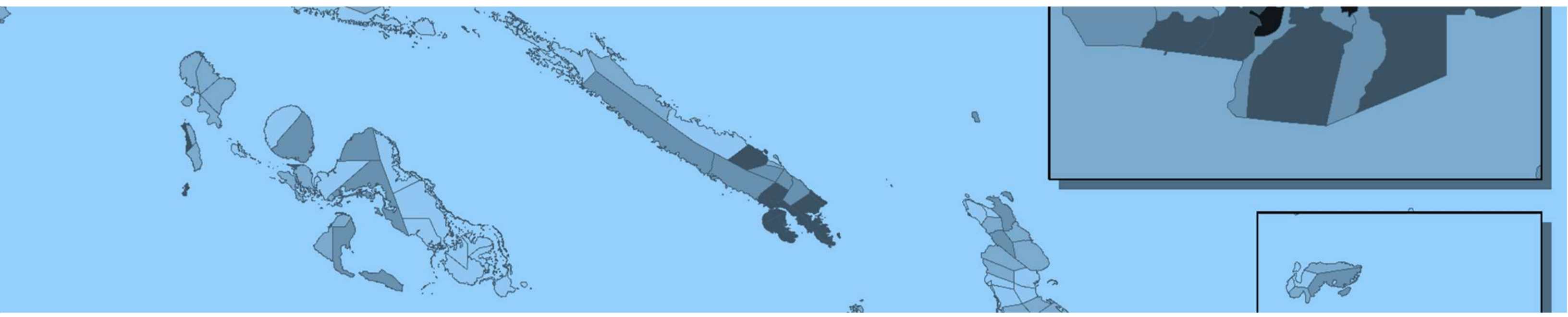
SOLOMON ISLANDS GOVERNMENT

SOLOMON ISLANDS POVERTY MAPS

Based on the 2012/13 Household Income and Expenditure Survey and the 2009 Population and Housing Census



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Australian High Commission

Solomon Islands

SOLOMON ISLANDS POVERTY MAPS
BASED ON
THE 2012/13 HOUSEHOLD INCOME AND EXPENDITURE SURVEY
AND THE 2009 POPULATION AND HOUSING CENSUS

SOLOMON ISLANDS NATIONAL STATISTICS OFFICE
THE WORLD BANK GROUP

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Minister's Foreword

On behalf of the Government of Solomon Islands (SIG) and as Minister responsible for the National Statistics Office (NSO), it is my pleasure to welcome the findings of this notable and first ever report on small-area estimates of poverty, *Solomon Islands Poverty Maps Based on the 2012/13 Household Income and Expenditure Survey and the 2009 Census of Population.*

This report is another significant statistical milestone for the nation. The analysis makes use of an internationally recognised method by pooling together the census data and survey data (2009 Census and 2012/13 Household Income and Expenditure Survey) to enable the production of poverty and inequality measures at a lower geographical ward level or small area (EAs) that was previously statistically implausible. The poverty rates generated are then profiled on maps. The results enable policy makers, planners, students and even the average citizen to easily identity the scale of poverty among households in these relatively smaller geographical areas within and across the provinces.

This report extends from the *Solomon Islands Poverty Profile Based on the 2012/13 Household Income and Expenditure Survey* report published in December 2015. It shows that new and value adding research about the dynamics of poverty can be undertaken to inform government policy.

The results and maps generated from this report provide a formidable guide in the fight against poverty across the country and in supporting SIG address poverty alleviation through our fiscal (budgetary) policy in the allocation of limited resources, and in targeting interventions through the National Development Strategy (NDS) and the Medium-Term Development Strategy (MTDS). This report further strengthens our partnership and collaboration with our regional and international development partners towards addressing poverty and the sustainable development goals.

I want to remind us that in mid-2014, the Solomon Islands Cabinet recognised the need for an integrated and vibrant national statistical system (NSS) when it endorsed the development of the first ever National Statistics Development Strategy (NSDS) 2015-16 to 2035. The key goal of the NSDS is to ensure the country's NSS is capable of regularly suppling timely, relevant and vital socio-economic statistics such as small area poverty measures, to support evidence based monitoring, planning and implementation of SIG's policies and strategies.

I am honoured that the NSO under my Ministry, with technical and funding support from our key technical assistance and development partners, have worked hard to develop this report. From the SIG side, I am grateful to the leadership of Mr Douglas Kimi, Government Statistician and Mr. Harry Kuma, Permanent Secretary, Ministry of Finance and Treasury in the overall oversight of this project.

I would like to thank the World Bank for technical assistance provided towards the production of this report. I also take this opportunity to acknowledge the Australian Government Department of Foreign Affairs and Trade (DFAT) - Aid Program for their continued financial support and program management support towards this project.

I commend this report to the people of the Solomon Islands.

Hon. Manasseh Sogavare, MP
Minister for Finance and Treasury
Government of Solomon Islands

Acknowledgements

This report is the result of collaborative work between the Solomon Islands Government and development partners in pursuing a shared goal in the alleviation of poverty in the Solomon Islands and in the pacific region.

We must, first of all, acknowledge that this analysis could not have been achieved without the valuable support of a number of people and organisations. We want to firstly acknowledge the contribution of Professor John Gibson (World Bank Consultant) who was the principle author of this analytical report. We also acknowledge reviewers who provided comments on the draft analysis, namely the peer reviewer, Nobuo Yoshida (Lead Economist, World Bank), and Virginia Horscroft (Senior Economist, World Bank).

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ABBREVIATIONS AND ACRONYMS

CPD	Country-Product-Dummy
EA	Enumeration Area
ELL	Elbers, Lanjouw, and Lanjouw (2003) Approach
GLS	Generalized Least Squares
HIES	Household Income and Expenditure Survey
NGO	Nongovernmental Organization
SIWA	Solomon Islands Water Authority

EXECUTIVE SUMMARY

Poverty mapping is a powerful way to identify and monitor small areas of particular affluence and poverty across the country. In this study, detailed maps of poverty in the Solomon Islands are created by combining information from the 2012/13 Solomon Islands Household Income and Expenditure Survey (HIES) with data from the 2009 Solomon Islands Population and Housing Census.

The Solomon Islands HIES is an extremely rich survey, including comprehensive questions on households' consumption and expenditure. The resulting data can, and have, been used to estimate poverty rates at the national and provincial level. However, HIES data are only collected for a limited sample of households, and so they cannot be used in isolation to construct a complete picture of poverty at the ward level. On the other hand, while the 2009 census covered all households across the country, censuses include insufficient detail for estimating consumption-based poverty directly. Poverty maps reflect the results of a statistical exercise designed to link HIES and census data in order to derive small-area estimates of poverty. The exercise exploits a subset of variables common to both the census and the HIES (e.g. relating to household demographics and dwelling characteristics). It uses the parameter estimates from a consumption model derived using the HIES data to simulate consumption data for each census household. These simulated consumption data are then used to derive poverty rates at the ward level using the same poverty lines used for the official poverty estimates based on the HIES data.

This study focuses on two key poverty measures: the headcount poverty rate (the proportion of the population living below the poverty line), and the number of poor. Estimates of these measures are derived for each of the 183 wards in the Solomon Islands and maps are drawn to illustrate the results. The study also derives and reports small-area estimates of the average level of consumption per adult equivalent, the poverty gap index (the average proportionate shortfall from the poverty line averaged over the whole population), the poverty severity index (where those with the biggest poverty gaps are weighted highest), and the Gini index of inequality in the level of consumption. In addition to predicted values for these poverty statistics, measures of precision are also calculated. In this study, roughly speaking, the precision of the ward-level estimates from the survey-to-census imputation, is similar to the precision of the survey estimates at the provincial level.

The results show a wide range in the prevalence of poverty across the Solomon Islands. The estimated ward-level headcount poverty rates range from zero to 59 percent, with the highest poverty rates in southern parts of Guadalcanal and eastern parts of Makira. The estimates also reveal a great deal of within-province heterogeneity in poverty rates, which may partly reflect the difficult topography and other barriers limiting the spread of benefits from economic development. Maps illustrating the number of people in each ward are an important complement to the maps of poverty rates since there is wide variation in population density across different parts of the Solomon Islands. For example, in Honiara the average number of people per ward is more than 5000, while outside of Honiara it is only one-half as large, on average, and in more remote areas like Temotu there is an average of only 1200 people per ward. In total, 22 wards each have more than 1000 people predicted to be poor, with 14 of these wards in Guadalcanal, 1 in Malaita, 2 in Makira and 5 in Honiara.

Key findings include the following:

- There are significant pockets of poverty across the central part of the Solomon Islands.
    - The small-area estimates suggest that most wards in Honiara City have above-average rates of poverty. The highest rates are evident in the wards of Naha (although the small population of this ward makes the estimate relatively imprecise) and Vuhokesa. At the same time, the census data provide some favourable indicators of welfare for residents of Honiara City relative to residents nearby in Guadalcanal Province (e.g. greater access to wage employment, improved quality housing, higher rates of durable goods ownership).
    - In Guadalcanal Province, there are many wards, including a continuous belt along the Weather Coast, where estimated poverty rates are very high, above 34 percent. The highest rates (50 percent plus) are evident in the wards of Valasi, Avuavu, Talise, Moli and Tetekanji. There are large numbers of people living throughout the province of Guadalcanal, and so also large numbers of poor.
    - There is another pocket of concentrated poverty in eastern Makira, where there are five wards with poverty rates above 34 percent (Wainori East and West, Star Harbour South and North, and Santa Ana) and relatively large numbers of poor.
    - Poverty rates tend to be lower in wards of Malaita, consistent with the low incidence of poverty for the province as a whole. However, moderately higher

rates of poverty, and larger numbers of poor people, are still apparent in some wards in the north of the province.
    - Estimates indicate relatively low levels of poverty in wards of Central Province.
- While there are not especially large numbers of poor people living in the west of the Solomon Islands, there are still some wards where the share of the population living in poverty is relatively high.
    - There is a concentration of wards with above average poverty rates (from 22 to 33 percent) in eastern Isabel.
    - For Choiseul, most wards with above-average poverty rates can be found in the northwest.
    - In Western Province, the highest poverty rate is on Ranongga Island, but this area has a relatively small population and so the largest number of poor people are located in wards of only average-to-below-average poverty rates, reflecting the larger populations on Ghizo, Kohinggo and Kolombangara islands.
- The small-area estimates suggest relatively low levels of consumption-based poverty in the more remote provinces, but the small scale and relative isolation of these areas may bring other disadvantages.
    - The wards of Rennell and Bellona have very few people living in basic needs poverty (populations are small, and poverty rates relatively low due to a low cost of living).
    - Estimated rates of poverty are also low across wards of Temotu (again reflecting the low cost of basic needs), and there are relatively small populations of people living below the poverty line.

These small-area estimates of poverty can inform policy design (e.g. the spatial targeting of poverty interventions), and contribute to monitoring efforts (e.g. facilitating analyses of the correlation of poverty with other socio-economic phenomena). Ultimately, it is hoped that the information presented in the poverty maps can help policy makers better allocate resources to support faster, more effective poverty reduction.

1. Introduction

Successful and financially feasible public spending for poverty reduction requires targeting to prevent the leakage of benefits to the non-poor. If poor households are easy to identify, transfer payments and other direct interventions can be made, and increasingly, this ‘give directly’ approach is advocated, particularly in the form of conditional cash transfers. However, there are concerns about the applicability to Melanesia, in part because of the unknown interplay between new sources of social transfers and the existing informal safety net (Gibson 2015) and also because the informational requirements for screening and the financial infrastructure for making direct payments may not be present. Moreover, distributing benefits to only some people in a particular village or area requires institutions and personnel that can resist the temptations of corruption and the reciprocal (and possibly nepotistic) obligations that can be present in clan-based societies in Melanesia.

However, if poor people are highly concentrated in certain areas, spatial targeting may be feasible, whereby extra development projects and public services are provided to everyone in those areas. Geographic targeting is highly relevant in Melanesia because of the difficult topography, which in turn has contributed to high levels of cultural, ethnic, and linguistic heterogeneity, and also because the enclave nature of much modern development has created high levels of spatial inequality (Gibson et al. 2005). Moreover, the continuing importance of customary land tenure and the small, fragmented, and poorly functioning market for alienated land may also constrain geographic mobility; so many people remain tied to ancestral lands. Therefore, outsiders are unlikely to move to particular areas that receive spatially targeted interventions, which further improves the feasibility of this form of targeting.

A practical problem with geographic targeting is that its effectiveness rises as the size of the targeted areas falls, yet the detailed household surveys used to measure poverty are rarely of sufficient size to yield statistically precise estimates for small areas.[1] For example, in the 2012/13 Solomon Islands Household Income and Expenditure Survey (HIES), the sample of 4,500 households was almost 5 percent of all households in the country, who came from just over one-

[1] For example, Bigman and Srinivasan (2002) illustrate how a given budget for poverty alleviation targeted at the level of districts in India (*n* = 340 in their sample) rather than at the broader state level (*n* = 15) would allow an extra 4.3 million poor people to benefit from the program at no extra cost.

quarter of all enumeration areas (EAs), and so, by the standards of most countries, this is a relatively large sample. Even with this sample size, it was only possible to provide poverty estimates at the provincial level, where the standard errors were about one-quarter of the value of the headcount index, and there was sufficient statistical confidence (at the 10 percent level) to conclude that the poverty rate was higher than the national average for only the two provinces with the highest poverty rates (Makira and Guadalcanal). For all the other provinces, there was insufficient precision to detect differences in poverty rates.

To enable finer geographic targeting and to provide more spatially detailed databases for research needs, poverty mapping techniques that combine detailed data from household surveys with the more extensive coverage of a census have become popular in recent years (Elbers, Lanjouw, and Lanjouw 2003). The basic idea is to use household survey data to estimate a model of consumption, with the explanatory variables restricted to those that are also available from a recent census. The coefficients from this model are then combined with the variables from the census, and consumption is predicted for each household in the census. With these predictions available for all households, inequality and poverty statistics can be estimated for small geographic areas, and there may be sufficient precision in these estimates to allow one to discriminate between the poverty rates for various locations.

Early studies in this literature had commonalities with other small-area estimation techniques, which have been used in developed countries and in other disciplines.[2] An important breakthrough in poverty mapping methods was made by Elbers, Lanjouw, and Lanjouw (2003), who paid close attention to the characteristics of the residuals from the first-stage regressions fitted on the survey data, particularly to the threats to statistical precision that come from the presence of common location terms in these errors. Subsequently, the Elbers, Lanjouw, and Lanjouw (2003) poverty mapping method has been used for survey-to-census imputation in many developing countries to develop small-area poverty estimates. Bedi, Coudouel, and Simler (2007) provide several examples. A validation of the method using census data from Brazil is provided in Elbers, Lanjouw, and Leite (2008), and extensions to survey-to-survey imputations for situations where

[2] Articles by Bigman et al. (2000) and Hentschel et al. (2000) in a mini symposium in the *World Bank Economic Review* provide a good coverage of the early poverty mapping literature.

survey methods have not maintained comparability over time are provided by Christiaensen et al. (2012).

In this paper, disaggregated maps of poverty in the Solomon Islands are created by combining information from the 2012/13 HIES with data from the 2009 Population and Housing Census. Estimates of the poverty headcount rate (that is, the proportion of the population living in households below the poverty line), the poverty gap index (the average proportionate shortfall from the poverty line averaged over the whole population), and the poverty severity index (where those with the biggest poverty gaps are weighted the highest) are reported at the ward level (n = 183). The output from the models also includes the average predicted level of consumption per adult equivalent in each ward and the Gini index for inequality in this predicted level of consumption. These statistics also have associated standard errors reported.

2. Overview of the Methodology

The methodology is based on the Elbers, Lanjouw, and Lanjouw (2003) approach (hereafter referred to as ELL) and is implemented using *Stata* for the preliminary analysis and *PovMap2* (Zhao and Lanjouw 2003) for the later stages. In the first stage, a model of (log) consumption per adult equivalent for people living in household h in location c is estimated, where the consumption data on the left-hand side and many (perhaps all) of the regressors on the right-hand side of the equation are from the HIES. In what follows, the location c will correspond to an EA (or 'cluster'), of which there are n = 1,340 in the Solomon Islands, and n = 375 of these were included in the HIES sample:

$$\ln y_{ch} = \mathbf{x}_{ch}^{'}\boldsymbol{\beta} + u_{ch} \qquad (1)$$

The vector of explanatory variables, $\mathbf{x}_{ch}$ for household h in location c is restricted to those survey variables that can also be found in the census and that have an overlap with the distribution of the same variable in the census (the vector may also include 'external' variables that can be geographically linked to both data sources, such as environmental data). The parameter vector $\boldsymbol{\beta}$ is not given any causal interpretation in the model because equation (1) is a prediction equation, not a model of what causes consumption. Nevertheless, it is assumed that the error term, u_{ch}, satisfies $E[u_{ch} | x_{ch}]=0$. This error term has two independent components: a cluster-specific effect η_c and a household-specific effect ε_{ch}.

The cluster-specific effect reflects aspects of the environment that are common to households that live in the same location. If one was working just with the survey data, these unseen elements could be controlled with cluster fixed effects (that is, a dummy variable for each cluster). However, because the survey samples only 375 of the 1,340 EAs, there will be no way to extrapolate from the fixed effects estimated on the n = 375 clusters to the remaining n = 965 clusters in the census that are not in the HIES sample. Consequently, another way has to be found to incorporate location information, which will otherwise end up in the residuals of equation (1). These location effects are potentially disruptive components of the residuals because the more important they are, the less precise will be the resulting predictions of consumption and the derived poverty maps will tend to blur the differences between areas. The reason for this is that when the predictions for each household are summed or averaged, even if there are hundreds of census households in a locality, if a large component of the error is common to groups of households rather than being idiosyncratic and random, the gains in precision that normally come from averaging over larger numbers are muted.

To reduce the contribution from location effects, the poverty mapping literature tends to use cluster means of household-level variables, which are calculated from the census data so that they are available for all census and survey clusters (another advantage is that the averages are calculated over all households in an EA rather than just the 12 households from the EA in the sample for the HIES). That approach is followed here as well, to reduce the contribution of the location component in the error. The residuals from the equation (1) regression are then decomposed into two parts; the uncorrelated household idiosyncratic components and the correlated location components:

$$\hat{u}_{ch} = \hat{\eta}_c + \hat{\varepsilon}_{ch} \tag{2}$$

The estimated location components given by $\hat{\eta}_c$ are the within-cluster means of the overall residuals, while the household component estimates given by $\hat{\varepsilon}_{ch}$ are the overall household-level residuals net of the location components. The additional parameters needed by the ELL method are $\hat{\sigma}_\eta^2$, the variance of η_c, and $\hat{V}(\sigma_\eta^2)$, the variance of σ_η^2.

To allow for heteroskedasticity in the household idiosyncratic component, a logistic model of the variance of ε_{ch} conditional on a set of explanatory variables, $\mathbf{x}_{ch}$, is estimated as

$$\ln\left[\frac{\varepsilon_{ch}^2}{A-\varepsilon_{ch}^2}\right]=\mathbf{x}'_{ch}\hat{\alpha}+r_{ch} \qquad (3),$$

where $\mathbf{x}_{ch}$ is a set of variables that are selected from a larger candidate pool by using a stepwise approach to find the model that most parsimoniously explains the variation in ε_{ch}^2. The candidate variables are not only those from equation (1) but also interactions between those variables and the predictions and squared predictions from equation (1), and *A* is set equal to $1.05\times\max\{\varepsilon_{ch}^2\}$. The model used to estimate equation (3) is referred to as the 'alpha model' and that used to estimate equation (1) is the 'beta model'. The results from the alpha model feed into the calculation of a household-specific variance estimator for ε_{ch}, which is calculated as

$$\hat{\sigma}_{\varepsilon,ch}^2=\left[\frac{AB}{1+B}\right]+\frac{1}{2}Var(r)\left[\frac{AB(1-B)}{(1+B)^3}\right] \qquad (4),$$

where $\exp\{\mathbf{x}'_{ch}\hat{\alpha}\}=B$. These error calculations are used to produce two $n\times n$ square matrices, where n is the number of surveyed households. The first is a block matrix, where each block corresponds to a cluster, and the cell entries within each block are $\hat{\sigma}_\eta^2$. The second is a diagonal matrix, with household-specific entries given by $\hat{\sigma}_{\varepsilon,ch}^2$. The sum of these two matrices is $\hat{\mathbf{\Sigma}}$, the estimated variance-covariance matrix for the consumption model. Once this matrix has been calculated, the original model in equation (1) can be re-estimated by the Generalized Least Squares (GLS) method; this re-estimation is done with *PovMap2* and sometimes results in a different set of covariates chosen by the backward stepwise routine used in the beta model rather than those that were initially chosen by the stepwise routine in *Stata* (both sets of regression results are reported below).

In the simulation stage of the analysis, the estimated regression coefficients from equation (1) are applied to $\mathbf{x}_{ch}$ from the census to obtain predicted consumption for each household. A series of 100 simulations are conducted, and for each simulation, *r*, a set of beta and alpha coefficients, $\tilde{\boldsymbol{\beta}}$ and $\tilde{\boldsymbol{\alpha}}$, are drawn from the multivariate normal distributions described by the first-stage point estimates and their associated variance-covariance matrices. Additionally, a simulated value of the variance of the location error component, $(\tilde{\sigma}_{\eta}^{2})^{r}$, is drawn. Combining the coefficients from the alpha model with the census data, for each census household the household-specific variance of the household error component, $(\tilde{\sigma}_{\varepsilon,ch}^{2})^{r}$, is estimated. Then for each household, simulated disturbance terms, $\tilde{\eta}_{c}^{r}$ and $\tilde{\varepsilon}_{ch}^{r}$, are drawn from their corresponding distributions. A value of consumption expenditure for each census household, $\hat{y}_{ch}^{r}$, is then simulated, which is based on the combined effect of the predicted log expenditure, $\mathbf{x}_{ch}'\tilde{\boldsymbol{\beta}}^{r}$, and the disturbance terms:

$$\hat{y}_{ch}^{r} = \exp(\mathbf{x}_{ch}'\tilde{\boldsymbol{\beta}}^{r} + \tilde{\eta}_{c}^{r} + \tilde{\varepsilon}_{ch}^{r}) \tag{5}$$

Finally, the full set of simulated $\hat{y}_{ch}^{r}$ values are used to calculate the expected values and standard errors of distributional statistics, including poverty measures, for small areas. Specifically, the simulations are repeated 100 times, drawing a new set of coefficients and disturbance terms for each simulation. The mean of a given statistic, such as the headcount poverty rate or the Gini index, can be calculated across these 100 simulated data sets for any level of geography. The mean provides the point estimate of that statistic for that location, and the standard deviation serves as an estimate of the standard error.

The prior analysis of the HIES data has already reported poverty rates for each of the 10 provinces of the Solomon Islands (with Honiara Capital Territory treated as a province); so, for the current poverty mapping to add value, it needs to go to a finer spatial level. The n = 183 wards provide a suitable subnational level that are below the level of provinces. The average ward has 500 households and 2,750 people; so, reporting results at this level represents spatially detailed information on the distribution of living standards and the inequality between households that occurs in various areas.

