RESEARCH ARTICLE

Comparison of tillage costs among eight paddy farm regions in East Kalimantan, Indonesia [version 1; peer review: 1 approved, 1 approved with reservations]

Karmini Karmini

Faculty of Agriculture, University of Mulawarman, City of Samarinda, Province of East Kalimantan, 75123, Indonesia

Abstract

Background: Tillage is done to prepare land for wetland paddy farming, and it is commonly done by hand tractor. The purposes of this study were to identify the levels of ownership of hand tractor by paddy farmers, to describe the rental of hand tractor in rural areas, to calculate and compare the tillage costs on eight paddy farm regions, and to understand the utilization of farm machinery for paddy farming in East Kalimantan, Indonesia.

Methods: The study areas were Subcities/Subdistricts of North Bontang, South Bontang, Muara Muntai, Loa Janan, Tenggarong Seberang, Waru, Penajam, and Babulu. Data collection was done by interviewing 380 respondents. Analysis of data used the Chi Square test.

Results: The number of hand tractor renters (87.37%) in East Kalimantan 2014 was bigger than that of hand tractor owners (12.63%). The tillage costs in Tenggarong Seberang, Loa Janan, and Muara Muntai in 2014 were IDR700,000.00 ha\(^{-1}\), IDR750,000.00 ha\(^{-1}\), and IDR700,000.00 ha\(^{-1}\), respectively. Tillage costs were the same in Babulu, Penajam, Waru, South Bontang, and North Bontang (IDR1,000,000.00 ha\(^{-1}\) in each district).

Conclusions: There are significant differences the number of hand tractor owners, the number of hand tractor renters, and the tillage costs among the eight paddy farm regions in East Kalimantan, Indonesia.

Keywords
Cost, East Kalimantan, land, paddy farm, tillage.

This article is included in the Agriculture, Food and Nutrition gateway.
Introduction
Wetland paddy farming in East Kalimantan is a method of modern farming in which paddy farmers commonly by using hand tractor in land preparation. Tillage cost has important role in cost structure of paddy farming. The tillage cost can vary significantly, and negatively affects paddy farm income in East Kalimantan, Indonesia (Karmini, 2017). The increase of tillage cost leads the increase of production cost of paddy farming and the decrease of paddy farm income and household income of paddy farmers. This is supported by the research result of Larson & Plessmann (2009).

Wetland paddy farming is done in most regions in East Kalimantan. Information is needed about the tillage cost in different paddy farm areas to formulate policy on farm machinery utilization in specific areas containing paddy farms. The purposes of this study were to identify the ownership of hand tractor by paddy farmers, to describe the rental of hand tractors in rural areas, to calculate and compare the tillage costs on eight paddy farm regions, and to know the machinery utilization for paddy farming in East Kalimantan, Indonesia. The hypotheses of this study were that there are no significant differences the number of hand tractor owners, the number of hand tractor renters, and the tillage costs among the eight paddy farm regions in East Kalimantan, Indonesia.

Methods
Study area
This study was held from November 2013 to April 2014 in Province of East Kalimantan, Republic of Indonesia. The determination of study areas based on two-stage clustered sampling. The study areas were Bontang City (North Bontang and South Bontang), Kutai Kartanegara District (Muara Muntai, Loa Janan, and Tenggarong Seberang), and Penajam Paser Utara District (Waru, Penajam, and Babulu).

Subject recruitment
The overall population in the areas examined in this study was 36,970 households of paddy farmers. The minimum sample size for populations of 20,000 and 50,000 people is 377 and 382, respectively (Rea & Parker, 1997). The sample size used in this study was therefore 380 respondents. The determination of the number of respondents in each study areas was based on proportional sampling.

Purposive sampling was applied in selecting respondents. Inclusion criteria for respondents were farmers who are currently engaged in wetland paddy farming, lived minimum 5 years in study area, and had experience continuously minimum 2 years cultivate paddy. Exclusion criteria for respondents were lived less than 5 years in study area and had experience less than 2 years cultivate paddy but farmers have own land or become labors. Respondents were paddy farmers who are currently engaged in wetland paddy farming. The researcher went to paddy field and met with potential respondents in person, then provided information on the purposes of study and the right of them to not answer the questions at any time and assured that the data would be kept confidential and only aggregate data would be used. After they gave the consent to be interviewed, they were given the choice to decide the place for the interviews using the questionnaire (Karmini, 2018), either at home or other places which were convenient for them. Both the researcher and respondents discussed directly at the same place. This study was approved by Head of Department of Agribusiness, Faculty of Agriculture, University of Mulawarman (Tetty Wijayanti, SP, MP; approval number 2104/UN17.3/TU/2013). Each participant gave their written informed consent to participate in the study.

