


RESULTS OF THE METHODOLOGICAL STUDIES FOR AGRICULTURAL AND RURAL STATISTICS

ASIAN DEVELOPMENT BANK

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Foreword

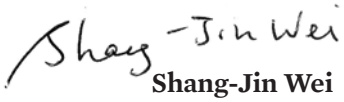
We are pleased to present the *Results of the Methodological Studies for Agricultural and Rural Statistics*, a compendium of six research papers from four countries—Bhutan, Lao People's Democratic Republic, the Philippines, and Viet Nam, contributing to the Global Strategy to Improve Agricultural and Rural Statistics. The Global Strategy was developed by the United Nations Statistical Commission with the support of the Food and Agricultural Organization of the United Nations and the World Bank. It provides a framework to rebuild statistical systems producing agricultural and rural statistics, meet emerging data requirements, and address the need to monitor cross-cutting development issues to guide decision making in the 21st century. The Global Strategy expands the scope of agricultural statistics to include aquaculture, fisheries, forestry, and land and water use. This compendium is a component of ADB's Regional Policy and Advisory Technical Assistance 8029 that was implemented to support the Global Strategy from the research perspective.

The key focus of this compendium is to compare agricultural statistics generated from sample surveys to those from administrative records. While designing sample surveys, special care must be taken to ensure adequate coverage to obtain unbiased estimates at appropriate statistical domains alongside standardizing definitions, improving consistency in timing of data collection across multiple time periods, and minimizing measurement and sampling errors. While nonsampling errors cannot be measured, improvements in quality of interviewers, survey instruments, and data processing can reduce systematic and random errors that are not due to sampling procedures. Also, the precision of estimates for key agricultural statistics from sample surveys can be further improved by utilizing innovative data sources such as satellite data.

Developing countries with statistical systems that are still maturing prefer to use statistics from administrative reporting system since these are timely and inexpensive. One viable approach for improving the administrative reporting system for agricultural and rural statistics is to control for measurement errors by incorporating "audit surveys." An audit survey is similar to postenumeration surveys for evaluating measurement errors which can subsequently be compared with the results obtained through an administrative reporting system.

Finally, the social and economic dimensions of agriculture also need to be considered since the majority of the world's poor live in rural areas, relying heavily on agriculture for their main source of employment. Policies that not only facilitate a shift from agriculture to other productive sectors but simultaneously increase productivity in agriculture should be encouraged.

We hope that this compendium will assist governments of countries participating in this project in addressing existing gaps in the production of agricultural and rural statistics. Further, the report is important in setting future directions for the improvement of agricultural and rural statistics, not only for the countries represented in the publication but also for others in the region.



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STUDY I
Examining the Available Data Sources for Agriculture Statistics in Bhutan

1. Introduction

Bhutan is a landlocked country surrounded by India in the east, west, and south and People's Republic of China in the north. It has an estimated population of 745,153 in 2014, based on population projections by the National Statistics Bureau (NSB). In 2013, the agriculture sector contributed 16.2% to the country's gross domestic product and employed 56.2% of Bhutan's workers. Poverty incidence in rural areas in which agriculture is the primary source of livelihood was at 16.7% in 2012, which was significantly higher than in urban areas (1.8%). To address this critical disparity, the government's 11th Five-Year Plan (2013-2018) aimed to accelerate and sustain growth in the agriculture sector and improve the rural livelihood of farming households. To achieve this objective, the plan included the implementation of policies that can foster higher growth in the agriculture sector.

In recognition of the increasing need for timely and regular statistics and information for agriculture, the Ministry of Agriculture and Forests (MoAF) of Bhutan launched the Renewable Natural Resources (RNR) Statistical Framework in January 2012 to improve the overall RNR statistical system for targeted decision-making. The RNR Statistical Framework called for streamlining statistical mandates, strengthening coordination mechanism, promoting use of appropriate methodologies, and capacity building. The Asian Development Bank (ADB) assisted MoAF to further improve the RNR Statistical Framework by working with both MoAF and NSB in developing an action plan to improve agricultural and rural statistics through intensive consultations with major stakeholders. This process was undertaken in Paro, Bhutan on 12-14 September 2012.

The major stakeholders consulted agreed that in order to improve the collection and analytical methods for RNR data, documentation of current methods must first be undertaken. Detailed, comprehensive documentations of the concepts and definitions, methods, sampling procedures, field operations and data capture method used, etc. of the major censuses, survey and administrative reporting systems of MoAF should be given top priority. They also suggested that the accuracy of the official agricultural and rural statistics, especially production and area of the major crops and livestock, should be examined. To contribute to this undertaking, this study compares the data series that are common to both MoAF and the NSB.

Section 1 presents a brief introduction and rationale for conducting this study. Section 2 describes the existing agricultural statistical system in Bhutan and presents information on how agricultural data are collected and the government agencies responsible for collecting, compiling, and disseminating agriculture data. The methodology, specific indicators, and data sources used in the study are presented in Section 3 while data comparisons on livestock statistics and statistics on landholding and agricultural land use are shown in Section 4. Conclusions and recommendations are presented in Section 5 while references used in the study are listed in Section 6. Statistical Tables are presented in the appendix and referenced in the text with a prefix A.

2. Agricultural Statistical System

Bhutan has a decentralized statistical system. Line ministries and agencies collect, compile, analyze and disseminate their data while the NSB is mandated to lead the country's statistical development and statistics dissemination. The legal and institutional authority of NSB is provided by numerous executive orders and promulgations issued by the Cabinet. Administratively, NSB is directly under the Office of the Prime Minister.

The NSB does not have a separate unit established for the compilation of agriculture statistics. It does not collect agricultural data but it estimates agriculture gross value added using the statistical data from MoAF. The authority to conduct agriculture-related surveys and census is vested with MoAF. However, there is a focal person identified at NSB to liaise with the statistical officer in the MoAF for collection and compilation of agriculture statistics required for national accounts estimation and Statistical Yearbook publications from time to time. The NSB provides technical advice, particularly in the area of sampling and data analysis to line agencies that conduct surveys of national coverage.

The NSB, in consultation with all the line ministries and various international and national experts and through the assistance of the World Bank, developed a National Statistical Development Strategy (NSDS) in 2008. However, due to lack of a legal statistical framework, NSDS has not been fully implemented. The NSB continues to pursue through the Parliament the enactment of a Statistics Law.

On the other hand, MoAF conducts RNR censuses every 10 years. The first was carried out in 2000 and the second in 2009 covering agriculture, livestock, and forestry activities. Both censuses were fully funded by the Danish International Development Agency (DANIDA). Going by the frequency of 10 years, the next census will be conducted in 2018. However, if NSB conducts population and housing census in 2015, MoAF is planning to conduct its RNR census in 2016 in order to take advantage of using the frame generated by the former.

Harvested area and crop production data are estimated annually through a sample survey that is conducted by the Department of Agriculture under MoAF. Livestock data, including fisheries, are collected through the annual livestock reporting system. Forestry information is compiled annually from the administrative reporting system.

The MoAF policy and planning division compiles and analyzes the data produced by those departments/agencies and publishes these annually in *Bhutan RNR Statistics*. The statistical data estimated through surveys and censuses are available at *geogs* (subdistricts), *dzongkhags* (districts) and national level while most of the compiled administrative and secondary data are available at *dzongkhags* and national level.

3. Analytical Framework

Methodology

Data on livestock population and areas of landholding and land use from MoAF which were sourced from various publications and internet sources were summarized and presented as time series data for comparison with data derived from the Bhutan Living Standards Survey (BLSS). On the other hand, statistics on livestock ownership (number of livestock owned by households by livestock type) and landholding [area of landholding by households (in hectares)] from the three rounds of BLSS were computed using the available BLSS survey data.

To determine if significant differences exist between estimates from the two data sources, comparisons were made on the livestock and landholding data by analyzing the percent differences in their estimates. Using statistical measures computed from the BLSS survey data, estimates from the two data sources were also compared using the margin of error of the BLSS estimates and the confidence interval estimates computed. Comparisons were made for the years 2003, 2007, and 2012, where estimates from BLSS are available. For BLSS years where MoAF data are not available, comparison was made for years close to the BLSS years (e.g. BLSS 2012 data on landholding were compared with 2010 land use data from MoAF). Coefficients of variations or relative standard errors were also used to analyze the reliability of the estimates computed from BLSS, comparing the three survey rounds.

Specifically, comparisons were made on livestock ownership, including ownership of cattle, buffalo, yak, horse, sheep, goat, pig, and poultry. For statistics on landholding, comparisons were made for estimates of land owned by households by land use types, including dry lands, wetlands, orchards, and total landholding. Analysis was also done to look at how livestock counts and landholding in Bhutan changed over certain periods of time by analyzing statistical trends based on available data. *Dzongkhag* level analysis was also done for indicators and years where data are available.

Data Sources

Data used in the succeeding analyses were sourced from the results of censuses, annual surveys, and administrative records which include Livestock Statistics 2006, Livestock Statistics 2007, Compendium of RNR Statistics 2008, RNR Census 2009, RNR Statistics 2012, Livestock Statistics 2013 published by the Ministry of Agriculture and Forests, and the BLSS published by the National Statistics Bureau. Other data from RNR censuses and surveys published on the *countrystat.org* website were also used.

The NSB conducted the BLSS in 2003, 2007, and 2012 under the sponsorship of the ADB and the United Nations Development Programme. Although BLSS is primarily a source of relevant information on the economic and social conditions of households in Bhutan, these surveys also include questions on household ownership of assets such as land and livestock. Data on the number of livestock owned by households, specifically, cattle, buffalo, yak, horse, sheep, goat, pig, and poultry and data on landholding among households by land use type (dry lands, wetlands, orchards, and other lands) were used in the analysis of BLSS agriculture data. Data published in the BLSS reports on the ownership of livestock and poultry as well as landholdings only refer to the number of households that own these assets. Estimates on the number of livestock or poultry owned or the area of land owned by households were not presented in the BLSS reports. However, statistics for these indicators may be estimated from the BLSS data.

Data from MoAF came from several source publications and databases found on the Internet, including data downloaded from the *countrystat.org* website. For livestock statistics, data from MoAF were derived from RNR censuses and surveys, as published on the *countrystat.org* website; livestock statistics publications prepared by the Department of Livestock (Livestock Statistics 2006, Livestock Statistics 2007, and Livestock Statistics 2013); and RNR Statistics publications (RNR Census 2009 and RNR Statistics 2012, which also presented data from the Livestock Census 2011).

For landholding statistics, data taken from the *countrystat.org* website were sourced from RNR censuses and surveys. Landholding data from the cadastral database provided by the National Land Commission Secretariat (NLCS), as published in the Compendium of RNR Statistics 2008 and from the RNR Census 2009 were also used. Land cover and land use data from the Land Cover Mapping Project (LCMP) Reports 2010, as published in RNR Statistics 2012 were also presented. The MoAF cautions about comparing the LCMP 2010 results with landholding data from the National Land Commission and the RNR Census figures. However, since the statistics used refer to cultivated agricultural areas, these can be used as proxy indicators to landholding statistics, and thus, were analyzed and compared with the BLSS results.

Agricultural data from MoAF, particularly data on the ownership of livestock and poultry as well as landholdings, were compared with data estimated from BLSS. Results of this comparison may be used in improving the agriculture statistical system in Bhutan and may guide MoAF and NSB in reviewing their respective data collection procedures.

4. Data Comparison

A. Livestock Statistics

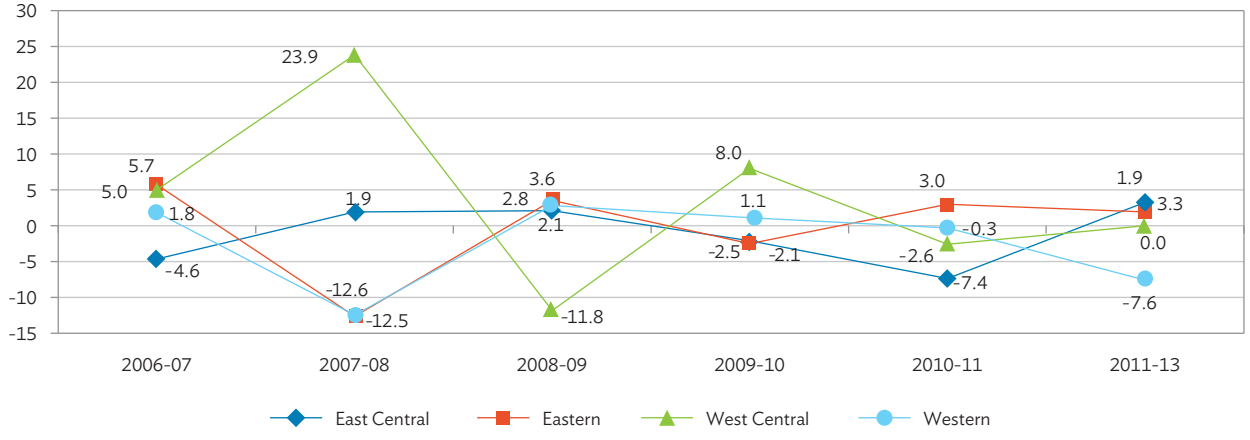
Livestock and Poultry Data of MoAF

Table A1 presents the number of livestock owned by households by livestock type using data from MoAF and BLSS while Table A2 shows how much these numbers changed over time. Based on MoAF reports, the national cattle counts increased by 27.9% between 1999 and 2000 but decreased significantly by 22.0% between 2000 and 2002. Considering the long gestation period of cattle, the annual rise in cattle counts of nearly a third is not possible; similarly with the decline, except if a major disease or severe winter occurred resulting in massive deaths in livestock. This irregular trend in cattle population during those years may also be caused by the importation of live cattle for breeding purposes, although data on cattle importation were not readily available. The trend in cattle population, however, stabilized beginning 2008 as shown in Figure 1.

Similar variations in regional and *dzongkhag* level estimates on livestock and poultry counts were also observed in the MoAF reports (Tables A3 to A10). For example, Figure 1 shows that the number of cattle owned by households in the West Central region rose by 23.9% between 2007 and 2008 but dropped by almost 12% between 2008 and 2009. The same variations were observed in the estimates on cattle counts by *dzongkhag* (Figure 2). As shown in the figure, estimates on cattle counts in Bumthang in the East Central region increased by 27.5% between 2011 and 2013, from a drop of 12.6% between 2010 and 2011. Variations were also observed in the cattle estimates in Sarpang, Trongsa and Zhemgang.

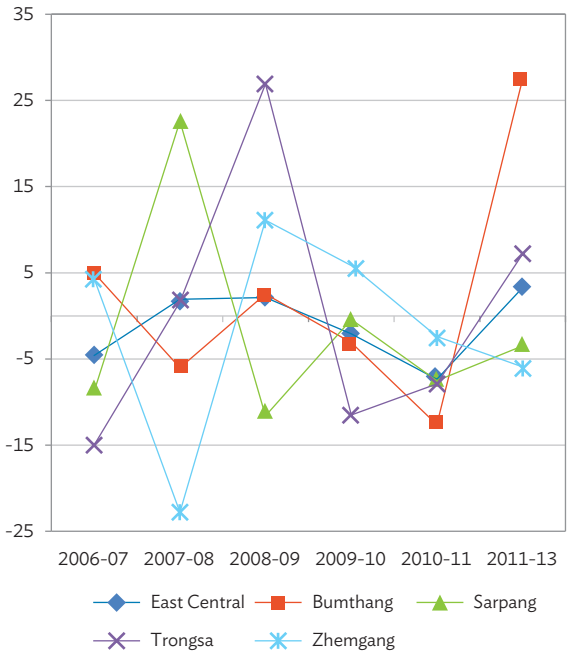
In the Eastern region (Figure 3), large variations were observed in Mongar, Pemagatshel, Trashigang, and Trashiyangtse. Meanwhile, in the Western region, Thimphu had the most inconsistent estimates on cattle counts (Figure 4). Table A3 shows that in 2006, the total number of cattle owned by households in Thimphu was 6,271, which dropped to 3,913 in 2013. Between 2007 and 2008, MoAF reports showed a drop of 37.8% in cattle ownership in Thimphu. However, between 2008 and 2009, an increase of 22.6% was recorded. Cattle count in Thimphu again dropped between 2010 and 2011 by almost 28% then increased by 26.0% between 2011 and 2013. Although the actual number of cattle owned by households in Thimphu only number around 3,000 to 6,000 between 2006 and 2013, the variations were still considerably large across years.

Figure 1: Percent Change in the Number of Cattle Owned by Households by Region



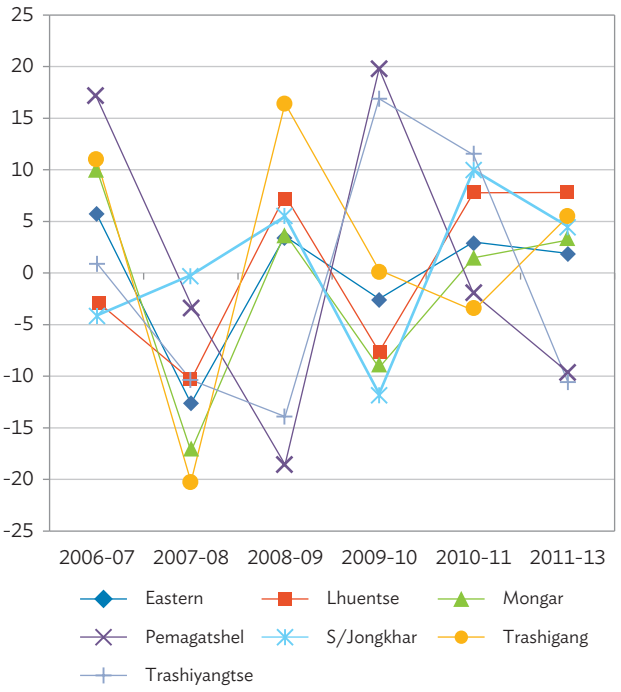
Source: Ministry of Agriculture and Forests, Bhutan.

Figure 2: Percent Change in the Number of Cattle Owned by Households by *Dzongkhag*, East Central Region



Source: Ministry of Agriculture and Forests, Bhutan.