3. Data

3.1 Census

The Solomon Islands Population and Housing Census was conducted in November 2009 and consisted of 27 questions for individuals (some of which were age-specific), 6 questions for women of child-bearing age, and 20 questions at the household level, which included questions about the dwelling. There were 91,251 private households that were enumerated, and a further 990 institutional households. Attention here is restricted to the private households because these were the only ones with housing information provided and they better match with the scope of the household survey. These households were located in 1,342 EAs; the mean and median are 68 households per EA, and the largest EA had just over 300 households. The latitude and longitude of households and EAs are not included in the unit record census data that were provided for this project but the administrative codes at the province, ward, and EA level match those used in the survey, which enables census data to be aggregated to the EA-level means for inclusion in the survey model predicting expenditures (that is, in equation (1)). These EA-level means are expected to help reduce the importance of the cluster effects in the residuals, to improve the precision of the predictions.

3.2 HIES

The data on consumption expenditures come from the HIES that ran from October 2012 until November 2013. The survey is based on a sample that is stratified over urban and rural areas of all 10 provinces, except Rennell and Bellona which only have rural clusters and Honiara which only has urban clusters. The sample frame came from the 2009 census, with 384 census EAs selected with probability proportional to size, and within each EA, a target of 12 households was to be surveyed to give a final sample of just over 4,600 households.[3] The achieved sample size was 375

[3] This count includes a small number of census EAs that were split, presumably to enable easier listing of households before the selection of the 12 households per EA. These splits are accounted for when the survey data are merged back into the census, with details in the *census_survey_link.dta* file.

EAs, and there were just under 4,500 households that were surveyed, among whom there are approximately 4,360 households with usable consumption data that the poverty calculations are based upon. The sampling weights that are applied to the survey data in all stages of the poverty mapping process take account of the deviations of the final sample size from the planned sample size.

3.3 Poverty Line

The cost of basic needs poverty line is calculated from a national basket of locally consumed foods that provide 2,200 calories per day and is based on the budgets of the poorest quintile (ranked by real total expenditure per adult equivalent, and children ages 0–6 years count as 0.5 of an adult and all other age groups count as 1.0). The initial ranking used the provincial food price level calculated from a country-product-dummy (CPD) regression on province-level median prices, and a re-ranking was done after each set of poverty lines was estimated (using the 'lower' poverty line as the implicit spatial price index) until convergence occurred, following the general approach of Pradhan et al. (2001). The most important foods in the basket (comprising 64 foods that contributed 95 percent of calories for the reference quintile) were priced in each province based on transaction-level records from the expenditure diaries, and an allowance was made for spending on 300 other foods that were not separately examined (including unquantified foods such as those identified solely as 'meals' in the consumption diary). The food poverty line was further inflated by a non-food allowance calculated from an Engel curve, using methods described by Ravallion (1994). The 'upper poverty line' is used in the mapping, where this poverty line has a non-food allowance that is calculated from the food budget shares of those households whose food spending exactly meets the food poverty line.

The upper poverty lines vary from just under SBD 3,600 per adult equivalent per year in Temotu and just over SBD 3,700 in Malaita to over SBD 6,000 in Guadalcanal and just over SBD 10,300 in Honiara.[4] The ratio of almost three between the poverty line in the capital city and in the cheapest areas is typical of Melanesia where infrastructure is limited, markets are poorly integrated, traditional staples are bulky and costly to transport, labor costs are high making services expensive, and urban housing prices are high because of poorly functioning land markets. While the poverty lines are

[4] In 2012/13, the market exchange rate for the Solomon Islands dollar was approximately SBD 7.2 per US$.

calculated separately by province, they are not calculated separately for urban and rural areas within each province. With the exception of Honiara, whose population is over 60,000, the largest towns in the other provinces have only from 500 to 8,000 people, and so, the economic differentiation between residents of these towns and those living in rural areas is likely to be less marked than in more populous countries. Moreover, there was an insufficient sample size to price the food poverty line separately for urban areas within each province because there were not enough transactions available from the diaries for calculating these prices.

In other words, it is assumed that cost of living differences occur between provinces because of transport costs and environmental variation (the Solomon Islands spans approximately 1,500 km from the northwest to southeast). It is further assumed that this interprovince variation is greater than the intraprovince variation between the (small) urban areas and the rural areas of the same province. Nevertheless, the alpha and beta models used for predicting the consumption of each census household allow for potential urban-rural variations by using different coefficients and predictor variables for each geographic area (combining across provinces, except for Honiara, which is treated as a separate domain). Furthermore, the predicted poverty rates from these subnational models are compared with those from a national-level model to see if this more flexible modelling framework makes a difference.

4. Empirical Analysis

4.1 Comparing the Questionnaires

The first step in the empirical analysis was to compare the questions and response options that were available in the Population and Housing Census with those in the HIES. The questions and response options were divided into two types: 254 personal characteristics or attributes that are collected at the person level and 218 dwelling- and household-level attributes. A match key was made, to link the field identifiers for particular question and answer combinations across the survey and census, and the strength of the match was evaluated as ‘high’, ‘medium’, or ‘low’ based on the wording of the questions and the pre-coded response options and also based on the filtering that was applied (for example, restricting to age 12 years and older that was meant to be used by census enumerators for certain questions). There were 93 potential variables of high/medium match strength from the personal characteristics and 72 of high/medium match strength among the dwelling- and household-level questions and answers. The ones that appeared to have the best potential for matching among the data collected at the person level were age, sex, marital status, educational attainment, and employment status, while for the dwelling- and household-level questions, they were the number of rooms in the dwelling; the main materials of roof, walls, and floor; the water source; cooking energy source; building type; toilet facility; and lighting source and questions about the dwelling tenure; the ownership of certain household durables (vehicles, computers, televisions, and so on); and the demographic structure of the household. The details on this matching exercise are available upon request.

4.2 Comparing the Variables

Even though questions may appear similar in the census and the survey, there is no guarantee that variables derived from these questions provide a close match. Therefore, the next step in the empirical analysis was to construct variables from the high/medium match strength questions and to compare the distributions of these variables coming from the survey (using the sampling weights to expand up to national totals) with the distributions for what should ostensibly be the same variable in the census. There were three groups of these variables constructed: 20 household head characteristics (such as age, gender, schooling, and economic activity), 24 demographic variables for the household (household size, shares that various age and gender groups have in the household, and household-level shares of the age 12 years and older residents with various levels of schooling and various types of economic activity), and a further 32 variables that relate to the dwelling or the household and are not asked at the person level (such as whether the household owns certain durable goods and the size and type of dwelling). The *Stata* do-files used to construct these variables are shown in a separate document (available from the Solomon Islands National Statistics Office), where *person.do* corresponds to the household head and demographic characteristics, and *house.do* corresponds to the dwelling attributes and the variables defined at the household level. The counterpart do-files for working with the census data are prefixed by *c_*.

The details from this comparison of census and survey variables are provided in Table 1. It appears that the household head variables are least likely to have overlapping distributions, with just 7 out of 20 having comparable means and standard deviations from the two data sources.

Table 1: Comparison of Census and HIES Variables (Derived from High and Medium Match Strength Questions)

	HIES (Weighted)		Census	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
Household head characteristics				
Female	0.099	0.299	0.160	0.367
Age	43.669	12.362	44.040	14.361
Married (legal/custom/de facto)	0.901	0.298	0.867	0.340
Birth province (1 to 10)	5.709	2.518	6.962	10.887
Non-Melanesian	0.038	0.191	0.050	0.218
School level (0 lowest, 4 highest)	1.504	1.387	3.892	16.167
Economically inactive (student/homemaker/retired)	0.043	0.204	0.119	0.324
Employer	0.008	0.088	0.009	0.094
Public sector wage and salary worker	0.122	0.328	0.090	0.286
Private sector/NGO/church sector wage and salary worker	0.180	0.385	0.132	0.338
Self-employed business or production for sale	0.152	0.359	0.182	0.386
Own-account activity (producing for own consumption)	0.396	0.489	0.339	0.473
Unpaid worker in family business/household	0.074	0.262	0.107	0.310
Sum of self-employed, own-account, and unpaid family worker	0.622	0.485	0.629	0.483
Unpaid voluntary work	0.024	0.154	0.022	0.146
Migrant (born in different province to current residence)	0.188	0.391	0.188	0.391
Incomplete primary school/no schooling	0.313	0.464	0.366	0.482
Completed primary school	0.259	0.438	0.335	0.472
Completed junior secondary school	0.173	0.378	0.112	0.316
Completed senior secondary school	0.120	0.326	0.067	0.251
Some tertiary education	0.134	0.341	0.091	0.288
Demographic characteristics of the household				
Household size	5.556	2.412	5.534	2.802
Number of males age 0–6 years	0.587	0.790	0.603	0.799
Number of females age 0–6 years	0.524	0.735	0.557	0.769
Number of males age 7–14 years	0.664	0.865	0.584	0.826
Number of females age 7–14 years	0.573	0.801	0.528	0.776
Number of males age 15–50 years	1.336	1.022	1.363	1.169
Number of females age 15–50 years	1.382	0.936	1.370	1.001
Number of males age 50 years and older	0.267	0.456	0.275	0.471
Number of females age 50 years and older	0.223	0.437	0.254	0.464
Number of residents age 12 years and older	3.657	1.837	3.645	2.076
Number of household members age 12 years and older with no schooling	0.295	0.643	0.570	0.954
Number of household members age 12 years and older whose highest schooling is preprimary	0.018	0.149	0.027	0.175
Number of household members age 12 years and older whose highest schooling is incomplete primary	0.967	1.069	0.994	1.166
Number of household members age 12 years and older whose highest schooling is completing primary	0.807	0.941	1.080	1.150
Number of household members age 12 years and older whose highest schooling is completion of junior secondary	0.804	0.945	0.409	0.715
Number of household members age 12 years and older whose highest schooling is completion of senior secondary	0.452	0.799	0.270	0.653
Number of household members age 12 years and older whose highest schooling is completion of some tertiary	0.314	0.729	0.188	0.557

	HIES (Weighted)		Census	
	Mean	Standard Deviation	Mean	Standard Deviation
Number of household members age 12 years and older who are economically inactive or volunteers	1.249	1.343	1.435	1.640
Number of household members age 12 years and older who are employers	0.013	0.127	0.015	0.153
Number of household members age 12 years and older who are public sector employees	0.206	0.482	0.160	0.450
Number of household members age 12 years and older who are private sector/NGO/church employees	0.329	0.696	0.273	0.698
Number of household members age 12 years and older who are self-employed in business or selling	0.315	0.699	0.411	0.819
Number of household members age 12 years and older who are own-account workers for self-consumption	1.141	1.231	0.962	1.180
Number of household members age 12 years and older who are in unpaid family work/business	0.405	0.792	0.389	0.795
Sum of self-employed, own-account, and unpaid family workers	1.861	1.354	1.761	1.351
Dwelling- and household-level characteristics				
Household has at least one car or station wagon	0.035	0.184	0.024	0.152
Household has at least one utility or pickup vehicle	0.020	0.139	0.015	0.123
Household has at least one truck or bus or van	0.021	0.145	0.015	0.123
Household has at least one motorcycle	0.018	0.134	0.003	0.052
Household has at least one boat with a motor	0.057	0.232	0.054	0.226
Household has at least one boat without a motor (for example, canoe)	0.283	0.451	0.388	0.487
Household has at least one car/bus/truck/4-wheeled vehicle	0.041	0.199	0.035	0.183
Household has at least one refrigerator or freezer	0.057	0.232	0.057	0.233
Household has at least one television	0.080	0.271	0.116	0.320
Household has at least one desktop or laptop computer	0.067	0.249	0.034	0.181
Dwelling is rented (including subsidized rent)	0.037	0.189	0.031	0.174
Dwelling is owned outright	0.838	0.369	0.740	0.438
Dwelling is owned with mortgage payments being made	0.001	0.035	0.740	0.438
Dwelling is not owned but is rent-free	0.124	0.330	0.115	0.319
Main material of dwelling roof is tin or corrugated iron	0.408	0.492	0.363	0.481
Main material of dwelling floor is concrete, cement, or brick	0.051	0.221	0.065	0.246
Main material of dwelling walls is makeshift or improvised	0.008	0.091	0.015	0.121
Dwelling is a detached house separated from others	0.939	0.239	0.924	0.266
Number of rooms in the dwelling (including kitchen)	2.907	1.102	2.780	1.197
Drinking water is mainly from metered SIWA source	0.109	0.311	0.092	0.289
Drinking water is mainly from communal standpipe	0.386	0.487	0.351	0.477
Drinking water is mainly from household tank	0.135	0.341	0.125	0.330
Drinking water is mainly from community tank	0.100	0.301	0.106	0.308
Drinking water is mainly from river, stream, or spring	0.218	0.413	0.245	0.430
Householders normally wash in river, stream, or sea	0.301	0.459	0.327	0.469
Main toilet facility is private flush toilet	0.104	0.305	0.101	0.301
Main toilet facility is private pit latrine	0.107	0.309	0.115	0.319
Main fuel for cooking is wood or coconut shells	0.901	0.298	0.925	0.263
Main fuel for cooking is gas	0.067	0.249	0.054	0.227
Main source of lighting is electricity	0.445	0.497	0.118	0.322
Main source of lighting is solar lamp	0.399	0.490	0.087	0.282
Main source of lighting is kerosene lamp	0.112	0.315	0.747	0.435

Note: Highlighted variables do not seem to have overlapping distributions and are not considered further; NGO = Nongovernmental organization; SIWA = Solomon Islands Water Authority.

The lack of comparability of census and survey variables for the household head is especially apparent for education and economic activity, and this also spills over into household counts of people with particular levels of completed schooling or engaged in particular economic activities in the previous week.[5] The survey suggests a more highly educated population than what is apparent in the census (and the four-year gap between the two is too short to have seen much real change, even with rising educational attainment over time). Similarly, the survey has more wage employment than was apparent in the census although an aggregation of the unpaid family worker category with the self-employment/producing goods for sale category and the own-account activity category gives a closer match, with this aggregate category covering 62 percent of household heads in the survey and 63 percent in the census.

The comparability of the variables related to a dwelling is greater than for the education and economic activity variables, except for questions related to lighting where the survey has just over 10 percent of households relying mainly on kerosene lamps while the census has over three-quarters relying on kerosene lamps. The main dwelling and household variables that do not seem to match relate to vehicles, where the vehicle categories are not the same, with the census asking about 'car/bus' as one option and 'truck' as another, while the survey distinguishes between 'car/station wagon', 'utility/pickup', and 'truck/bus/van'. If these categories are aggregated, so that the variable identifies households with at least one motorized, four-wheeled vehicle, there is a closer match, of a 4.1 percent ownership rate in the survey and 3.5 percent in the census. Because the survey is up to four years after the census, and monetary living standards appear to be rising, examples of a higher ownership rate in the survey than in the census seem more likely to be plausible than the reverse, although even with that caveat, it is unlikely that the ownership rate of computers doubled between the time of the census and the survey (from 3.4 percent to 6.7 percent).

While most of the variables that appear comparable are dummy variables, there are two continuous variables with a good match. The census records an average household size of 5.53 people, and in the survey, it is 5.56, while the number of rooms in the dwelling are reported as 2.8 in the census and 2.9 in the survey. Because both variables have an overlapping distribution between the two

[5] Because the count of people age 12 years and older per household is very similar (3.66 versus 3.65), the unequal counts by education group and economic activity group also mean that expressing these variables as shares will also show divergence between the census and the survey.

data sources, the candidate variables for the beta model also include squares of household size and of the number of rooms. The EA-level means from the census for the matched variables are also considered as possible candidates for including in the model.

4.3 Variable Selection for Initial Models

A data bank of almost 100 variables was created from (a) the variables in Table 1 that were not excluded on the grounds of having non-overlapping distributions, and (b) the EA means of the same variables, calculated over the census households. These variables were candidates for initial beta models of log total expenditure per adult equivalent from the survey data, where these models were estimated over four domains: a national model (n = 4,364), a model for Honiara households (n = 752), a model for rural households (n = 3,117), and a model for urban households outside of Honiara (n = 495). A backward stepwise approach was used, where variables were removed from the model until the threshold of all variables being significant at the $p = 0.1$ level was reached. The resulting models had adjusted R-squared values of 0.52 (national), 0.60 (Honiara), 0.46 (rural), and 0.48 (urban non-Honiara) and used 43, 33, 43, and 34 regressors, respectively. The do-files for merging the various files with census and survey variables and for carrying out these regressions are reported in a separate document (available from the Solomon Islands National Statistics Office), but the details on the initial beta models are available in Table A1 of Appendix A to this document.

The residuals from these initial beta models were then decomposed, following equation (2), and the alpha model for the variance of the household idiosyncratic component was estimated, again using a backward stepwise approach but with the threshold for removal set at $p > 0.05$. The candidate variables for the alpha model included all variables that were selected into the beta model, the predictions and squared predictions from the beta model, and the interactions of these predictions and squared predictions with the other candidate variables. The details on these initial alpha models are reported in Table A2 of Appendix A. For these models, the extent of the idiosyncratic variance that was explained was much lower, with adjusted R-squared values of 0.026, 0.030, 0.030, and 0.123 from using 25, 15, 22, and 32 regressors for the national, Honiara, rural, and other urban domains, respectively.

4.4 Estimation of the Final Models

The variables that were identified in the initial beta and alpha models with *Stata* were imported into *PovMap2* for further checking the overlap of their distributions in the census and survey. The stepwise procedures in *PovMap2* were then used to create the beta and alpha models. The candidate list of starting variables included the quadratics in household size and the number of rooms in the dwelling, irrespective of whether these had survived the stepwise elimination in *Stata*; these variables are privileged as the only continuous, household-level variables with good overlap in the survey and census. However, their ultimate inclusion into the final models depended on the operation of the stepwise procedures in *PovMap2*, which seemed to operate somewhat differently than those in *Stata*.

Details on the finally selected beta and alpha models from *PovMap2*, for the national, Honiara, rural, and other urban domains are reported in Appendix B. The summary details on these models and their success in dealing with the location component of the residuals are reported in Table 2. The ratio of the variance of the location error to that of the total error, $\hat{\sigma}_{\eta}^{2} / \hat{\sigma}_{u}^{2}$, was less than one-fifth in the national model, was of similar magnitude in the rural model (0.19), was almost zero for the urban non-Honiara model (0.02), and was zero for Honiara. This pattern is plausible because having unobserved common factors that affect the economic livelihoods of the households in the same EA is more likely in rural areas, where people typically work where they live, than is the case in urban areas, where there may be a geographic separation between the location of employment, the location of places of human capital investment (for example, schools), and the location of places of residence. With most of the error variance being due to the idiosyncratic household component, rather than due to the correlated location component, the precision of the small-area predictions based on the imputed consumption for each census household should be enhanced.

Table 2: Summary Statistics for Finally Selected Beta and Alpha Models

	Domain			
	National	**Honiara**	**Rural**	**Other Urban**
Beta model				
Number of predictor variables used	44	33	43	31
Adjusted *R*-squared	0.523	0.603	0.463	0.469

	Domain			
	National	**Honiara**	**Rural**	**Other Urban**
Relative variance of location error, $\hat{\sigma}_{\eta}^{2} / \hat{\sigma}_{u}^{2}$	0.194	0.000	0.189	0.022
Alpha model				
Number of predictor variables used	23	11	11	16
Adjusted R-squared	0.035	0.036	0.033	0.093

Note: Summary statistics are based on models reported in Appendix B. The zero-relative variance of the location component of the error for Honiara is estimated, rather than imposed by omitting location effects.

The simulations used normal distributions for both the cluster effects and the household idiosyncratic effects because the cumulative distribution plots for each type of error showed that they were either normal or close to being normally distributed (using the *t*-normal mixture). The simulations used simultaneous draws and were trimmed to the maximum and minimum values of consumption expenditures per adult equivalent that were recorded in the survey. Because the survey is relatively large (almost 5 percent of all households) and drawn from a sample that covers over one-quarter of all EAs, it should provide reasonable estimates of the plausible extreme values for consumption expenditures in the Solomon Islands.

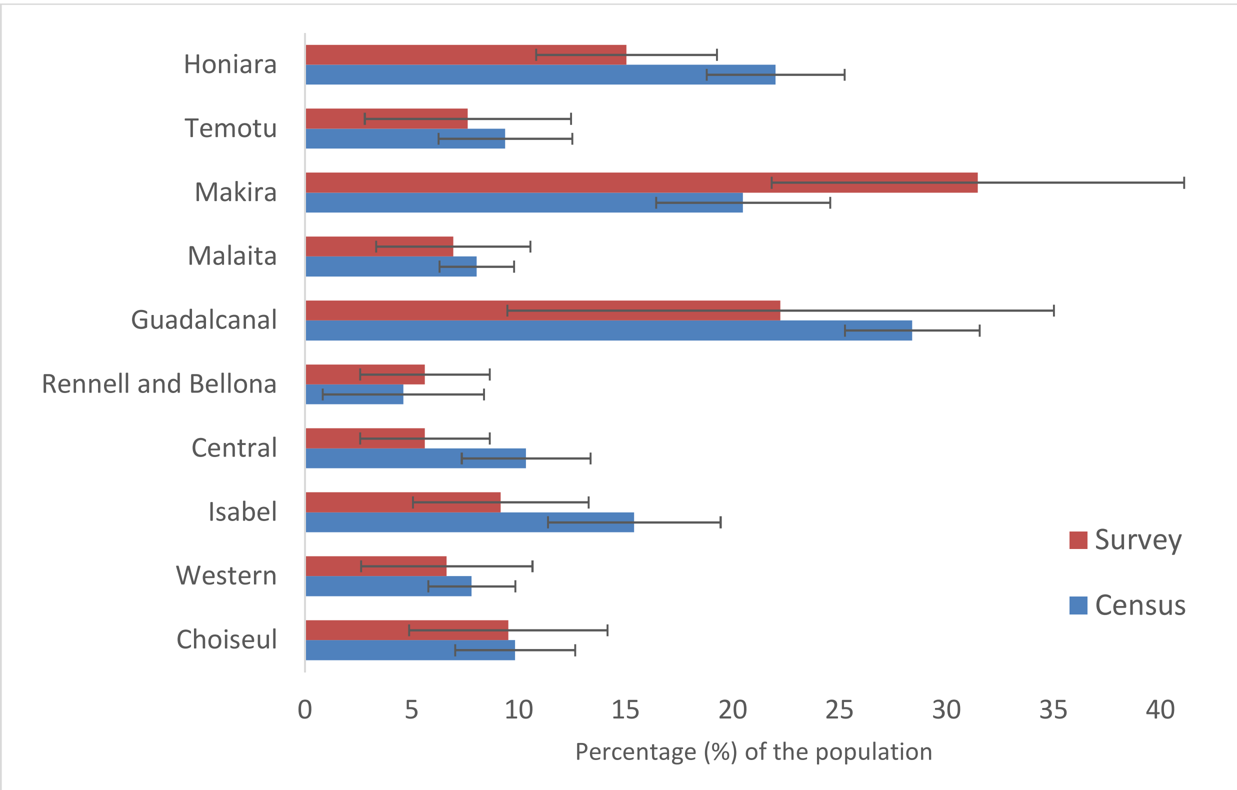
5. Results

5.1 Comparison with National and Provincial Poverty Estimates from the Survey

The headcount poverty rate, calculated as the number of people living in census households whose imputed consumption per adult equivalent is below the upper poverty line, is just under 15 percent, with a standard error of 0.8 percent. The equivalent figure from the survey was a headcount poverty rate of just under 13 percent (with a standard error of 1.3 percent). It is plausible that the predicted poverty rate may be slightly higher, because it relates to the situation in 2009 when the census was fielded (under the maintained assumption that the coefficients relating characteristics to expenditures did not change from 2009 to 2013). The analysis of the HIES data suggested that poverty rates fell between the time of the last survey in 2005/06 and 2012/13. Although some survey elements were not comparable, a revised, temporally consistent poverty line and welfare aggregate suggested the national headcount poverty rate fell from 22 percent in 2005/06 to 14 percent in 2012/13. Thus, the finding that imputed poverty in 2009 was slightly higher than the measured poverty in 2012/13 is consistent with this trend.