Statistical analysis
This study performed analysis by using the software of IBM SPSS Statistics 20 and tested hypotheses using the Chi Square test with $\alpha = 0.05$.

Results and discussion
Characteristics of respondents
All 380 respondents completed the questionnaire in full. From our study, we observed that paddy farmers in East Kalimantan, Indonesia, are typically male, married, 3–4 members in their household, and are Javanese.

Hand tractor ownership
A small number of paddy households had the ability to buy hand tractor in the study areas (12.63%) (Table 1). There are significant differences the number of hand tractor owners among different paddy farm areas.

Table 1. Number of respondents who were hand tractor owners in East Kalimantan the year 2014.

<table>
<thead>
<tr>
<th>City/District</th>
<th>Region (Subcity/Subdistrict)</th>
<th>Respondent (paddy household)</th>
<th>Percentage (%)</th>
<th>Hand tractor owner (respondent)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bontang City</td>
<td>North Bontang</td>
<td>1</td>
<td>0.26</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>South Bontang</td>
<td>2</td>
<td>0.53</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Kutai Kartanegara Regency</td>
<td>Muara Muntai</td>
<td>4</td>
<td>1.05</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Loa Janan</td>
<td>17</td>
<td>4.47</td>
<td>2</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>Tenggarong Seberang</td>
<td>128</td>
<td>33.68</td>
<td>17</td>
<td>4.47</td>
</tr>
<tr>
<td>Penajam Paser Utara Regency</td>
<td>Waru</td>
<td>16</td>
<td>4.21</td>
<td>4</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Penajam</td>
<td>84</td>
<td>22.11</td>
<td>17</td>
<td>4.47</td>
</tr>
<tr>
<td></td>
<td>Babulu</td>
<td>128</td>
<td>33.68</td>
<td>8</td>
<td>2.11</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>380</td>
<td>100</td>
<td>48</td>
<td>12.63</td>
</tr>
</tbody>
</table>
the eight paddy farm regions in East Kalimantan, Indonesia ($\chi^2$ calculated $62.35 > \chi^2$ table $dk = 7; \alpha = 0.05$ 14.1). Narayananmoothy et al. (2014) found that the factors such as coverage of irrigation, yield enhancing inputs cost, land-labor ratio, and human labor use in man-hours have significantly influence the use of machine labor in paddy cultivation.

**Hand tractor renters**

Farmers who did not own a hand tractor (87.37%) could rent from the owners of hand tractor who live in the same village or from nearby village (Table 2). There are significant differences the number of hand tractor renters among the eight paddy farm regions in East Kalimantan, Indonesia ($\chi^2$ calculated $429.45 > \chi^2$ table $dk = 7; \alpha = 0.05$ 14.1). This was reasonable, because owning a hand tractor is very costly. Hand tractor prices ranged from IDR6,000,000.00 each to IDR25,000,000.00 each.

**Tillage cost**

Farm size varies among paddy farming households in all regions (0.25-5.00 ha). Small land-holding farmers in the study areas did not have constraints to rent and use of hand tractors because the wetland fields for the most part are located in same area. However, Hristova & Maddock (1993) mentioned that land size could be a constraint in applying mechanized farming. The proportion of machine labour costs (11.13%) of total cost of cultivation of borewell irrigated paddy in Tumakuru District, India (Hamsa et al., 2017).

The tillage costs (Table 3) in Tenggarong Seberang and Muara Muntai were lower than those in Loa Janan. Tillage costs were same in other five regions. Limitations of the study, such as limited access to several study areas which more time was needed to collect data, influenced the diversity of respondents and data. There are significant differences the tillage costs among the eight paddy farm regions in East Kalimantan, Indonesia ($\chi^2$ calculated $17.01 > \chi^2$ table $dk = 7; \alpha = 0.05$ 14.1). The difference of tillage costs could be happened because of the difference of buying price of machine, operator wage, and machine maintenance cost.