Figure 3: Percent Change in the Number of Cattle Owned by Households by *Dzongkhag*, Eastern Region



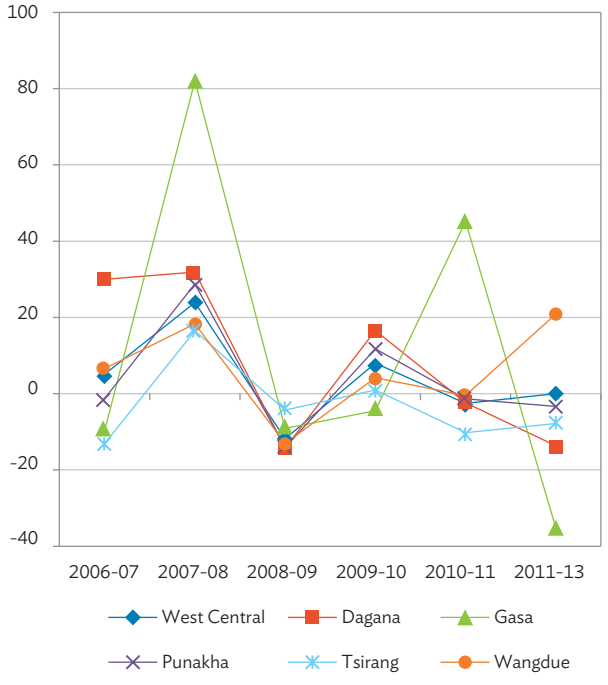
Source: Ministry of Agriculture and Forests, Bhutan.

Figure 5 shows the apparent variation in cattle counts in the West Central region, which is largely due to variations in the estimates in all *dzongkhags* particularly in the earlier years. In Dagana, cattle counts increased by more than 30% from 14,966 in 2007 to 19,735 in 2008. Similarly, an increase of 82.1% between 2007 and 2008 was recorded in Gasa, although actual cattle count was relatively low at only 541 in 2007 and 985 in 2008.

Figure 4: Percent Change in the Number of Cattle Owned by Households by *Dzongkhag*, Western Region

Source: Ministry of Agriculture and Forests, Bhutan.

Figure 5: Percent Change in the Number of Cattle Owned by Households by *Dzongkhag*, West Central Region



Source: Ministry of Agriculture and Forests, Bhutan.

Similar variations were also observed from the MoAF estimates for other livestock and poultry owned by households (Tables A1 and A2). For instance, the national count for buffaloes dropped from 1,468 in 2008 to 955 in 2009, declining by almost 35%. However, this may be due to the noninclusion of Zo-Zoms (a hybrid male and female progeny of yak bull and cattle) in the 2009 counts. The coverage of the 2009 data was not clearly defined on data posted in the *countrystat.org* website. There was also a significant increase in buffalo counts between 2008 and 2013, where counts included Zo-Zoms for both years. As presented in Table A4, there was a very significant increase in the number of Zo-Zoms in Trashigang, from only 165 in 2008 to 6,297 in 2013. No buffaloes were raised in Trashigang in 2013 based on the Livestock Statistics 2013 Report of the Department of Livestock. Data on buffaloes illustrate the importance of having a clear definition of which livestock types are counted and included in a particular livestock category to ensure consistency and comparability of data across years. In the case of buffalo counts, Zo-Zoms were counted in some years but not in others.

The same variations in the counts for yak were also observed. Between 2003 and 2004, the number of yaks in the country increased by 32.1% then dropped by 23.1% between 2007 and 2008. At the *dzongkhag* level, yak inventory in Gasa in the West Central region was reduced by half from 12,076 in 2007 to 5,694 in 2008 (Table A5). Similarly, the number of horses owned by households dropped by more than 40% between 2002 and 2003, as reported by MoAF. In more recent years and at the regional and *dzongkhag* level, a 43.0% increase in the number of horses in Pemagatshel on the Eastern region was recorded from a total of 963 in 2007 to 1,377 in 2008. On the West Central region in Gasa, counts on horses were irregular; declining by 20.5% between 2007 and 2008 and then posting an increase of 61.8% between 2008 and 2011. The total number of horses in Gasa from 2006 to 2013 ranged from only about 1,000 to 1,600 (Table A6).

Sheep inventory in Bhutan was at the 20,000 level from 1999 to 2003, even reaching 28,032 in 2002 (Table A1). However, starting 2004, sheep inventory declined to about 15,000 or lower. Earlier estimates on sheep ownership showed larger variations than in the more recent years, where variations were fairly regular (changes in inventory were at ±5%) except between 2006 and 2007 where a 17.7% decrease in sheep inventory was recorded.

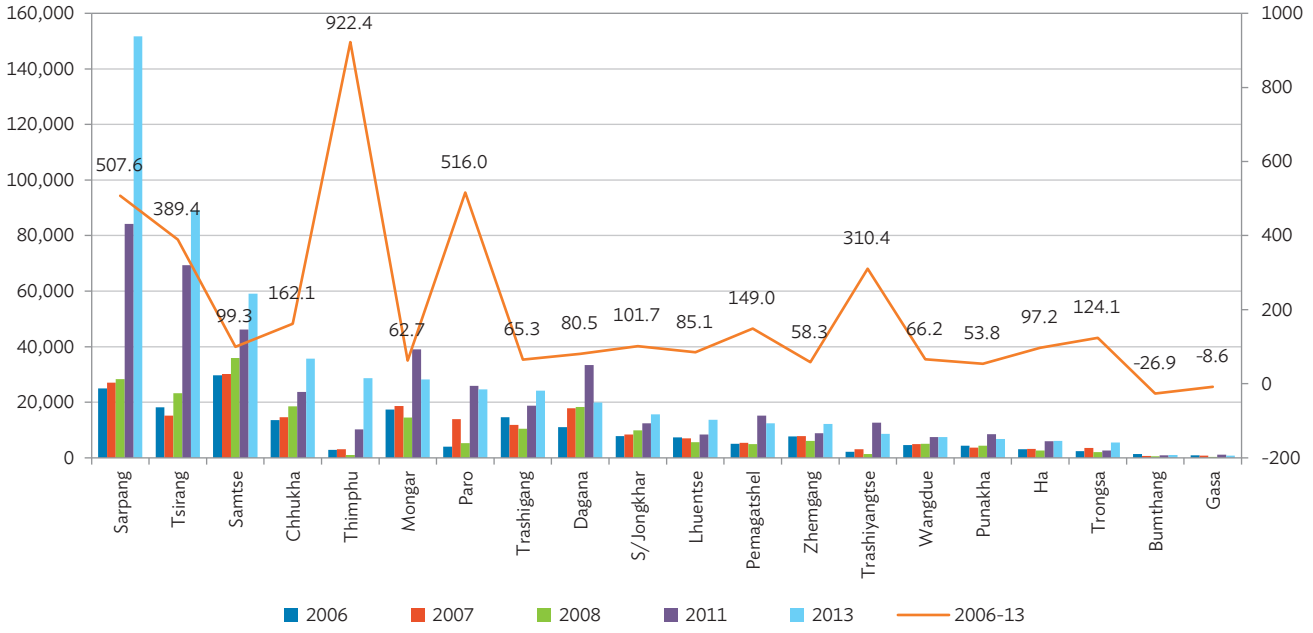
Goat population between 1999 and 2000 posted a big decline of 89.2%. Could this extreme case be supported by actual causes? As mentioned, a significant decline in livestock inventory such as this could only happen in cases of severe weather conditions or disease affecting livestock population or due to importation of live animals for breeding. In Mongar, goat inventory significantly increased from only 153 in 2008 to 1,034 in 2011, increasing by almost seven-fold, before dropping again to just 88 goats owned in 2013. During the same period, goat inventory in Wangdue also posted a significant increase; from only 156 goats owned in 2008, goat ownership increased to a high of 2,233 in 2011, as shown in Table A8.

Between 2003 and 2004, pig inventory grew by 32.9% but dropped by 43.7% the following year. Similarly, pig inventory was halved from 29,484 in 2012 to 15,373 in 2013 (Table A1). Among the *dzongkhags*, cases of uneven changes in inventories were observed in Mongar, Trashigang, and Thimphu (Table A9).

Another example of this variation is shown in the poultry inventory of MoAF wherein a drop of 48.6% was recorded between 2002 and 2003 while an increase in inventory was posted the following year at 52.2%. MoAF records also showed a consistent growth in poultry inventory of about 25% from 2008 to 2012 (with a growth posted at 40.7% between 2009 and 2010) then slowed down between 2012 and 2013 where only 0.3% growth was recorded. The *dzongkhags*, Sarpang, Tsirang, and Samtse were the

top three poultry producers in the country in 2013, based on data presented in Table A10. Between 2006 and 2013, a boom in household poultry production took place in Sarpang, among other *dzongkhags* in the country. From a poultry count of 24,967 in 2006, poultry inventory in Sarpang grew by more than 500% to more than 150,000 (151,691) in 2013 (Figure 6). Similarly, poultry population in Tsirang posted a growth of almost 390% in the same period. Large growths were also noted in Trashiyangtse (310.4%), Paro (516.0%), and Thimphu (922.4%) between 2006 and 2013. The question remains whether these numbers reflect actual occurrences.

Figure 6: Poultry Inventory and Percent Change (from 2006 to 2013) by *Dzongkhag*



Source: Ministry of Agriculture and Forests, Bhutan.

One source of discrepancy and reason to further examine the livestock data is that published estimates may not be validated well. For example, based on the published results of RNR Census 2009 Volume I, Tables 43a and 43b, which present livestock population data by *dzongkhag* and by livestock type for 2008, the total counts published for Bhutan do not tally with the computed totals by *dzongkhag*. Also, two tables in the Bhutan RNR Statistics 2012 (Table 31: Local and Improved cattle population by *dzongkhag*; and Table 106: Livestock Population, 2011), which both present data on cattle population by *dzongkhag* for 2011 do not tally, specifically for two *dzongkhags*. The population of local cattle in Trashigang and population of improved cattle in Zhemgang have different figures.

Livestock and Poultry Data of BLSS

With available survey data from the three rounds of BLSS, it was possible to compute sampling errors to assess the reliability of agricultural estimates resulting from the three surveys. Table A11 presents the number of livestock owned by households in Bhutan by livestock type. Considering the coefficient of variations or the relative standard errors (RSE) of the estimated total number of livestock, it should be noted that estimates based on BLSS 2007 resulted in the lowest RSEs among the three survey rounds and for all livestock types. The RSEs from BLSS 2003 were highest for all livestock types except for estimates on buffalo and poultry, where the 2012 estimates had the highest RSEs. This indicates that estimates

based on BLSS 2003 are less reliable compared to the later rounds of BLSS, where improvements on the survey design and implementation were made. In addition, rural areas in two *dzongkhags*, Sarpang and Samdrup Jongkhar were not covered in BLSS 2003 due to security reasons. In all three surveys, only the cattle count estimates had tolerable RSEs of less than 5% (except for the 2003 estimate where RSE was at 5.2%). RSEs as high as 29.0% for estimates on yak and sheep counts, and 35.6% on buffalo counts were computed from BLSS 2012 results.

At the *dzongkhag* level, the RSEs were high (more than 5%) for all livestock types and for all *dzongkhags*, as shown in Tables A12 to A19. This implies high variability among the *dzongkhag* level estimates. The lowest RSEs computed for estimates of cattle counts in BLSS 2007 and 2012 were in Samtse with RSEs of 13.2% for 2007 and 13.6% for the 2012 estimates. RSEs for estimates on goat population were also lowest for Samtse at 14.3% in 2007 and 15.5% in 2012. For *dzongkhag* level estimates on poultry, the estimate for Trashigang had the lowest RSE in 2007 at 14.6% while the estimate for Samtse had the lowest RSE in 2012 at 14.0%.

Some of the differences between the BLSS 2007 and 2012 estimates on livestock counts fell outside the margin of error (computed as twice the standard error of the difference between two estimates of total livestock counts), as shown in Table A11. This was observed on the estimates for cattle counts, which declined by 17.7% between 2007 and 2012; buffalo counts, which declined by 61.1%; horse population, which declined by 29.0%; pig population, which declined by 37.4%; and poultry counts, which grew by 63.4%.

At the *dzongkhag* level and comparing the 2007 and 2012 estimates, the difference for cattle counts in Paro (Table A12) was outside the margin of error while the rest were within the computed margin of error. Similarly, from Table A13, only the difference in the estimate for buffalo counts in Pemagatshel fell outside the margin of error while differences in the estimates on horse population for Tsirang and Paro fell outside the margin of error (Table A15). Differences on the estimates for Dagana on sheep population, Mongar on goat population, and Sarpang and Mongar on pig population, all fell outside the margin of error (Tables A16 to A18).

These results are not surprising considering that BLSS was not designed as an agricultural data survey. In fact, at the village level, nonagricultural and agricultural characteristics often manifest low correlation and sometimes, negative correlation, which has been observed in developing countries, in general.

Comparison of BLSS and MoAF Data on Livestock and Poultry

The 2003 livestock data from BLSS and MoAF are not expected to be comparable at the onset because the rural households in Sarpang and Samdrup Jongkhar *dzongkhags* were excluded from the 2003 BLSS survey due to security reasons. Based on Table A20, Sarpang and Samdrup Jongkhar had an average combined contribution to total poultry population in 2007 and 2012 of 20.0% and to total goat population of almost 15%. However, based on BLSS 2003, the two dzongkhags had a combined contribution of only 0.4% and 0.6% to total poultry and goat population, respectively. Rural areas in Sarpang and Samdrup Jongkhar *dzongkhags* are largely agricultural, especially Sarpang (Table A20). Thus, estimates of agricultural statistics at the national level derived from BLSS 2003 may not be unbiased due to lack of data from rural areas in the two *dzongkhags*. As such, discussions focused more on comparisons between data from MoAF and results of BLSS 2007 and 2012.

The summary of differences between the BLSS and MoAF livestock data is presented in Tables A21 and A22. Considering that livestock population estimates in BLSS 2003 may be underestimated due to the exclusion of rural areas in Sarpang and

Samdrup Jongkhar, the resulting estimates were still considerably larger than the estimates from MoAF. Likewise, BLSS 2007 produced higher estimates than MoAF for all livestock types, with percent differences ranging from 18.6% (pig) to 51.6% (goat).

Similarly, estimates based on BLSS 2012 were higher than the MoAF estimates for all livestock types, except for pig and poultry in which MoAF estimates were higher (Table A21). BLSS 2012 estimates on the number of pig and poultry owned by households were smaller by 32.1% and 16.7%, respectively, than the figures reported by MoAF. It should be noted that BLSS estimates on horse and sheep population were compared to the MoAF 2013 estimates due to lack of 2012 data (livestock data for 2012 was taken from data published on the *countrystat.org* website). Not much differences were observed between data from BLSS 2012 and MoAF on the number of buffaloes (0.7%), yaks (2.7%), and sheep (3.9%) owned by households while percent differences of 8.4%, 17.7%, and 22.6% were observed for estimates for cattle, goat, and horse, respectively.

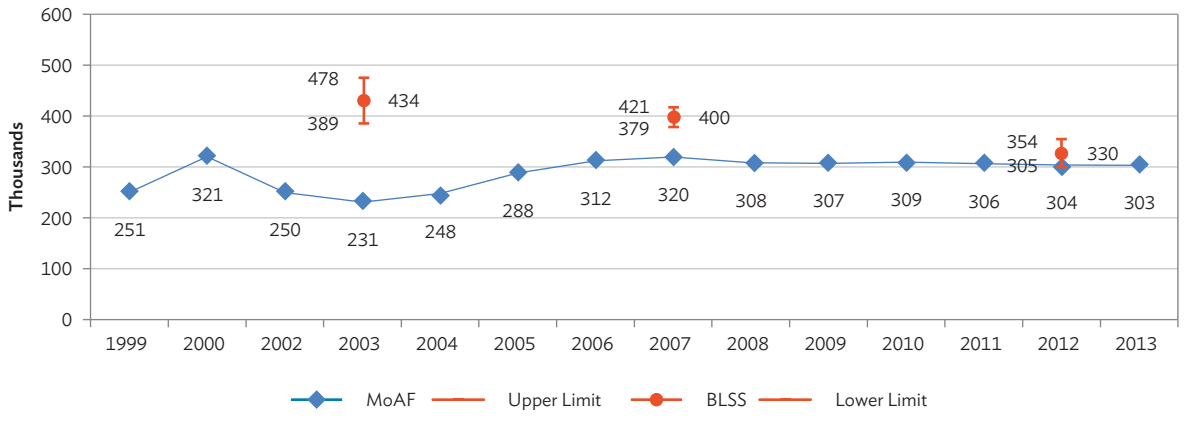
For all livestock types, except for yak and sheep population, the differences between the MoAF and BLSS estimates for 2007 were outside the margin of error (Table A22). This implies that for the 2007 survey, there are large sampling errors for the estimates for cattle, horse, goat, pig, and poultry. However, for the 2012 estimates, only estimates for cattle and pig population were over the margin of error.

Cattle and Buffalo

Both estimates from BLSS and MoAF reveal that cattle population declined between 2007 and 2012. However, the decline based on BLSS was greater at 17.7% compared to a decline of 4.9% based on MoAF reports. MoAF data also show that cattle counts were steady, ranging from about 303,000 to 310,000 beginning 2008, as shown in Figure 7. The figure also shows that the MoAF estimates on cattle population were lower than the estimated counts from BLSS, and that the MoAF estimates for 2003, 2007 and 2012 fell below the confidence interval estimates based on BLSS data, indicating significant differences between the estimates from the two sources. The narrow range of values of the confidence interval estimates computed from the BLSS data indicate that there was relatively low variability in the BLSS estimates yielding more precise estimates on cattle counts.

Also, there were large variations in the BLSS and MoAF cattle counts at the regional and *dzongkhag* level, as shown in Table A3. One significant difference on cattle population counts was on the West Central region of Bhutan. Based on MoAF data, there was a 20.8% increase in cattle population in the region between 2006 and 2013. However, based on BLSS results, a decline of 10.8% was recorded between 2007 and 2012. Large differences were also noted in the East Central and Eastern regions.

Figure 7: Number of Cattle Owned by Households



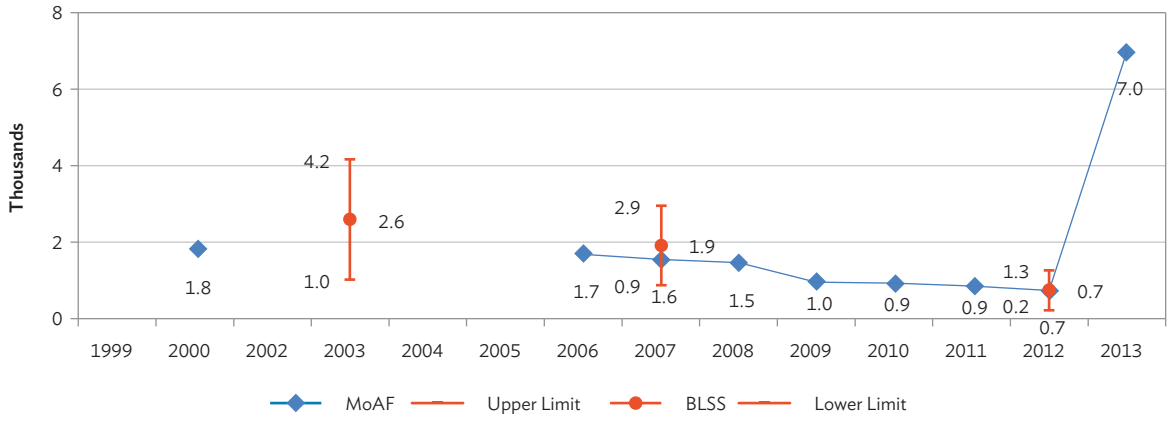
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Based on MoAF reports, the significant increase in buffalo counts from 2012 to 2013 (Figure 8) was mainly due to the large increase in the number of buffaloes (which include Zo-Zoms) in Trashigang. Buffalo counts in Trashigang increased from 165 in 2008 to 6,297 in 2013. As mentioned earlier in the report, situations such as this must be explained whether the numbers reported from the surveys or administrative reports were based on actual events. Figure 8 also shows that in 2012, there was no significant difference between the BLSS and MoAF estimates because the MoAF estimate was within the confidence limits computed for buffalo counts based on BLSS data.

number of horses owned by households were outside and lower than the confidence interval estimates computed from BLSS data. The interval estimates on horse ownership based on BLSS were relatively more precise as indicated by the narrow confidence interval estimates, particularly in 2007 and 2012.