At the provincial level, there are some differences in the poverty estimates based on imputed consumption of census households compared with the poverty measured from the HIES, even though the basic pattern that poverty rates were highest in Makira, Guadalcanal, and Honiara is repeated with both types of data. Figure 1 reports the headcount poverty rates for each province, using the upper poverty line, and also shows the 95 percent confidence intervals, which always show overlap between the survey-based estimates and the census-based imputations.

Figure 1: Headcount Poverty Rates at Province Level: Census Imputed and Surveyed



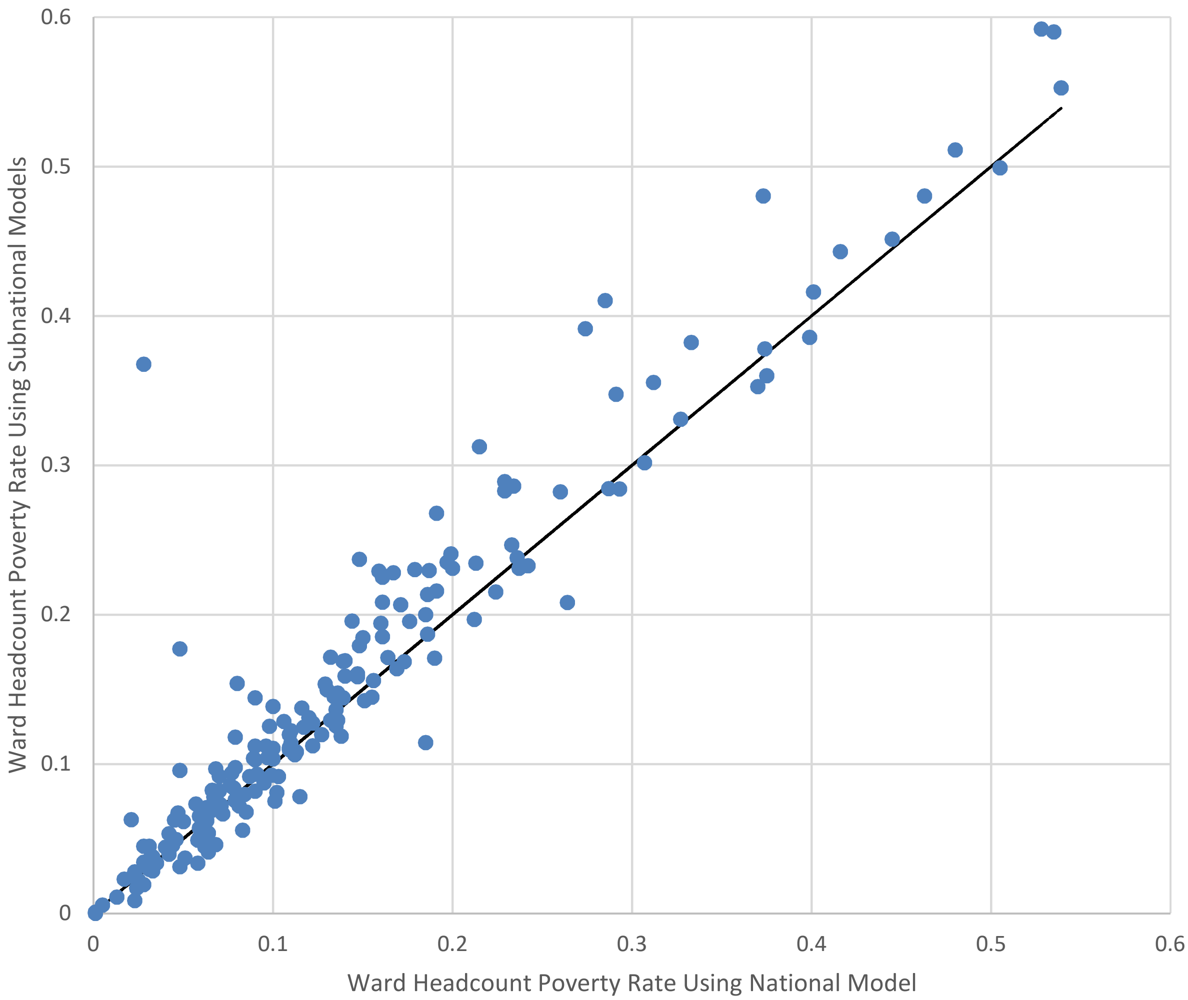
The poverty rates from the two approaches give quite similar results for Choiseul, Western, Malaita, and Temotu. The comparison is inconclusive for Rennell and Bellona and for Central because the survey analysis of poverty had to combine these two provinces due to the small sample size from Rennell and Bellona; thus, having the census-based estimates exceed the survey-based estimates for one of these provinces, and the reverse for the other may just reflect this aggregation. The main discrepancies are Isabel, Guadalcanal, Honiara, and Makira, with the census-based approach showing higher poverty rates for the first three than what the survey measured, and the reverse pattern holding for Makira. The report on the survey-based poverty estimates noted that economic activity was badly affected in Makira at about the time of the HIES, due to flash floods and landslides in the eastern part of the province in June 2012 and due to the damage from Tropical Cyclone Freda in December 2012, and these sorts of transitory shocks will not be captured by the census-based analysis, which not only is dated from 2009 but also is driven by more slowly changing factors because census questions often relate to permanent components of wealth and livelihoods that show up in asset ownership, dwelling attributes, and human capital. Thus, it is possible that Makira being revealed to have the highest poverty rate in 2012/13 is not a pattern that would occur every year, and instead, it may be (parts of) Guadalcanal that faces more deeply rooted and permanent poverty.

The other feature of the estimates that Figure 1 illustrates is the difference in the precision of the poverty rates coming from the two approaches. On average, the 95 percent confidence interval for the survey-based estimates of headcount poverty for each province is 11 percentage points. In contrast, the census-based confidence intervals average just 6 percentage points, and even when going down to the ward-level analysis, which is discussed below, the average confidence intervals only increase slightly, to 8 percentage points. It would be impossible for the survey to provide equally precise estimates for such fine-grained spatial units.

5.2 Comparing Results of National and Subnational Models

Applications of the ELL poverty mapping approach typically will consider several subnational domains rather than just using a single national-level model. It is expected that within a domain, the parametric relationship between characteristics (regressors) and poverty is the same across areas, while the relationship may differ between domains. In this case, the subnational models will provide a better basis for imputing consumption of census households. Because the Solomon Islands is a much smaller country than most countries where poverty mapping techniques have been used, there may be less need for subnational models, although it is still likely that the rate at which personal and household characteristics are transformed into consumption will differ between urban and rural areas and between small urban areas and Honiara. The factors that are relevant for predicting consumption are also likely to differ between these domains.

Figure 2: Ward-level Headcount Poverty Rates from National and Subnational Models



While there is a close relationship between the estimated ward-level headcount poverty rates from the national model and those from the aggregation of the subnational models ($r = 0.95$), there are some key differences. On average, the subnational models estimate slightly higher rates of poverty than what the national model estimates; so, more of the points in Figure 2 are above the 45° line. It appears that the coefficient structure chosen for the national model (including the choice of predictor variables) may cause consumption to be overstated (so poverty is understated); a particular example was for a rural ward from Rennell and Bellona where the rural model gave a predicted poverty rate of over 35 percent, while under the national model, the predicted poverty rate was less than 5 percent. While this is the largest discrepancy, some other wards had differences in predicted poverty rates of up to 10 percent. Therefore, the subnational models are used for the ward-level analysis reported below. In a few cases, a ward had both urban and rural EAs; so, for these wards, it is a weighted average of the rural and urban poverty rates that is mapped, while the tabulations of the welfare profile separately specify the rural and urban poverty rates. For most wards, this does not matter because they contain exclusively urban or exclusively rural EAs.

5.3 Ward-level Poverty Maps

The ward-level results from the simulations are shown in two ways. The first way of reporting these results is in a series of maps, which show the headcount poverty rate and also the number of people that are predicted to be poor in each ward. The reason for having both types of maps is that a focus on poverty rates may be misleading when the population is very unequally distributed over space; there may be far more poor people in areas where the poverty rate is not as high because it is in some low population density areas. Thus, it is helpful to know about both rates and numbers when designing geographically targeted interventions.

In Figure 3, the results are mapped for all areas of the Solomon Islands, to provide a national overview, even though, at this scale, it is not possible to see the finer detail for each ward. The higher poverty rates in Guadalcanal and Makira were already apparent in the survey analysis and in the initial results from the survey-to-census imputation, but the map shows the heterogeneity within those provinces; some wards are in the second lowest poverty rate class (8–13 percent), while others along the Weather Coast of Guadalcanal and in eastern Makira are in the highest poverty class with more than 34 percent of people living in households below the upper poverty line. The remoteness of Rennell and Bellona and, especially, Temotu, is also apparent from this map, and even though these provinces are not locations of high predicted poverty (except for the western end of Rennell) due to their low cost of living calculated from the HIES data, their small scale and relative isolation from the rest of the Solomon Islands may bring other disadvantages.

In Figure 4, the situation in the west of the Solomon Islands is shown in detail, for Choiseul, Western, and Isabel provinces. While most wards in this part of the Solomon Islands are in the lowest two classes for headcount poverty, there is a concentration of wards with above-average poverty rates (from 22 percent to 33 percent) in eastern Isabel and the majority of the predicted poor in that province are located there, which makes it a plausible candidate for spatial targeting. For Choiseul, the largest numbers of the poor, and all but one ward with an above-average poverty rate, can be found in the northwest. The more difficult case for spatial targeting is shown by

Western Province, where the highest poverty rate is on Ranongga Island, but this area has a relatively small population, and so, the largest number of poor people are located in wards of only average to below-average poverty rates, reflecting the larger populations on Ghizo, Kohinggo, and Kolombangara islands.

In Figure 5, the situation in the central regions of the Solomon Islands is shown in detail, for Central, Guadalcanal, Malaita, and Makira provinces. With the exception of the wards near Honiara, the rest of Guadalcanal is in the highest three poverty classes, with a continuous belt running along the Weather Coast, where poverty rates are above 34 percent. The map with the number of predicted poor shows that most of these wards have large numbers of poor people; in fact, there are 13 wards in Guadalcanal that each have more than 1,000 people in predicted poverty, while there are only two such wards in Makira and only one in Malaita. The other region of high poverty rates shown in this map is eastern Makira, where there are five wards with poverty rates above 34 percent.

In Figure 6, the maps for the remaining parts of the Solomon Islands are reported, which are either areas that are more distant (Rennell and Bellona, and Temotu), so that in the national-scale map they are too small to reveal finer detail, or they are very small in an absolute sense (the Honiara Capital Territory) and so need to be mapped with a different scale. In Honiara, the largest number of poor are in Panatina ward, although the poverty rates are higher in three other wards. In the wards from Temotu, the number of people predicted to be poor is never more than 300 per ward, reflecting the small population in these wards and that poverty rates are generally lower than average. The same feature is true of Rennell and Bellona, and this reflects a challenge for spatial targeting when the absolute number of poor people in an area is quite low, because most interventions are likely to have considerable fixed costs.

5.4 Ward-level Welfare Profiles

While the presentation of the ward-level estimates of headcount poverty in the form of maps is one of the main outputs from the analysis, the simulations also reveal other potentially useful information on monetary welfare (Table 3). The two other poverty indicators calculated—the poverty gap index and the squared poverty gap index—are quite closely correlated with the headcount rate (r = 0.99 for the poverty gap and r = 0.97 for the squared poverty gap, when compared to the headcount), which is why they were not mapped. However, the ward-level values of the poverty gap index may be useful to discussions about targeted transfers, because this index is calculated as the ratio of the sum of the poverty gaps across all individuals relative to the product of the total population and the poverty line for the particular domain under consideration. For example, just considering households in the rural sector, this total poverty gap averages just under SBD 0.5 million per ward and has a maximum value of SBD 3.3 million (for Moli ward, in Guadalcanal). This figure can be interpreted as the bare minimum annual cost to eliminate poverty by means of perfectly targeted transfers that are both administratively costless and have no disincentive effects; these are, of course, unrealistic assumptions but they help provide a monetary frame of reference for thinking about the scale of the poverty alleviation task.

The other potentially useful welfare indicator in Table 3 for thinking about spatial differences in economic development is the Gini index for the inequality in (nominal) expenditure per adult equivalent. There is greater inequality in urban areas than in rural areas, with the ward-level estimates of the Gini index ranging from 0.30 to 0.46 in Honiara and from 0.24 to 0.51 in other urban areas (and with a value for the aggregate urban sector of 0.44). In contrast, in rural areas, the Gini index ranges from 0.25 to 0.39, with an aggregate value of 0.34.

5.5 Validation

To support the findings of the ward-level poverty map calculations, a series of additional maps were created from the census-level variables. Because these variables are eligible for inclusion into the models, both at the household and EA levels, there is necessarily some correlation between the variable and the poverty estimate, but it is also logical to conclude that for certain variables, higher or lower incidence would be indicative of higher or lower poverty rates. The spatial comparison between the two measures serves, therefore, as a level of validation for the poverty map estimates. In addition, the geographic incidence of certain variables also demonstrates the added benefit of subnational modelling. For example, as shown in Figure 7, on average, the largest share of working age population engaged in wage employment, comprising both private and public sectors, is concentrated in the urban wards of Honiara, Western, and Central provinces, which are also areas of low poverty incidence.

The importance of geography to modelling is demonstrated through the ownership of large durable assets, such as motor vehicles (car, bus, or truck), which could be expected to be highly inversely correlated with poverty headcount. The coefficient on this variable is positive and significant in all four beta models (national, Honiara, other urban areas, and rural areas). Looking at the map in Figure 8, however, shows that ownership is clustered around Honiara. This would indicate that, at the ward level, motor vehicle ownership is less informative, likely because limited and poor quality road networks make motor vehicle ownership impractical in many areas, regardless of income level. Within Honiara and its environs, however, the comparison is more relevant (see Figure 9 for a side-by-side comparison). Similarly, Figure 10 shows how the ownership of durable household goods, particularly a refrigerator, is meaningful for understanding the poverty distribution within Honiara. According to the 2009 census data, 88 percent, 60 percent, and 58 percent of households own a refrigerator in Cruz, Rove-Lengakiki, and Kukum wards, respectively, compared to the rest of the province that range between 23 percent and 51 percent).

In contrast, the ownership of motorboats and ships is less affected by geography, though it is less relevant for Honiara. The highest prevalence of mechanized boat ownership is found in the eastern parts of Western, in eastern Rennell and Bellona, and western Isabel, where poverty rates are comparatively low, while the lowest levels of ownership were found in areas with higher poverty rates, including east Makira, west Rennell and Bellona, and Weather Coast of Guadalcanal. See Figure 11.

Certain dwelling characteristics are also correlated with poverty, though some are limited to only within specific provinces. Households in wards with high poverty incidence, particularly those located in east Makira, west Rennell and Bellona, and Weather Coast of Guadalcanal, are less likely to have concrete, cement, or brick floors, whereas wards in which over 40 percent of the interviewed households had these flooring materials are concentrated in Honiara, specifically in Banika, Cruz, and Kukum wards (88 percent, 70 percent, and 64 percent, respectively), which also has the lowest poverty rates. There are, however, some exceptions, including the small Naha ward in Honiara, which has a high percentage of households with improved flooring (70 percent) but also has a high poverty rate (41 percent). Further related to dwelling characteristics, tin or corrugated iron roofs were found in more than 66 percent of the households in Honiara and Rennell and Bellona, but with lower frequency in the poorest wards. See figures 12 and 13.

The validation exercise reveals one area where the pattern suggested by the poverty mapping exercise differs from the pattern suggested by census variables, which warrants further comment. The small area estimates indicate higher rates of poverty in the wards of Honiara than some of the peri-urban area outside Honiara City; notably, in Tandai ward in Guadalcanal Province. In contrast, several census variables suggest patterns which would indicate higher poverty outside the Honiara City boundary; for example, lower rates of wage employment, lower rates of ownership of motor vehicles, refrigerators, lower rates of gas as a cooking fuel, and lower rates of improved flooring and roofing in dwellings. The poverty estimates for peri-urban areas in Guadalcanal could be underestimating poverty, since those households' consumption welfare is assessed against a poverty line derived for Guadalcanal Province as a whole, and peri-urban households near the capital could potentially face the higher prices implicit in the higher poverty line for Honiara City. The census indicators could also reflect a situation where households closer to Honiara have better access to the infrastructure (such as roads, electricity) and markets (such as for imported building materials) that support the ownership of certain assets. Note that the census indicators do appear to align with the pattern of poverty within Guadalcanal Province (that higher rates of poverty are apparent further from Honiara City).

5.6 Analytical Uses of the Ward-level Estimates

While the poverty maps and welfare profile provide a descriptive analysis that may help guide spatially targeted interventions, the output of the simulations may also be helpful for analytical and research purposes. With just 10 provinces (counting Honiara as equivalent to a province), there are too few observations to enable the study of interprovincial differences under standard statistical frameworks compared with what is possible in larger countries (for example, Papua New Guinea has 22 provinces and Indonesia has 34 provinces). However, with the creation of the ward-level database of average levels of economic welfare (predicted consumption), the inequality in that indicator (the Gini index), and the extent of shortfalls from reasonable standards of living (the poverty measures), some new research possibilities eventuate.

One example is given here, using the simulations for the rural sector, which gives n = 168 observations. With this many data points, relationships between economic growth, inequality, and poverty can be precisely estimated, with growth and inequality elasticities derived, as follows (and t-statistics in parentheses):

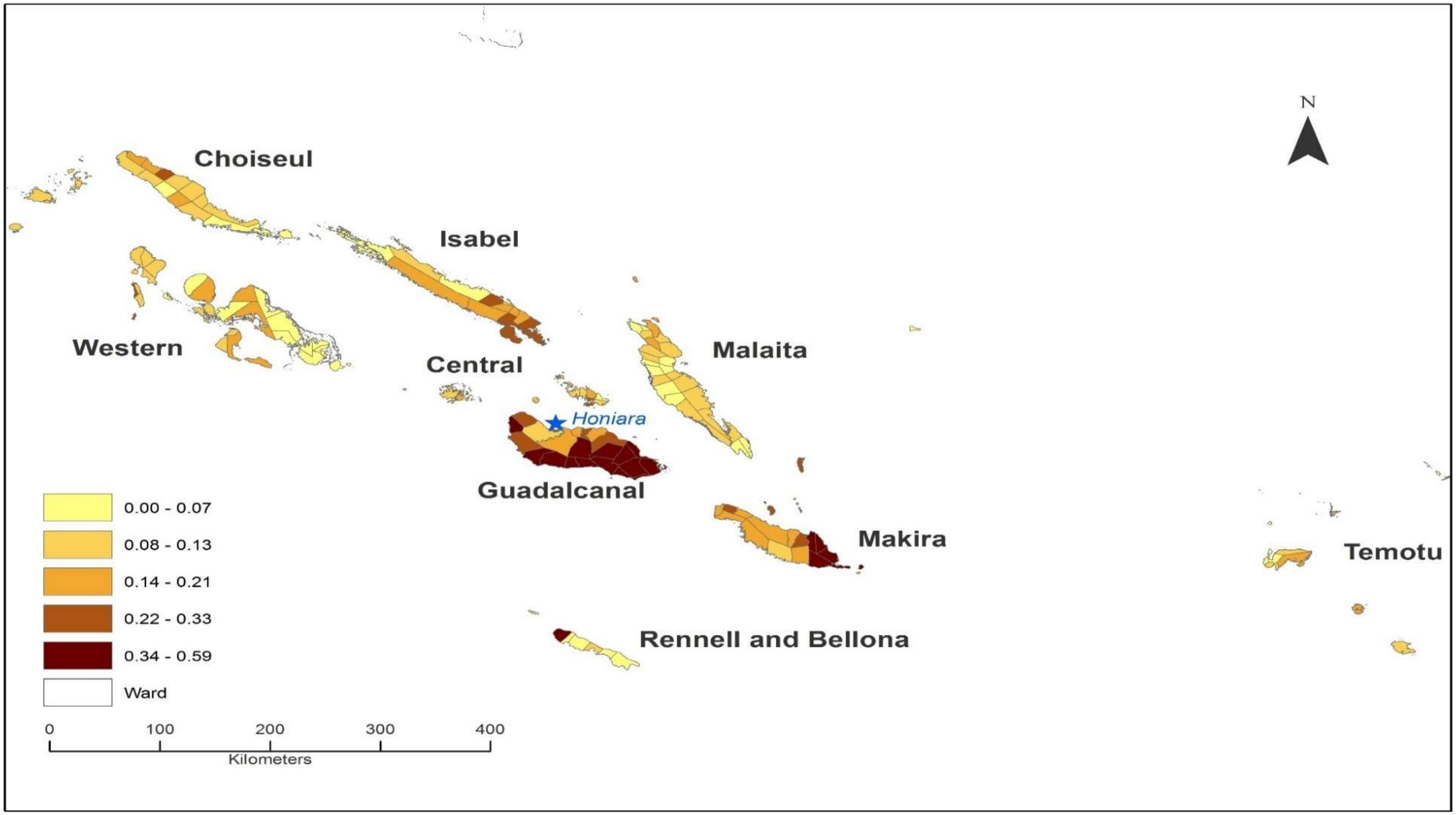
$$\ln(headcountindex)_i = 32.84 - \underset{(20.43)}{3.42} \ln y_i + \underset{(5.85)}{3.05} \ln Gini_i \qquad R^2 = 0.74 \qquad (6)$$

The growth elasticity of the headcount poverty rate is −3.4 and the inequality elasticity is 3.1; so, actions to raise mean living standards in the rural Solomon Islands and to reduce inequality will both have large effects in reducing the poverty headcount rate. However, the same relationship cannot be precisely estimated at the provincial level, with *t*-statistics of 0.99 and 1.57, and the model as a whole being statistically insignificant ($p = 0.24$). In other words, a meaningful and analytically useful relationship that would be difficult to estimate with province-level data can be more successfully estimated using the ward-level database that is one of the outputs of the poverty mapping simulations.