<table>
<thead>
<tr>
<th>City/District</th>
<th>Region (Subcity/Subdistrict)</th>
<th>Respondent (paddy household)</th>
<th>Percentage (%)</th>
<th>Hand tractor owner (respondent)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bontang City</td>
<td>North Bontang</td>
<td>1</td>
<td>0.26</td>
<td>1</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>South Bontang</td>
<td>2</td>
<td>0.53</td>
<td>2</td>
<td>0.53</td>
</tr>
<tr>
<td>Kutai Kartanegara Regency</td>
<td>Muara Muntai</td>
<td>4</td>
<td>1.05</td>
<td>4</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Loa Janan</td>
<td>17</td>
<td>4.47</td>
<td>15</td>
<td>3.95</td>
</tr>
<tr>
<td></td>
<td>Tenggarong Seberang</td>
<td>128</td>
<td>33.68</td>
<td>111</td>
<td>29.21</td>
</tr>
<tr>
<td>Penajam Paser Utara Regency</td>
<td>Waru</td>
<td>16</td>
<td>4.21</td>
<td>12</td>
<td>3.16</td>
</tr>
<tr>
<td></td>
<td>Penajam</td>
<td>84</td>
<td>22.11</td>
<td>67</td>
<td>17.63</td>
</tr>
<tr>
<td></td>
<td>Babulu</td>
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<td>33.68</td>
<td>120</td>
<td>31.58</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>380</td>
<td>100</td>
<td>332</td>
<td>87.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>City/District</th>
<th>Region (Subcity/Subdistrict)</th>
<th>Respondent (paddy household)</th>
<th>Mean of farm size (ha)</th>
<th>Mean of tillage cost (IDR)</th>
<th>Mean of tillage cost (IDR ha$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bontang City</td>
<td>North Bontang</td>
<td>1</td>
<td>0.63</td>
<td>625,000.00</td>
<td>1,000,000.00</td>
</tr>
<tr>
<td></td>
<td>South Bontang</td>
<td>2</td>
<td>0.63</td>
<td>625,000.00</td>
<td>1,000,000.00</td>
</tr>
<tr>
<td>Kutai Kartanegara Regency</td>
<td>Muara Muntai</td>
<td>4</td>
<td>0.75</td>
<td>525,000.00</td>
<td>700,000.00</td>
</tr>
<tr>
<td></td>
<td>Loa Janan</td>
<td>17</td>
<td>0.71</td>
<td>529,411.76</td>
<td>750,000.00</td>
</tr>
<tr>
<td></td>
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<td>700,000.00</td>
</tr>
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<td></td>
<td>Penajam</td>
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<td>1,000,000.00</td>
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<tr>
<td></td>
<td>Babulu</td>
<td>128</td>
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<td>1,761,328.13</td>
<td>1,000,000.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>380</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Farm machinery**

Hand tractor usage is still recommended for the development of paddy farming as an important physical asset in paddy farming. The number of hand tractors in rural areas could be increased, either through purchase by paddy farmers or by grants from government, to decrease the tillage cost and production cost, thus increasing income of paddy farming and paddy farmers.

**Conclusions**

The number of paddy households as hand tractor owners and hand tractor renters in East Kalimantan in 2014 were 12.63% and 87.37%, respectively. The tillage cost was between IDR700,000.00 ha⁻¹ and IDR1,000,000.00 ha⁻¹. There are significant differences the number of hand tractor owners, the number of hand tractor renters, and the tillage costs among the eight paddy farm regions in East Kalimantan, Indonesia.

**Data availability**

**Underlying data**

The answers to the questionnaire, along with basic demographic information generated in this study are available on OSF. DOI: https://doi.org/10.17605/OSF.IO/C7EX9 (Karmini, 2018).

**Extended data**

The questionnaire used in this study is available on OSF. DOI: https://doi.org/10.17605/OSF.IO/C7EX9 (Karmini, 2018).

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

**Grant information**

The author declares that no grants were involved in supporting this work.

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**References**


Open Peer Review

Current Peer Review Status: ✔️ ❓

Version 1

Reviewer Report 11 March 2021

https://doi.org/10.5256/f1000research.18576.r78026

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Ganganee Chandima Samaraweera
Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Matara, Sri Lanka

Even the author mentioned significant differences, p values are not given (specially in case of ownership and other variables, it says, (There are significant differences the number of hand tractor owners, the number of hand tractor renters, and the tillage costs among the eight paddy farm regions in East Kalimantan, Indonesia.). However, it didn't show clearly. The demographic status of the respondents is not mentioned, and the statistical analyses are not adequate as the author used only Chi-Square test. It is a serious issue as this is the only stat method used here. Better to expand the analytical tools as this cannot be generalized to the vast majority.

More recent literature is needed to be addressed and authors should mention the compatibility of their research findings with other relevant literature documented so far.

In the Methodology, it should be clearly mention the reason of selecting study areas, and the clear way of selecting the sample from the population

Hence, I will give my recommendation after adding those comments.

Is the work clearly and accurately presented and does it cite the current literature?
No

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Are all the source data underlying the results available to ensure full reproducibility?

Are the conclusions drawn adequately supported by the results?