Based on Tables A5 and A6, the trends at the regional level for yak and horse counts based on BLSS and MoAF were at opposite directions. Based on BLSS, yak counts increased between 2007 and 2012 on the East Central, Eastern, and West Central regions but declined by 73.4% on the Western region. However, based on MoAF reports, there was a decline

Figure 8: Number of Buffaloes Owned by Households



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Yak and Horse

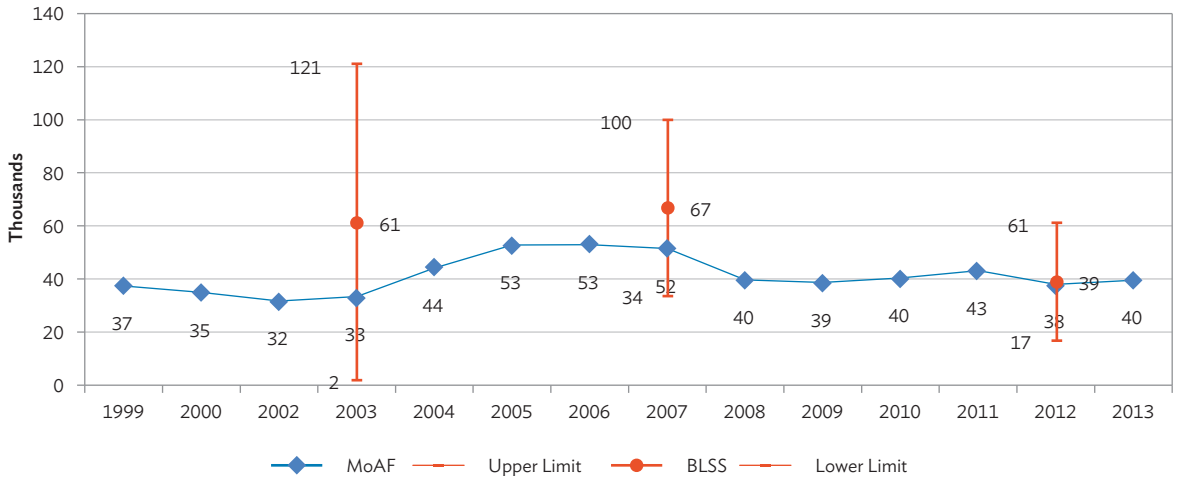
On the number of yaks and horses owned by households, the differences were more obvious in the earlier years (2003 and 2007). Data from MoAF and BLSS seemed to converge in 2012 (Figures 9 and 10). MoAF reports and BLSS results had the same declining trends for both yaks and horses, although the reported decline was greater based on BLSS. Figure 9 also shows that there was a large variability in the BLSS data on yaks, leading to wide confidence interval estimates. As such, it is not surprising that MoAF estimates on yak fell within the estimated range. On the other hand, MoAF estimates on the

in yak population in all regions from 2006 to 2013. As for the number of horses, MoAF and BLSS estimates differed at the Western region where MoAF reported a growth of 5.5% (between 2006 and 2013) while BLSS results had a decline of 45.6% (between 2007 and 2012).

Sheep and Goat

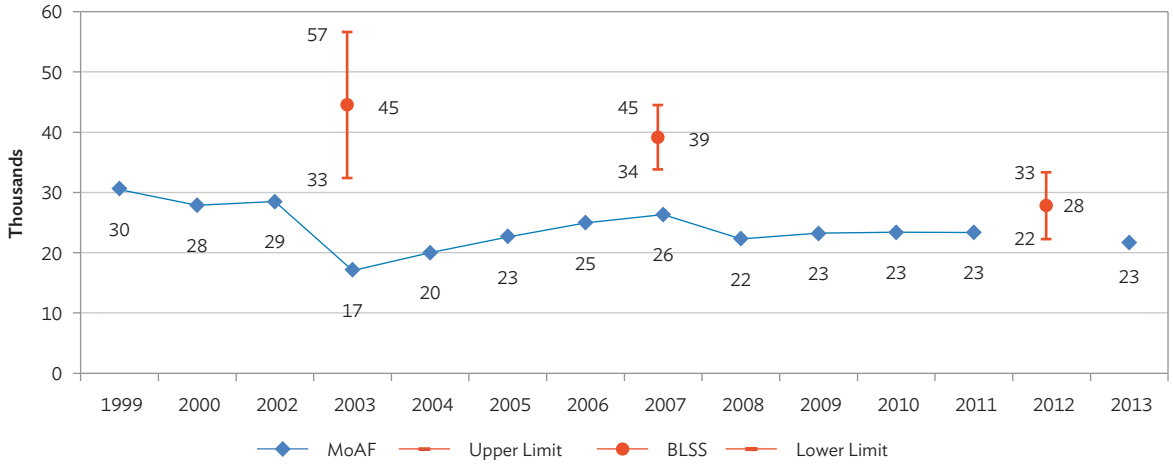
Not much difference between the MoAF and BLSS estimates on sheep population were observed particularly in 2007 and 2012 (Figure 11). As shown in the figure, sheep population based on both the MoAF and BLSS data had a decreasing trend. The interval

Figure 9: Number of Yaks Owned by Households



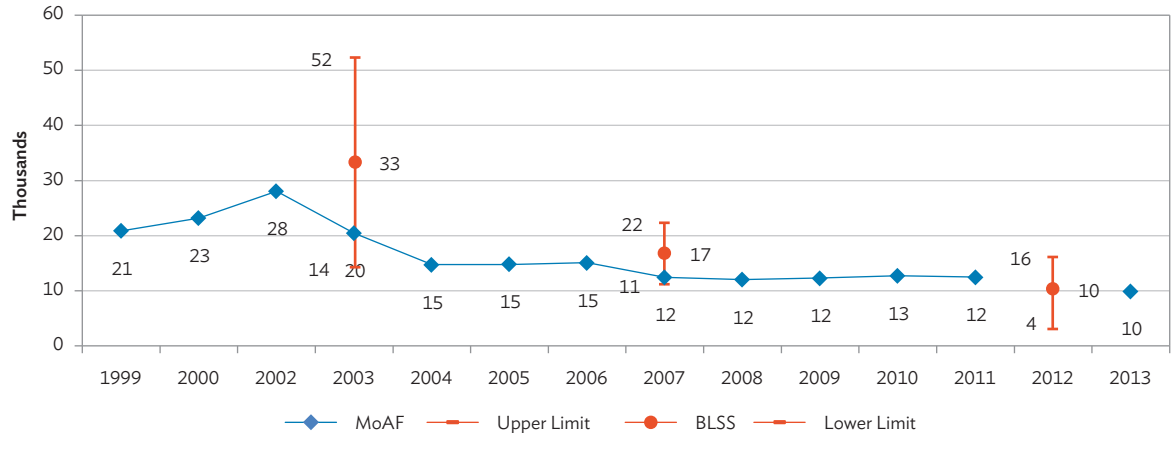
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Figure 10: Number of Horses Owned by Households



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Figure 11: Number of Sheep Owned by Households



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

estimates on sheep population from the BLSS were likewise relatively precise, specifically in 2007 and 2012.

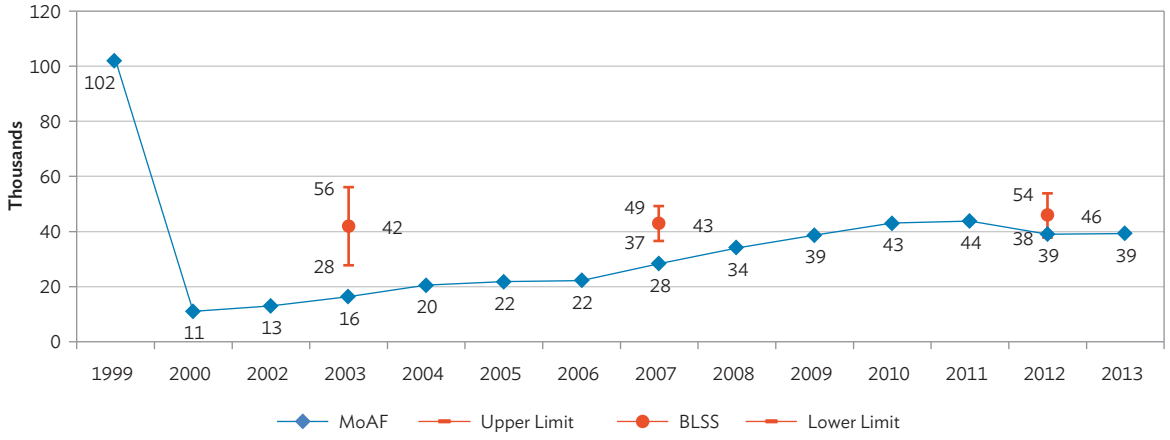
Similarly, MoAF and BLSS data had the same trend with regard to goat population counts. Both data sources showed an increasing trend. However, between 2007 and 2012, the reported increase on goat population by MoAF of 37.9% was higher than the increase of 7.0% based on BLSS data. Furthermore, the interval estimates based on BLSS had relatively high precision (Figure 12). Although the MoAF estimates on goat population counts were outside the confidence interval estimates based on BLSS (except in 2012), the differences were not very significant especially in 2007 and 2012.

However, looking at the regional level data on Tables A7 and A8, a reversal of trends was observed. The two data sources had opposite trends on sheep population at the Eastern and Western regions. Meanwhile, for goat population counts, the trends were on opposite directions at the East Central and Eastern regions.

Pig and Poultry

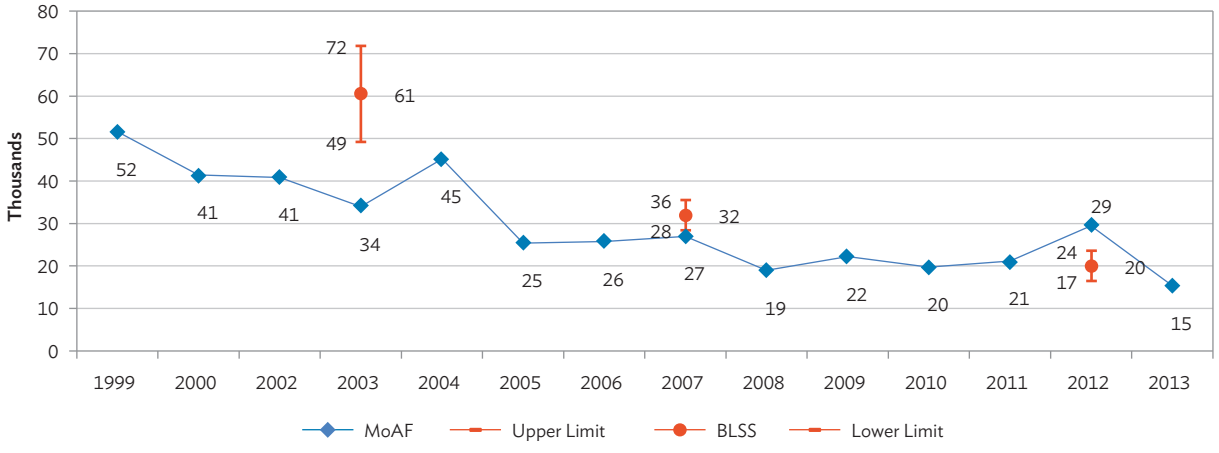
Figure 13 shows that BLSS estimates on the number of pigs owned by households, particularly in 2007 and 2012, were relatively precise considering the narrow interval estimates. This indicates that there is low variability in the data on pig population from BLSS. Also, between 2007 and 2012, there were

Figure 12: Number of Goats Owned by Households



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Figure 13: Number of Pigs Owned by Households



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

observed differences on pig population estimates between BLSS and MoAF. BLSS data showed a decline of 37.4% between 2007 and 2012 while MoAF data showed otherwise (an increase of 9.3%). MoAF estimates also fell outside the interval estimates based on BLSS. MOAF estimates were lower than BLSS estimates in 2003 and 2007 but were higher in 2012. Furthermore, *dzongkhag* level estimates on Table A9 had an increasing pig population in Sarpang and Dagana, as reported by MoAF. However, BLSS estimates for these *dzongkhags* showed a decline in pig inventory.

Both MoAF and BLSS had increasing trends on poultry population. Based on MoAF reports, poultry counts went up by 174.0% between 2007 and 2012 whereas BLSS estimated an increase of 63.4% (Figure 14). The figure also shows that the MoAF estimates fell outside the confidence interval estimates from BLSS, except in 2012. However, the interval estimate in 2012 was relatively less precise compared to the 2003 or 2007 estimates, indicating a high variability on poultry data from BLSS 2012.

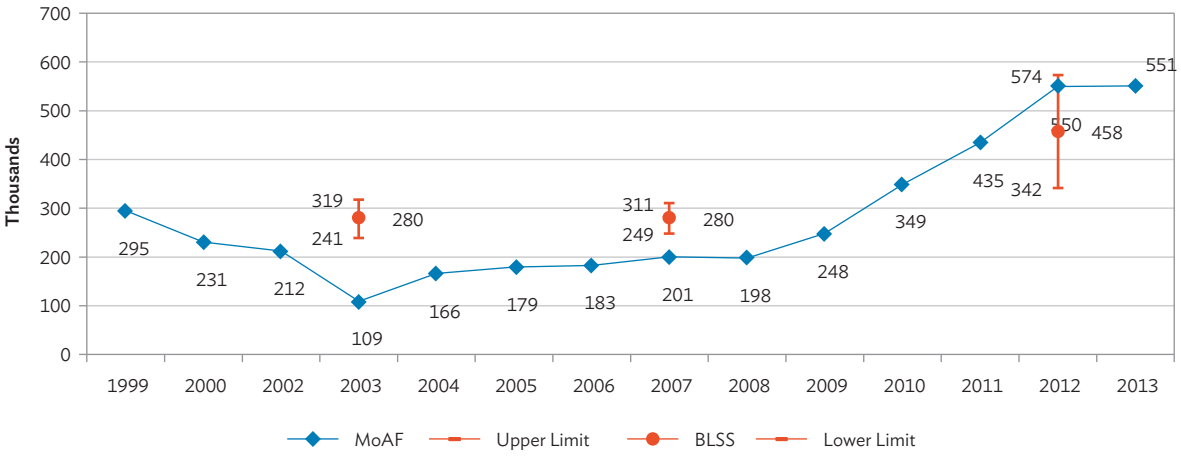
The same differences in the rate of increase at the regional and *dzongkhag* level were noted (Table A10). MoAF reports had significant increases in poultry counts in Sarpang, Trashiyangtse, Tsirang, and Thimphu, which posted growths between 2006 and 2013 of 310.4% (Trashiyangtse) to as high as 922.4% (Thimphu). However, poultry counts in Trashiyangtse and Thimphu started at a low base of only 2,108 and 2,802 in 2006, respectively. It is also worth noting that based on BLSS data, poultry population in Thimphu dropped by 9.8% between 2007 and 2012. This is very far from the MoAF report which recorded the poultry population in Thimphu in 2013 at 28,648 while BLSS recorded only 4,031 in 2012.

B. Statistics on Land Ownership and Land Use

Data of MoAF on Landholding and Land Use

From Tables A23 and A24, total agricultural landholding in Bhutan significantly decreased between 1999 and 2000 by 36.5% and continued to decline until 2003, based on data from MoAF. Between 2003 and 2004, agricultural landholding in the country slightly increased by 7.7% with total wetlands utilized mainly as paddy fields, increasing by 29.2% while lands utilized as orchards increased by 19.8%. Between 2004 and 2007, total agricultural landholding significantly increased by more than 50% from 103.5 thousand hectares in 2004 to 156.7 thousand hectares in 2007 (Figure 15). This resulted

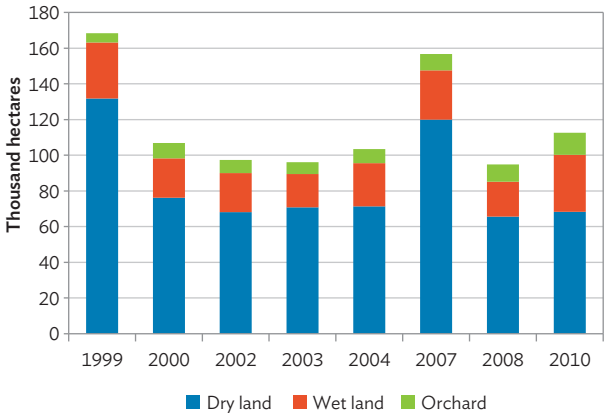
Figure 14: Number of Poultry Owned by Households



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

from a significant increase in the holdings of dry lands which are used mainly for growing food crops such as maize, wheat, millet, as well as horticulture crops.

Figure 15: Landholding by Land Use Type



Note: MoAF data in 2010 refer to cultivated agricultural areas and not landholding size.
Sources: Ministry of Agriculture and Forests, Bhutan.

Landholding of agricultural dry lands increased by 68.0% between 2004 and 2007. It should be noted that data on agricultural landholding in 2007 includes lands owned by private or household owners, community-owned lands, or lands belonging to *rabdeys* and *lhakhangs*. Total agricultural landholding in the country again dropped to 94,903 hectares in 2008, declining by 39.5% from the previous year's figures. Based on RNR Statistics 2012, total cultivated agricultural areas in Bhutan in 2010 was 112.6 thousand hectares which increased by 18.6% from 2008. It should be noted that MoAF data in 2010 refer to cultivated agricultural areas and not landholding size. The latest report from MoAF on agricultural land use in Bhutan covers up to the year 2010 only, as published on the RNR Statistics 2012. This indicates a 3 to 4 year lag in the availability of statistics on agricultural landholdings or land use in Bhutan.