6. Conclusions

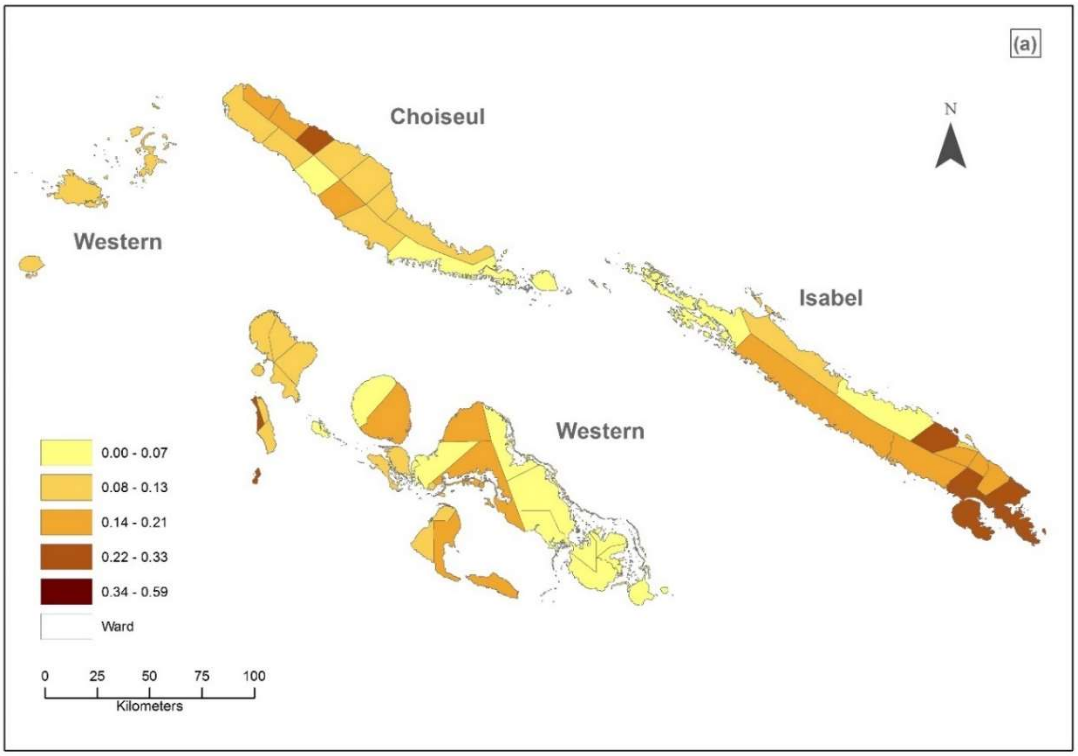
This paper combines data from the 2009 Population and Housing Census with the 2012/13 HIES to estimate poverty and inequality indexes for each province and each ward of the Solomon Islands. The previous measurements of poverty using only the survey data had already established that poverty in the Solomon Islands is predominantly rural, with the highest poverty rates in Guadalcanal and Makira. Yet, even within the rural sector and within provinces, there is great variation in the living standards and in the extent of poverty. In particular, the topography of some provinces, such as Guadalcanal, makes it hard for the benefits of economic development to spread widely over space. The survey-to-census imputations carried out in this paper enable some of this variation to be revealed, providing useful information for developing interventions such as spatial targeting that can assist in reducing poverty and also providing useful data for future analytic studies to explore some of the driving forces behind different levels of poverty and inequality.

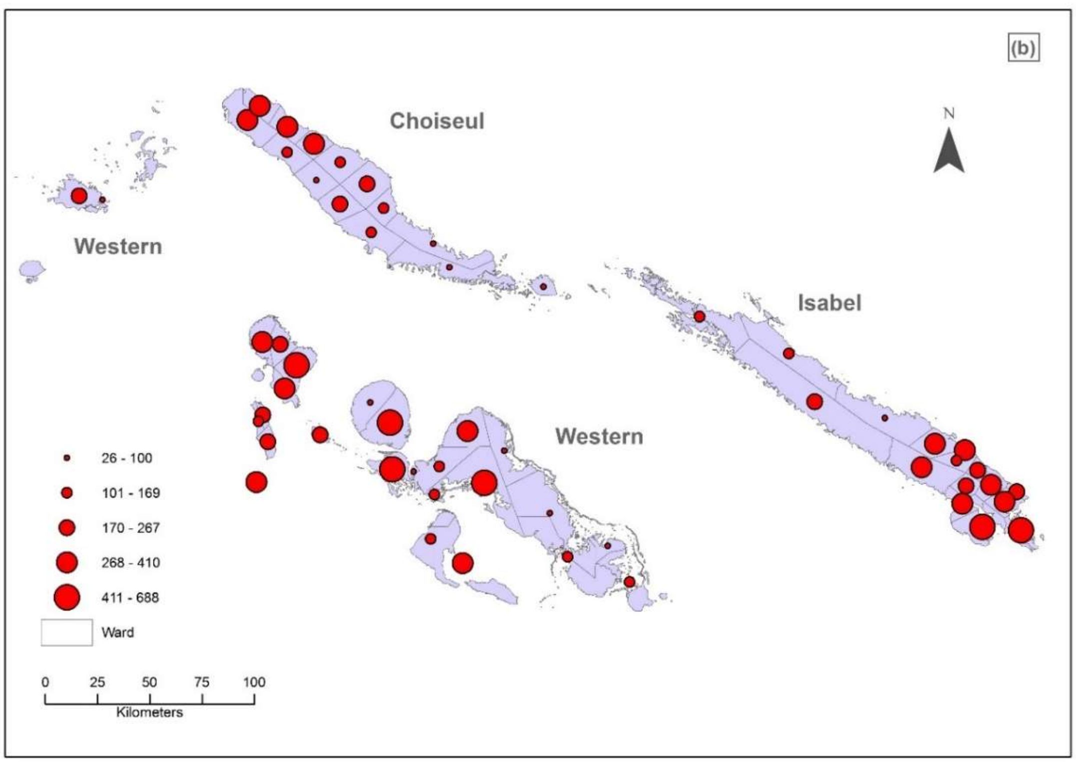
Figure 3: Predicted Headcount Poverty Rate by Ward, Solomon Islands - 2009



Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.

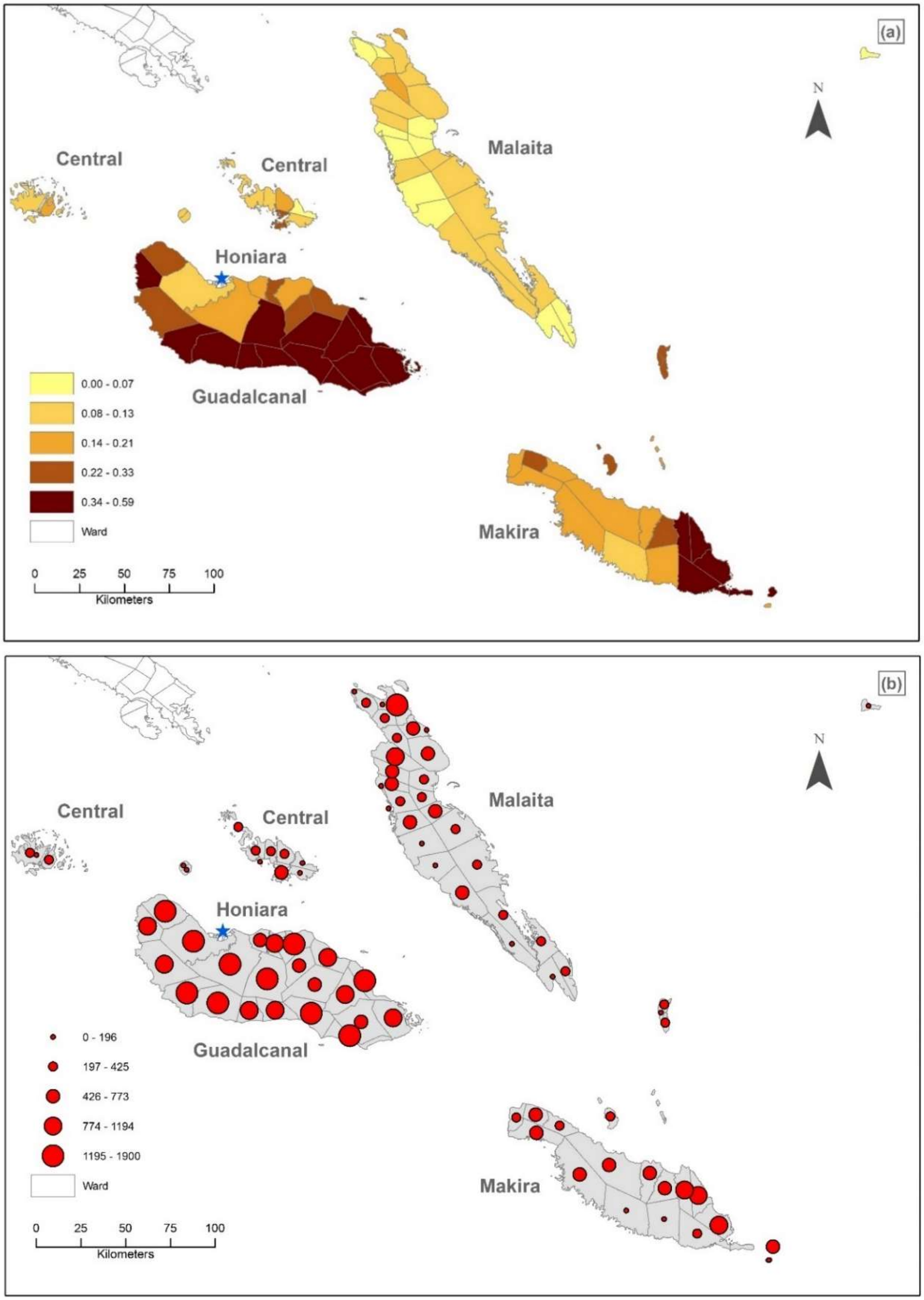
Figure 4: Predicted Poverty Rate (a) and Number in Poor Households (b): West





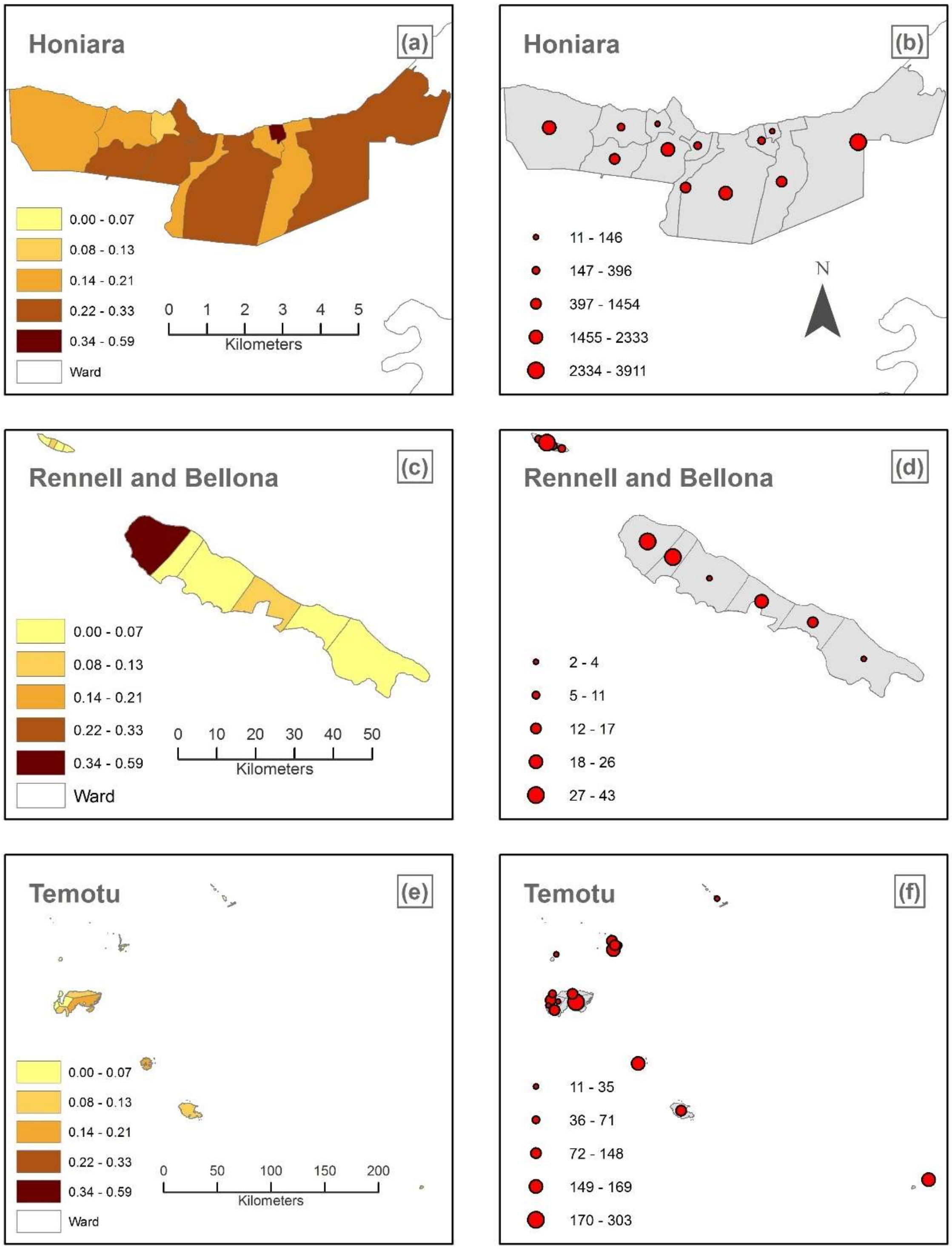
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.

Figure 5: Predicted Poverty Rate (a) and Number in Poor Households (b): Center



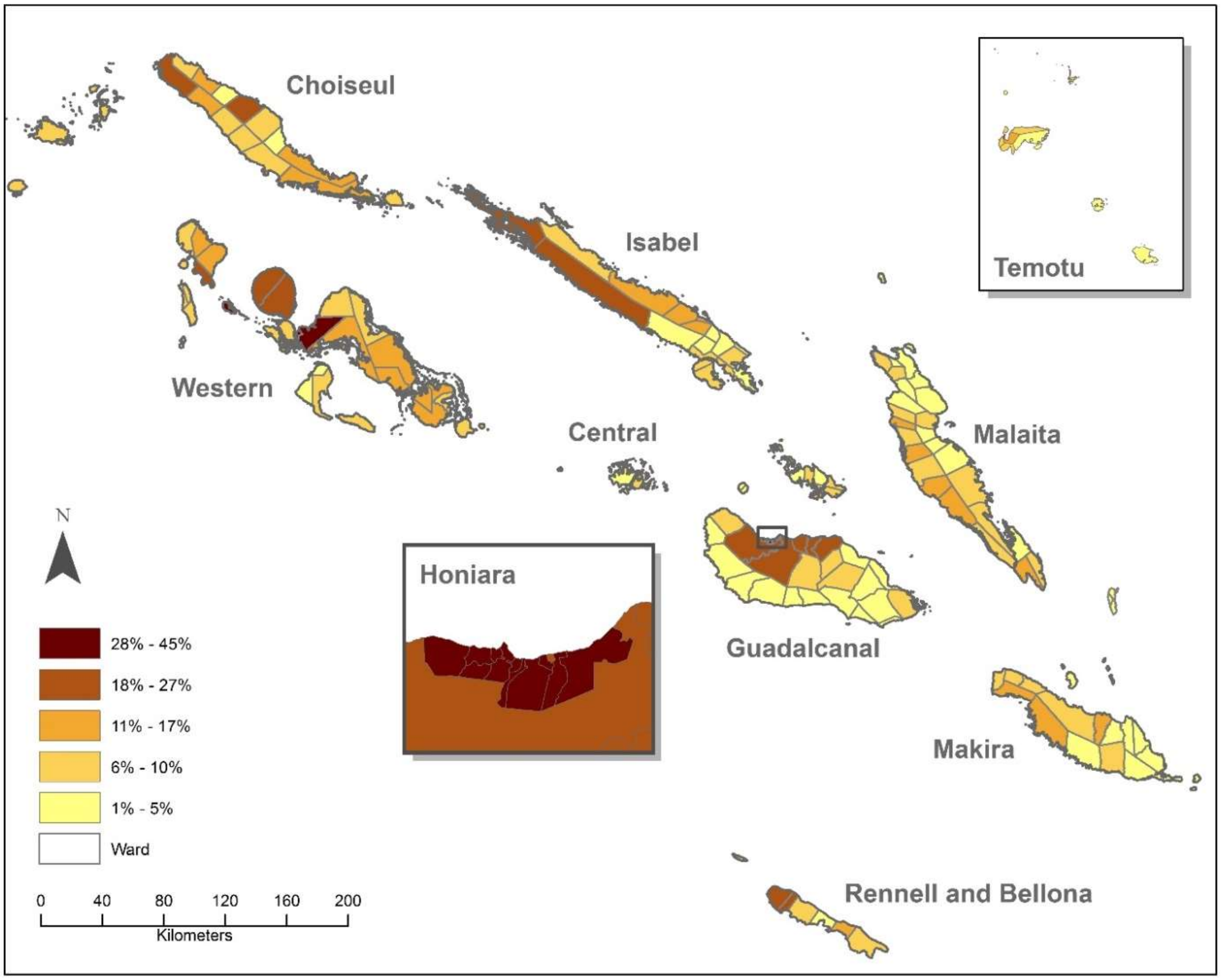
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.

Figure 6: Predicted Poverty Rate (a), (c), and (e) and Number in Poor Households (b), (d), and (f): Honiara, Rennell and Bellona, and Temotu



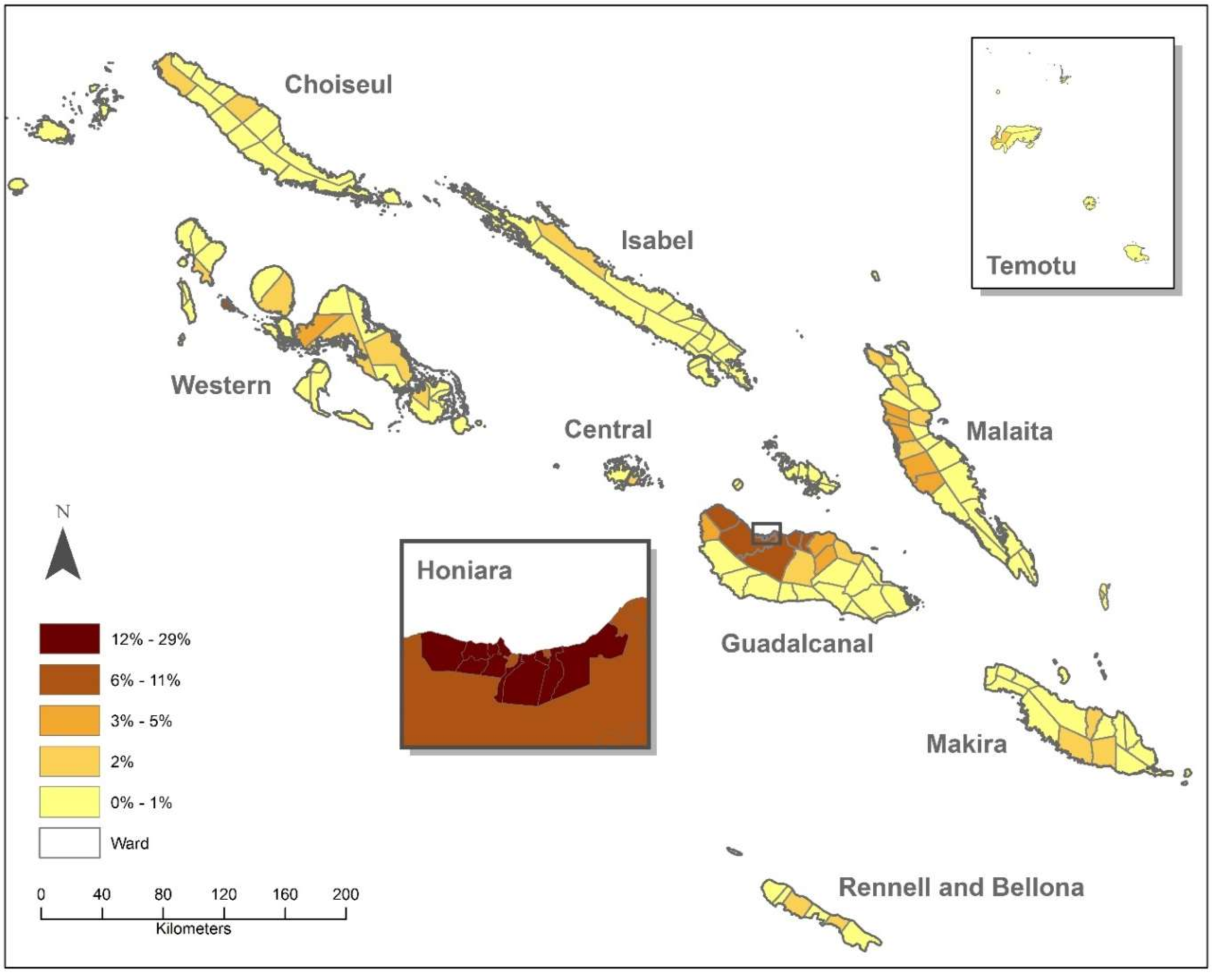
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.

Figure 7: Percentage of Working Age Population Engaged in Wage Employment (Private and Public Sectors)



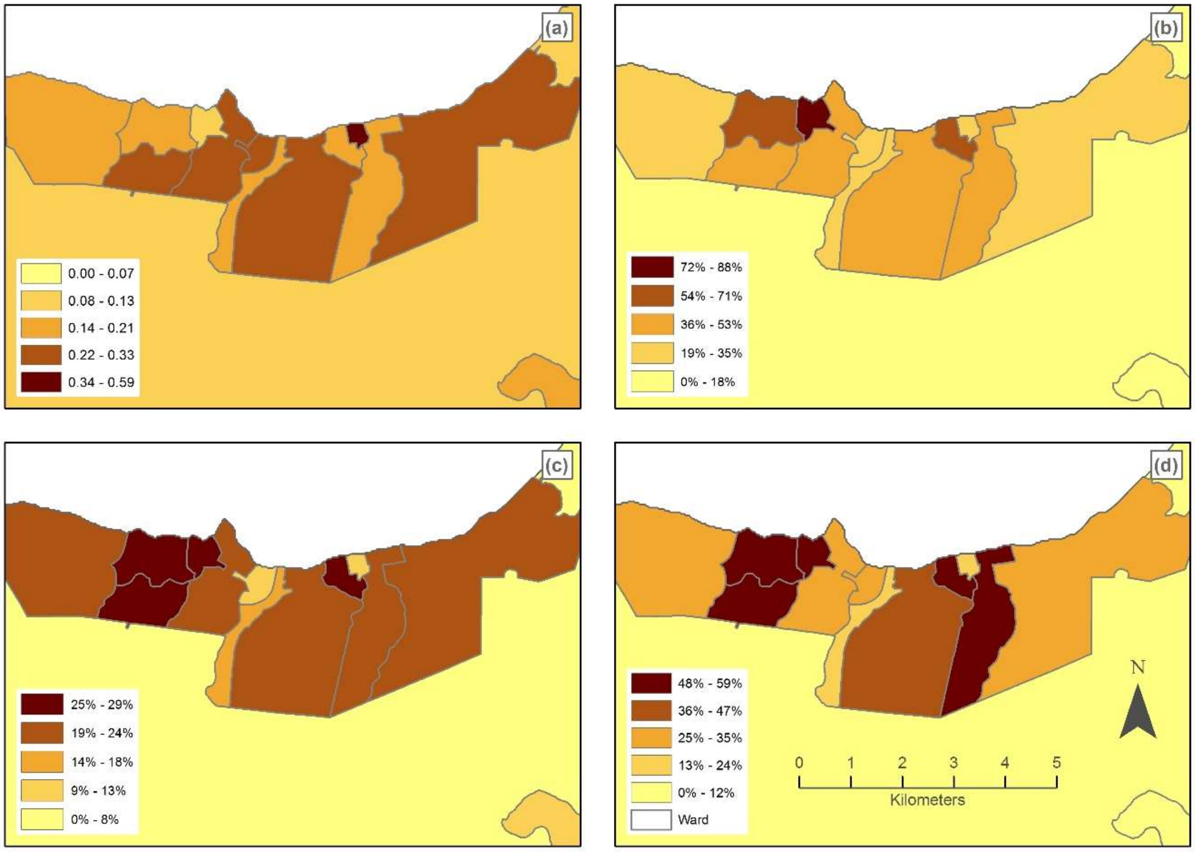
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail.