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Agricultural Economics, Agricultural Marketing, Consumer behavior

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 10 Apr 2021

Karmini Karmini, University of Mulawarman, City of Samarinda, Indonesia

The authors revision for review on 11 March 2021 by Ganganee Chandima Samaraweera, Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Matara, Sri Lanka.

Reviewer: Even the author mentioned significant differences, p values are not given (specially in case of ownership and other variables, it says, (There are significant differences the number of hand tractor owners, the number of hand tractor renters, and the tillage costs among the eight paddy farm regions in East Kalimantan, Indonesia.). However, it didn't show clearly.
Authors: We added \( p \)-values in sections of Hand tractor ownership, Hand tractor renter, and Tillage cost.

Reviewer: The demographic status of the respondents is not mentioned,
Authors: We added Table 1 and information of respondents' socioeconomic-demographic characteristics in section of Characteristics of respondents.

Reviewer: and the statistical analyses are not adequate as the author used only Chi-Square test. It is a serious issue as this is the only stat method used here. Better to expand the analytical tools as this cannot be generalized to the vast majority.
Authors: We added descriptive statistics to count the frequency, total, percentage, maximum, and minimum in section Statistical analysis. We revised Chi Square One Sample with One Way Anova to test hypothesis that there are no significant differences the tillage costs among Bontang, Kutai Kartanegara, and Penajam Paser Utara in sections of Statistical analysis and Tillage cost.

Reviewer: More recent literature is needed to be addressed
Authors: We added references of Pobhirun and Pinitsoontorn (2019), Statistics Indonesia (2008), Statistics East Kalimantan (2009), and Ogunbanwo et al. (2019) in section
Reviewer: and authors should mention the compatibility of their research findings with other relevant literature documented so far.

Reviewer: In the Methodology, it should be clearly mention the reason of selecting study areas,
Authors: We added the reasons of selecting study areas associate with comparison of paddy farmer income and paddy productivity in provinces in Kalimantan in section Study area.

Reviewer: and the clear way of selecting the sample from the population. Hence, I will give my recommendation after adding those comments.
Authors: We added the random number method assigned every sample a number, then randomly picked samples by using a table of random numbers in section of Subject recruitment.

Is the work clearly and accurately presented and does it cite the current literature?
Reviewer: No
Authors: Additional references in sections of Methods (Study area, Statistical analysis) and References.

Is the study design appropriate and is the work technically sound?
Reviewer: Partly
Authors: Additional information in section of Methods (Study area and Subject recruitment).

Are sufficient details of methods and analysis provided to allow replication by others?
Reviewer: Partly
Authors: Additional and revision of methods in sections of Methods (Statistical analysis) and Results and discussion (Tillage cost)

If applicable, is the statistical analysis and its interpretation appropriate?
Reviewer: Partly
Authors: Additional the results of data analysis and information in section of Results and discussion (Characteristics of respondents, Hand tractor ownership, Hand tractor renter, and Tillage cost).

Are all the source data underlying the results available to ensure full reproducibility?
Reviewer: Partly
Authors: The questionnaire and data already available in section of Data Availability (Underlying data and Extended data).

Are the conclusions drawn adequately supported by the results?
Reviewer: Partly
Authors: Additional and revision of analysis results in sections of Conclusions and Abstract.

**Competing Interests:** No competing interests were disclosed.

Reviewer Report 14 January 2019

[https://doi.org/10.5256/f1000research.18576.r42260](https://doi.org/10.5256/f1000research.18576.r42260)

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Ahmad Shuib
University Putra Malaysia (UPM), Seri Kembangan, Malaysia

1. **Is the work clearly and accurately presented and does it cite the current literature?**
   
   Very limited references and a few dated references.

2. **Is the study design appropriate and is the work technically sound?**

   This is a straightforward descriptive study using Chi-squared tests to determine significant differences. It would have been more informative if the author had included the derivation of the costs of the equipment and the tillage operation from the user's actual expenditure.

3. **Are sufficient details of methods and analysis provided to allow replication by others?**

   The process of collecting data was sufficiently discussed although the determination of the sample size was not clearly explained. If the data collection was carried out by the researcher herself without any assistant, it must have taken a long time to get data from 380 respondents. Samples of 1 and 2 for Bontang North and Bontang South respectively was not justified.

4. **If applicable, is the statistical analysis and its interpretation appropriate?**

   For a descriptive study to determine differences in usage of the machinery, the analysis is adequate. But for practical and policy decision purposes, the analysis may not provide sufficient evidence to help the relevant agencies to take the appropriate actions.

5. **Are all the source data underlying the results available to ensure full reproducibility?**

   The author has clearly discussed the sources of data used in the study.