Considering that data on agricultural landholdings and land use from MoAF were derived from different reports, care should be taken when comparing data across years. In particular, the 2007 data on agricultural landholding derived from the cadastral database of the Department of Survey and Land Records (DSLR) and published on the Compendium of RNR Statistics 2008, refer to land owned by private or household owners, community-owned lands, or those belonging to *rabdeys* and *lhakhangs*, as mentioned; agricultural land use data in 2010 derived from reports from the Land Cover Mapping Project in 2010 refers to cultivated agricultural areas and not landholding size as published in RNR Statistics 2012 while data for the other years were taken from RNR censuses and surveys as published on the *countrystat.org* website. In this connection, data on agricultural landholdings or land use provided by several data sources may need to be evaluated for consistency (e.g. according to who owns the land, as in the 2007 data) to ensure comparability in the area estimates of landholdings and land use.

Data of BLSS on Landholding

Based on data from the three rounds of BLSS presented in Table A23, total agricultural landholding in Bhutan increased by 23.6%; from 167,206 hectares in 2003 to 206,662 hectares in 2007. Considering that rural areas in Sarpang and Samdrup Jongkhar were excluded from the 2003 round of BLSS, the estimated total agricultural landholding in Bhutan in 2003 may be underestimated. However, in 2012, total landholding dropped by 41.4% to 121,140 hectares. Total agricultural landholding in 2003 includes dry land, wetland, orchards, and other lands owned by households. In 2007, total landholding also includes other lands used for pasture, *sokshing*, and *tseri* while in 2012, total landholding refers to ownership of dry lands, wetlands, and orchards.

Data on agricultural landholding also appear to be more behaved than livestock data resulting from the same BLSS surveys. The coefficient of variations or the RSE of the estimated total landholdings in all three rounds of BLSS for all land use types were below 10%, except for the 2003 estimate for orchards (with

RSE of 14.6%) as shown in Table A26. Estimates from BLSS 2007 resulted in the lowest RSEs among the three survey rounds for all land use types, which were all below 5%, except for the estimate for orchards with an RSE of 7.4%. The RSEs from BLSS 2003 were highest for all land use types. Similar to the result of the analysis on BLSS livestock data, estimates based on BLSS 2003 were less reliable compared to the later rounds of BLSS where improvements on the survey design and implementation were made. Estimates based on BLSS 2007 (for both dry and wetlands) and BLSS 2012 (for dry lands) had respectable RSEs of less than 5%, which is good considering that these are national level estimates. As for the estimate on total landholding, the estimate from BLSS 2012 was the most reliable with an RSE of 3.5%.

However, at the *dzongkhag* level, the RSEs were high (more than 5%) for all land use types and for all *dzongkhags* (Tables A27 to A31). This implies high variability among the *dzongkhag* level estimates. Generally, estimates for Trashigang, Chhukha, and Samtse in 2007, and Thimphu in 2012 had relatively low RSEs (about 15% or lower).

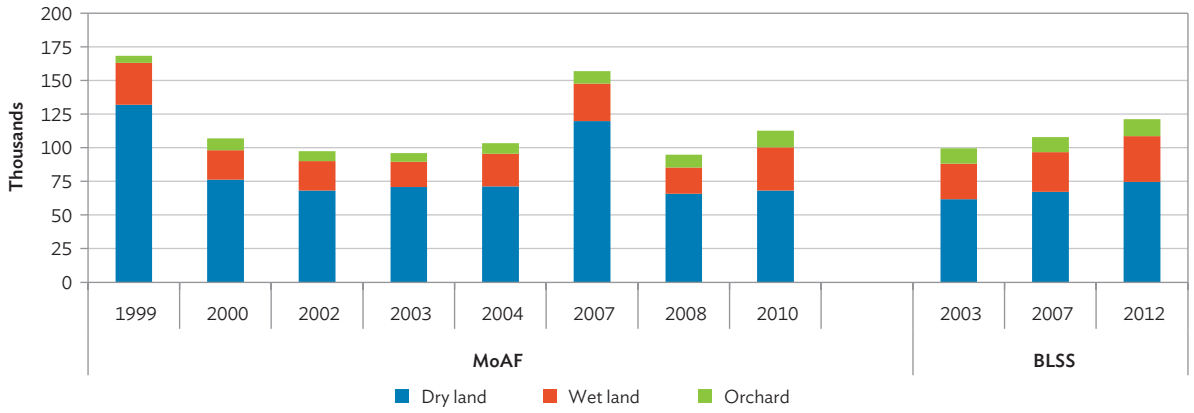
Differences between BLSS 2007 and 2012 estimates on operated and total dry landholdings among households fell outside the margin of error (computed as twice the standard error of the difference between two estimates) as shown in Tables A27 and A28. This implies that aside from sampling errors contributing to the discrepancies, other factors contributing to nonsampling errors may be present as well. Estimates for operated dry lands increased by 17.7% between 2007 and 2012 while estimates on total dry lands owned by households grew by 10.9%.

At the *dzongkhag* level, the difference between the 2007 and 2012 estimates for operated dry lands in Zhemgang, Samtse, and Thimphu (Table A27) were outside the margin of error while the rest were within the computed margin of error. Similarly, from Table A29, differences in the estimate for operated wetlands in Bumthang, Punakha, and Thimphu fell outside the margin of error while differences in the estimates on total wetlands owned by households in Bumthang, Trashigang, and Punakha fell outside the margin of error (Table A30). Differences on the estimates for Bumthang, Lhuentse, Samdrup Jongkhar, Trashigang, and Punakha on land utilized as orchards all fell outside the margin of error (Table A31). As with the livestock BLSS estimates, these results are not surprising considering that the BLSS was not designed as an agricultural data survey.

Comparison of BLSS and MoAF Data on Landholding

Arable land in Bhutan is less than 3% of the country's total area. As a landlocked country and with limited water resource for irrigation, the bulk of agricultural landholdings in Bhutan consist of dry lands (Figure 16). As previously noted, land cover and land use data from the Land Cover Mapping Project (LCMP)

Figure 16: Comparison of BLSS and MoAF Data on Landholding by Land Use Type (in ha)



Note: MoAF data in 2010 refer to cultivated agricultural areas and not landholding size.
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

2010, as published in RNR Statistics 2012, are used as proxy indicator to landholding statistics because the data used refer to cultivated agricultural areas and are analyzed and compared with BLSS results.

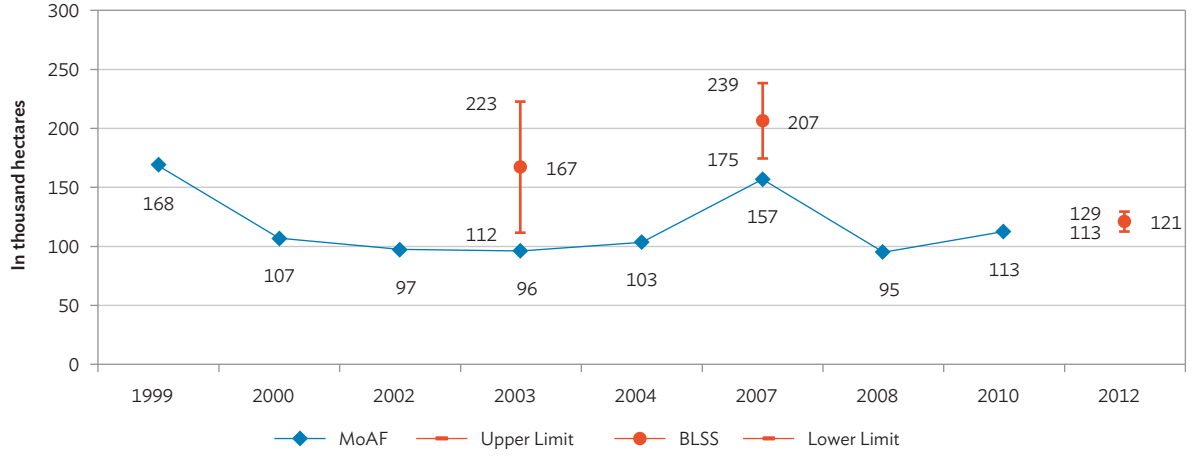
Based on the MoAF data on cultivated agricultural areas (2010) and BLSS data on landholdings (2012), dry lands consist 61% of the total agricultural lands in the country; wetlands, 28%; and orchards, 10-11%. BLSS data show that agricultural utilization of dry lands, wetlands, and orchards continuously increased between 2003 and 2012. Likewise, MoAF data had an increasing trend between 2008 and 2010, although the 2010 data refer to cultivated agricultural areas and not landholding size. As previously mentioned, the 2007 data on landholding from MoAF refer to land owned not only by households but also include privately- or community-owned lands, or those belonging to *rabdeys* and *lhakhangs*.

Similar to the discussion made on livestock statistics, a comparison between the 2003 data on landholdings from BLSS and MoAF was not made since rural households in Sarpang and Samdrup Jongkhar *dzongkhags* were excluded from BLSS 2003. Based on Table A32, households in Sarpang and Samdrup Jongkhar had an average combined percent share to total ownership of dry lands in Bhutan in 2007 and 2012 of 15.4% and a combined share of 12.6% to total ownership of wetlands. However, based on BLSS 2003, the two dzongkhags had a combined contribution of only 0.51% and 0.95% to total ownership of dry lands and wetlands, respectively. As such, discussions focused more on comparisons between data from MoAF and results of BLSS 2007 and 2012.

With the exclusion of rural areas in Sarpang and Samdrup Jongkhar in BLSS 2003, estimates on total agricultural landholding for 2003 may be underestimated. However, the resulting BLSS estimate of total agricultural landholding was still considerably larger than the estimate from MoAF, with the BLSS estimate larger by 74.0% than the MoAF estimate. Furthermore, the MoAF estimate was also found to be outside the confidence interval estimate for the total agricultural landholding based on the BLSS 2003 data (Figure 17). BLSS 2003 estimate include ownership of other lands, in addition to dry lands, wetlands, and orchards, and had a large variability considering the size of the confidence interval estimate.

Similarly, Figure 17 also shows that estimates on total agricultural landholding between MoAF and BLSS for 2007 and 2012 (BLSS 2012 was compared with 2010 data from MoAF) were outside the confidence interval estimate, particularly for the 2007 estimate where a difference of almost 50,000

Figure 17: Total Agricultural Landholding



Note: MoAF data in 2010 refer to cultivated agricultural areas and not landholding size.
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

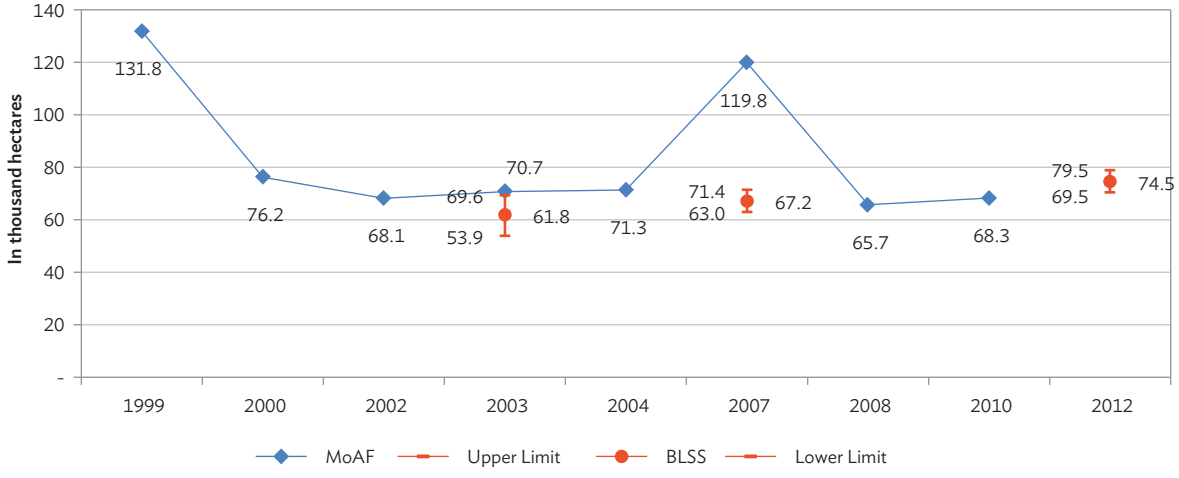
hectares was noted. This is not surprising considering the difference in coverage on ownership between the BLSS and MoAF data in 2007 (BLSS covers household-owned agricultural lands only while MoAF data includes land owned by communities and others). Also, since the BLSS 2012 estimates are being compared with the 2010 data from MoAF, which refer to cultivated agricultural areas and not landholding size, differences in the estimates from the two sources may arise. Large changes in landholding and agricultural land cultivation statistics can also be noted from the MoAF data particularly between 1999 and 2000 (with a -36.5% change), between 2004 and 2007 (51.5% change), and between 2007 and 2008 (-39.5% change). These fluctuations may be attributed to differences in coverage or due to the use of various data sources within MoAF.

As shown in Figure 18, the estimate on the ownership of agricultural dry lands based on BLSS 2007 (67.2 thousand hectares) was considerably lower than the MoAF estimate (119.8 thousand hectares). This is because BLSS estimates only cover land owned by households while the MoAF data includes privately- or community-owned lands. The figure also shows that the 2007 MoAF estimate on dry land ownership was outside the confidence interval estimate based on BLSS, which ranged from 63 to 71.4 thousand hectares. This indicates that the BLSS estimates are relatively precise. On the other hand, the 2010 MoAF estimate on total agricultural dry lands of 68.3 thousand hectares was slightly lower than the BLSS 2012 estimates (74.5 thousand hectares), which was outside the confidence limits set for the estimate of dry lands based on the BLSS 2012 data.

For the estimates on the ownership of agricultural wetlands and orchards, Figures 19 and 20 show that for 2007, BLSS estimates were higher than estimates from MoAF. In addition, the MoAF estimate for wetlands (27.7 thousand hectares) was within the confidence interval estimate (27.2 to 31.8 thousand hectares) based on BLSS 2007. BLSS estimates for wetlands were also relatively precise as shown in Figure 19. On the other hand, the MoAF estimate for orchards owned by households in 2007 was outside the confidence interval estimate from BLSS. This indicates that BLSS estimates on ownership of orchards are less precise compared to estimates for wetlands and dry lands.

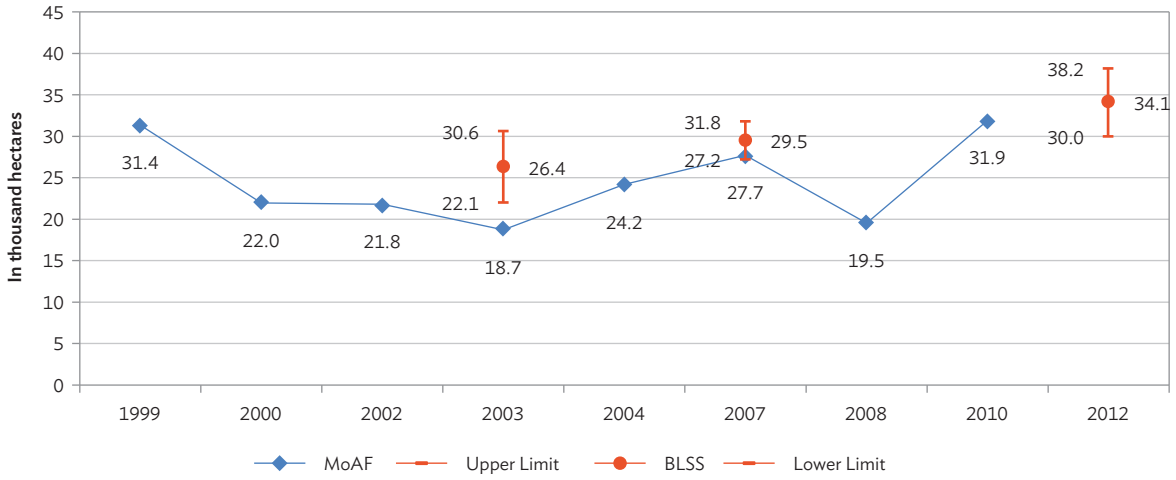
Comparing the BLSS 2012 estimates and the 2010 estimates from MoAF, Figures 19 and 20 illustrate that the BLSS estimates were slightly higher than the MoAF estimates for both wetlands and

Figure 18: Total Agricultural Dry Land Owned



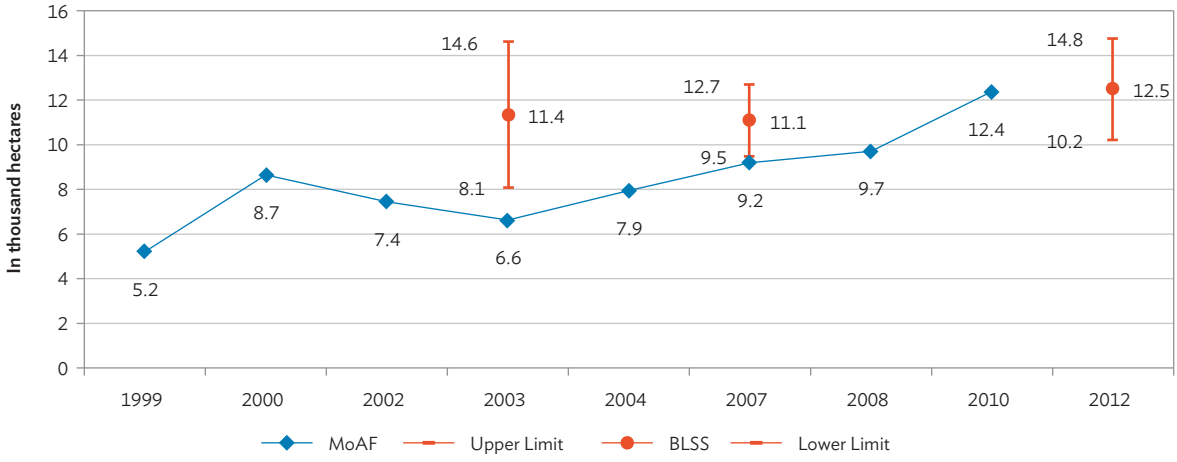
Note: MoAF data in 2010 refer to cultivated agricultural areas and not landholding size.
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Figure 19: Total Agricultural Wetland Owned



Note: MoAF data in 2010 refer to cultivated agricultural areas and not landholding size.
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Figure 20: Total Orchards Owned



Note: MoAF data in 2010 refer to cultivated agricultural areas and not landholding size.
Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

orchards. Estimates for wetlands were higher by 9.1% and for orchards by 0.9%. Also, for both wetlands and orchards, the 2010 MoAF estimates were within the BLSS 2012 confidence interval estimates, indicating that the estimates from the two sources do not differ significantly.

Regional and *Dzongkhag* Level Comparison

Regional and *dzongkhag* level data from MoAF were available in 2008 and 2010, where the 2008 data refer to landholdings while the 2010 data refer to cultivated agricultural areas. Hence, data from BLSS 2007 and 2012 were compared with MoAF data for 2008 and 2010, respectively, at these levels. It was noted that variations exist between BLSS and MoAF data at the regional and *dzongkhag* level (Figures 21 and 22).