Figure 8: Percentage of Households Owning a Motor Vehicle (Car, Bus, or Truck)



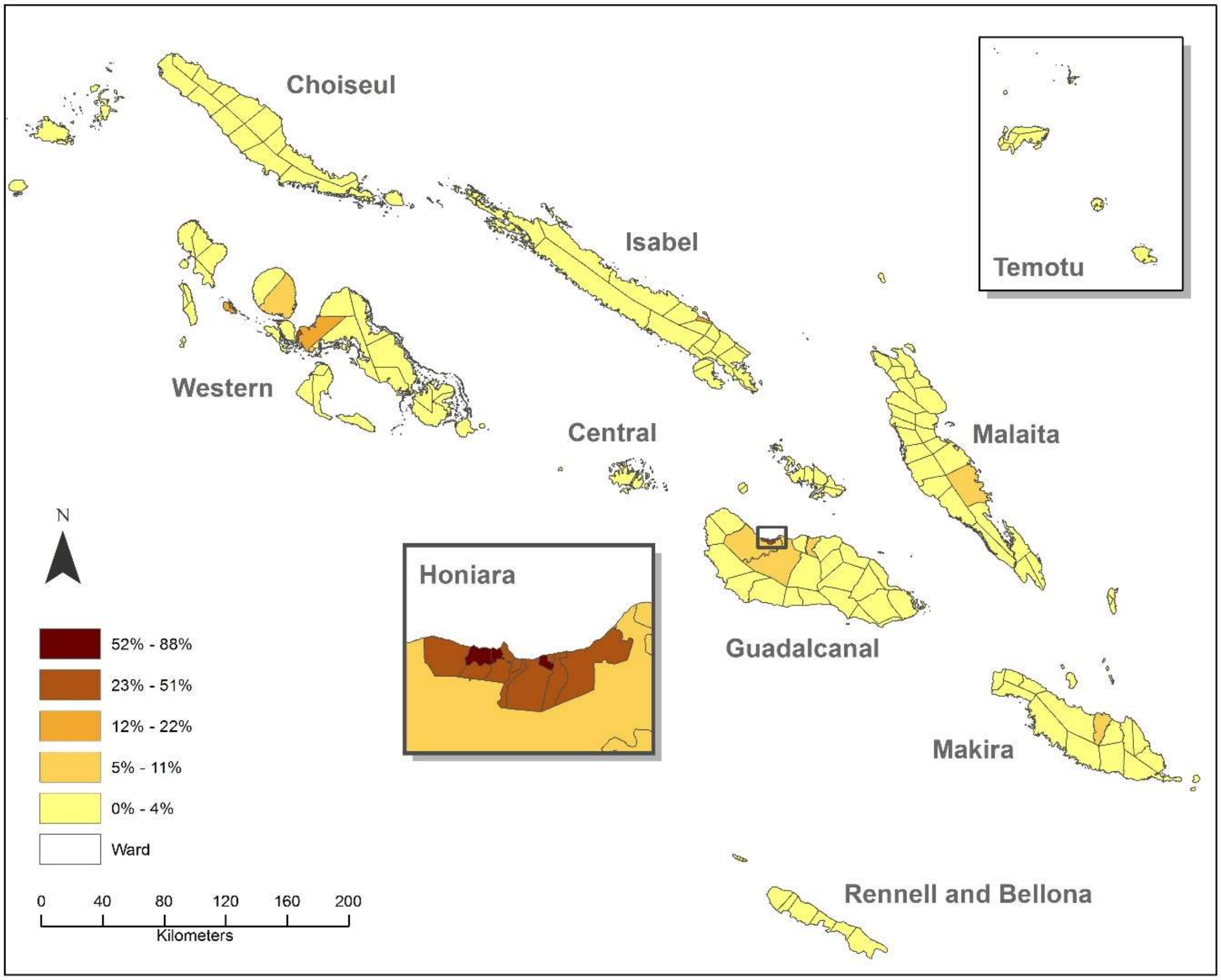
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail.

Figure 9: Predicted Poverty Rate (a) and Percentage of Households in Honiara Owning a Refrigerator (b), Owning a Motor Vehicle (Car, Bus, or Truck) (c), or Using Gas as the Main Cooking Fuel (d)



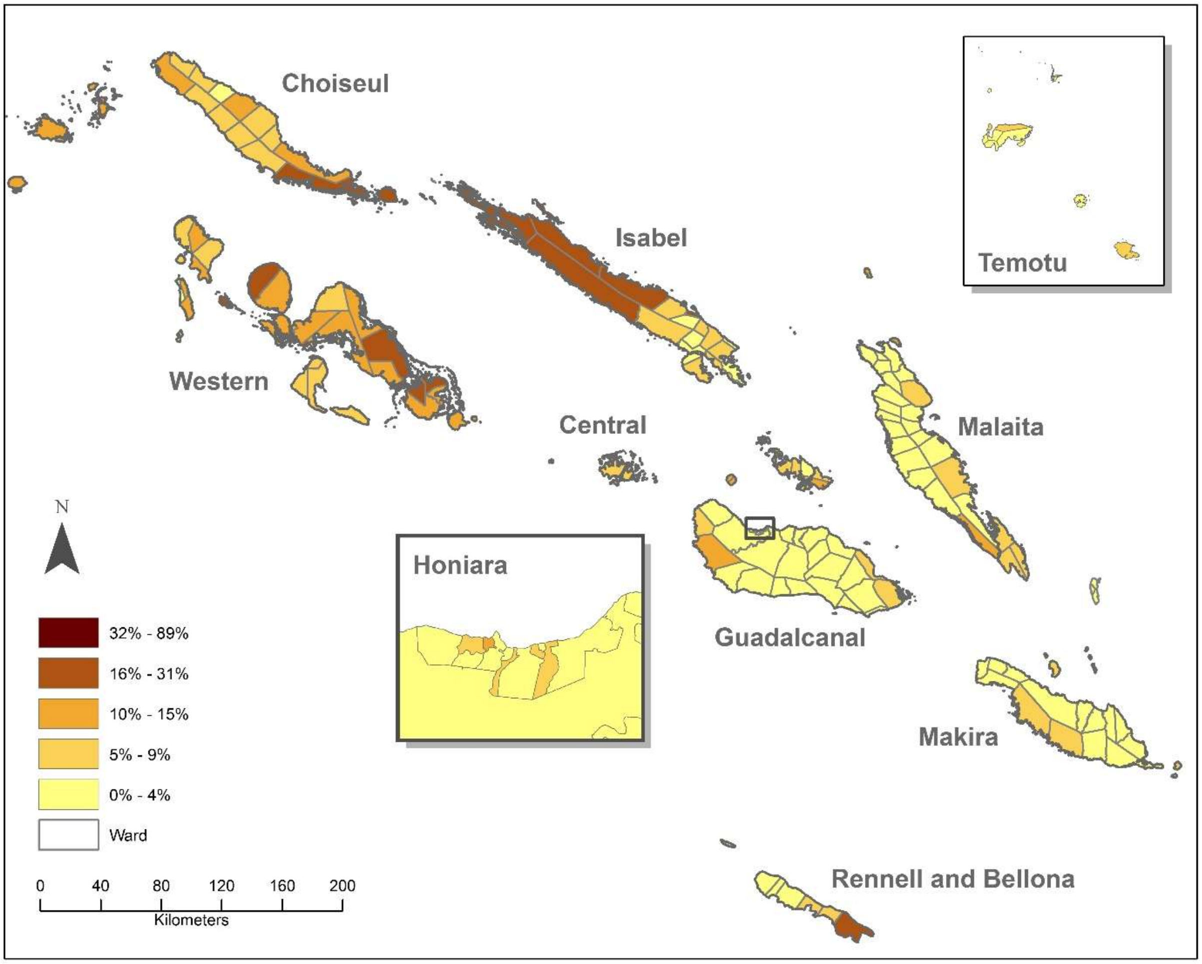
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail. Data breaks were readjusted to display within-province variation in Honiara.

Figure 10: Percentage of Households Owning a Refrigerator



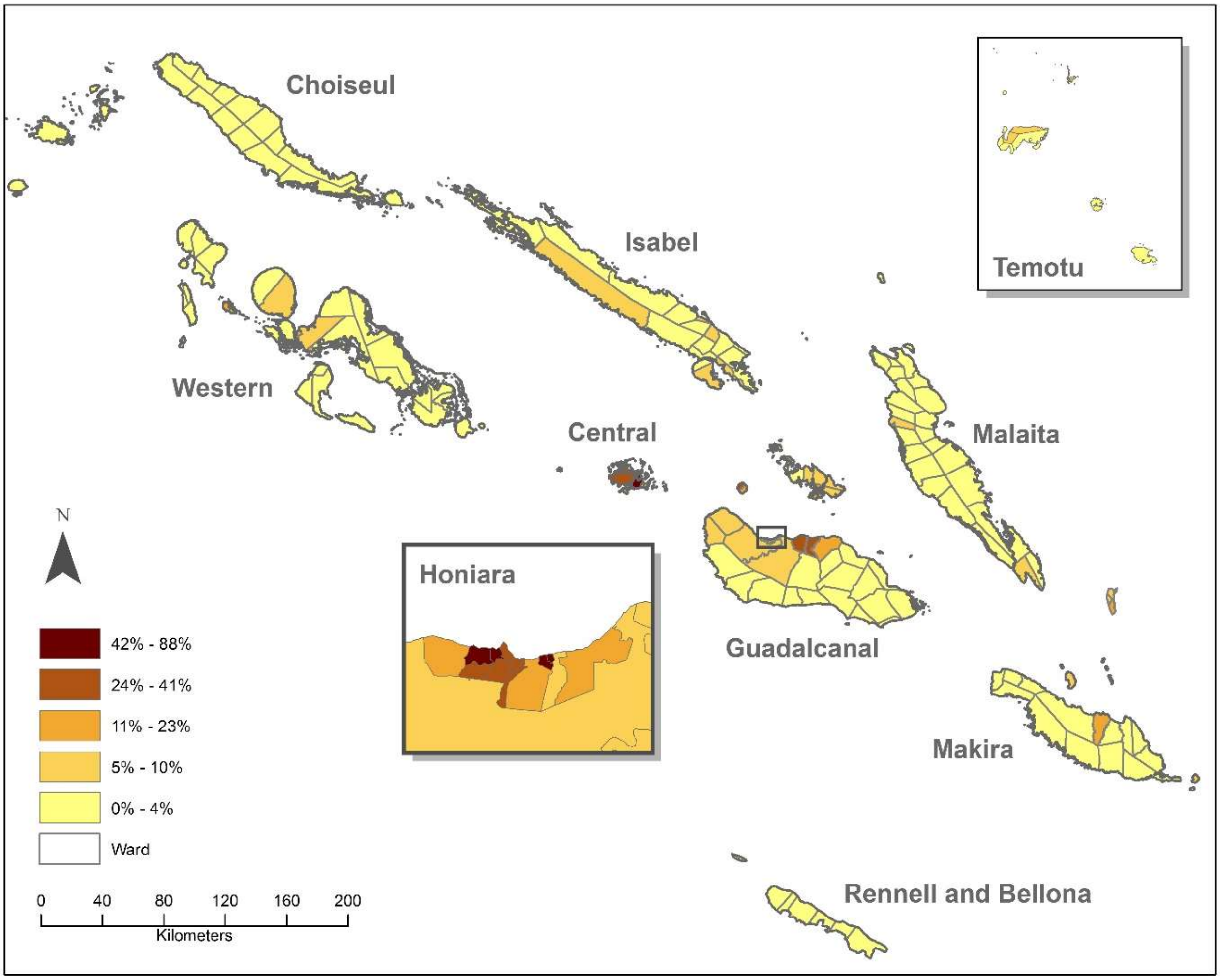
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail.

Figure 11: Percentage of Households Owning a Motorboat or Ship



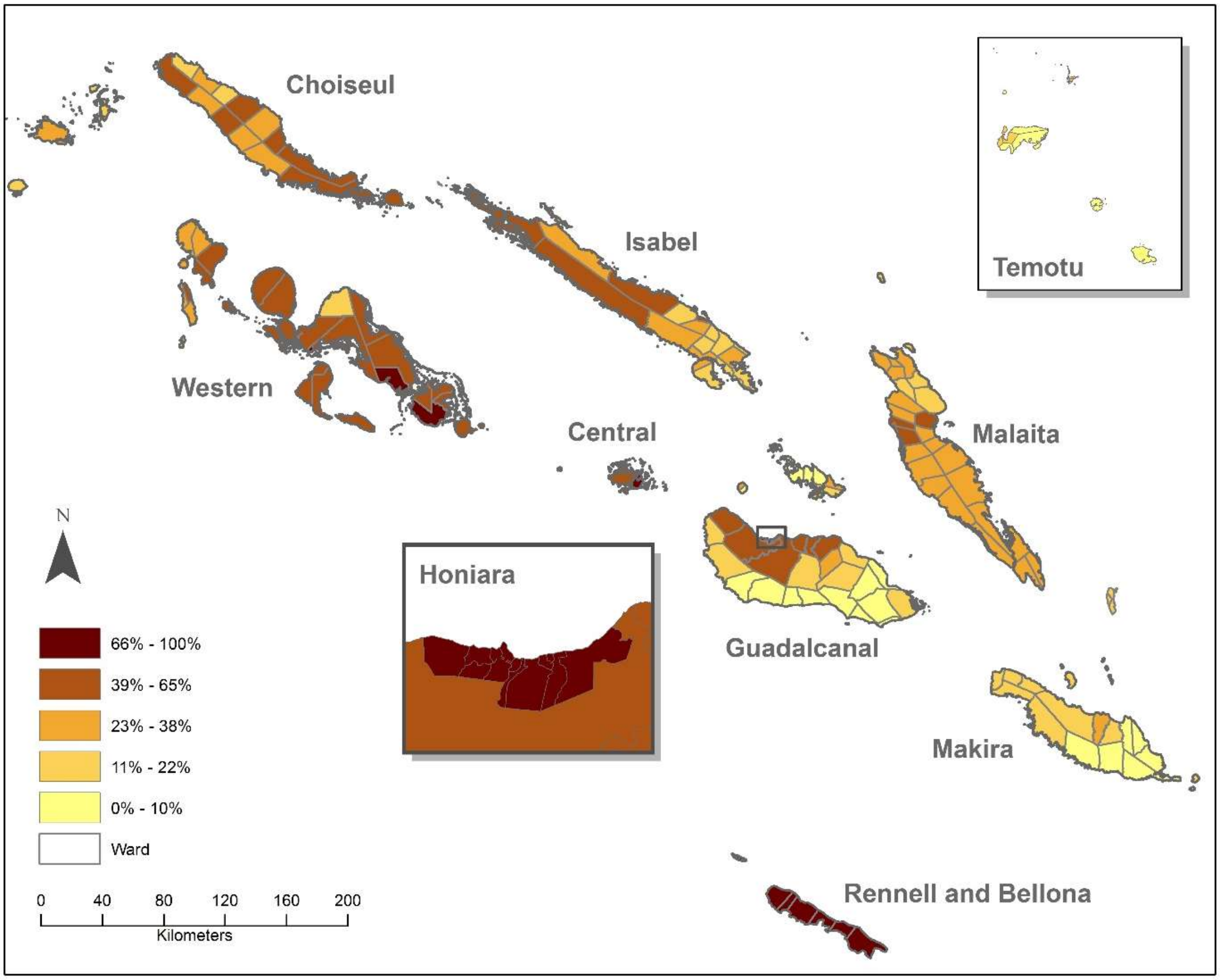
Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail.

Figure 12: Percentage of Households with Concrete, Cement, or Brick as the Main Flooring Material



Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail.

Figure 13: Percentage of Households with Tin or Corrugated Iron as Their Main Roofing Material



Source: Maps developed by authors using ArcGIS 10.4 for Desktop with shapefiles from Global Administrative Areas (www.gadm.org). Geographic Coordinated System: World Geodetic System (WGS) 1984.
Note: Temotu is shown at correct scale but was relocated to fit into the map frame and allow a larger overall map scale. Honiara is shown in the inset at a larger scale to allow for more detail.

Table 3: Welfare Profile

Part A - Rural Sector

Province	Ward	Ward Name	Ward Population (2009)		Imputed Expenditure per Adult Equivalent				Headcount Poverty		Poverty Gap		Poverty Severity		Gini Inequality	
			Hholds	Persons	Minimum	Maximum	Mean	Std Error	Rate	Std Error	Index	Std Error	Index	Std Error	Index	Std Error
Choiseul	1	Waghina	250	1636	1344	2194969	16633	2554	0.038	0.021	0.007	0.005	0.002	0.002	0.357	0.031
Choiseul	2	Katupika	399	1965	1104	7056992	17611	2623	0.022	0.014	0.004	0.003	0.001	0.001	0.388	0.054
Choiseul	3	Vasiduki	312	1569	1242	197047	9501	851	0.093	0.035	0.017	0.008	0.005	0.003	0.285	0.018
Choiseul	4	Vivuri	289	1499	915	172161	8323	744	0.153	0.051	0.032	0.014	0.010	0.006	0.287	0.019
Choiseul	5	Babatana	324	1720	1416	455996	11644	1032	0.049	0.024	0.008	0.005	0.002	0.002	0.302	0.021
Choiseul	6	Tepakaza	322	1665	959	243260	10049	924	0.078	0.034	0.015	0.008	0.004	0.003	0.291	0.016
Choiseul	7	Batava	657	3886	1089	908111	11803	817	0.079	0.024	0.016	0.006	0.005	0.002	0.334	0.018
Choiseul	8	Tavula	418	2487	884	3440266	8662	754	0.136	0.041	0.027	0.010	0.008	0.004	0.296	0.019
Choiseul	9	Polo	302	1699	941	151539	7814	826	0.196	0.063	0.043	0.018	0.014	0.007	0.297	0.019
Choiseul	10	Bangara	189	1158	630	70679	6424	762	0.284	0.095	0.069	0.031	0.025	0.013	0.270	0.022
Choiseul	11	Susuka	304	1746	592	2343743	11703	1496	0.097	0.042	0.019	0.011	0.006	0.004	0.374	0.034
Choiseul	12	Senga	345	1856	1028	242273	9353	899	0.106	0.038	0.020	0.009	0.006	0.003	0.290	0.018
Choiseul	13	Kerepangara	204	1077	1307	111796	9516	1087	0.098	0.052	0.019	0.013	0.006	0.005	0.280	0.021
Choiseul	14	Kirugela	252	1170	1390	664569	10831	1365	0.085	0.044	0.016	0.011	0.005	0.004	0.322	0.031
Western	1	Outer Shortlands	253	1287	1298	137318	11566	1200	0.076	0.031	0.016	0.007	0.005	0.003	0.309	0.021
Western	2	Inner Shortlands	448	2385	483	2036562	11983	1176	0.112	0.030	0.025	0.009	0.008	0.004	0.380	0.030
Western	3	Simbo	314	1782	1031	113353	7230	570	0.230	0.054	0.050	0.016	0.016	0.007	0.275	0.016
Western	4	North Ranongga	92	520	991	126684	6854	1093	0.284	0.102	0.069	0.036	0.025	0.016	0.283	0.025
Western	5	Central Ranongga	488	2514	1149	1174269	10758	819	0.094	0.035	0.019	0.010	0.006	0.004	0.316	0.025
Western	6	South Ranongga	644	3294	1193	478867	10221	663	0.079	0.027	0.014	0.006	0.004	0.002	0.295	0.015
Western	7	Vonunu	645	3445	751	1428548	12066	1016	0.092	0.029	0.018	0.007	0.006	0.003	0.369	0.028
Western	8	Bilua	754	4215	1087	1869551	9815	760	0.125	0.033	0.026	0.009	0.008	0.004	0.319	0.019
Western	9	Dovele	378	1967	972	1127880	10584	897	0.114	0.038	0.023	0.010	0.007	0.004	0.336	0.026
Western	10	Iringgila	501	2645	1109	1004872	10317	905	0.122	0.037	0.026	0.010	0.008	0.004	0.334	0.024
Western	11	Gizo	675	3615	384	2431036	13545	1255	0.055	0.023	0.010	0.005	0.003	0.002	0.361	0.024
Western	12	South Kolombangara	722	3797	116	1353133	10564	1110	0.177	0.066	0.074	0.049	0.044	0.038	0.375	0.038
Western	13	Vonavona	990	5334	736	527764	11095	715	0.110	0.026	0.025	0.007	0.008	0.003	0.339	0.014
Western	14	Kusaghe	332	2144	913	168950	8236	697	0.168	0.057	0.035	0.016	0.011	0.007	0.283	0.021
Western	15	Munda	221	1076	670	1065326	12734	1626	0.070	0.040	0.016	0.011	0.006	0.005	0.340	0.027
Western	16	Nusa Roviana	80	454	902	195968	10496	2123	0.113	0.076	0.023	0.019	0.007	0.007	0.310	0.026
Western	17	Roviana Lagoon	757	4332	790	759207	9882	763	0.159	0.038	0.038	0.012	0.014	0.005	0.346	0.017
Western	18	South Rendova	451	2441	940	2327207	9650	692	0.139	0.039	0.031	0.012	0.011	0.005	0.322	0.021
Western	19	North Rendova	334	1724	1128	388333	10084	987	0.092	0.037	0.017	0.009	0.005	0.003	0.294	0.023
Western	20	Kolombaghea	322	1571	1196	663164	12280	1094	0.039	0.020	0.007	0.004	0.002	0.002	0.297	0.018
Western	21	Buini Tusu	486	2781	1180	1448242	15205	1242	0.029	0.015	0.005	0.003	0.001	0.001	0.338	0.021
Western	22	Nono	628	3388	712	3193642	14868	1277	0.044	0.018	0.009	0.005	0.003	0.002	0.343	0.018
Western	23	Nggatokae	584	2897	959	568011	12251	1139	0.053	0.022	0.010	0.005	0.003	0.002	0.309	0.019
Western	24	North Vangunu	461	2527	1081	673168	14327	1236	0.028	0.016	0.005	0.003	0.001	0.001	0.322	0.018
Western	26	North Kolombangara	404	1999	1651	789375	14834	1449	0.024	0.013	0.004	0.003	0.001	0.001	0.311	0.021
Isabel	1	Kia	437	1876	545	1717550	18044	2107	0.062	0.026	0.014	0.007	0.005	0.003	0.365	0.031
Isabel	2	Havulei	244	1103	1461	1119075	12127	1542	0.120	0.046	0.026	0.013	0.008	0.005	0.337	0.039
Isabel	3	Kokota	249	1134	1485	1504955	15334	1895	0.045	0.030	0.008	0.007	0.002	0.002	0.302	0.023
Isabel	4	Hovikoilo	392	1819	912	229480	9123	940	0.213	0.063	0.049	0.019	0.017	0.008	0.295	0.020