6. **Are the conclusions drawn adequately supported by the results?**
This is a simple descriptive study with straight forward conclusions. The analysis will be useful for further causal relationship analysis.

**Is the work clearly and accurately presented and does it cite the current literature?**
Partly

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Partly

**Are the conclusions drawn adequately supported by the results?**
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Natural Resource Economics, Tourism Planning and Development

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

---

Author Response 10 Apr 2021

Karmini Karmini, University of Mulawarman, City of Samarinda, Indonesia

The authors revision for review on 14 January 2019 by Ahmad Shuib, University Putra Malaysia (UPM), Seri Kembangan, Malaysia.

1. Is the work clearly and accurately presented and does it cite the current literature?
Reviewer: Very limited references and a few dated references.
Authors: We added references of Pobhirun and Pinitsoontorn (2019), Statistics Indonesia (2008), Statistics East Kalimantan (2009), and Ogunbanwo et al. (2019) in section of References.

2. Is the study design appropriate and is the work technically sound?
Reviewer: This is a straight forward descriptive study using Chi-squared tests to determine significant differences.
Authors: We added methods of Descriptive statistics (to count the frequency, total,
percentage, maximum, and minimum) and One Way Anova besides Chi Square One Sample (to test hypotheses) in section of Statistical analysis.

Reviewer: It would have been more informative if the author had included the derivation of the costs of the equipment and the tillage operation from the user's actual expenditure.

Authors: We added information if the amount of hand tractor rental cost at the research location includes machine rental cost, machine maintenance cost, and operator wage in section of Tillage cost.

3. Are sufficient details of methods and analysis provided to allow replication by others?

Reviewer: The process of collecting data was sufficiently discussed although the determination of the sample size was not clearly explained.

Authors: We added method to determine the sample size in section of Subject recruitment.

Reviewer: If the data collection was carried out by the researcher herself without any assistant, it must have taken a long time to get data from 380 respondents.

Authors: We added second author and enumerators whereas the researchers employed the enumerators to help the interviews process in sections of Author and Subject recruitment.

Reviewer: Samples of 1 and 2 for Bontang North and Bontang South respectively was not justified.

Authors: The determination of number of samples for North Bontang (24 paddy households; 1 sample) and South Bontang (120 paddy households; 2 samples) was already appropriate based on proportional sampling method and already fulfilled the minimum sample size for population (380 samples) in section of Subject recruitment.

4. If applicable, is the statistical analysis and its interpretation appropriate?

Reviewer: For a descriptive study to determine differences in usage of the machinery, the analysis is adequate. But for practical and policy decision purposes, the analysis may not provide sufficient evidence to help the relevant agencies to take the appropriate actions.

Authors: We added recommendations if farm machinery are required to develop paddy farming also Bontang and Penajam Paser Utara are the recommended regions for the activities in relation to increase the ownership of hand tractors because have higher tillage costs rather than Kutai Kartanegara in section of Conclusions.

5. Are all the source data underlying the results available to ensure full reproducibility?

Reviewer: The author has clearly discussed the sources of data used in the study.

Authors: The questionnaire and data are already available in sections of Extended data and Underlying data

6. Are the conclusions drawn adequately supported by the results?

Reviewer: This is a simple descriptive study with straight forward conclusions.

Authors: We revised the results of hypotheses testing in sections of Conclusions and Abstract.

Reviewer: The analysis will be useful for further causal relationship analysis.

Authors: We added some factors caused differences the number of hand tractor owners,
the number of hand tractor renters, and the tillage costs among some regions in East Kalimantan, Indonesia in section of Conclusions.

Is the work clearly and accurately presented and does it cite the current literature?
Reviewer: Partly
Authors: Additional references in section of References.

Is the study design appropriate and is the work technically sound?
Reviewer: Yes
Authors: Additional information in sections of Methods (Statistical analysis) and Results and discussion (Tillage cost).

Are sufficient details of methods and analysis provided to allow replication by others?
Reviewer: Partly
Authors: Additional of method, second author, and enumerators in sections of Author and Methods (Subject recruitment).

If applicable, is the statistical analysis and its interpretation appropriate?
Reviewer: Yes
Authors: Additional recommendations in section of Conclusions.

Are all the source data underlying the results available to ensure full reproducibility?
Reviewer: Partly
Authors: The questionnaire and data already available in section of Data Availability (Underlying data and Extended data).

Are the conclusions drawn adequately supported by the results?
Reviewer: Yes
Authors: Additional and revision of the analysis results in sections of Conclusions and Abstract.

**Competing Interests:** No competing interests were disclosed.
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