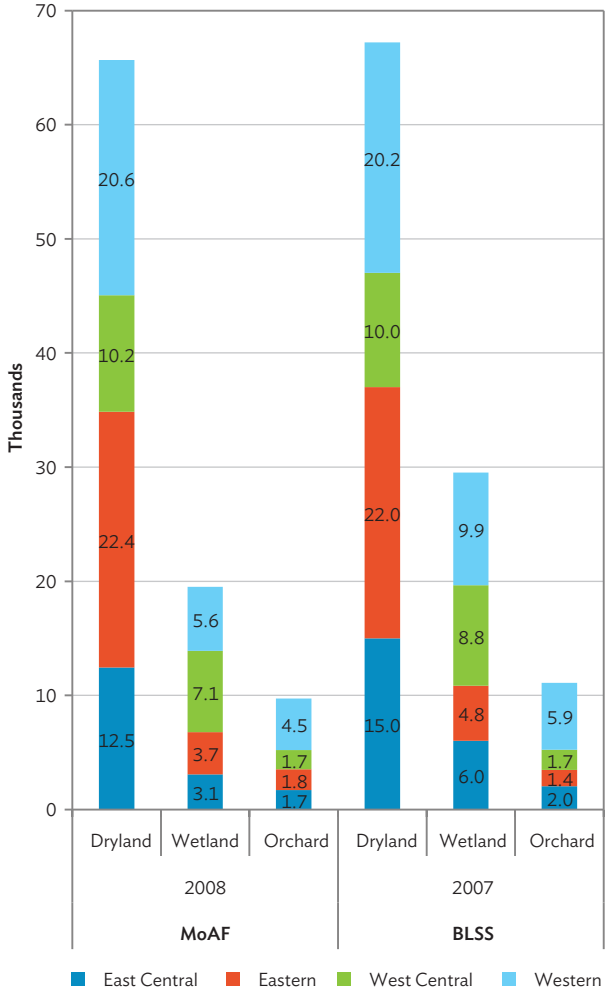
A comparison of the BLSS 2007 data and the 2008 data from MoAF (Figure 21) reveal that among all four regions, there was a slight difference in the estimates for the ownership of dry lands, except in the East Central region where the BLSS estimate

was higher by 20.3% than the MoAF estimate. At the *dzongkhag* level, the only significant difference was noted in Thimphu where the BLSS estimate was higher by 450.6% than the MoAF estimate. Similarly, as shown in Figure 21, only slight differences between the BLSS and MoAF estimates on the ownership of agricultural lands used as orchards were noted.

However, there were marked differences in the BLSS and MoAF estimates on the ownership of wetlands, particularly in the East Central and Western regions (Figure 21). In the East Central region, BLSS 2007 estimate for wetlands was higher by 96.8% than the 2008 MoAF estimate. Similarly, in the Western region, the BLSS estimate was higher by 75.3%. Large differences were also noted among the *dzongkhag* level estimates for wetland ownership as shown in Table A34. Specifically, BLSS estimates on wetlands were significantly higher than the MoAF estimates for Bhumtang in the East Central region, Pemagatshel in the Eastern region, Gasa in the West Central region, and for Chhukha, Ha, and Thimphu in the Western region.

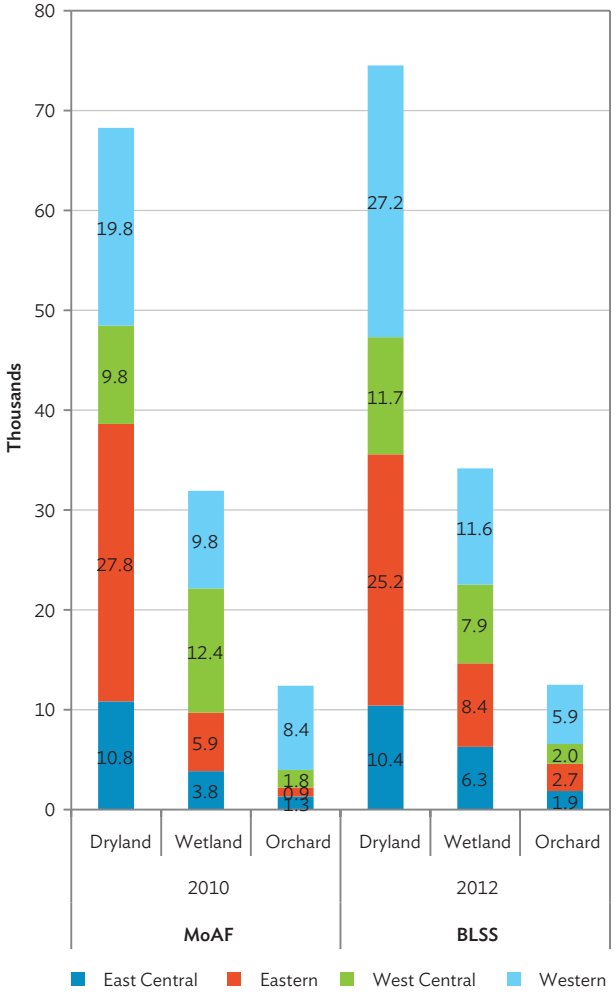
As shown in Figure 22, there were also differences between the 2010 MoAF and 2012 BLSS estimates of agricultural dry lands particularly in the West Central and Western regions. BLSS estimate for dry lands in the West Central region was higher by 19.2% than the MoAF estimate while in the Western

Figure 21: Comparison of BLSS (2007) and MoAF (2008) Landholding Data by Region and by Land Use Type (in ha)



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2007.

Figure 22: Comparison of Data from BLSS (Landholding, 2012) and MoAF (Cultivated Area, 2010) by Region and by Land Use Type (in ha)



Sources: Ministry of Agriculture and Forests, Bhutan; and BLSS 2012.

region, estimates from BLSS 2012 were higher than the MoAF estimates by 37.3%. The largest differences were found in the estimates of agricultural dry lands in Punakha and Thimphu (Table A34).

Similar to the 2007/2008 comparison of data from BLSS and MoAF, marked differences in the estimates for wetlands were observed in all regions. The BLSS 2012 estimates were higher than the MoAF estimates by 63.5% in the East Central region, by 42.8% in the Eastern region, and by 19.0% in the Western region. On the other hand, in the West Central region, the BLSS estimate was lower by 36.7% than the estimate from MoAF. The most significant difference between the BLSS and MoAF estimates on wetlands was in Bumthang, where MoAF estimated the wetland area at only 25 hectares, while BLSS estimated it at 2,125 hectares (Table A33). Other considerable differences were noted in Mongar, Trashigang, Ha, and Thimphu *dzongkhags* (Table A34).

For the estimated area on orchards, the largest difference was noted in the Eastern region where the BLSS 2012 estimate was higher by more than 200% than the estimate from MoAF in 2010, as shown in Figure 22. The difference in the estimates from the two sources is largely due to the differences in the area estimates in Mongar and Samdrup Jongkhar. From Table A33, MoAF estimated the orchard area in Mongar at only 3 hectares and in Samdrup Jongkhar at 249 hectares while the BLSS estimate for the two *dzongkhags* were 317 hectares and 1,465 hectares, respectively.

5. Conclusions and Recommendations

This study examined the two major sources of agricultural statistics in Bhutan—the MoAF and NSB. MoAF data are published in the RNR Statistics, a compendium of RNR-related statistics from various sources within and outside the Ministry, either from administrative reports or surveys. These include the Livestock Statistics Reports and Livestock Census Report from the Department of Livestock (DoL); cadastral databases provided by the DSLR, National Land Commission; Bhutan Land Cover Mapping Project (LCMP) Report by the National Soil Services Centre (NSSC) and MoAF; and reports for the RNR Census. On the other hand, NSB conducts the BLSS that estimate livestock production and landholding data. BLSS is a probability sample survey of households, thus, sampling errors and other statistical measures can be computed to evaluate the reliability of the results.

Sample surveys, in general, can provide good estimates at the domain level or at the level at which the sample sizes are determined while administrative reporting systems can provide estimates at much lower geographical levels. However, the reliability of the estimates cannot be ascertained for administrative reporting systems.

This study found that there were significant differences between the livestock and land ownership data from MoAF and the results of the three rounds of BLSS. Considering the MoAF data series only, there was huge decline in goat population between 1999 and 2000 (which dropped from about 102,000 in 1999 to only 11,005 in 2000); big increase in buffalo and Zo-Zom counts in Trashigang from only 165 in 2008 to 6,297 in 2013; and pig inventories dropping by almost 50% between 2004 and 2005, and between 2012 and 2013 that are difficult to explain without discarding the possibility of measurement and other types of errors. Similarly, the data series from the three rounds of BLSS were not completely consistent because of changes in the sampling design. In general, discrepancies within data series and between the MoAF and BLSS data arise due to factors like differences in coverage, definition, or method of collection including sampling design and errors committed in data collection and processing. While we cannot ascertain the true source of discrepancy, we were able to identify possible sources of the significant differences between MoAF and BLSS, and also across years of each of these two data sources. These discrepancies are discussed further below to give insights on how future compilation of agricultural statistics could be improved.

Coverage. One good example of differences in coverage is the data on the ownership of drylands. The estimate based on BLSS 2007 (67.2 thousand hectares) was considerably lower than the MoAF estimate (119.8 thousand hectares). This is because BLSS only covers land owned by households while the MoAF data includes privately- or community-owned lands, or those belonging to *rabdeys* and *lhakhangs*.

Definition. The change in definition across time was very apparent in the significant increase in buffalo counts between 2008 and 2013, in which the counts included Zo-Zoms, a hybrid male and female progeny of yak bull and cattle. Based on the report of DoL, there were no buffaloes raised in Trashigang *dzongkhag* in 2013 but there was a very significant increase in the number of Zo-Zoms from only 165 in 2008 to 6,297 in 2013. This illustrates the importance of having a clear definition of which livestock types are counted and included in a particular livestock category for consistency and comparability of data across years.

Data collection process. In gathering data for this study, we observed that MoAF data series could come from different sources within MoAF, causing in some cases differences in

coverage and definition. For example, the 2007 data on landholding derived from the cadastral database of the DSLR, as published on the Compendium of RNR Statistics 2008, refer to land owned by private or household owners, community-owned lands, or those belonging to *rabdeys* and *lhakhangs* while data for 2008 derived from RNR Census 2009 refer to household landholdings only. In the other years, data taken from RNR censuses and surveys and published on the *countrystat.org* website did not include notes on the coverage, that is, whether data presented refer to household ownership only or whether ownership by other groups or entities are included. Furthermore, estimates on land use in 2010 from the NSSC and MoAF were land cover assessment using satellite data. Within an agency that collects data, the data collection process usually remains the same over time to maintain consistency across time. To achieve this, only one unit in the agency is designated responsible for a particular data series.

Sampling design. The BLSS sampling design changed over time, not only in terms of sample sizes but also in terms of coverage. In 2003, Sarpang and Samdrup Jongkhar were not covered in BLSS 2003 due to security reasons. More importantly, however, since BLSS was not designed to estimate agriculture production at the *dzongkhag* level, the RSEs of agriculture production estimates were beyond the established tolerable level. The BLSS produced reliable statistics (with RSEs below 5%) only for cattle counts and for landholding of dry lands. The RSEs were even higher at lower geographical levels.

The technical documentations of the sampling designs or the corresponding microdata of MoAF surveys were not available as of this writing. There were also no published RSEs or MSEs of major characteristics from these surveys, hence, the reliability of the estimates cannot be evaluated.

Measurement errors. We found significant differences between MoAF and BLSS estimates of landholding for both the 2008/2007 and 2010/2012 comparisons in the East Central and Western regions for almost all land use types. Comparing 2010/2012 estimates, BLSS estimates in the Western region for dry lands were higher by 37.3% than the MoAF estimates; for wetlands by 19.0% and for orchards, BLSS estimates were lower by 29.3%. On the other hand, in the East Central region, BLSS estimates for wetlands were higher by 63.5% while estimates for orchards were higher by 41.5% during the same periods. Significant differences on estimates for wetland ownership also existed in Bumthang, Mongar, Trashigang, Ha, and Thimphu. In Bumthang, wetland ownership based on 2010 MoAF estimates covered only 25 hectares while based on BLSS results, total wetland owned in 2012 was 2,125 hectares, posting a very large difference. These substantial differences are indicative that measurement errors could have been committed in these *dzongkhag*.

For surveys, measurement errors may arise from the following: (1) interviewer's errors; (2) respondents that provide wrong information; (3) questions that have not been formulated properly; and (4) data processing errors. From administrative reporting system, measurement errors could come from the reporter or the persons responsible for summarizing data at specific level of the reporting hierarchy; and data processing. Measurement errors cannot be estimated from surveys and administrative reporting systems. To mitigate these, intensive training of interviewers, supervisors and data processors are done. Also, questionnaires are designed carefully and pretested to ensure that appropriate responses are elicited from

respondents. Moreover, rigorous vetting mechanisms (e.g. field supervision, data validation) are implemented.

In general, estimates from cattle, yak, and similar major livestock are more accurate and stable than minor livestock like goat and poultry. However, if there are problems with data on major livestock, the problem on minor livestock may be more severe. If these estimates are presented as official statistics, these should be supported or explained by actual events. In addition, actions should be taken to ensure that official statistics are readily available at MoAF and NSB websites and that statistics posted are updated regularly. Care must also be taken when posting official statistics on the Internet as well as on published documents, ensuring that computations made are correct and accurate. For example, two tables in the Bhutan RNR Statistics 2012 (Table 31: Local and Improved Cattle Population by *Dzongkhag* and Table 106: Livestock Population, 2011), which both presented data on cattle population by *dzongkhag* for 2011 do not tally specifically for two *dzongkhags*. The population of local cattle in Trashigang and the population of improved cattle in Zhemgang have different figures.

Inaccurate estimates of the staple food production and other relevant characteristics can lead to inappropriate policies and consequently, unfavorable outcomes, including the possibility of a worsening food security level. Timely and reliable data should be a strong cornerstone for crafting better and relevant policies that will uplift the development in the agriculture sector. In light of the findings of this study, we put forward the following recommendations.

To ensure reliable data trends, a set of uniform standards and definitions concerning agricultural statistics should be developed and implemented by all government agencies in Bhutan. These standards and definitions should be published in countrystat.org and other government websites and should be adopted in all the data collection forms and questionnaires. There should also be a unit that monitors the implementation of the standards and definitions.

Data collection processes, be it surveys or administrative reporting systems, should be properly documented so that they can be improved, if needed. The technical documentation will also support the data quality assessment that should be periodically conducted. With the help of the Partnership in Statistics for Development in the 21st century (Paris21) and ADB, MoAF conducted the workshop on Metadata Production and Microdata Archiving in 2014 in which participants used the International Household Survey Network (IHSN) Microdata Management Toolkit to document data collection processes for agricultural statistics. Some of the processes documented during the workshop were the Renewable Natural Resources Census 2000, Agriculture Survey 2011, Annual Livestock Census 2013, Water Resource Inventory 2014, Bhutan Trade Statistics 2013, National Health Survey 2000 and BLSS 2012. These documentations, if thoroughly prepared could be the starting point of experts that could help MoAF and NSB improve the quality of agricultural statistics.

Sample surveys that estimate agricultural production and relevant data items should be improved so that these could provide more reliable statistics at the *dzongkhag* level. One possibility would be to revise the BLSS sampling design and coverage to include crop area and production in the survey, which are currently not covered (although it is unclear whether this approach will succeed). Expanding the coverage of BLSS might also increase the risks of complicating the sampling design beyond the capability of MoAF and NSB. Further expansion

to include agricultural indicators in BLSS would also entail increasing the sample size and costs, and increasing the errors in the nonagricultural estimates. A second option would be to develop a separate agricultural sample survey in MoAF with the assistance from NSB and with external technical assistance—a survey focused to gather agricultural data and applied with statistical sampling techniques appropriate for agricultural sample surveys.

Appendix: Statistical Tables

Agriculture Data from the Bhutan Living Standards Survey (BLSS) and the Ministry of Agriculture and Forests (MoAF)

A. Livestock Statistics

Table A1: Number of Livestock Owned by Households in Bhutan (number of heads)

Livestock Type	Ministry of Agriculture and Forests (MoAF)														BLSS[1/]		
	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003	2007	2012
Cattle	250,539	320,509	250,032	230,963	247,896	287,951	312,063	319,899	308,224	307,013	309,277	306,190	304,076	303,150	433,500	400,213	329,551
Buffalo/Others[2/]		1,800*					1,683	1,551	1,468	955**	928**	851	740	6,988	2,591	1,914	745
Yak	37,363	34,906	31,748	33,380	44,079	52,837	52,911	51,500	39,609	38,690	40,374	43,144	38,011	39,543	61,093	66,823	39,031
Horse	30,470	27,888	28,525	17,058	20,011	22,608	24,928	26,303	22,301	23,245	23,423	23,344		22,692	44,603	39,201	27,831
Sheep	20,855	23,174	28,032	20,416	14,737	14,770	15,084	12,415	11,984	12,296	12,699	12,459		9,917	33,334	16,764	10,303
Goat	102,000	11,005	13,016	16,402	20,486	21,781	22,207	28,300	34,042	38,618	43,134	43,734	39,019	39,264	42,008	42,892	45,906
Pig	51,619	41,401	40,869	33,989	45,174	25,423	25,743	26,966	18,944	22,184	19,711	21,170	29,484	15,373	60,564	31,984	20,020
Poultry	294,978	230,727	212,130	109,085	166,073	179,323	182,776	200,629	198,130	248,118	349,004	434,576	549,733	551,185	280,344	280,015	457,673

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
2/ Data from MoAF for 2006 include buffaloes and others; for 2008 and 2013, include Zo-Zom and buffaloes.