Province	Ward	Ward Name	Ward Population (2009)		Imputed Expenditure per Adult Equivalent				Headcount Poverty		Poverty Gap		Poverty Severity		Gini Inequality	
			Hholds	Persons	Minimum	Maximum	Mean	Std Error	Rate	Std Error	Index	Std Error	Index	Std Error	Index	Std Error
Isabel	5	Buala	353	1832	888	1344902	10315	1242	0.155	0.047	0.032	0.012	0.010	0.005	0.299	0.029
Isabel	6	Tirotonga	161	683	1423	179048	9202	1387	0.172	0.090	0.035	0.022	0.011	0.008	0.260	0.021
Isabel	7	Koviloko	253	1206	1212	185216	9314	941	0.179	0.062	0.038	0.016	0.012	0.006	0.277	0.017
Isabel	8	Kmaga	351	1721	698	330463	9054	975	0.194	0.068	0.042	0.019	0.014	0.008	0.276	0.017
Isabel	9	Kaloka	197	959	1069	157292	8763	1129	0.216	0.080	0.050	0.024	0.017	0.010	0.271	0.019
Isabel	10	Tatamba	282	1383	991	145241	8737	945	0.235	0.070	0.055	0.023	0.019	0.010	0.290	0.019
Isabel	11	Sigana	438	2280	1304	168778	8286	739	0.246	0.058	0.056	0.017	0.019	0.007	0.278	0.019
Isabel	12	Japuana	405	2087	997	122387	8494	815	0.240	0.064	0.055	0.018	0.018	0.007	0.284	0.020
Isabel	13	Kolomola	205	949	987	79701	8152	1136	0.235	0.098	0.052	0.028	0.017	0.011	0.251	0.018
Isabel	14	Kolotubi	303	1539	780	279822	8635	950	0.230	0.069	0.052	0.021	0.017	0.009	0.280	0.020
Isabel	15	Susabona	361	1880	1315	87390	8975	819	0.200	0.058	0.044	0.017	0.014	0.007	0.279	0.016
Isabel	16	Samasodu	354	1804	833	1153866	11759	1642	0.144	0.058	0.033	0.017	0.011	0.007	0.337	0.027
Central	1	Sandfly/Buenavesta	672	3170	980	1494256	10111	721	0.084	0.024	0.016	0.006	0.005	0.002	0.308	0.017
Central	2	West Nggella	443	2220	1107	168686	8049	567	0.129	0.036	0.025	0.009	0.008	0.003	0.270	0.013
Central	3	East Nggella	400	2026	960	113527	8474	742	0.125	0.040	0.025	0.010	0.008	0.004	0.285	0.019
Central	5	South West Nggella	474	2521	447	143245	7566	788	0.225	0.059	0.064	0.025	0.027	0.014	0.322	0.022
Central	6	South East Nggella	323	1662	925	539004	8902	826	0.109	0.046	0.021	0.011	0.006	0.004	0.288	0.018
Central	7	North East Nggella	429	2118	1493	121466	12545	1235	0.033	0.019	0.006	0.004	0.001	0.001	0.291	0.018
Central	8	North West Nggella	330	1714	1084	72136	7742	770	0.142	0.058	0.027	0.013	0.008	0.005	0.261	0.014
Central	9	Banika	333	2015	581	139361	9755	1269	0.154	0.051	0.040	0.016	0.015	0.007	0.343	0.022
Central	10	Pavuvu	333	1940	744	119004	8802	882	0.125	0.046	0.026	0.013	0.008	0.005	0.293	0.016
Central	11	Lovukol	358	2042	737	350070	11221	1115	0.078	0.030	0.016	0.008	0.005	0.003	0.322	0.024
Central	12	North Savo	287	1513	970	407939	9898	1112	0.087	0.043	0.017	0.011	0.005	0.004	0.308	0.022
Central	13	South Savo	203	1207	1176	117383	9272	1130	0.093	0.042	0.018	0.010	0.006	0.004	0.283	0.019
Rennell-Bell	1	East Tenggano	85	367	2385	1474447	21960	4418	0.006	0.016	0.001	0.003	0.000	0.001	0.326	0.038
Rennell-Bell	2	West Tenggano	81	378	1743	363878	13270	2525	0.046	0.046	0.008	0.010	0.002	0.003	0.307	0.025
Rennell-Bell	3	Lughu	81	362	1057	198806	10683	2106	0.073	0.055	0.015	0.015	0.005	0.006	0.291	0.027
Rennell-Bell	4	Kangava	60	238	1574	190488	15673	3275	0.016	0.028	0.003	0.006	0.001	0.002	0.292	0.037
Rennell-Bell	5	Tetau Nangoto	123	551	1232	835054	11528	1853	0.067	0.051	0.013	0.013	0.004	0.005	0.330	0.045
Rennell-Bell	6	Mugihenu	23	117	543	170692	5974	1717	0.363	0.214	0.098	0.079	0.038	0.040	0.271	0.055
Rennell-Bell	7	Matangi	32	144	1672	333984	11504	2543	0.055	0.058	0.010	0.013	0.003	0.005	0.294	0.039
Rennell-Bell	8	East Ghongau	70	265	1094	285663	14813	3383	0.038	0.042	0.008	0.011	0.003	0.005	0.338	0.048
Rennell-Bell	9	West Ghongau	76	337	1015	143264	10756	2150	0.104	0.076	0.024	0.023	0.009	0.010	0.315	0.029
Rennell-Bell	10	Sa'aiho	57	247	1483	124069	12803	2568	0.043	0.052	0.008	0.010	0.002	0.004	0.301	0.028
Guadalcanal	1	Tandai	665	4036	1206	273597	10129	809	0.237	0.045	0.057	0.014	0.021	0.006	0.286	0.019
Guadalcanal	2	Saghalu	1044	5990	345	547710	10848	790	0.231	0.038	0.063	0.016	0.026	0.009	0.313	0.019
Guadalcanal	3	Savulai	471	2992	1076	112484	8452	656	0.353	0.059	0.090	0.022	0.033	0.010	0.275	0.018
Guadalcanal	4	Tangarare	551	3017	761	116413	9221	651	0.302	0.051	0.073	0.017	0.026	0.007	0.284	0.015
Guadalcanal	5	Wanderer Bay	649	3421	956	65273	7657	518	0.416	0.056	0.110	0.023	0.041	0.011	0.266	0.013
Guadalcanal	6	Duidui	700	3174	1031	103943	7413	540	0.443	0.060	0.121	0.025	0.046	0.012	0.265	0.014
Guadalcanal	7	Vatukula	417	1822	835	177141	7172	674	0.480	0.077	0.141	0.034	0.057	0.018	0.275	0.021
Guadalcanal	8	Talise	364	1681	808	96477	6557	658	0.553	0.079	0.172	0.038	0.072	0.021	0.272	0.015
Guadalcanal	9	Avuavu	470	2247	862	1004694	6235	494	0.590	0.063	0.187	0.033	0.080	0.018	0.271	0.016
Guadalcanal	10	Moli	802	3685	940	100105	6795	400	0.511	0.051	0.146	0.023	0.058	0.012	0.260	0.013

Province	Ward	Ward Name	Ward Population (2009)		Imputed Expenditure per Adult Equivalent				Headcount Poverty		Poverty Gap		Poverty Severity		Gini Inequality	
			Hholds	Persons	Minimum	Maximum	Mean	Std Error	Rate	Std Error	Index	Std Error	Index	Std Error	Index	Std Error
Guadalcanal	11	Tetekanji	214	1076	1056	35782	6845	719	0.499	0.089	0.143	0.040	0.057	0.021	0.253	0.019
Guadalcanal	12	Birao	588	3131	1287	533530	8610	559	0.360	0.050	0.092	0.019	0.034	0.009	0.293	0.016
Guadalcanal	13	Valasi	272	1463	901	48677	6199	590	0.592	0.079	0.183	0.038	0.076	0.021	0.258	0.019
Guadalcanal	14	Kolokara	280	1325	1036	97202	7600	751	0.451	0.081	0.131	0.037	0.053	0.020	0.287	0.023
Guadalcanal	15	Longgu	654	3649	730	189738	8368	565	0.386	0.052	0.103	0.020	0.039	0.009	0.293	0.016
Guadalcanal	16	Aola	681	3607	931	248691	9214	626	0.313	0.040	0.082	0.015	0.031	0.007	0.294	0.015
Guadalcanal	17	Paripao	604	2935	1222	134706	10027	849	0.233	0.050	0.053	0.015	0.018	0.007	0.276	0.020
Guadalcanal	18	East Tasimboko	1419	7388	383	2987243	13884	1217	0.187	0.032	0.046	0.011	0.017	0.006	0.381	0.037
Guadalcanal	19	Vulolo	911	4428	692	876824	8515	553	0.378	0.049	0.102	0.020	0.039	0.010	0.302	0.016
Guadalcanal	20	Melango	1031	5821	611	1054067	10970	909	0.279	0.040	0.074	0.015	0.029	0.008	0.363	0.036
Guadalcanal	21	West Ghaobata	976	4962	870	536411	13642	1422	0.156	0.042	0.040	0.012	0.015	0.005	0.335	0.023
Guadalcanal	22	East Ghaobata	807	4340	128	851529	12338	1482	0.229	0.062	0.074	0.032	0.037	0.023	0.359	0.033
Malaita	2	Aimela	1338	7526	873	1184824	10061	597	0.061	0.017	0.011	0.004	0.003	0.001	0.315	0.015
Malaita	3	Buma	1049	6213	958	156916	7904	505	0.093	0.027	0.016	0.006	0.004	0.002	0.274	0.013
Malaita	4	Fauabu	1534	8829	647	168065	8048	375	0.104	0.021	0.020	0.005	0.006	0.002	0.286	0.012
Malaita	5	West Baegu	454	2477	753	68075	6973	582	0.158	0.049	0.033	0.013	0.010	0.005	0.274	0.014
Malaita	6	Mandalua/Folotana	546	2679	985	1023102	7885	563	0.128	0.035	0.026	0.009	0.008	0.004	0.297	0.015
Malaita	7	Fo'ondo/Gwaiau	1135	5526	828	395830	8863	535	0.066	0.019	0.011	0.004	0.003	0.002	0.275	0.011
Malaita	8	Malu'u	851	4193	1342	985675	10926	659	0.034	0.015	0.005	0.003	0.001	0.001	0.296	0.016
Malaita	9	Matakwai	558	2758	936	80510	9645	948	0.054	0.020	0.009	0.004	0.003	0.001	0.282	0.017
Malaita	10	Takwa	1802	10005	851	155269	7333	344	0.131	0.024	0.025	0.006	0.007	0.002	0.278	0.011
Malaita	11	East Baegu	839	4775	718	879985	7424	472	0.127	0.032	0.024	0.009	0.007	0.003	0.277	0.015
Malaita	12	Fouenda	321	1885	655	142452	8548	914	0.137	0.048	0.031	0.016	0.011	0.007	0.330	0.025
Malaita	13	Sulufou / Kwarande	157	866	1277	64700	8681	1080	0.075	0.042	0.014	0.011	0.004	0.004	0.276	0.022
Malaita	14	Sububenu	884	5053	831	222479	8386	503	0.103	0.028	0.020	0.007	0.006	0.002	0.297	0.016
Malaita	15	Nafinua	765	4139	1268	455719	9044	674	0.065	0.024	0.012	0.005	0.003	0.002	0.284	0.014
Malaita	16	Faumaman	648	3580	1105	144438	9552	735	0.062	0.022	0.011	0.005	0.003	0.002	0.300	0.018
Malaita	17	Gulalafou	1081	5946	403	1021390	8312	558	0.103	0.027	0.021	0.007	0.007	0.003	0.294	0.016
Malaita	18	Waneagu / Taelanasin	636	3478	949	287568	7828	626	0.120	0.043	0.024	0.011	0.007	0.004	0.285	0.017
Malaita	19	Aiaisi	561	3574	1013	251056	8693	942	0.082	0.034	0.015	0.008	0.004	0.003	0.285	0.016
Malaita	20	AreAre	544	3494	926	207743	8309	654	0.112	0.036	0.023	0.009	0.007	0.003	0.298	0.015
Malaita	21	Raroisu'u	867	4981	1015	296900	8905	612	0.076	0.022	0.014	0.005	0.004	0.002	0.289	0.015
Malaita	22	Aba / Asimeuru	939	4863	936	170111	8764	509	0.068	0.020	0.012	0.004	0.003	0.001	0.276	0.011
Malaita	23	Asimae	561	2898	1261	2719847	10025	742	0.049	0.019	0.008	0.004	0.002	0.001	0.304	0.019
Malaita	24	Mareho	399	2539	1019	83899	8893	737	0.073	0.031	0.013	0.008	0.004	0.003	0.287	0.015
Malaita	25	Tai	787	4621	753	866556	8583	607	0.118	0.032	0.026	0.011	0.009	0.005	0.325	0.021
Malaita	26	Kwarekwareo	318	1878	1285	805156	11048	1237	0.051	0.026	0.009	0.006	0.003	0.002	0.324	0.025
Malaita	27	Siesie	656	3738	1083	784284	10447	766	0.046	0.018	0.008	0.004	0.002	0.001	0.301	0.016
Malaita	28	Weagu Silana Sina	806	5040	750	1679032	8667	657	0.108	0.029	0.022	0.007	0.007	0.003	0.314	0.020
Malaita	29	Kwaimala	1767	9553	1151	503017	11488	613	0.028	0.010	0.005	0.002	0.001	0.001	0.300	0.014
Malaita	30	LangaLanga	341	1922	1366	121623	12905	1150	0.019	0.012	0.003	0.002	0.001	0.001	0.296	0.017
Malaita	31	Luaniua	216	1396	2334	1643792	37638	10480	0.001	0.004	0.000	0.001	0.000	0.000	0.315	0.027
Malaita	32	Pelau	128	689	2207	1720788	39682	11536	0.000	0.002	0.000	0.000	0.000	0.000	0.334	0.048
Malaita	33	Sika'iana	60	249	1137	858845	12020	2799	0.043	0.051	0.008	0.012	0.002	0.004	0.307	0.038

Province	Ward	Ward Name	Ward Population (2009) Hholds	Persons	Imputed Expenditure per Adult Equivalent Minimum	Maximum	Mean	Std Error	Headcount Poverty Rate	Std Error	Poverty Gap Index	Std Error	Poverty Severity Index	Std Error	Gini Inequality Index	Std Error
Makira-Ulawa	1	North Ulawa	217	1156	1010	57229	7379	807	0.231	0.079	0.054	0.025	0.019	0.011	0.265	0.021
Makira-Ulawa	2	South Ulawa	275	1281	703	96973	7550	885	0.268	0.070	0.068	0.024	0.025	0.011	0.298	0.023
Makira-Ulawa	3	West Ulawa	202	860	926	150909	8303	1172	0.228	0.078	0.058	0.025	0.021	0.011	0.309	0.027
Makira-Ulawa	4	Ugi ni Masi	207	1125	852	88152	7345	870	0.289	0.087	0.074	0.028	0.028	0.012	0.304	0.022
Makira-Ulawa	5	Arosi South	545	2904	860	275765	8796	748	0.169	0.046	0.037	0.013	0.012	0.005	0.295	0.017
Makira-Ulawa	6	Arosi West	388	1909	956	150477	8280	647	0.168	0.046	0.035	0.012	0.011	0.005	0.278	0.021
Makira-Ulawa	7	Arosi North	405	2344	976	78069	7882	748	0.215	0.061	0.048	0.019	0.016	0.008	0.285	0.018
Makira-Ulawa	8	Arosi East	383	2040	1064	85116	7739	576	0.208	0.048	0.045	0.013	0.015	0.006	0.271	0.018
Makira-Ulawa	9	Bauro West	691	3722	1122	441912	9181	800	0.148	0.040	0.030	0.010	0.010	0.004	0.298	0.018
Makira-Ulawa	10	Bauro Central	426	2466	609	96463	7584	746	0.244	0.063	0.058	0.020	0.020	0.009	0.287	0.016
Makira-Ulawa	11	Bauro East	265	1607	692	123410	7154	815	0.313	0.088	0.082	0.033	0.030	0.016	0.307	0.029
Makira-Ulawa	12	Wainoni West	367	2044	704	140748	6416	553	0.391	0.063	0.112	0.027	0.045	0.014	0.316	0.021
Makira-Ulawa	13	Wainoni East	470	2486	642	61010	5587	613	0.480	0.079	0.139	0.032	0.056	0.016	0.294	0.023
Makira-Ulawa	14	Star Harbour North	526	3171	692	108401	6731	558	0.347	0.055	0.092	0.019	0.035	0.009	0.306	0.016
Makira-Ulawa	15	Santa Ana	288	1547	623	90464	6805	694	0.382	0.077	0.109	0.036	0.043	0.019	0.335	0.029
Makira-Ulawa	16	Santa Catalina	167	799	916	97704	8925	1397	0.207	0.074	0.054	0.024	0.021	0.011	0.320	0.027
Makira-Ulawa	17	Star Harbour South	187	1137	809	51957	6535	997	0.356	0.105	0.092	0.038	0.034	0.017	0.286	0.022
Makira-Ulawa	18	Rawo	114	662	1275	58697	7977	1078	0.170	0.083	0.035	0.022	0.011	0.009	0.255	0.021
Makira-Ulawa	19	Weather Coast	297	1578	1417	316332	8745	770	0.119	0.045	0.022	0.011	0.006	0.004	0.254	0.015
Makira-Ulawa	20	Haununu	437	2551	1046	187050	8470	862	0.196	0.064	0.042	0.018	0.014	0.007	0.310	0.021
Temotu	1	Fenualoa	279	1301	693	108361	9041	898	0.092	0.035	0.019	0.009	0.006	0.004	0.312	0.021
Temotu	2	Polynesian Outer Islands	90	353	1472	85467	12338	2059	0.031	0.035	0.006	0.008	0.002	0.003	0.294	0.031
Temotu	3	Nipua/Nopoli	173	880	786	132258	7587	1126	0.144	0.063	0.032	0.017	0.011	0.007	0.300	0.020
Temotu	4	Lipa/Temua	158	793	1059	118774	9048	1409	0.082	0.044	0.017	0.011	0.005	0.004	0.295	0.023
Temotu	5	Manuopo	209	1028	1166	170122	9731	1055	0.069	0.032	0.013	0.008	0.004	0.003	0.318	0.024
Temotu	6	Nenumpo	250	1166	689	136756	7716	939	0.145	0.053	0.032	0.014	0.011	0.006	0.314	0.020
Temotu	7	Nevenema	212	947	1049	128856	10958	1323	0.037	0.023	0.007	0.005	0.002	0.002	0.298	0.020
Temotu	8	Luva Station	70	353	1758	510644	13945	2807	0.012	0.021	0.002	0.004	0.001	0.001	0.292	0.029
Temotu	9	Graciosa Bay	254	1197	1199	547310	12458	1307	0.011	0.010	0.002	0.002	0.000	0.001	0.279	0.020
Temotu	10	Nea/Noole	382	1746	375	329075	8048	672	0.081	0.031	0.015	0.007	0.004	0.003	0.276	0.016
Temotu	11	Northeast Santa Cruz	349	1811	837	98435	8134	815	0.082	0.036	0.015	0.009	0.004	0.003	0.280	0.019
Temotu	12	Nanggu/Lordhowe	339	1852	968	49499	6555	605	0.164	0.051	0.034	0.014	0.011	0.005	0.271	0.018
Temotu	13	Duff Islands	126	511	1312	88565	9189	1418	0.041	0.040	0.007	0.008	0.002	0.003	0.252	0.017
Temotu	14	Utupua	232	1168	1061	47182	6656	664	0.145	0.056	0.029	0.014	0.009	0.005	0.261	0.018
Temotu	15	vanikoro	266	1293	1049	102319	7528	826	0.112	0.048	0.022	0.013	0.007	0.005	0.275	0.019
Temotu	16	Tikopia	262	1285	1102	52244	7132	893	0.129	0.062	0.026	0.016	0.008	0.006	0.269	0.019
Temotu	17	Neo	301	1558	1126	210471	10740	1275	0.044	0.023	0.008	0.005	0.002	0.002	0.304	0.018

Part B - Honiara

			Ward Population (2009)		Imputed Expenditure per Adult Equivalent				Headcount Poverty		Poverty Gap		Poverty Severity		Gini Inequality	
Province	Ward	Ward Name	Hholds	Persons	Minimum	Maximum	Mean	Std Error	Rate	Std Error	Index	Std Error	Index	Std Error	Index	Std Error
Honiara	1	Nggosi	1430	9877	288	5734366	23941	2144	0.197	0.023	0.055	0.011	0.023	0.006	0.401	0.034
Honiara	2	Mbumburu	513	3625	470	1944349	19192	886	0.237	0.034	0.063	0.016	0.025	0.009	0.344	0.019
Honiara	3	Rove/lengakiki	334	2310	543	4679567	22776	3340	0.172	0.058	0.044	0.023	0.017	0.012	0.360	0.044
Honiara	4	Cruz	17	115	4920	697985	25566	4216	0.094	0.101	0.015	0.021	0.004	0.007	0.316	0.067
Honiara	5	Vavaea	942	6746	620	611425	17240	840	0.286	0.031	0.079	0.014	0.032	0.008	0.333	0.016
Honiara	6	Vuhokesa	148	1167	1059	732695	15896	989	0.331	0.053	0.097	0.023	0.042	0.013	0.331	0.029
Honiara	7	Mataniko	542	4300	827	30982561	30354	25330	0.208	0.037	0.052	0.013	0.020	0.006	0.455	0.084
Honiara	8	Kola'a	1499	9802	671	2230159	19513	1030	0.238	0.020	0.061	0.008	0.023	0.004	0.351	0.023
Honiara	9	Kukum	233	1735	1874	585102	18793	861	0.185	0.038	0.041	0.013	0.014	0.006	0.295	0.022
Honiara	10	Naha	54	356	987	162183	13558	1428	0.411	0.083	0.119	0.035	0.050	0.021	0.296	0.038
Honiara	11	Vura	1268	9069	855	7950993	23207	5603	0.160	0.019	0.037	0.007	0.013	0.004	0.364	0.086
Honiara	12	Panatina	2001	13858	752	4412148	19057	1855	0.282	0.021	0.074	0.010	0.029	0.005	0.379	0.046

