longer-term trends, respondents were asked to consider conditions over the past 5 years (from 2018 to 2022). To allow for comparison across diverse regions globally, collection of categorical data was prioritised in the design of the survey. Respondents, however, could add text with clarifications and additional detail at the end of each block in the survey. For every question, respondents assessed their own confidence in their answer on a scale of 1 to 5. In so doing, they were asked to consider the recency of their knowledge, and the applicability of their knowledge across the whole region. Some questions were compulsory, while others could be answered with ‘I don’t know’ (Table 1). The survey was translated from English into French, Spanish and Portuguese by native language speakers who were also fire researchers, enabling them to translate specialist terms accurately.

**Table 1. Global Fire Use Survey questions and response options.** Note that some questions, e.g. those around consent to participate are not included.

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| --- | --- | --- | --- | --- |
| **Block** | **Question number** | **Question** | **Compulsory?** | **Question type and response options** |
| 1. Fire use by specific fire user groups | 3 | Do people use fire in the landscape in this region? | Yes | Binary: Yes; No |
| 4 | Which of the following groups use fire in the landscape in this region? | Yes | Binary: Yes; No - People who use fire to support small-scale livelihoods and/or for cultural reasons; People working for commercial enterprises and/or large landowners; Protected area managers and/or people working for state agencies |
| 5 | Why do they use fire on the land today? | Yes | Binary: Yes, No - See list of categories of fire purposes in table 2 (below)Question repeated for each fire user group active in the region |
| 6 | Please indicate how many communities in this region use fire / on how much of the land in this region owned by commercial enterprises fire us used/ on how much of the state managed and protected land in this region fire is used for the reasons you selected. | No | Ordinal: Most communities / of the land; Some communities / of the land; A very small number of communities / of the landQuestion repeated for each fire use reason applying in the region, and for each fire user group active in the region |
| 7 | Are some ignitions on the landscape commonly associated with multiple reasons for burning? | Yes | Binary: Yes; NoQuestion repeated for each fire user group active in the region |
| (If yes to previous question) Please select a cluster of reasons for fire use that are associated with the same ignitions on the landscape. | No | Categorical: Set of fire use reasons (participant choosing from those fire use reasons that apply in the region)Participant able to select as many sets as desiredQuestion repeated for each fire user group active in the region |
| 8 | In what month or months are fires set for each of the reasons you identified above? | No | Binary: Yes; No – each calendar monthQuestion repeated for each fire use reason applying in the region, and for each fire user group active in the region |
| If you would like to add any clarifications, comments, or context to your responses for this block, please do so here | No | Qualitative |
| 2. Human fire regime (including fire use by all fire user groups) | 9 | Please indicate how the relative number of human fire ignitions varies by month | No | Ordinal: For each calendar month: No ignitions; Low number of ignitions; Medium number of ignitions; High number of ignitions; Highest number of ignitions |
| 10 | Please indicate how the relative total area of the landscape burned through human fire use varies by month | No | Ordinal: For each calendar month: No area burned; Small area burned; Medium area burned; Large area burned; Largest area burned |
| 11 | Have the times of year in which people use fire in this region changed in the period from 1990 to 2022? Please describe any changes below | No | Qualitative |
| 12 | Please indicate how the relative risk of escaped fire varies by month. | No | Ordinal: For each calendar month: No risk; Low risk; Medium risk; High risk; Highest risk |
| 13 | Overall, in the period from 1990 to 2022, has the total annual number of human fire ignitions in this region increased, remained stable, decreased, or been variable? | No | Ordinal: Increased; Stable; Decreased; Variable |
| 14 | Overall, in the period from 1990 to 2022, has the total annual area of the region burned through human fire use, increased, remained stable, decreased, or been variable?  | No | Ordinal: Increased; Stable; Decreased; Variable |
| If you would like to add any clarifications, comments, or context to your responses in this block, please do so here | No | Qualitative |
| 3. Fire governance | 15 | Is the level of fire prevention, fire control and direct fire suppression by state and non-state agencies in this region high, medium, or low?  | No | Ordinal: High; Medium; Low |
| 16 | Which of the following types of governance apply to fire use in this region? | No | Binary: Yes; No - State regulations making it illegal to use fire in the landscape for any reason; State regulations making it illegal to use fire for certain reasons; Regulations limiting or banning fire use within protected areas; State regulations making some or all types of fire use conditional upon certain criteria; Economic incentives to reduce or limit fire use; Informational or educational campaigns designed to encourage reduced or limited fire use; Local forms of governance based on traditional knowledge, intended to ensure fire use is controlled |
| 17 | For the types of governance you selected, do you feel they are effective in achieving their intended outcome, in terms of fire use?   | No | Ordinal: Very effective; Somewhat effective; Not effectiveQuestion repeated for each type of governance applicable in the region |
| If you would like to add any clarifications, comments, or context to your responses in this block, please do so here | No | Qualitative |
| 4. Information about respondent expertise | 3 | Please specify the range of years for which you have lived, worked, or conducted research in this region. | Yes | Qualitative |
| 18 | Which of the following statements describe you? Select all that apply | Yes | Binary: Yes; No - I am a researcher; I am a fire manager; I use fire as part of my livelihood for agriculture, pastoralism, hunting and/or gathering; I own a company that uses fire; I work for a company that uses fire; I work for a university; I work for a government agency; I work for a non-governmental organisation; None of the above |
| 19 | What kinds of research did you draw on when answering this questionnaire? Select all that apply(question only appearing to researchers) | Yes | Binary: Yes; No - Ethnography; Research Interviews; Research questionnaires/ surveys; Remote sensing/ GIS; Participatory research; Other (please specify below) |
| 20 | Did anyone else help you to answer this questionnaire? | Yes | Binary: Yes; No |
| (If yes to previous question) Which of the following statements apply to the person, or people, who helped you? Select all that apply. | No | Binary: Yes; No - They are a researcher; They are a fire manager; They use fire as part of their livelihood for agriculture, pastoralism, hunting and/or gathering; They own a company that uses fire; They work for a company that uses fire; They work for a university; They work for a government agency; They work for a non-governmental organisation; None of the above |
| 21 | Did you have specific parts of the region in mind when answering this questionnaire (perhaps because these are the areas you know best)? If so, please describe these locations briefly, providing latitude and longitude points if possible.  | No | Qualitative |
| 22 | Do you feel that you could give very similar answers if you filled the survey out for another of our regions? If so, please tell us here.  | No | Qualitative |
|  | If you know of written reports, articles, or books about human fire use in this region, please list them here. If you have any final comments or clarifications, please also provide them here.  | No | Qualitative |