Sources: For 1999-2005 and 2012: Livestock Statistics and RNR censuses, as published on the countrystat.org website; * for 2000: RNR Statistics 2000; for 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2009-2010: RNR Statistics 2012; ** for 2009-2010: RNR surveys and censuses, as published on the countrystat.org website; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A2: Percent Change in Livestock Owned by Households in Bhutan

Livestock Type	MoAF													MoAF		BLSS[1/]	
	1999-2000	2000-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2003-07	2007-12	2003-07	2007-12
Cattle	27.9	-22.0	-7.6	7.3	16.2	8.4	2.5	-3.6	-0.4	0.7	-1.0	-0.7	-0.3	38.5	-4.9	-7.7	-17.7
Buffalo/Others							-7.8	-5.4	-34.9	-2.8	-8.3	-13.0	844.3		-52.3	-26.1	-61.1
Yak	-6.6	-9.0	5.1	32.1	19.9	0.1	-2.7	-23.1	-2.3	4.4	6.9	-11.9	4.0	54.3	-26.2	9.4	-41.6
Horse	-8.5	2.3	-40.2	17.3	13.0	10.3	5.5	-15.2	4.2	0.8	-0.3			54.2		-12.1	-29.0
Sheep	11.1	21.0	-27.2	-27.8	0.2	2.1	-17.7	-3.5	2.6	3.3	-1.9			-39.2		-49.7	-38.5
Goat	-89.2	18.3	26.0	24.9	6.3	2.0	27.4	20.3	13.4	11.7	1.4	-10.8	0.6	72.5	37.9	2.1	7.0
Pig	-19.8	-1.3	-16.8	32.9	-43.7	1.3	4.8	-29.7	17.1	-11.1	7.4	39.3	-47.9	-20.7	9.3	-47.2	-37.4
Poultry	-21.8	-8.1	-48.6	52.2	8.0	1.9	9.8	-1.2	25.2	40.7	24.5	26.5	0.3	83.9	174.0	-0.1	63.4

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Table A3: Number of Cattle Owned by Households by *Dzongkhag*

Region/	MoAF							Percent change							BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2009	2010	2011	2013	2006-07	2007-08	2008-09	2009-10	2010-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**57,338**	**54,694**	**55,746**	**56,935**	**55,746**	**51,647**	**53,337**	**-4.6**	**1.9**	**2.1**	**-2.1**	**-7.4**	**3.3**	**-7.0**	**53,529**	**70,242**	**52,131**	**31.2**	**-25.8**
Bumthang	10,093	10,595	9,955	10,209	9,893	8,645	11,024	5.0	-6.0	2.6	-3.1	-12.6	27.5	9.2	14,696	15,175	9,988	3.3	-34.2
Sarpang	22,559	20,582	25,229	22,301	22,206	20,539	19,825	-8.8	22.6	-11.6	-0.4	-7.5	-3.5	-12.1	1,023	29,974	23,533	2829.1	-21.5
Trongsa	11,584	9,848	10,008	12,699	11,238	10,351	11,095	-15.0	1.6	26.9	-11.5	-7.9	7.2	-4.2	23,179	12,981	9,166	-44.0	-29.4
Zhemgang	13,102	13,669	10,554	11,726	12,409	12,112	11,393	4.3	-22.8	11.1	5.8	-2.4	-5.9	-13.0	14,631	12,112	9,443	-17.2	-22.0
Eastern	**105,282**	**111,320**	**97,255**	**100,708**	**98,205**	**101,158**	**103,099**	**5.7**	**-12.6**	**3.6**	**-2.5**	**3.0**	**1.9**	**-2.1**	**160,459**	**127,616**	**103,740**	**-20.5**	**-18.7**
Lhuentse	14,057	13,676	12,261	13,180	12,172	13,120	14,146	-2.7	-10.3	7.5	-7.6	7.8	7.8	0.6	27,460	14,426	10,729	-47.5	-25.6
Mongar	28,159	31,002	25,648	26,640	24,199	24,555	25,341	10.1	-17.3	3.9	-9.2	1.5	3.2	-10.0	32,900	31,013	25,362	-5.7	-18.2
Pemagatshel	7,979	9,339	9,056	7,376	8,837	8,660	7,829	17.0	-3.0	-18.6	19.8	-2.0	-9.6	-1.9	16,379	12,768	11,245	-22.0	-11.9
S/Jongkhar	17,871	17,132	17,097	18,032	15,921	17,509	18,304	-4.1	-0.2	5.5	-11.7	10.0	4.5	2.4	148	20,184	16,273	13501.3	-19.4
Trashigang	25,689	28,530	22,757	26,494	26,572	25,607	27,000	11.1	-20.2	16.4	0.3	-3.6	5.4	5.1	59,646	35,681	29,403	-40.2	-17.6
Trashiyangtse	11,527	11,641	10,436	8,986	10,504	11,707	10,479	1.0	-10.4	-13.9	16.9	11.5	-10.5	-9.1	23,926	13,544	10,728	-43.4	-20.8
West Central	**53,751**	**56,444**	**69,917**	**61,662**	**66,613**	**64,914**	**64,940**	**5.0**	**23.9**	**-11.8**	**8.0**	**-2.6**	**0.0**	**20.8**	**93,078**	**87,130**	**77,758**	**-6.4**	**-10.8**
Dagana	11,515	14,966	19,735	16,931	19,734	19,255	16,622	30.0	31.9	-14.2	16.6	-2.4	-13.7	44.4	21,570	16,738	16,612	-22.4	-0.8
Gasa	601	541	985	895	855	1,241	805	-10.0	82.1	-9.1	-4.5	45.1	-35.1	33.9	2,247	2,668	2,549	18.7	-4.5
Punakha	9,504	9,372	12,070	10,364	11,582	11,426	11,044	-1.4	28.8	-14.1	11.8	-1.3	-3.3	16.2	9,797	17,044	15,118	74.0	-11.3
Tsirang	13,507	11,727	13,657	13,066	13,187	11,842	10,914	-13.2	16.5	-4.3	0.9	-10.2	-7.8	-19.2	24,288	15,485	14,882	-36.2	-3.9
Wangdue	18,624	19,838	23,470	20,406	21,255	21,150	25,555	6.5	18.3	-13.1	4.2	-0.5	20.8	37.2	35,175	35,195	28,597	0.1	-18.7
Western	**95,692**	**97,441**	**85,306**	**87,708**	**88,713**	**88,471**	**81,774**	**1.8**	**-12.5**	**2.8**	**1.1**	**-0.3**	**-7.6**	**-14.5**	**126,431**	**115,224**	**95,922**	**-8.9**	**-16.8**
Chhukha	28,017	31,355	23,253	22,312	23,029	24,959	21,663	11.9	-25.8	-4.0	3.2	8.4	-13.2	-22.7	29,054	33,465	32,183	15.2	-3.8
Ha	10,368	9,207	7,728	8,194	8,749	9,087	9,703	-11.2	-16.1	6.0	6.8	3.9	6.8	-6.4	7,147	8,489	10,519	18.8	23.9
Paro	16,837	15,066	13,886	14,799	14,418	15,602	13,059	-10.5	-7.8	6.6	-2.6	8.2	-16.3	-22.4	25,195	27,199	12,213	8.0	-55.1
Samtse	34,199	35,783	36,686	37,801	38,221	35,717	33,436	4.6	2.5	3.0	1.1	-6.6	-6.4	-2.2	48,169	38,849	36,839	-19.3	-5.2
Thimphu	6,271	6,030	3,753	4,602	4,296	3,106	3,913	-3.8	-37.8	22.6	-6.6	-27.7	26.0	-37.6	16,866	7,222	4,168	-57.2	-42.3
Bhutan	**312,063**	**319,899**	**308,224**	**307,013**	**309,277**	**306,190**	**303,150**	**2.5**	**-3.6**	**-0.4**	**0.7**	**-1.0**	**-1.0**	**-2.9**	**433,500**	**400,213**	**329,551**	**-7.7**	**-17.7**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2009 and 2010: RNR Statistics 2012; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A4: Number of Buffalo Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**625**	**388**	**208**	**109**	**89**	**-37.9**	**-46.4**	**-47.6**	**-18.3**	**-85.8**	**337**	**227**	**18**	**-32.9**	**-92.2**
Bumthang	424	151	41	0	0	-64.4	-72.8				0	0	0		
Sarpang	201	237	167	109	89	17.9	-29.5	-34.7	-18.3	-55.7	0	227	18		-92.2
Trongsa	0	0	0	0	0						219	0	0		
Zhemgang	0	0	0	0	0						118	0	0		
Eastern	**239**	**248**	**320**	**15**	**6,307**	**3.8**	**29.0**	**-95.3**	**41946.7**	**2538.9**	**66**	**282**	**0**	**329.1**	
Lhuentse	0	0	17	0	0						0	0	0		
Mongar	0	0	0	0	0						0	0	0		
Pemagatshel	0	0	0	0	0						0	282	0		
S/Jongkhar	42	45	26	15	10	7.1	-42.2	-42.3	-33.3	-76.2	0	0	0		
Trashigang	0	0	165	0	6,297						66	0	0		
Trashiyangtse	197	203	112	0	0	3.0	-44.8			-100.0	0	0	0		
West Central	**217**	**214**	**320**	**340**	**254**	**-1.4**	**49.5**	**6.3**	**-25.3**	**17.1**	**814**	**455**	**467**	**-44.1**	**2.6**
Dagana	50	30	80	119	101	-40.0	166.7	48.8	-15.1	102.0	290	241	20	-16.9	-91.8
Gasa	0	0	0	0	0						0	0	0		
Punakha	0	0	0	0	0						0	0	0		
Tsirang	167	184	236	221	153	10.2	28.3	-6.4	-30.8	-8.4	462	214	447	-53.6	108.7
Wangdue	0	0	4	0	0						62	0	0		
Western	**602**	**701**	**620**	**387**	**338**	**16.4**	**-11.6**	**-37.6**	**-12.7**	**-43.9**	**1,374**	**950**	**260**	**-30.9**	**-72.6**
Chhukha	53	59	0	6	6	11.3	-100.0		0.0	-88.7	158	521	0	228.8	
Ha	0	0	55	0	0						0	0	0		
Paro	0	0	21	0	0						109	0	0		
Samtse	549	642	427	381	332	16.9	-33.5	-10.8	-12.9	-39.5	1,107	429	260	-61.2	-39.3
Thimphu	0	0	117	0	0						0	0	0		
Bhutan	**1,683**	**1,551**	**1,468**	**851**	**6,988**	**-7.8**	**-5.4**	**-42.0**	**721.2**	**315.2**	**2,591**	**1,914**	**745**	**-26.1**	**-61.1**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006, includes buffaloes and others; for 2007: Livestock Statistics 2007, includes buffaloes only; for 2008: RNR Census 2009, includes Zo-Zom and buffaloes; for 2011: Livestock Census 2011, as published in RNR Statistics 2012, includes buffaloes only; and for 2013: Livestock Statistics 2013, includes Zo-Zom and buffaloes, MoAF; and BLSS 2003, 2007, and 2012.

Table A5: Number of Yak Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**3,487**	**3,490**	**3,335**	**3,574**	**3,054**	**0.1**	**-4.4**	**7.2**	**-14.5**	**-12.4**	**4,702**	**1,214**	**1,811**	**-74.2**	**49.2**
Bumthang	3,487	3,418	3,197	3,501	2,974	-2.0	-6.5	9.5	-15.1	-14.7	4,702	1,214	1,811	-74.2	49.2
Sarpang	0	0	0	0							0	0	0		
Trongsa	0	72	138	73	80		91.7	-47.1	9.6		0	0	0		
Zhemgang	0	0	0	0							0	0	0		
Eastern	**12,914**	**12,671**	**9,421**	**9,581**	**7,956**	**-1.9**	**-25.6**	**1.7**	**-17.0**	**-38.4**	**15,530**	**10,094**	**11,025**	**-35.0**	**9.2**
Lhuentse	456	456	241	216	234	0.0	-47.1	-10.4	8.3	-48.7	0	73	0		
Mongar	0	0	0	0							423	0	97		
Pemagatshel	0	0	0	0							0	0	0		
S/Jongkhar	0	0	0	50	28				-44.0		0	0	0		
Trashigang	11,863	11,813	8,780	8,724	7,153	-0.4	-25.7	-0.6	-18.0	-39.7	15,107	10,021	10,848	-33.7	8.3
Trashiyangtse	595	402	400	591	541	-32.4	-0.5	47.8	-8.5	-9.1	0	0	79		
West Central	**14,522**	**14,989**	**8,447**	**10,855**	**9,060**	**3.2**	**-43.6**	**28.5**	**-16.5**	**-37.6**	**1,771**	**11,113**	**14,388**	**527.6**	**29.5**
Dagana	0	0	0	0							0	76	0		
Gasa	11,910	12,076	5,694	7,640	5,787	1.4	-52.8	34.2	-24.3	-51.4	0	4,006	10,599		164.6
Punakha	0	0	0	0							0	25	0		
Tsirang	0	0	0	0							0	0	0		
Wangdue	2,612	2,913	2,753	3,215	3,273	11.5	-5.5	16.8	1.8	25.3	1,771	7,006	3,789	295.6	-45.9
Western	**21,988**	**20,350**	**18,406**	**19,134**	**19,473**	**-7.4**	**-9.6**	**4.0**	**1.8**	**-11.4**	**39,090**	**44,402**	**11,807**	**13.6**	**-73.4**
Chhukha	0	0	0	0							0	2,628	25		-99.0
Ha	7,520	4,874	4,652	4,763	5,857	-35.2	-4.6	2.4	23.0	-22.1	10,598	6,670	3,341	-37.1	-49.9
Paro	4,823	5,388	3,773	3,217	2,632	11.7	-30.0	-14.7	-18.2	-45.4	3,065	14,702	1,175	379.7	-92.0
Samtse	0	0	0	0							0	0	0		
Thimphu	9,645	10,088	9,981	11,154	10,984	4.6	-1.1	11.8	-1.5	13.9	25,427	20,402	7,266	-19.8	-64.4
Bhutan	**52,911**	**51,500**	**39,609**	**43,144**	**39,543**	**-2.7**	**-23.1**	**8.9**	**-8.3**	**-25.3**	**61,093**	**66,823**	**39,031**	**9.4**	**-41.6**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A6: Number of Horse Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**3,823**	**4,089**	**3,657**	**3,793**	**3,710**	**7.0**	**-10.6**	**3.7**	**-2.2**	**-3.0**	**4,569**	**5,756**	**4,044**	**26.0**	**-29.7**
Bumthang	1,398	1,420	1,237	1,130	1,213	1.6	-12.9	-8.6	7.3	-13.2	2,156	2,404	1,326	11.5	-44.8
Sarpang	344	308	358	492	573	-10.5	16.2	37.4	16.5	66.6	0	425	519		22.2
Trongsa	389	486	308	428	428	24.9	-36.6	39.0	0.0	10.0	565	549	350	-2.9	-36.2
Zhemgang	1,692	1,875	1,754	1,743	1,496	10.8	-6.5	-0.6	-14.2	-11.6	1,847	2,379	1,849	28.8	-22.3
Eastern	**12,730**	**13,036**	**10,783**	**10,924**	**10,773**	**2.4**	**-17.3**	**1.3**	**-1.4**	**-15.4**	**24,753**	**17,581**	**13,757**	**-29.0**	**-21.8**
Lhuentse	1,968	1,864	1,426	1,551	1,725	-5.3	-23.5	8.8	11.2	-12.3	3,397	2,568	1,587	-24.4	-38.2
Mongar	3,121	2,617	2,449	2,006	1,706	-16.1	-6.4	-18.1	-15.0	-45.3	6,474	3,134	2,559	-51.6	-18.4
Pemagatshel	775	963	1,377	1,469	1,048	24.3	43.0	6.7	-28.7	35.2	1,442	2,194	1,741	52.2	-20.7
S/Jongkhar	1,630	1,665	1,268	1,372	1,307	2.1	-23.8	8.2	-4.7	-19.8	0	2,397	1,752		-26.9
Trashigang	3,399	4,296	2,927	3,331	3,687	26.4	-31.9	13.8	10.7	8.5	9,232	5,036	4,252	-45.4	-15.6
Trashiyangtse	1,837	1,631	1,336	1,195	1,300	-11.2	-18.1	-10.6	8.8	-29.2	4,209	2,252	1,866	-46.5	-17.1
West Central	**3,689**	**4,067**	**3,441**	**3,803**	**3,264**	**10.2**	**-15.4**	**10.5**	**-14.2**	**-11.5**	**6,355**	**6,224**	**4,789**	**-2.0**	**-23.1**
Dagana	253	439	445	327	283	73.5	1.4	-26.5	-13.5	11.9	377	380	369	1.0	-3.1
Gasa	1,269	1,251	994	1,608	1,515	-1.4	-20.5	61.8	-5.8	19.4	1,695	1,566	2,171	-7.6	38.7
Punakha	667	685	616	607	486	2.7	-10.1	-1.5	-19.9	-27.1	1,151	1,118	746	-2.8	-33.3
Tsirang	199	213	243	230	108	7.0	14.1	-5.3	-53.0	-45.7	504	441	76	-12.4	-82.8
Wangdue	1,301	1,479	1,143	1,031	872	13.7	-22.7	-9.8	-15.4	-33.0	2,629	2,719	1,427	3.4	-47.5
Western	**4,686**	**5,111**	**4,420**	**4,824**	**4,945**	**9.1**	**-13.5**	**9.1**	**2.5**	**5.5**	**8,927**	**9,639**	**5,241**	**8.0**	**-45.6**
Chhukha	553	592	460	503	592	7.1	-22.3	9.3	17.7	7.1	1,051	1,414	743	34.6	-47.5
Ha	1,400	1,390	922	1,170	1,289	-0.7	-33.7	26.9	10.2	-7.9	1,106	1,228	1,099	11.0	-10.5
Paro	1,334	1,596	1,548	1,394	1,293	19.6	-3.0	-9.9	-7.2	-3.1	1,748	4,152	1,206	137.5	-71.0
Samtse	182	209	433	528	468	14.8	107.2	21.9	-11.4	157.1	419	349	808	-16.8	131.7
Thimphu	1,217	1,324	1,057	1,229	1,303	8.8	-20.2	16.3	6.0	7.1	4,603	2,496	1,386	-45.8	-44.5
Bhutan	**24,928**	**26,303**	**22,301**	**23,344**	**22,692**	**5.5**	**-15.2**	**4.7**	**-2.8**	**-9.0**	**44,603**	**39,201**	**27,831**	**-12.1**	**-29.0**