Part C - Other Urban Sector

			Ward Population (2009)		Imputed Expenditure per Adult Equivalent				Headcount Poverty		Poverty Gap		Poverty Severity		Gini Inequality	
Province	Ward	Ward Name	Hholds	Persons	Minimum	Maximum	Mean	Std Error	Rate	Std Error	Index	Std Error	Index	Std Error	Index	Std Error
Choiseul	7	Batava	145	783	199	6239681	17980	10663	0.029	0.027	0.007	0.008	0.003	0.005	0.384	0.105
Western	11	Gizo	660	3387	146	20260904	26868	5798	0.012	0.008	0.003	0.003	0.002	0.002	0.459	0.071
Western	15	Munda	250	1218	93	8356174	16042	4713	0.045	0.024	0.010	0.007	0.004	0.003	0.414	0.077
Western	16	Nusa Roviana	299	1513	230	4848165	14410	2637	0.061	0.035	0.014	0.010	0.005	0.004	0.399	0.054
Western	25	Noro	589	3071	117	5460625	20612	3436	0.008	0.009	0.002	0.002	0.001	0.001	0.371	0.071
Isabel	5	Buala	158	892	1484	850227	18658	3359	0.020	0.020	0.003	0.004	0.001	0.002	0.345	0.063
Central	4	Tulagi	244	1251	88	1199062	15221	1911	0.046	0.025	0.011	0.007	0.005	0.004	0.359	0.046
Central	13	South Savo	76	410	645	528685	15920	3229	0.010	0.018	0.002	0.004	0.001	0.002	0.301	0.055
Guadalcanal	1	Tandai	1798	10636	39	35483532	19824	9330	0.068	0.027	0.014	0.007	0.005	0.003	0.403	0.104
Guadalcanal	16	Aola	77	406	2476	212676	15395	2884	0.033	0.061	0.006	0.016	0.002	0.006	0.240	0.029
Guadalcanal	20	Melango	718	4441	97	6450996	21083	8362	0.062	0.028	0.013	0.009	0.005	0.004	0.432	0.094
Malaita	1	Auki	873	4996	198	26537832	20545	13788	0.023	0.015	0.005	0.005	0.002	0.002	0.466	0.098
Makira-Ulawa	10	Bauro Central	316	2018	103	17311893	20113	7620	0.035	0.042	0.008	0.012	0.003	0.005	0.414	0.079
Temotu	8	Luva Station	351	1847	35	5862251	17919	11367	0.072	0.028	0.024	0.010	0.013	0.006	0.506	0.110

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Appendix A: Initial Beta and Alpha Models

Table A1: Coefficients of Initial Beta Models, from *Stata* Backward Stepwise Regression (with Removal at p>0.1)

	National	Honiara	Rural	Other Urban
Household has a motorboat	0.102		0.193	−0.233
	(2.70)**		(5.21)**	(2.50)*
Household has a car, bus, or truck	0.221	0.431		0.234
	(4.84)**	(9.93)**		(2.81)**
Household has a refrigerator or freezer	0.158	0.086		0.219
	(3.66)**	(2.01)*		(3.50)**
EA mean: Household has a car, bus, or truck	0.779		3.475	
	(3.90)**		(6.61)**	
EA mean: Drinking water from household tank	−0.527		−0.569	−0.508
	(6.60)**		(5.85)**	(3.54)**
Dwelling roof is tin or corrugated iron	0.160	0.168	0.167	
	(7.55)**	(3.90)**	(6.89)**	
EA mean: % self-employed, unpaid, own-account work	0.646		0.941	
	(3.12)**		(3.62)**	
EA mean: Dwelling not owned, but rent-free	−0.188	0.194	−0.299	
	(4.55)**	(2.44)*	(6.04)**	
EA mean: Household size	0.031	−0.060	0.062	
	(2.17)*	(2.75)**	(3.12)**	
Number of rooms in dwelling	0.068		0.063	
	(7.82)**		(6.40)**	
EA mean: % of household members age 0–6 years who are male	−1.061		−2.097	
	(1.95)$^{+}$		(3.59)**	
Cooking fuel is wood or coconut shells	−0.190		−0.339	−0.126
	(4.79)**		(3.84)**	(2.40)*
EA mean: Age of household head	−0.007		−0.010	0.030
	(1.67)$^{+}$		(2.28)*	(2.78)**
Drinking water from SIWA-metered source	−0.114			
	(2.84)**			
Drinking water from communal standpipe	−0.138			−0.125
	(4.49)**			(1.76)$^{+}$
EA mean: % of household members age 7–14 years who are male	−2.913		−2.964	−4.949
	(5.42)**		(5.12)**	(2.93)**
Drinking water from community tank	−0.089			
	(2.37)*			
Drinking water from river, stream, or spring	−0.137			
	(3.73)**			
Wash in river, stream, or sea	−0.046	−0.146	−0.044	
	(1.74)$^{+}$	(2.59)**	(2.06)*	
Household uses a private flush toilet	0.180	0.136	0.262	0.186
	(4.77)**	(2.99)**	(3.92)**	(3.17)**
EA mean: Drinking water from river, stream, or spring	−0.151	−0.274	−0.193	
	(3.09)**	(2.31)*	(3.81)**	
EA mean: Household has a refrigerator/freezer	−0.423	0.402	−1.098	
	(3.84)**	(2.87)**	(3.37)**	
EA mean: % of households getting water from communal standpipe	−0.222	0.621	−0.299	
	(4.99)**	(3.28)**	(6.40)**	
Household head is non-Melanesian	0.186	0.128	0.220	0.374

	National	Honiara	Rural	Other Urban
	(3.40)**	(1.83)$^{+}$	(3.37)**	(3.21)**
EA mean: % of household members age 12 years and older who are economically inactive	0.518		0.552	
	(3.42)**		(2.65)**	
EA mean: % of household members age 15–50 years who are male	0.878			2.475
	(2.84)**			(2.98)**
EA mean: Drinking water from SIWA-metered source	−0.134			
	(2.00)*			
Household head has less than grade 6 schooling	−0.069		−0.057	
	(3.44)**		(2.63)**	
EA mean: % of dwellings with temporary / makeshift walls	−0.540	−0.548	−1.408	−1.512
	(2.41)*	(1.87)$^{+}$	(2.89)**	(4.02)**
Household size	−0.203	−0.173	−0.213	−0.277
	(14.78)**	(9.65)**	(13.63)**	(6.78)**
Household size squared	0.007	0.005	0.008	0.013
	(7.45)**	(4.78)**	(7.03)**	(4.41)**
Share of household members age 0–6 years who are male	0.384		0.392	0.545
	(5.61)**		(5.18)**	(3.30)**
Share of household members age 0–6 years who are female	0.314		0.316	0.637
	(4.39)**		(3.95)**	(3.33)**
EA mean: Household head self-employed, unpaid, own-account work	−0.311	0.494	−0.594	0.486
	(2.45)*	(2.16)*	(4.12)**	(2.19)*
EA mean: Number of rooms in dwelling	0.041		0.051	
	(2.20)*		(2.15)*	
Share of household members age 15–50 years who are male	0.249		0.261	0.298
	(4.19)**		(3.67)**	(2.16)*
Share of household members age 15–50 years who are female	0.225		0.193	0.462
	(4.01)**		(2.87)**	(2.99)**
EA mean: % with a church in the village	−0.146	−0.129	−0.231	−0.198
	(4.58)**	(2.62)**	(5.11)**	(2.84)**
EA mean: % of dwellings with tin/iron roof	0.237	−0.497	0.230	
	(4.13)**	(3.14)**	(3.11)**	
Share of household members age 12 years and older who are economically inactive	−0.322	−0.159	−0.325	
	(6.40)**	(2.56)*	(4.39)**	
Household head is an employer	0.490		5.953	
	(1.97)*		(4.13)**	
Share of household members age 12 years and older who are self-employed, unpaid, own-account work	−0.269		−0.238	−0.205
	(6.24)**		(3.29)**	(2.02)*
EA mean: % of households with motorboat	1.104		1.345	1.641
	(8.24)**		(7.87)**	(4.45)**
EA mean: % of dwellings with private pit toilet		−0.444	−0.106	0.973
		(2.94)**	(2.11)*	(4.00)**
Dwelling is rent-free but not owned		−0.112		
		(2.60)**		
Dwelling walls are temporary/makeshift		−0.237		−0.408
		(2.00)*		(3.98)**
Dwelling is detached from others		0.094		
		(2.29)*		
Number of rooms in dwelling, squared		0.010		0.015
		(5.01)**		(4.71)**
Household uses gas for cooking		0.080		
		(2.05)*		

	National	Honiara	Rural	Other Urban
EA mean: % with private flush toilet		0.285		
		(1.84)$^{+}$		
EA mean: % who wash in river, stream, or sea		0.543		
		(2.36)*		
EA mean: % who cook with wood/coconuts		0.287		0.740
		(1.73)$^{+}$		(1.73)$^{+}$
EA mean: % drinking water from community tank		1.177		
		(2.75)**		
Household head is married		0.120		
		(2.74)**		
Household head is an employer		0.292		
		(2.80)**		
Household head does unpaid voluntary work		0.157		
		(2.22)*		
EA mean: % of household heads non-Melanesian		0.911		
		(5.11)**		
Share of household members age 12 years and older with some primary schooling		−0.176		
		(2.26)*		
EA mean: % of households cooking with gas			−1.780	1.166
			(4.24)**	(2.26)*
EA mean: % of household heads with some primary schooling			−0.127	−2.402
			(1.73)$^{+}$	(5.34)**
Household head is self-employed, own account work, or unpaid			−0.053	0.133
			(1.74)$^{+}$	(2.02)*
EA mean: % of household members age 12 years and older with some primary schooling				2.716
				(4.28)**
Dwelling has a concrete/cement/brick floor				−0.223
				(2.93)**
EA mean: % of household heads who are married				2.145
				(3.98)**
EA mean: % of dwellings with concrete floor				0.668
				(2.50)*
Household uses private pit toilet				−0.127
				(1.68)$^{+}$
EA mean: % of household members age 12 years and older who are employers			−10.909	
			(3.42)**	
Drinking water from household tank			0.120	
			(3.34)**	
EA mean: % of dwellings that are rented			−3.959	
			(5.79)**	
EA mean: % of household members age 7–14 years who are female			−1.051	
			(1.91)$^{+}$	
Constant	10.189	10.424	10.823	5.917
	(41.23)**	(51.87)**	(39.14)**	(5.69)**
Observations	4,364	752	3,117	495
R-squared	0.528	0.620	0.471	0.512
Adjusted R-squared	0.523	0.602	0.464	0.476

Note: Robust t-statistics in parentheses; $^{+}$ significant at 10%; * significant at 5%; ** significant at 1%.

Table A2: Coefficients of Initial Alpha Models, from *Stata* Backward Stepwise Regression (with removal at p>0.05)

	National	Honiara	Rural	Other Urban
Household has a motorboat	0.436			
	(2.53)*			
Yhat^2 * EA mean of household size	0.017			
	(2.05)*			
Yhat^2 * Number of rooms in dwelling	0.223			
	(3.45)**			
Yhat * EA mean of household size	−0.186			
	(2.23)*			
Yhat * Household size squared	0.001			
	(2.84)**			
Dwelling roof is tin or corrugated iron	−107.541			
	(3.11)**			
Yhat^2 * Household size	−0.002	−0.002		
	(2.36)*	(2.63)**		
Yhat * EA mean % with a church in the village	−0.779			
	(2.22)*			
Yhat * Cooking fuel is wood or coconut shells	−0.931		−1.290	
	(2.25)*		(2.34)*	
Number of rooms in dwelling	19.658			
	(3.20)**			
Yhat * Drinking water from communal standpipe	−20.628			
	(3.04)**			
Cooking fuel is wood or coconut shells	8.804			
	(2.20)*			
Yhat * Dwelling roof is tin or corrugated iron	23.013			
	(3.16)**			
Yhat^2 * Drinking water from communal standpipe	1.132			
	(3.08)**			
Drinking water from communal standpipe	93.682			
	(3.00)**			
Yhat * Household has a car, bus, or truck	0.040			
	(2.03)*			
Yhat^2 * EA mean of water from communal standpipe	−0.005			
	(2.36)*			
Yhat * Number of rooms in dwelling	−4.198			
	(3.33)**			
EA mean: % with a church in the village	−69.279			
	(2.17)*			
EA mean: Drinking water from river, stream, or spring	−0.495			
	(2.74)**			
Yhat * Household head has less than grade 6 schooling	−0.537			
	(2.23)*			
Yhat^2 * Dwelling roof is tin or corrugated iron	−1.227			
	(3.19)**			
Yhat * EA mean % with a church in the village	14.735			
	(2.20)*			
EA mean: % of households with motorboat	−1.585			83.027

	National	Honiara	Rural	Other Urban
	(2.24)*			(2.18)*
Yhat^2 * household head has less than grade 6 schooling	0.057			
	(2.14)*			
Yhat^2 * EA mean % of dwelling rent-free		−2.365		
		(2.29)*		
Yhat^2 * Wash in river, stream, or sea		−0.012		
		(2.74)**		
Yhat * Dwelling is detached from others		0.842		
		(2.23)*		
Yhat * Dwelling walls are temporary/makeshift		2.762		
		(2.02)*		
Yhat^2 * EA mean of tin or corrugated iron roof		1.763		
		(4.23)**		
Yhat^2 * EA mean of household heads who are non-Melanesian		−0.441		
		(3.22)**		
Dwelling walls are temporary/makeshift		−26.379		
		(1.98)*		
Yhat^2 * Dwelling is detached from others		−0.082		
		(2.21)*		
EA mean: Dwelling not owned, but rent-free		−220.187		
		(2.18)*		
Yhat * EA mean % of dwellings with tin/iron roof		−33.456		
		(4.10)**		
Yhat * EA mean of household heads who are non-Melanesian		4.479		
		(3.21)**		
EA mean: % of dwellings with tin/iron roof		158.602		
		(3.95)**		
Yhat * EA mean % of dwellings rent-free		45.639	0.068	
		(2.23)*	(2.73)**	
Yhat^2 * Household size squared		0.000		
		(2.37)*		
Yhat * share of household members age 0–6 years who are female			2.299	
			(2.19)*	
Yhat^2 * share of household members age 15–50 years who are male			0.145	0.388
			(2.01)*	(2.29)*
Yhat * share of household members age 15–50 years who are male			−1.380	−3.742
			(2.04)*	(2.24)*
Yhat * EA mean of drinking water from household tank			0.076	63.339
			(2.54)*	(2.07)*
Yhat^2 * EA mean of drinking water from household tank				−3.225
				(2.05)*
Yhat * Household uses a private flush toilet				−2.338
				(3.23)**
Yhat^2 * EA mean of households cooking with gas				−1.300
				(2.52)*
Yhat * EA mean age of household head				−0.209
				(2.63)**
Yhat^2 * share of household members age 15–50 years who are female				5.520
				(3.41)**
Yhat^2 * Number of rooms in dwelling, squared				−0.083
				(2.62)**
Yhat * Number of rooms in dwelling, squared				1.664

	National	Honiara	Rural	Other Urban
				(2.58)*
Yhat^2 * EA mean age of household head				0.023
				(2.74)**
Number of rooms in dwelling, squared				−8.293
				(2.54)*
Yhat^2 * EA mean % of household heads with less than grade 6 schooling				−1.085
				(3.10)**
Yhat * share of household members age 15–50 years who are female				−107.764
				(3.38)**
Yhat * EA mean % of households that have a motorboat				−8.579
				(2.18)*
Yhat^2 *EA mean % who cook with wood/coconuts				−0.409
				(2.45)*
Yhat * household has a refrigerator or freezer				0.073
				(2.17)*
Yhat * EA % of households using private pit toilet				−7.965
				(3.00)**
Share of household members age 15–50 years who are female				526.164
				(3.34)**
EA-mean: Drinking water from household tank				−310.280
				(2.08)*
Household uses a private flush toilet				22.355
				(3.21)**
Household uses private pit toilet				−638.518
				(3.65)**
Yhat * EA % of household heads with less than grade 6 schooling				10.493
				(3.12)**
Household head is non-Melanesian				2,083.039
				(2.14)*
Yhat^2 * Household head is non-Melanesian				20.720
				(2.16)*
EA mean: % who cook with wood/coconuts				46.711
				(2.93)**
Yhat * Household uses private pit toilet				135.623
				(3.67)**
Yhat^2 * Household uses private pit toilet				−7.201
				(3.71)**
Yhat^2 * EA % of households using private pit toilet				0.837
				(3.05)**
Yhat * Household head is non-Melanesian				−415.630
				(2.15)*
Yhat * EA mean % of households cooking with gas				13.451
				(2.67)**
Yhat * share of household members age 12 years and older who are economically inactive			2.368	
			(2.68)**	
Share of household members age 0–6 years who are female			−20.906	
			(2.18)*	
Yhat * share of household members age 12 years and older who are self-employed, own account work, and so on			2.380	
			(3.02)**	
Yhat * share of household members age 15–50 years who are female			−3.598	
			(3.57)**	

	National	Honiara	Rural	Other Urban
Yhat^2 * share of household members age 15–50 years who are female			0.391	
			(3.58)**	
Yhat * household head is self-employed, own account work, and so on			−23.844	
			(2.57)*	
Yhat^2 * household head is self-employed, own account work, and so on			1.321	
			(2.64)**	
Yhat^2 * share of household members age 12 years and older who are self-employed and so on			−0.250	
			(2.99)**	
Yhat^2 * Cooking fuel is wood or coconut shells			0.121	
			(2.11)*	
EA-mean: Household has a car, bus, or truck			−10.305	
			(2.07)*	
Household head is self-employed, own account work, or unpaid			107.216	
			(2.50)*	
Yhat^2 * share of household members age 12 years and older who are economically inactive			−0.250	
			(2.66)**	
Yhat^2 * EA mean % of household members age 7–14 years who are male			−9.922	
			(2.43)*	
Yhat * EA mean of households having a refrigerator			−0.818	
			(2.60)**	
Yhat * EA mean % of household members age 7–14 years who are male			183.857	
			(2.40)*	
EA mean: % of household members age 7–14 years who are male			−849.596	
			(2.35)*	
Constant	−2.424	−3.704	−3.499	−17.045
	(4.58)**	(7.88)**	(6.09)**	(4.81)**
Observations	4,363	751	3,116	494
R-squared	0.032	0.049	0.037	0.180
Adjusted R-squared	0.026	0.030	0.030	0.123

Note: Robust t statistics in parentheses; $^{+}$ significant at 10%; * significant at 5%, ** significant at 1% level.

Appendix B: Final Beta and Alpha Models from *PovMap2*

Table B1: National Beta Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	10.1887	0.27	37.7319	0	Intercept
COOK_WOOD_1	−0.1897	0.0325	−5.8361	0	Dummy for Wood is main cooking fuel = 1
DWELL_NROOMS	0.0679	0.0087	7.7934	0	Number of rooms in dwelling
DWELL_TINROOF_1	0.1601	0.0225	7.1066	0	Dummy for Tin/corrugated iron is the main roof material = 1
EMPL_INACTIVE	−0.3221	0.0498	−6.4728	0	Person is inactive
EMPL_SELF	−0.2691	0.0445	−6.0455	0	Person is self-employed
F06	0.3138	0.0804	3.9012	0.0001	Female under 7 seven years old
F1550	0.2255	0.0627	3.596	0.0003	Female between 15 and 50 years old
HAS_CARBUSTRUCK_1	0.2206	0.038	5.8016	0	Dummy for Has a car, bus, or truck = 1
HAS_FRIDGE_1	0.1583	0.0403	3.9268	0.0001	Dummy for Has a refrigerator = 1
HAS_MOTORBOAT_1	0.1021	0.0359	2.8457	0.0045	Dummy for Has a motorboat = 1
HEAD_NONMELANESIAN_1	0.1862	0.0382	4.8817	0	Dummy for Ethnic origin is not Melanesian = 1
HEAD_SUBGR6_1	−0.0688	0.0224	−3.0754	0.0021	Dummy for Household head has incomplete primary education = 1
HHSIZE	−0.2029	0.0113	−18.0229	0	Household size
HHSIZE2	0.007	0.0007	9.6981	0	Household size squared
M06	0.3838	0.0744	5.1596	0	Male under 7 years old
M1550	0.2485	0.0584	4.2579	0	Male between 15 and 50 years old
MEAN_DWELL_NROOMS	0.0412	0.0198	2.081	0.0375	(Mean) Number of rooms in dwelling
MEAN_DWELL_TEMPWALL	−0.5402	0.2001	−2.6989	0.007	(Mean) Makeshift is the main material for walls
MEAN_DWELL_TINROOF	0.2368	0.0614	3.8551	0.0001	(Mean) Tin/corr. iron is the main roof material
MEAN_EACHURCH	−0.1463	0.0348	−4.2	0	(Mean) Village has a church
MEAN_EMPL_INACTIVE	0.5179	0.1738	2.9804	0.0029	(Mean) Person is inactive
MEAN_EMPL_SELF	0.6457	0.232	2.7832	0.0054	(Mean) Person is self-employed
MEAN_HAS_CARBUSTRUCK	0.7788	0.2034	3.8285	0.0001	(Mean) Has a car, bus, or truck
MEAN_HAS_FRIDGE	−0.423	0.121	−3.4967	0.0005	(Mean) Has a refrigerator
MEAN_HAS_MOTORBOAT	1.1044	0.1528	7.2271	0	(Mean) Has a motorboat
MEAN_HEAD_AGE	−0.0069	0.004	−1.6987	0.0895	(Mean) Age of Household head
MEAN_HEAD_EMPLOYER	0.4905	0.273	1.7966	0.0725	(Mean) Household head is employer
MEAN_HEAD_SELF	−0.3111	0.1347	−2.3095	0.021	(Mean) Household head is self-employed
MEAN_HHSIZE	0.0307	0.0165	1.8637	0.0624	(Mean) Household size
MEAN_M06	−1.0609	0.5447	−1.9479	0.0515	(Mean) Male under 7 years old
MEAN_M1550	0.8777	0.3199	2.7441	0.0061	(Mean) Male between 15 and 50 years old