**Table 2. Categories of reasons for burning used in the Global Fire Use Survey, and fire user types for which they were response options in the survey.**

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| --- | --- | --- | --- |
| **Reasons for burning** | **Response option for small-scale livelihood and/or cultural (SSLC) fire users?**  | **Response option for commercial fire users?** | **Response option for state/NGO fire users?** |
| Clear vegetation to establish a plot for swidden or semi-permanent agriculture | Yes | Yes | No |
| Clear vegetation to establish a plot for permanent agriculture | Yes | Yes | No |
| Clear weeds and/or crop residues before planting crops | Yes | Yes | No |
| Reduce crop pests and parasites | Yes | Yes | No |
| Clear vegetation to establish new pasture areas | Yes | Yes | No |
| Maintain pastures or rangelands and enhance forage for grazing livestock (e.g. by excluding woody growth or bringing up fresh shoots) | Yes | Yes | No |
| Herd livestock (e.g. by driving livestock in a particular direction or attracting them to certain areas) | Yes | Yes | No |
| Reduce livestock pests and predators | Yes | Yes | No |
| Create habitat or forage for animals for hunting or fishing | Yes | No | No |
| Improve visibility or access for hunting or fishing | Yes | No | No |
| Drive, kill, injure or tire animals for hunting | Yes | No | No |
| Enhance productivity of a foraged resource (e.g. by reducing competition from other plants, inducing flowering, germination or fruiting, reducing pests and diseases) | Yes | No | No |
| Ease the collection of foraged resource (e.g. by improving visibility or access) | Yes | No | No |
| Drive bees away from hives to enable wild honey collection | Yes | No | No |
| Produce charcoal | Yes | No | No |
| Produce fuelwood for gathering | Yes | No | No |
| Open and maintain trails and waterways for general access | Yes | Yes | Yes |
| Reduce animals that are dangerous to or unwanted by humans (e.g. snakes) | Yes | Yes | No |
| Reduce fuel loads to reduce risk of wildfires at a landscape scale | Yes | Yes | Yes |
| Create firebreaks (using fire) to protect e.g. specific resources, sacred sites, homes, farms | Yes | Yes | Yes |
| Suppress a wildfire by back burning (fighting fire with fire) | Yes | Yes | Yes |
| Produce a more aesthetically pleasing landscape, or for enjoyment | Yes | No | No |
| Communicate about current activity (e.g. use of smoke signals to indicate current location) | Yes | No | No |
| Show disapproval or protest (e.g. burning a protected area to protest against state land use regulations) | Yes | No | No |
| As part of rituals or ceremonies, or to maintain cultural identity associated with fire use | Yes | No | No |
| Ecosystem management for nature conservation or forestry | No | Yes | Yes |
| Manage vegetation along highways | No | Yes | Yes |
| Claim land or make it available for development | No | Yes | No |
| Other (please specify) | Yes | Yes | Yes |