Notes: Data from the MoAF includes mules and donkeys.
1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A7: Number of Sheep Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**2,833**	**2,210**	**1,851**	**1,315**	**1,164**	**-22.0**	**-16.2**	**-29.0**	**-11.5**	**-58.9**	**5,501**	**3,120**	**473**	**-43.3**	**-84.8**
Bumthang	1,197	821	467	480	268	-31.4	-43.1	2.8	-44.2	-77.6	1,567	643	0	-59.0	
Sarpang	1,471	600	954	582	562	-59.2	59.0	-39.0	-3.4	-61.8	66	1,147	373	1639.4	-67.5
Trongsa	165	781	430	245	328	373.3	-44.9	-43.0	33.9	98.8	3,868	1,330	100	-65.6	-92.5
Zhemgang	0	8	0	8	6				-25.0		0	0	0		
Eastern	**5,223**	**3,178**	**1,743**	**2,478**	**2,243**	**-39.2**	**-45.2**	**42.2**	**-9.5**	**-57.1**	**7,117**	**2,919**	**3,506**	**-59.0**	**20.1**
Lhuentse	151	151	63	99	101	0.0	-58.3	57.1	2.0	-33.1	828	0	18		
Mongar	55	62	40	11	23	12.7	-35.5	-72.5	109.1	-58.2	0	194	0		
Pemagatshel	1	4	3	0	1	300.0	-25.0			0.0	0	0	0		
S/Jongkhar	37	52	70	82	23	40.5	34.6	17.1	-72.0	-37.8	0	0	72		
Trashigang	4,942	2,866	1,528	2,262	2,078	-42.0	-46.7	48.0	-8.1	-58.0	6,213	2,700	3,340	-56.5	23.7
Trashiyangtse	37	43	39	24	17	16.2	-9.3	-38.5	-29.2	-54.1	76	25	75	-67.2	203.4
West Central	**3,042**	**3,088**	**3,694**	**3,817**	**2,349**	**1.5**	**19.6**	**3.3**	**-38.5**	**-22.8**	**11,351**	**4,505**	**2,154**	**-60.3**	**-52.2**
Dagana	351	491	540	441	374	39.9	10.0	-18.3	-15.2	6.6	1,222	735	39	-39.8	-94.7
Gasa	186	194	4	43	2	4.3	-97.9	975.0	-95.3	-98.9	0	0	0		
Punakha	0		8	2	15			-75.0	650.0		0	0	0		
Tsirang	973	723	749	422	161	-25.7	3.6	-43.7	-61.8	-83.5	2,296	567	358	-75.3	-36.9
Wangdue	1,532	1,680	2,393	2,909	1,797	9.7	42.4	21.6	-38.2	17.3	7,833	3,202	1,757	-59.1	-45.1
Western	**3,986**	**3,939**	**4,696**	**4,849**	**4,161**	**-1.2**	**19.2**	**3.3**	**-14.2**	**4.4**	**9,365**	**6,220**	**4,170**	**-33.6**	**-33.0**
Chhukha	1,367	1,327	1,091	833	556	-2.9	-17.8	-23.6	-33.3	-59.3	1,718	1,315	1,078	-23.5	-18.0
Ha	1	1	20	0	1	0.0	1900.0			0.0	0	0	36		
Paro	0		27	10	12			-63.0	20.0		0	0	0		
Samtse	2,613	2,582	3,556	3,999	3,583	-1.2	37.7	12.5	-10.4	37.1	7,628	4,854	3,056	-36.4	-37.0
Thimphu	5	29	2	7	9	480.0	-93.1	250.0	28.6	80.0	19	50	0	167.8	
Bhutan	**15,084**	**12,415**	**11,984**	**12,459**	**9,917**	**-17.7**	**-3.5**	**4.0**	**-20.4**	**-34.3**	**33,334**	**16,764**	**10,303**	**-49.7**	**-38.5**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A8: Number of Goat Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**2,509**	**3,408**	**3,973**	**5,019**	**4,026**	**35.8**	**16.6**	**26.3**	**-19.8**	**60.5**	**689**	**7,072**	**5,537**	**925.7**	**-21.7**
Bumthang	0	46	5	3	36		-89.1	-40.0	1100.0		0	0	0		
Sarpang	2,309	3,046	3,920	4,948	3,905	31.9	28.7	26.2	-21.1	69.1	244	6,646	5,282	2625.6	-20.5
Trongsa	0	26	2	5	8		-92.3	150.0	60.0		292	235	168	-19.6	-28.3
Zhemgang	200	290	46	63	77	45.0	-84.1	37.0	22.2	-61.5	154	191	86	24.6	-54.9
Eastern	**1,119**	**1,198**	**1,424**	**2,890**	**2,061**	**7.1**	**18.9**	**102.9**	**-28.7**	**84.2**	**1,403**	**1,588**	**713**	**13.2**	**-55.1**
Lhuentse	33	24	18	80	76	-27.3	-25.0	344.4	-5.0	130.3	0	0	37		
Mongar	313	313	153	1,034	88	0.0	-51.1	575.8	-91.5	-71.9	308	285	34	-7.6	-88.2
Pemagatshel	83	114	37	34	21	37.3	-67.5	-8.1	-38.2	-74.7	886	192	21	-78.3	-89.2
S/Jongkhar	390	445	942	1,447	1,579	14.1	111.7	53.6	9.1	304.9	12	816	494	6769.6	-39.5
Trashigang	125	129	192	187	189	3.2	48.8	-2.6	1.1	51.2	197	195	59	-1.3	-69.8
Trashiyangtse	175	173	82	108	108	-1.1	-52.6	31.7	0.0	-38.3	0	100	69		-30.7
West Central	**8,770**	**9,278**	**10,860**	**13,914**	**12,205**	**5.8**	**17.1**	**28.1**	**-12.3**	**39.2**	**14,411**	**12,025**	**14,730**	**-16.6**	**22.5**
Dagana	2,715	3,964	5,036	5,761	5,821	46.0	27.0	14.4	1.0	114.4	5,234	5,005	5,564	-4.4	11.2
Gasa	25		4	2				-50.0	-100.0	-100.0	0	0	0		
Punakha	15	37	76	199	115	146.7	105.4	161.8	-42.2	666.7	0	89	165		85.2
Tsirang	5,668	4,936	5,588	5,719	5,839	-12.9	13.2	2.3	2.1	3.0	8,926	6,645	8,890	-25.6	33.8
Wangdue	347	341	156	2,233	430	-1.7	-54.3	1331.4	-80.7	23.9	250	286	111	14.1	-61.3
Western	**9,809**	**14,416**	**17,785**	**21,911**	**20,972**	**47.0**	**23.4**	**23.2**	**-4.3**	**113.8**	**25,504**	**22,207**	**24,926**	**-12.9**	**12.2**
Chhukha	4,678	8,637	5,330	6,378	6,279	84.6	-38.3	19.7	-1.6	34.2	8,124	7,374	7,173	-9.2	-2.7
Ha	9	109	72	167	42	1111.1	-33.9	131.9	-74.9	366.7	27	88	0	227.5	-100.0
Paro	57	179	111	181	118	214.0	-38.0	63.1	-34.8	107.0	75	101	0	35.2	-100.0
Samtse	5,026	5,445	12,266	15,163	14,492	8.3	125.3	23.6	-4.4	188.3	17,260	14,541	17,657	-15.8	21.4
Thimphu	39	46	6	22	41	17.9	-87.0	266.7	86.4	5.1	19	103	95	448.6	-7.2
Bhutan	**22,207**	**28,300**	**34,042**	**43,734**	**39,264**	**27.4**	**20.3**	**28.5**	**-10.2**	**76.8**	**42,008**	**42,892**	**45,906**	**2.1**	**7.0**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A9: Number of Pig Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**2,997**	**3,394**	**2,198**	**2,555**	**2,511**	**13.2**	**-35.2**	**16.2**	**-1.7**	**-16.2**	**1,807**	**4,735**	**2,010**	**162.1**	**-57.6**
Bumthang	0	4	0	0	1						34	85	70	146.9	-17.3
Sarpang	1,148	1,794	1,264	1,502	1,585	56.3	-29.5	18.8	5.5	38.1	88	2,813	893	3114.3	-68.3
Trongsa	252	490	70	59	33	94.4	-85.7	-15.7	-44.1	-86.9	371	552	80	48.9	-85.5
Zhemgang	1,597	1,106	864	994	892	-30.7	-21.9	15.0	-10.3	-44.1	1,314	1,285	967	-2.2	-24.8
Eastern	**9,291**	**7,763**	**4,432**	**7,151**	**3,493**	**-16.4**	**-42.9**	**61.3**	**-51.2**	**-62.4**	**27,744**	**8,820**	**4,357**	**-68.2**	**-50.6**
Lhuentse	968	792	229	227	216	-18.2	-71.1	-0.9	-4.8	-77.7	2,085	660	294	-68.3	-55.4
Mongar	2,524	2,161	1,231	2,275	1,021	-14.4	-43.0	84.8	-55.1	-59.5	9,236	2,098	846	-77.3	-59.7
Pemagatshel	981	1,002	678	708	625	2.1	-32.3	4.4	-11.7	-36.3	2,302	1,694	575	-26.4	-66.1
S/Jongkhar	805	880	565	534	523	9.3	-35.8	-5.5	-2.1	-35.0	0	1,089	1,024		-6.0
Trashigang	2,581	1,700	1,019	2,862	660	-34.1	-40.1	180.9	-76.9	-74.4	11,400	1,960	1,008	-82.8	-48.6
Trashiyangtse	1,432	1,228	710	545	448	-14.2	-42.2	-23.2	-17.8	-68.7	2,721	1,320	610	-51.5	-53.8
West Central	**6,440**	**6,466**	**6,349**	**5,175**	**4,229**	**0.4**	**-1.8**	**-18.5**	**-18.3**	**-34.3**	**16,732**	**8,537**	**6,056**	**-49.0**	**-29.1**
Dagana	1,430	1,889	2,557	1,918	1,775	32.1	35.4	-25.0	-7.5	24.1	3,912	2,716	1,882	-30.6	-30.7
Gasa	52	45	23	0	0	-13.5	-48.9				79	9	0	-88.2	-100.0
Punakha	1,549	1,238	892	755	378	-20.1	-27.9	-15.4	-49.9	-75.6	3,460	1,616	984	-53.3	-39.1
Tsirang	1,593	1,382	1,530	1,067	970	-13.2	10.7	-30.3	-9.1	-39.1	2,048	1,790	1,399	-12.6	-21.9
Wangdue	1,816	1,912	1,347	1,435	1,106	5.3	-29.6	6.5	-22.9	-39.1	7,232	2,405	1,791	-66.7	-25.5
Western	**7,015**	**9,343**	**5,965**	**6,289**	**5,140**	**33.2**	**-36.2**	**5.4**	**-18.3**	**-26.7**	**14,281**	**9,892**	**7,598**	**-30.7**	**-23.2**
Chhukha	3,112	4,568	2,598	2,035	1,774	46.8	-43.1	-21.7	-12.8	-43.0	4,095	4,092	2,796	-0.1	-31.7
Ha	559	805	605	439	311	44.0	-24.8	-27.4	-29.2	-44.4	487	576	256	18.4	-55.7
Paro	1,558	1,418	822	795	510	-9.0	-42.0	-3.3	-35.8	-67.3	4,351	2,183	540	-49.8	-75.3
Samtse	1,266	1,481	1,840	2,795	2,133	17.0	24.2	51.9	-23.7	68.5	3,055	2,342	3,737	-23.3	59.6
Thimphu	520	1,071	100	225	412	106.0	-90.7	125.0	83.1	-20.8	2,294	698	269	-69.6	-61.5
Bhutan	**25,743**	**26,966**	**18,944**	**21,170**	**15,373**	**4.8**	**-29.7**	**11.8**	**-27.4**	**-40.3**	**60,564**	**31,984**	**20,020**	**-47.2**	**-37.4**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.

Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A10: Number of Poultry Owned by Households by *Dzongkhag*

Region/	MoAF					Percent change					BLSS[1/]			Percent change	
Dzongkhag	2006	2007	2008	2011	2013	2006-07	2007-08	2008-11	2011-13	2006-13	2003	2007	2012	2003-07	2007-12
East Central	**36,436**	**39,140**	**36,914**	**96,456**	**170,288**	**7.4**	**-5.7**	**161.3**	**76.5**	**367.4**	**14,807**	**57,903**	**105,081**	**291.0**	**81.5**
Bumthang	1,361	702	534	849	995	-48.4	-23.9	59.0	17.2	-26.9	2,670	1,597	578	-40.2	-63.8
Sarpang	24,967	27,041	28,306	84,146	151,691	8.3	4.7	197.3	80.3	507.6	1,209	42,343	86,724	3403.6	104.8
Trongsa	2,438	3,585	2,000	2,613	5,463	47.0	-44.2	30.7	109.1	124.1	4,186	3,284	8,450	-21.5	157.3
Zhemgang	7,670	7,812	6,074	8,848	12,139	1.9	-22.2	45.7	37.2	58.3	6,743	10,678	9,329	58.4	-12.6
Eastern	**54,260**	**54,164**	**46,842**	**106,382**	**102,871**	**-0.2**	**-13.5**	**127.1**	**-3.3**	**89.6**	**92,077**	**63,762**	**114,071**	**-30.8**	**78.9**
Lhuentse	7,382	7,010	5,654	8,388	13,666	-5.0	-19.3	48.4	62.9	85.1	11,210	8,439	12,425	-24.7	47.2
Mongar	17,367	18,609	14,530	39,058	28,248	7.2	-21.9	168.8	-27.7	62.7	22,902	20,214	24,790	-11.7	22.6
Pemagatshel	4,999	5,374	4,968	15,150	12,449	7.5	-7.6	205.0	-17.8	149.0	16,911	7,418	43,370	-56.1	484.7
S/Jongkhar	7,756	8,341	9,849	12,458	15,645	7.5	18.1	26.5	25.6	101.7	17	11,260	8,754	65729.0	-22.3
Trashigang	14,648	11,802	10,444	18,715	24,211	-19.4	-11.5	79.2	29.4	65.3	33,144	13,677	19,295	-58.7	41.1
Trashiyangtse	2,108	3,028	1,397	12,613	8,652	43.6	-53.9	802.9	-31.4	310.4	7,892	2,754	5,437	-65.1	97.5
West Central	**38,953**	**42,319**	**51,132**	**119,796**	**123,903**	**8.6**	**20.8**	**134.3**	**3.4**	**218.1**	**85,396**	**61,597**	**128,466**	**-27.9**	**108.6**
Dagana	11,025	17,863	18,295	33,325	19,897	62.0	2.4	82.2	-40.3	80.5	27,643	18,685	22,300	-32.4	19.3
Gasa	860	747	339	1,149	786	-13.1	-54.6	238.9	-31.6	-8.6	1,560	768	349	-50.8	-54.6
Punakha	4,364	3,630	4,291	8,531	6,710	-16.8	18.2	98.8	-21.3	53.8	6,164	6,745	9,087	9.4	34.7
Tsirang	18,186	15,195	23,225	69,378	88,999	-16.4	52.8	198.7	28.3	389.4	36,380	27,702	85,650	-23.9	209.2
Wangdue	4,518	4,884	4,982	7,413	7,511	8.1	2.0	48.8	1.3	66.2	13,649	7,696	11,080	-43.6	44.0
Western	**53,127**	**65,006**	**63,242**	**111,942**	**154,123**	**22.4**	**-2.7**	**77.0**	**37.7**	**190.1**	**88,064**	**96,754**	**110,057**	**9.9**	**13.7**
Chhukha	13,602	14,641	18,471	23,721	35,650	7.6	26.2	28.4	50.3	162.1	25,663	27,958	26,913	8.9	-3.7
Ha	3,076	3,239	2,611	5,951	6,065	5.3	-19.4	127.9	1.9	97.2	3,646	3,646	2,924	0.0	-19.8
Paro	4,005	13,892	5,217	25,936	24,669	246.9	-62.4	397.1	-4.9	516.0	6,887	9,705	25,197	40.9	159.6
Samtse	29,642	30,137	35,925	46,129	59,091	1.7	19.2	28.4	28.1	99.3	46,659	50,974	50,992	9.2	0.0
Thimphu	2,802	3,097	1,018	10,205	28,648	10.5	-67.1	902.5	180.7	922.4	5,209	4,471	4,031	-14.2	-9.8
Bhutan	**182,776**	**200,629**	**198,130**	**434,576**	**551,185**	**9.8**	**-1.2**	**119.3**	**26.8**	**201.6**	**280,344**	**280,015**	**457,673**	**-0.1**	**63.4**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Sources: For 2006: Livestock Statistics 2006; for 2007: Livestock Statistics 2007; for 2008: RNR Census 2009; for 2011: Livestock Census 2011, as published in RNR Statistics 2012; and for 2013: Livestock Statistics 2013, MoAF; and BLSS 2003, 2007, and 2012.

Table A11: Statistics on the Total Number of Livestock Owned by Households by Livestock Type[1/]

Statistics	Year	Livestock Type							
		Cattle	Buffalo	Yak	Horse	Sheep	Goat	Pig	Poultry
Total Number of Livestock	2003	433,500	2,591	61,093	44,603	33,334	42,008	60,564	280,344
	2007	400,213	1,914	66,823	39,201	16,764	42,892	31,984	280,015
	2012	329,551	745	39,031	27,831	10,303	45,906	20,020	457,673
Standard Error (Total)	2003	22,469	801	30,365	6,106	9,696	7,239	5,771	19,960
	2007	10,644	526	16,956	2,706	2,844	3,194	1,824	15,863
	2012	12,363	265	11,320	2,779	2,983	4,070	1,781	59,139
Coefficient of Variation/Relative Standard Error (Total), %	2003	5.2	30.9	49.7	13.7	29.1	17.2	9.5	7.1
	2007	2.7	27.5	25.4	6.9	17.0	7.4	5.7	5.7
	2012	3.8	35.6	29.0	10.0	29.0	8.9	8.9	12.9
Variance (Total)	2003	504,855,961	641,590	922,033,225	37,282,051	94,014,656	52,405,008	33,308,941	398,401,600
	2007	113,294,736	276,571	287,505,936	7,322,372	8,089,519	10,202,913	3,328,136	251,634,769
	2012	152,843,769	70,223	128,142,400	7,722,450	8,900,151	16,561,877	3,170,760	3,497,421,321
Standard Error of the Difference	2003-2007	24,863	958	34,778	6,679	10,105	7,913	6,053	25,496
	2007-2012	16,314	589	20,387	3,879	4,122	5,173	2,549	61,230
Margin of Error of the Difference	2003-2007	48,731	1,878	68,166	13,090	19,805	15,509	11,864	49,972
	2007-2012	31,975	1,154	39,959	7,602	8,079	10,140	4,997	120,010
Absolute Difference (Total)	2003-2007	33,287	677	5,730	5,402	16,570	884	28,580	329
	2007-2012	70,662	1,169	27,792	11,370	6,461	3,014	11,964	177,658