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
MEAN_M714	−2.9133	0.5589	−5.2125	0	(Mean) Male between 7 and 14 years old
MEAN_TENURE_FREE	−0.188	0.0368	−5.1124	0	(Mean) Rent free housing
MEAN_WATER_HHTANK	−0.5265	0.0762	−6.913	0	(Mean) Household Tank is the main source of drinking water
MEAN_WATER_METER	−0.1335	0.0742	−1.8003	0.0719	(Mean) Metered-SIWA is the main source of drinking water
MEAN_WATER_RIVER	−0.1506	0.0555	−2.7129	0.0067	(Mean) River/stream is main source of drinking water
MEAN_WATER_STANDPIPE	−0.2222	0.0492	−4.5156	0	(Mean) Comm. standpipe is the main source of drinking water
TOILET_OWNFLUSH_1	0.1798	0.0372	4.8374	0	Dummy for Private flush toilet is the main toilet facility = 1
WASH_RIVER_LAKE_SEA_1	−0.0456	0.0275	−1.6563	0.0977	Dummy for River, lake, spring is the main source of washing water = 1
WATER_COMTANK_1	−0.0887	0.0361	−2.4541	0.0142	Dummy for Common tank is the main source of drinking water = 1
WATER_METER_1	−0.1143	0.0382	−2.9898	0.0028	Dummy for Metered-SIWA is the main source of drinking water = 1
WATER_RIVER_1	−0.1375	0.0414	−3.3169	0.0009	Dummy for River/stream is the main source of drinking water = 1
WATER_STANDPIPE_1	−0.1383	0.0313	−4.4169	0	Dummy for Comm. standpipe is the main source of drinking water = 1

Table B2: National Alpha Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	−2.2656	0.5108	−4.4355	0	Intercept
COOK_WOOD_1*_yhat_*_yhat_	−0.0033	0.0018	−1.7953	0.0727	Dummy for Wood is the main cooking fuel = 1*_yhat_*_yhat_
DWELL_NROOM2*_yhat_	0.0061	0.0024	2.5491	0.0108	Number of rooms in dwelling squared *_yhat_
DWELL_NROOMS	19.744	6.9257	2.8508	0.0044	Number of rooms in dwelling
DWELL_NROOMS*_yhat_	−4.2106	1.4349	−2.9344	0.0034	Number of rooms in dwelling *_yhat_
DWELL_NROOMS*_yhat_*_yhat_	0.2187	0.0741	2.9509	0.0032	Number of rooms in dwelling *_yhat_*_yhat_
DWELL_TINROOF_1	−97.4071	34.2531	−2.8437	0.0045	Dummy for Tin/corrugated iron is the main roof material = 1
DWELL_TINROOF_1*_yhat_	20.807	7.2503	2.8698	0.0041	Dummy for Tin/corrugated iron is the main roof material = 1 *_yhat_
DWELL_TINROOF_1*_yhat_*_yhat_	−1.1097	0.3833	−2.8948	0.0038	Dummy for Tin/corrugated iron is the main roof material = 1 *_yhat_*_yhat_
HAS_CARBUSTRUCK_1	4.9751	1.7318	2.8727	0.0041	Dummy for Has a car, bus, or truck = 1

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
HAS_CARBUSTRUCK_1*_yhat_*_yhat_	−0.0464	0.0175	−2.6548	0.008	Dummy for Has a car, bus, or truck = 1 *_yhat_*_yhat_
MEAN_EACHURCH	−114.1837	38.8708	−2.9375	0.0033	(Mean) Village has a church
MEAN_EACHURCH*_yhat_	24.1626	8.0893	2.987	0.0028	(Mean) Village has a church *_yhat_
MEAN_EACHURCH*_yhat_*_yhat_	−1.2749	0.4197	−3.0381	0.0024	(Mean) Village has a church *_yhat_*_yhat_
MEAN_HAS_CARBUSTRUCK	−2.6359	0.7177	−3.6725	0.0002	(Mean) Has a car, bus, or truck
MEAN_HAS_MOTORBOAT	−1.2863	0.6923	−1.858	0.0632	(Mean) Has a motorboat
MEAN_HHSIZE	11.8201	6.6584	1.7752	0.0759	(Mean) Household size
MEAN_HHSIZE*_yhat_	−2.6073	1.3869	−1.88	0.0602	(Mean) Household size*_yhat_
MEAN_HHSIZE*_yhat_*_yhat_	0.1417	0.072	1.9678	0.0492	(Mean) Household size*_yhat_*_yhat_
WATER_RIVER_1	−0.5958	0.1652	−3.6075	0.0003	Dummy for River/Stream is the main source of drinking water = 1
WATER_STANDPIPE_1	89.442	34.8702	2.565	0.0104	Dummy for Comm. standpipe is the main source of drinking water = 1
WATER_STANDPIPE_1*_yhat_	−19.9415	7.549	−2.6416	0.0083	Dummy for Comm. standpipe is the main source of drinking water = 1 *_yhat_
WATER_STANDPIPE_1*_yhat_*_yhat_	1.1018	0.4083	2.6983	0.007	Dummy for Comm. standpipe is the main source of drinking water = 1 *_yhat_*_yhat_

Table B3: Honiara Beta Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	10.4235	0.1791	58.1962	0	Intercept
COOK_GAS_1	0.081	0.0382	2.1193	0.0344	Dummy for Gas is the main cooking fuel = 1
DWELL_DETACHED_1	0.0947	0.0401	2.363	0.0184	Dummy for Dwelling is detached = 1
DWELL_NROOM2	0.0102	0.0019	5.3068	0	Number of rooms in dwelling squared
DWELL_TEMPWALL_1	−0.2379	0.13	−1.8295	0.0677	Dummy for Makeshift is the main material for walls = 1
DWELL_TINROOF_1	0.1677	0.0432	3.8811	0.0001	Dummy for Tin/corrugated iron is the main roof material = 1
EMPL_INACTIVE	−0.1572	0.0595	−2.6408	0.0085	Person is inactive
HAS_CARBUSTRUCK_1	0.4299	0.0436	9.8539	0	Dummy for Has a car, bus, or truck = 1
HAS_FRIDGE_1	0.083	0.0437	1.9002	0.0578	Dummy for Has a refrigerator = 1
HEAD_EMPLOYER_1	0.2921	0.0975	2.9953	0.0028	Dummy for Household head is employer = 1
HEAD_MARRIED_1	0.118	0.0481	2.4512	0.0145	Dummy for Household head is married = 1
HEAD_NONMELANESIAN_1	0.128	0.0577	2.2203	0.0267	Dummy for Ethnic origin of Household head is not Melanesian = 1
HHSIZE	−0.1734	0.0149	−11.6546	0	Household size

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
HHSIZE2	0.0049	0.0008	5.9361	0	Household size squared
MEAN_COOK_WOOD	0.2885	0.1592	1.8118	0.0704	(Mean) Wood is the main cooking fuel
MEAN_DWELL_TEMPWALL	−0.5464	0.2818	−1.9391	0.0529	(Mean) Makeshift is the main material for walls
MEAN_DWELL_TINROOF	−0.4999	0.1481	−3.3748	0.0008	(Mean) Tin/corrugated iron is the main roof material
MEAN_EACHURCH	−0.1289	0.0502	−2.5688	0.0104	(Mean) Village has a church
MEAN_HAS_FRIDGE	0.4062	0.1363	2.9798	0.003	(Mean) Has a refrigerator
MEAN_HEAD_NONMELANESIAN	0.9134	0.1646	5.5478	0	(Mean) Ethnic origin of Household head is not Melanesian
MEAN_HEAD_SELF	0.502	0.242	2.0746	0.0384	(Mean) Household head is self-employed
MEAN_HHSIZE	−0.0599	0.0205	−2.9184	0.0036	(Mean) Household size
MEAN_TENURE_FREE	0.1952	0.0862	2.2658	0.0238	(Mean) Rent free housing
MEAN_TOILET_OWNFLUSH	0.2876	0.1407	2.0446	0.0413	(Mean) Private flush toilet is the main toilet facility
MEAN_TOILET_OWNPIT	−0.4446	0.1384	−3.2115	0.0014	(Mean) Private pit latrine is the main toilet facility
MEAN_WASH_RIVER_LAKE_SEA	0.5459	0.2271	2.4035	0.0165	(Mean) River, lake, spring is the main source of washing water
MEAN_WATER_COMTANK	1.1764	0.4026	2.9221	0.0036	(Mean) Common tank is the main source of drinking water
MEAN_WATER_RIVER	−0.2749	0.1573	−1.7476	0.081	(Mean) River/stream is the main source of drinking water
MEAN_WATER_STANDPIPE	0.6206	0.2044	3.0356	0.0025	(Mean) Comm. standpipe is the main source of drinking water
SOMEPRIMARY	−0.1751	0.0771	−2.2716	0.0234	Some primary education
TENURE_FREE_1	−0.1129	0.0421	−2.6791	0.0076	Dummy for Rent Free Housing = 1
TOILET_OWNFLUSH_1	0.1368	0.0455	3.0087	0.0027	Dummy for Private flush toilet is the main toilet facility = 1
WASH_RIVER_LAKE_SEA_1	−0.1469	0.0717	−2.0483	0.0409	Dummy for River, lake, spring is the main source of washing water = 1

Table B4: Honiara Alpha Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	−4.7453	0.4188	−11.3296	0	Intercept
DWELL_DETACHED_1*_yhat_	0.0417	0.0207	2.0184	0.0439	Dummy for Dwelling detached = 1*_yhat_
MEAN_DWELL_TINROOF	107.0195	35.7436	2.9941	0.0028	(Mean) Tin/corrugated iron is the main roof material
MEAN_DWELL_TINROOF*_yhat_	−22.4156	7.2196	−3.1048	0.002	(Mean) Tin/corrugated iron is the main roof material*_yhat_
MEAN_DWELL_TINROOF*_yhat_*_yhat_	1.1763	0.3651	3.2219	0.0013	(Mean) Tin/corrugated iron is the main roof material*_yhat_*_yhat_
MEAN_HAS_FRIDGE	−1.0608	0.5123	−2.0706	0.0387	(Mean) Has a refrigerator

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
MEAN_HEAD_NONMELANESIAN*_yhat_	3.6045	1.3285	2.7131	0.0068	(Mean) Ethnic origin of Household head is not Melanesian*_yhat_
MEAN_HEAD_NONMELANESIAN*_yhat_*_yhat_	−0.3532	0.1308	−2.7009	0.0071	(Mean) Ethnic origin of Household head is not Melanesian*_yhat_*_yhat_
WASH_RIVER_LAKE_SEA_1	−376.014	233.9432	−1.6073	0.1084	Dummy for River, lake, spring is the main source of washing water = 1
WASH_RIVER_LAKE_SEA_1*_yhat_	80.0309	49.0137	1.6328	0.1029	Dummy for River, lake, spring is the main source of washing water = 1*_yhat_
WASH_RIVER_LAKE_SEA_1*_yhat_*_yhat_	−4.2627	2.5658	−1.6613	0.0971	Dummy for River, lake, spring is the main source of washing water = 1*_yhat_*_yhat_

Table B5: Rural Beta Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	10.8691	0.2746	39.5772	0	Intercept
COOK_WOOD_1	−0.3383	0.0648	−5.2204	0	Dummy for Wood is the main cooking fuel = 1
DWELL_NROOMS	0.0632	0.0101	6.2746	0	Number of rooms in dwelling
DWELL_TINROOF_1	0.1686	0.0258	6.53	0	Dummy for Tin/corrugated iron is the main roof material = 1
EMPL_INACTIVE	−0.3767	0.0646	−5.8304	0	Person is inactive
EMPL_SELF	−0.3176	0.0547	−5.8096	0	Person is self-employed
F06	0.3213	0.0899	3.5746	0.0004	Female under 7 seven years old
F1550	0.1895	0.0748	2.5315	0.0114	Female between 15 and 50 years old
HAS_MOTORBOAT_1	0.1908	0.0376	5.0719	0	Dummy for Has a motorboat = 1
HEAD_NONMELANESIAN_1	0.2209	0.0487	4.5371	0	Dummy for Ethnic origin of Household head is not Melanesian = 1
HEAD_SUBGR6_1	−0.059	0.0244	−2.4151	0.0158	Dummy for Household head has incomplete primary education = 1
HHSIZE	−0.2143	0.0158	−13.5729	0	Household size
HHSIZE2	0.0077	0.0011	6.9581	0	Household size squared
M06	0.3958	0.0828	4.7802	0	Male under 7 years old
M1550	0.2541	0.0694	3.6601	0.0003	Male between 15 and 50 years old
MEAN_COOK_GAS	−1.7551	0.47	−3.734	0.0002	(Mean) Gas is the main cooking fuel
MEAN_DWELL_NROOMS	0.0524	0.0236	2.2169	0.0267	(Mean) Number of rooms in dwelling
MEAN_DWELL_TEMPWALL	−1.4063	0.4514	−3.1152	0.0019	(Mean) Makeshift is the main material for walls
MEAN_DWELL_TINROOF	0.2238	0.0767	2.9165	0.0036	(Mean) Tin/corrugated iron is the main roof material
MEAN_EACHURCH	−0.2324	0.0444	−5.2395	0	(Mean) Village has a church
MEAN_EMPL_EMPLOYER	−11.0474	3.9851	−2.7722	0.0056	(Mean) Person is employer

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
MEAN_EMPL_INACTIVE	0.5474	0.2336	2.343	0.0192	(Mean) Person is inactive
MEAN_EMPL_SELF	0.9498	0.2995	3.171	0.0015	(Mean) Person is self-employed
MEAN_F714	−1.0418	0.5681	−1.8338	0.0668	(Mean) Female between 7 and 17 years old
MEAN_HAS_CARBUSTRUCK	3.5055	0.5906	5.9356	0	(Mean) Has a car, bus, or truck
MEAN_HAS_FRIDGE	−1.0946	0.5022	−2.1798	0.0293	(Mean) Has a refrigerator
MEAN_HAS_MOTORBOAT	1.3366	0.1895	7.0542	0	(Mean) Has a motorboat
MEAN_HEAD_AGE	−0.0099	0.0042	−2.3613	0.0183	(Mean) Age of Household head
MEAN_HEAD_EMPLOYER	6.008	1.8589	3.232	0.0012	(Mean) Household head is employer
MEAN_HEAD_SELF	−0.6047	0.1579	−3.8304	0.0001	(Mean) Household head is self-employed
MEAN_HEAD_SUBGR6	−0.1298	0.0791	−1.6401	0.1011	(Mean) Household head has incomplete primary education
MEAN_HHSIZE	0.0603	0.0201	3.0023	0.0027	(Mean) Household size
MEAN_M06	−2.0849	0.5939	−3.5103	0.0005	(Mean) Male under 7 years old
MEAN_M714	−2.96	0.5903	−5.0141	0	(Mean) Male between 7 and 17 years old
MEAN_TENURE_FREE	−0.2986	0.0446	−6.6883	0	(Mean) Rent free housing
MEAN_TENURE_RENT	−4.0058	0.7607	−5.2656	0	(Mean) Pays rent for housing
MEAN_TOILET_OWNPIT	−0.1057	0.0529	−1.9965	0.046	(Mean) Own pit latrine is the main toilet facility
MEAN_WATER_HHTANK	−0.5689	0.0912	−6.2402	0	(Mean) Household Tank, main source of drinking water
MEAN_WATER_RIVER	−0.193	0.0521	−3.7025	0.0002	(Mean) River/stream is the main source of drinking water
MEAN_WATER_STANDPIPE	−0.2982	0.046	−6.4899	0	(Mean) Comm. standpipe is the main source of drinking water
TOILET_OWNFLUSH_1	0.2603	0.0631	4.128	0	Dummy for Private flush toilet is the main toilet facility = 1
WASH_RIVER_LAKE_SEA_1	−0.0438	0.0232	−1.8856	0.0594	Dummy for River, lake, spring is the main source of washing water = 1
WATER_HHTANK_1	0.1204	0.0333	3.6143	0.0003	Dummy for household tank is the main source of drinking water = 1

Table B6: Rural Alpha Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	−2.7536	0.3597	−7.6546	0	Intercept
COOK_WOOD_1*_yhat_*_yhat_	−0.0166	0.0039	−4.2163	0	Dummy for Wood is the main cooking fuel = 1 *_yhat_*_yhat_
M1550*_yhat_	−1.915	0.4648	−4.1203	0	Male between 15 and 50 years old *_yhat_
M1550*_yhat_*_yhat_	0.2064	0.0488	4.2333	0	Male between 15 and 50 years old *_yhat_*_yhat_
MEAN_HAS_CARBUSTRUCK	−6.683	2.8308	−2.3608	0.0183	(Mean) Has a car, bus, or truck
MEAN_TENURE_FREE	−126.8487	52.7272	−2.4058	0.0162	(Mean) Rent free housing
MEAN_TENURE_FREE*_yhat_	28.9619	11.6658	2.4826	0.0131	(Mean) Rent free housing*_yhat_

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
MEAN_TENURE_FREE*_yhat_*_yhat_	−1.643	0.6444	−2.5499	0.0108	(Mean) Rent free housing*_yhat_*_yhat_
MEAN_TENURE_RENT*_yhat_*_yhat_	−0.1028	0.0532	−1.9318	0.0535	(Mean) Pays rent for housing*_yhat_*_yhat_
MEAN_WATER_RIVER	−0.6255	0.2052	−3.048	0.0023	(Mean) River/stream is the main source of drinking water
MEAN_WATER_STANDPIPE	−0.6169	0.1728	−3.5701	0.0004	(Mean) Comm. standpipe is the main source of drinking water

Table B7: Urban (Non-Honiara) Beta Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	7.0956	0.744	9.537	0	Intercept
COOK_WOOD_1	−0.1444	0.0599	−2.4104	0.0163	Dummy for Wood is the main cooking fuel = 1
DWELL_MODFLOOR_1	−0.2026	0.0739	−2.742	0.0063	Dummy for Concrete/cement brick as the main flooring material = 1
DWELL_NROOM2	0.0155	0.0029	5.3826	0	Number of rooms in the dwelling squared
DWELL_TEMPWALL_1	−0.4058	0.1681	−2.4143	0.0162	Dummy for Makeshift is the main material for walls = 1
EMPL_SELF	−0.2137	0.1012	−2.112	0.0352	Person is self-employed
F06	0.6133	0.1966	3.1196	0.0019	Female under 7 seven years old
F1550	0.4607	0.1481	3.1104	0.002	Female between 15 and 50 years old
HAS_CARBUSTRUCK_1	0.2461	0.0853	2.8849	0.0041	Dummy for Has a car, bus, or truck = 1
HAS_FRIDGE_1	0.2185	0.0646	3.3842	0.0008	Dummy for Has a refrigerator = 1
HAS_MOTORBOAT_1	−0.2384	0.0867	−2.7488	0.0062	Dummy for Has a motorboat = 1
HEAD_NONMELANESIAN_1	0.3843	0.1574	2.4414	0.015	Ethnic origin of Household head is not Melanesian
HEAD_SELF_1	0.1518	0.0676	2.2456	0.0252	Dummy for Household head is self-employed = 1
HHSIZE	−0.2776	0.0341	−8.1297	0	Household size
HHSIZE2	0.0134	0.0025	5.4628	0	Household size squared
M06	0.541	0.18	3.0058	0.0028	Male under 7 years old
M1550	0.2729	0.1453	1.8785	0.0609	Male between 15 and 50 years old
MEAN_DWELL_MODFLOOR	0.4349	0.2444	1.7797	0.0758	(Mean) Concrete/cement brick as the main flooring material
MEAN_DWELL_TEMPWALL	−1.4938	0.3349	−4.4601	0	(Mean) Makeshift or improvised materials as the main wall materials
MEAN_EACHURCH	−0.1849	0.0756	−2.4452	0.0148	(Mean) Village has a church
MEAN_HAS_MOTORBOAT	1.0804	0.3229	3.3456	0.0009	(Mean) Has a motorboat
MEAN_HEAD_AGE	0.0259	0.0098	2.6438	0.0085	(Mean) Age of Household head
MEAN_HEAD_MARRIED	2.1091	0.47	4.4879	0	(Mean) Household head is married
MEAN_HEAD_SUBGR6	−1.8744	0.3837	−4.8846	0	(Mean) Household head has incomplete primary education
MEAN_M1550	1.961	0.8246	2.3782	0.0178	(Mean) Male between 15 and 50 years old
MEAN_M714	−3.6908	1.5745	−2.3441	0.0195	(Mean) Male between 7 and 14 years old

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
MEAN_SOMEPRIMARY	2.3433	0.6495	3.6079	0.0003	(Mean) Has some primary education
MEAN_TOILET_OWNPIT	0.6067	0.2174	2.7908	0.0055	(Mean) Private pit latrine is the main toilet facility
MEAN_WATER_HHTANK	−0.4057	0.1299	−3.1241	0.0019	(Mean) Household Tank is the main source of drinking water
TOILET_OWNFLUSH_1	0.1696	0.0599	2.8339	0.0048	Dummy for Private flush toilet is the main toilet facility = 1
WATER_STANDPIPE_1	−0.1293	0.0706	−1.8316	0.0677	Dummy for Communal standpipe is the main source of drinking water = 1

Table B8: Urban (Non-Honiara) Alpha Model

Variable Name	Coefficient	Standard Error	t Statistics	|Probability| > t	Variable Label
intercept	1.778	1.9458	0.9138	0.3613	Intercept
DWELL_NROOMS	−1.6906	0.6802	−2.4853	0.0133	Number of rooms in dwelling
DWELL_NROOMS*_yhat_*_yhat_	0.0195	0.0069	2.8287	0.0049	Number of rooms in dwelling *_yhat_*_yhat_
HAS_FRIDGE_1*_yhat_	0.0687	0.0315	2.1794	0.0298	Has a refrigerator *_yhat_
HEAD_NONMELANESIAN_1	2,241.2697	1,343.606	1.6681	0.0959	Dummy for Ethnic origin of Household head is not Melanesian = 1
HEAD_NONMELANESIAN_1*_yhat_	−446.1099	266.1433	−1.6762	0.0944	Dummy for Ethnic origin of Household head is not Melanesian = 1*_yhat_
HEAD_NONMELANESIAN_1*_yhat_*_yhat_	22.1806	13.1725	1.6839	0.0929	Dummy for Ethnic origin of Household head is not Melanesian = 1*_yhat_*_yhat_
M06*_yhat_	−0.1448	0.0876	−1.6521	0.0992	Male under 7 years old*_yhat_
MEAN_DWELL_TEMPWALL	4.2797	1.5448	2.7704	0.0058	(Mean) Makeshift is the main material for walls
MEAN_HAS_MOTORBOAT*_yhat_*_yhat_	−0.021	0.0106	−1.9853	0.0477	(Mean) Has a motorboat*_yhat_*_yhat_
MEAN_HEAD_MARRIED*_yhat_	−0.4292	0.1958	−2.1921	0.0289	(Mean) Household head is married*_yhat_
MEAN_M1550	−7.3503	3.3698	−2.1813	0.0296	(Mean) Male between 15 and 50 years old
TOILET_OWNFLUSH_1*_yhat_	1.1862	0.5447	2.1776	0.0299	Dummy for Private flush toilet is the main toilet facility = 1*_yhat_
TOILET_OWNFLUSH_1*_yhat_*_yhat_	−0.1288	0.0559	−2.3032	0.0217	Dummy for Private flush toilet is the main toilet facility = 1*_yhat_*_yhat_
TOILET_OWNPIT_1	−1.1431	0.4218	−2.7098	0.007	Dummy for Private pit latrine is the main toilet facility = 1
WATER_STANDPIPE_1	0.5661	0.3281	1.7253	0.0851	Dummy for Communal Standpipe is the main source of drinking water = 1