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A12.: Statistics on the Total Number of Cattle Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	14,696	15,175	9,988	8,349	4,582	3,215	56.8	30.2	32.2	9,524	5,597	18,667	10,971	479	5,187
Sarpang	1,023	29,974	23,533	353	5,208	4,667	34.5	17.4	19.8	5,220	6,993	10,231	13,706	28,951	6,441
Trongsa	23,179	12,981	9,166	11,904	3,324	2,730	51.4	25.6	29.8	12,359	4,301	24,224	8,431	10,198	3,815
Zhemgang	14,631	12,112	9,443	8,585	2,741	2,565	58.7	22.6	27.2	9,012	3,754	17,664	7,358	2,519	2,669
Eastern Region															
Lhuentse	27,460	14,426	10,729	19,728	3,236	2,852	71.8	22.4	26.6	19,992	4,314	39,184	8,455	13,034	3,697
Mongar	32,900	31,013	25,362	12,369	5,038	4,569	37.6	16.2	18.0	13,356	6,801	26,177	13,330	1,887	5,651
Pemagatshel	16,379	12,768	11,245	9,419	2,304	2,454	57.5	18.0	21.8	9,697	3,366	19,005	6,597	3,611	1,523
S/Jongkhar	148	20,184	16,273	98	3,529	3,491	66.2	17.5	21.5	3,530	4,964	6,919	9,729	20,036	3,911
Trashigang	59,646	35,681	29,403	18,785	5,295	5,141	31.5	14.8	17.5	19,517	7,381	38,253	14,466	23,965	6,278
Trashiyangtse	23,926	13,544	10,728	12,879	2,921	2,756	53.8	21.6	25.7	13,206	4,016	25,884	7,872	10,382	2,816
West Central Region															
Dagana	21,570	16,738	16,612	8,660	3,488	3,539	40.1	20.8	21.3	9,336	4,969	18,299	9,738	4,832	126
Gasa	2,247	2,668	2,549	2,247	833	2,195		31.2	86.1	2,397	2,348	4,698	4,602	421	119
Punakha	9,797	17,044	15,118	5,631	3,303	3,652	57.5	19.4	24.2	6,528	4,924	12,795	9,652	7,247	1,926
Tsirang	24,288	15,485	14,882	9,708	3,244	3,597	40.0	21.0	24.2	10,236	4,844	20,062	9,494	8,803	603
Wangdue	35,175	35,195	28,597	12,201	6,291	5,389	34.7	17.9	18.8	13,728	8,284	26,906	16,236	20	6,598
Western Region															
Chhukha	29,054	33,465	32,183	12,529	6,164	9,290	43.1	18.4	28.9	13,963	11,149	27,368	21,852	4,411	1,282
Ha	7,147	8,489	10,519	5,094	2,859	3,972	71.3	33.7	37.8	5,841	4,894	11,449	9,593	1,342	2,030
Paro	25,195	27,199	12,213	15,994	4,892	2,480	63.5	18.0	20.3	16,726	5,485	32,782	10,750	2,004	14,986
Samtse	48,169	38,849	36,839	15,010	5,146	5,016	31.2	13.2	13.6	15,868	7,186	31,100	14,085	9,320	2,010
Thimphu	16,866	7,222	4,168	7,712	2,047	1,418	45.7	28.3	34.0	7,979	2,490	15,639	4,881	9,644	3,054
Bhutan	**433,500**	**400,213**	**329,551**	**22,469**	**10,644**	**12,363**	**5.2**	**2.7**	**3.8**	**24,863**	**16,314**	**48,731**	**31,975**	**33,287**	**70,662**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A13: Statistics on the Total Number of Buffaloes Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	0	0	0	0	0	0				0	0	0	0	0	0
Sarpang	0	227	18	0	108	18		47.5		108	109	211	214	227	209
Trongsa	219	0	0	219	0	0				219	0	429	0	219	0
Zhemgang	118	0	0	118	0	0				118	0	232	0	118	0
Eastern Region															
Lhuentse	0	0	0	0	0	0				0	0	0	0	0	0
Mongar	0	0	0	0	0	0				0	0	0	0	0	0
Pemagatshel	0	282	0	0	108	0		38.4		108	108	212	212	282	282
S/Jongkhar	0	0	0	0	0	0				0	0	0	0	0	0
Trashigang	66	0	0	66	0	0				66	0	129	0	66	0
Trashiyangtse	0	0	0	0	0	0				0	0	0	0	0	0
West Central Region															
Dagana	290	241	20	290	170	20		70.8		336	172	659	336	49	221
Gasa	0	0	0	0	0	0				0	0	0	0	0	0
Punakha	0	0	0	0	0	0				0	0	0	0	0	0
Tsirang	462	214	447	299	98	220	64.7	45.8	49.1	314	241	616	472	247	233
Wangdue	62	0	0	62	0	0				62	0	122	0	62	0
Western Region															
Chhukha	158	521	0	158	419	0		80.4		448	419	878	821	363	521
Ha	0	0	0	0	0	0				0	0	0	0	0	0
Paro	109	0	0	109	0	0				109	0	213	0	109	0
Samtse	1,107	429	260	649	209	148	58.6	48.7	56.7	682	256	1,336	502	678	169
Thimphu	0	0	0	0	0	0				0	0	0	0	0	0
Bhutan	**2,591**	**1,914**	**745**	**801**	**526**	**265**	**30.9**	**27.5**	**35.6**	**958**	**589**	**1,878**	**1,154**	**677**	**1,169**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A14: Statistics on the Total Number of Yaks Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	4,702	1,214	1,811	3,296	907	1,629	70.1	74.7	90.0	3,419	1,865	6,701	3,655	3,488	597
Sarpang	0	0	0	0	0	0				0	0	0	0	0	0
Trongsa	0	0	0	0	0	0				0	0	0	0	0	0
Zhemgang	0	0	0	0	0	0				0	0	0	0	0	0
Eastern Region															
Lhuentse	0	73	0	0	73	0				73	73	144	144	73	73
Mongar	423	0	97	423	0	97				423	97	829	190	423	97
Pemagatshel	0	0	0	0	0	0				0	0	0	0	0	0
S/Jongkhar	0	0	0	0	0	0				0	0	0	0	0	0
Trashigang	15,107	10,021	10,848	14,686	4,958	5,561	97.2	49.5	51.3	15,500	7,450	30,381	14,602	5,086	827
Trashiyangtse	0	0	79	0	0	79				0	79	0	156	0	79
West Central Region															
Dagana	0	76	0	0	76	0				76	76	149	149	76	76
Gasa	0	4,006	10,599	0	1,499	7,215		37.4	68.1	1,499	7,369	2,939	14,444	4,006	6,593
Punakha	0	25	0	0	25	0				25	25	50	50	25	25
Tsirang	0	0	0	0	0	0				0	0	0	0	0	0
Wangdue	1,771	7,006	3,789	1,411	3,942	3,399	79.7	56.3	89.7	4,187	5,205	8,206	10,202	5,235	3,217
Western Region															
Chhukha	0	2,628	25	0	2,628	25				2,628	2,628	5,151	5,151	2,628	2,603
Ha	10,598	6,670	3,341	10,598	3,008	1,803		45.1	54.0	11,017	3,507	21,593	6,874	3,928	3,328
Paro	3,065	14,702	1,175	2,340	10,331	1,175	76.4	70.3		10,593	10,398	20,762	20,379	11,637	13,527
Samtse	0	0	0	0	0	0				0	0	0	0	0	0
Thimphu	25,427	20,402	7,266	24,646	11,248	5,345	96.9	55.1	73.6	27,091	12,453	53,099	24,408	5,025	13,136
Bhutan	**61,093**	**66,823**	**39,031**	**30,365**	**16,956**	**11,320**	**49.7**	**25.4**	**29.0**	**34,778**	**20,387**	**68,166**	**39,959**	**5,730**	**27,792**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A15: Statistics on the Total Number of Horses Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	2,156	2,404	1,326	1,314	779	536	60.9	32.4	40.4	1,527	945	2,994	1,853	247	1,078
Sarpang	0	425	519	0	149	237		35.1	45.7	149	280	292	550	425	95
Trongsa	565	549	350	354	207	171	62.6	37.8	49.0	410	269	803	527	17	199
Zhemgang	1,847	2,379	1,849	1,106	607	628	59.9	25.5	34.0	1,262	874	2,473	1,712	532	530
Eastern Region															
Lhuentse	3,397	2,568	1,587	2,573	736	476	75.7	28.7	30.0	2,676	877	5,245	1,719	829	982
Mongar	6,474	3,134	2,559	2,745	628	609	42.4	20.1	23.8	2,816	875	5,519	1,716	3,340	575
Pemagatshel	1,442	2,194	1,741	973	531	530	67.5	24.2	30.5	1,109	751	2,173	1,471	752	453
S/Jongkhar	0	2,397	1,752	0	574	497		23.9	28.3	574	759	1,125	1,488	2,397	645
Trashigang	9,232	5,036	4,252	4,062	1,182	1,147	44.0	23.5	27.0	4,230	1,647	8,291	3,228	4,196	784
Trashiyangtse	4,209	2,252	1,866	2,169	512	564	51.5	22.8	30.2	2,229	762	4,368	1,494	1,957	386
West Central Region															
Dagana	377	380	369	210	126	178	55.8	33.1	48.2	245	218	480	427	4	12
Gasa	1,695	1,566	2,171	1,640	459	1,923	96.8	29.3	88.6	1,703	1,977	3,338	3,876	129	606
Punakha	1,151	1,118	746	706	399	314	61.4	35.7	42.0	811	508	1,590	996	32	372
Tsirang	504	441	76	282	162	47	56.0	36.7	61.6	325	169	638	331	63	365
Wangdue	2,629	2,719	1,427	1,059	669	416	40.3	24.6	29.2	1,252	788	2,454	1,545	90	1,292
Western Region															
Chhukha	1,051	1,414	743	816	552	456	77.7	39.0	61.4	985	716	1,931	1,403	364	671
Ha	1,106	1,228	1,099	787	423	391	71.1	34.4	35.6	893	576	1,750	1,129	122	129
Paro	1,748	4,152	1,206	1,076	1,344	510	61.6	32.4	42.3	1,721	1,437	3,374	2,817	2,404	2,946
Samtse	419	349	808	285	145	377	68.0	41.6	46.6	320	404	626	791	70	459
Thimphu	4,603	2,496	1,386	3,434	1,416	861	74.6	56.7	62.1	3,715	1,657	7,281	3,249	2,108	1,110
Bhutan	**44,603**	**39,201**	**27,831**	**6,106**	**2,706**	**2,779**	**13.7**	**6.9**	**10.0**	**6,679**	**3,879**	**13,090**	**7,602**	**5,402**	**11,370**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A16: Statistics on the Total Number of Sheep Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	1,567	643	0	930	386	0	59.4	60.0		1,007	386	1,973	756	924	643
Sarpang	66	1,147	373	66	398	167		34.7	44.6	403	431	790	845	1,081	774
Trongsa	3,868	1,330	100	2,566	794	100	66.3	59.7		2,686	801	5,265	1,569	2,538	1,230
Zhemgang	0	0	0	0	0	0				0	0	0	0	0	0
Eastern Region															
Lhuentse	828	0	18	828	0	18				828	18	1,623	36	828	18
Mongar	0	194	0	0	194	0				194	194	381	381	194	194
Pemagatshel	0	0	0	0	0	0				0	0	0	0	0	0
S/Jongkhar	0	0	72	0	0	72				0	72	0	141	0	72
Trashigang	6,213	2,700	3,340	5,827	1,285	2,122	93.8	47.6	63.5	5,967	2,481	11,695	4,863	3,513	640
Trashiyangtse	76	25	75	76	25	62			81.6	80	66	157	130	51	51
West Central Region															
Dagana	1,222	735	39	627	303	39	51.3	41.2		696	306	1,364	599	487	697
Gasa	0	0	0	0	0	0				0	0	0	0	0	0
Punakha	0	0	0	0	0	0				0	0	0	0	0	0
Tsirang	2,296	567	358	1,225	233	195	53.4	41.1	54.5	1,247	304	2,444	596	1,729	209
Wangdue	7,833	3,202	1,757	7,031	1,958	1,719	89.8	61.1	97.8	7,299	2,605	14,306	5,106	4,631	1,445
Western Region															
Chhukha	1,718	1,315	1,078	1,292	592	755	75.2	45.0	70.0	1,421	959	2,785	1,880	403	237
Ha	0	0	36	0	0	36				0	36	0	70	0	36
Paro	0	0	0	0	0	0				0	0	0	0	0	0
Samtse	7,628	4,854	3,056	3,112	1,218	968	40.8	25.1	31.7	3,342	1,556	6,551	3,050	2,774	1,798
Thimphu	19	50	0	19	36	0		70.7		40	36	79	70	31	50
Bhutan	**33,334**	**16,764**	**10,303**	**9,696**	**2,844**	**2,983**	**29.1**	**17.0**	**29.0**	**10,105**	**4,122**	**19,805**	**8,079**	**16,570**	**6,461**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A17: Statistics on the Total Number of Goats Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Total)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	0	0	0	0	0	0				0	0	0	0	0	0
Sarpang	244	6,646	5,282	93	1,369	1,242	38.2	20.6	23.5	1,373	1,849	2,690	3,624	6,402	1,364
Trongsa	292	235	168	292	224	133		95.3	79.2	368	261	721	511	57	66
Zhemgang	154	191	86	124	90	61	80.4	47.3	70.7	153	109	300	214	38	105
Eastern Region															
Lhuentse	0	0	37	0	0	37				0	37	0	72	0	37
Mongar	308	285	34	247	101	24	80.2	35.6	70.7	267	104	524	204	23	251
Pemagatshel	886	192	21	886	122	21		63.5		894	124	1,753	243	693	172
S/Jongkhar	12	816	494	12	379	304		46.4	61.6	379	486	743	952	805	323
Trashigang	197	195	59	197	137	34		70.2	58.0	240	141	470	276	3	136
Trashiyangtse	0	100	69	0	70	42		70.7	61.5	70	82	138	161	100	31
West Central Region															
Dagana	5,234	5,005	5,564	2,231	1,137	1,383	42.6	22.7	24.9	2,504	1,790	4,908	3,509	229	560
Gasa	0	0	0	0	0	0				0	0	0	0	0	0
Punakha	0	89	165	0	49	129		55.2	78.2	49	138	96	270	89	76
Tsirang	8,926	6,645	8,890	3,638	1,443	2,257	40.8	21.7	25.4	3,914	2,679	7,671	5,251	2,281	2,245
Wangdue	250	286	111	199	123	58	79.4	43.2	52.1	234	136	458	267	35	175
Western Region															
Chhukha	8,124	7,374	7,173	4,381	1,545	1,800	53.9	21.0	25.1	4,645	2,372	9,105	4,649	750	200
Ha	27	88	0	27	79	0		89.6		83	79	163	155	61	88
Paro	75	101	0	75	53	0		52.9		92	53	180	105	26	101
Samtse	17,260	14,541	17,657	5,339	2,084	2,745	30.9	14.3	15.5	5,731	3,446	11,233	6,755	2,719	3,116
Thimphu	19	103	95	19	81	52		78.9	54.5	83	96	163	189	84	7
Bhutan	**42,008**	**42,892**	**45,906**	**7,239**	**3,194**	**4,070**	**17.2**	**7.4**	**8.9**	**7,913**	**5,173**	**15,509**	**10,140**	**884**	**3,014**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A18: Statistics on the Total Number of Pigs Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	34	85	70	34	53	70		62.4		63	88	123	172	50	15
Sarpang	88	2,813	893	34	666	300	38.9	23.7	33.5	667	730	1,307	1,431	2,726	1,920
Trongsa	371	552	80	236	406	80	63.6	73.5		469	413	920	810	181	472
Zhemgang	1,314	1,285	967	776	443	342	59.1	34.5	35.4	894	560	1,753	1,098	29	318
Eastern Region															
Lhuentse	2,085	660	294	1,841	264	160	88.3	39.9	54.5	1,860	308	3,645	605	1,425	366
Mongar	9,236	2,098	846	3,872	449	276	41.9	21.4	32.6	3,898	527	7,641	1,032	7,138	1,252
Pemagatshel	2,302	1,694	575	1,977	623	321	85.9	36.8	55.9	2,073	701	4,062	1,374	609	1,119
S/Jongkhar	0	1,089	1,024	0	376	715		34.5	69.8	376	807	736	1,582	1,089	65
Trashigang	11,400	1,960	1,008	3,925	410	470	34.4	20.9	46.7	3,946	624	7,734	1,222	9,440	952
Trashiyangtse	2,721	1,320	610	1,741	577	318	64.0	43.7	52.1	1,834	659	3,595	1,291	1,401	709
West Central Region															
Dagana	3,912	2,716	1,882	1,761	744	447	45.0	27.4	23.8	1,912	868	3,747	1,701	1,196	834
Gasa	79	9	0	79	9	0				80	9	157	18	70	9
Punakha	3,460	1,616	984	1,886	407	359	54.5	25.2	36.5	1,930	543	3,783	1,063	1,844	632
Tsirang	2,048	1,790	1,399	875	455	458	42.7	25.4	32.8	986	646	1,933	1,266	257	391
Wangdue	7,232	2,405	1,791	3,205	546	755	44.3	22.7	42.1	3,251	932	6,372	1,826	4,827	614
Western Region															
Chhukha	4,095	4,092	2,796	1,726	814	831	42.1	19.9	29.7	1,908	1,163	3,740	2,280	3	1,296
Ha	487	576	256	345	258	126	70.7	44.8	49.2	430	287	844	563	90	321
Paro	4,351	2,183	540	2,375	545	195	54.6	25.0	36.1	2,437	579	4,776	1,135	2,167	1,643
Samtse	3,055	2,342	3,737	1,124	468	837	36.8	20.0	22.4	1,217	959	2,386	1,880	713	1,396
Thimphu	2,294	698	269	1,354	270	99	59.0	38.7	36.7	1,381	287	2,707	563	1,596	429
Bhutan	**60,564**	**31,984**	**20,020**	**5,771**	**1,824**	**1,781**	**9.5**	**5.7**	**8.9**	**6,053**	**2,549**	**11,864**	**4,997**	**28,580**	**11,964**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A19: Statistics on the Total Number of Poultry Owned by Households by *Dzongkhag*[1/]

Dzongkhag	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	2,670	1,597	578	1,619	519	233	60.6	32.5	40.3	1,700	569	3,332	1,115	1,073	1,019
Sarpang	1,209	42,343	86,724	646	8,878	39,556	53.4	21.0	45.6	8,902	40,540	17,448	79,459	41,134	44,381
Trongsa	4,186	3,284	8,450	2,423	918	5,169	57.9	28.0	61.2	2,591	5,250	5,079	10,291	901	5,166
Zhemgang	6,743	10,678	9,329	4,016	3,012	2,577	59.6	28.2	27.6	5,021	3,964	9,840	7,770	3,935	1,349
Eastern Region															
Lhuentse	11,210	8,439	12,425	8,404	1,997	3,550	75.0	23.7	28.6	8,638	4,073	16,931	7,983	2,771	3,986
Mongar	22,902	20,214	24,790	8,808	3,824	5,501	38.5	18.9	22.2	9,603	6,699	18,821	13,131	2,688	4,576
Pemagatshel	16,911	7,418	43,370	11,197	1,905	23,103	66.2	25.7	53.3	11,358	23,181	22,261	45,436	9,493	35,952
S/Jongkhar	17	11,260	8,754	10	2,261	2,248	59.5	20.1	25.7	2,261	3,188	4,432	6,249	11,243	2,506
Trashigang	33,144	13,677	19,295	10,460	1,995	4,296	31.6	14.6	22.3	10,649	4,737	20,871	9,284	19,467	5,618
Trashiyangtse	7,892	2,754	5,437	3,840	663	2,690	48.6	24.1	49.5	3,896	2,771	7,637	5,430	5,139	2,684
West Central Region															
Dagana	27,643	18,685	22,300	11,088	3,929	5,310	40.1	21.0	23.8	11,763	6,605	23,056	12,946	8,958	3,615
Gasa	1,560	768	349	1,560	328	208	100.0	42.6	59.6	1,594	388	3,124	760	792	420
Punakha	6,164	6,745	9,087	3,688	1,766	3,500	59.8	26.2	38.5	4,089	3,920	8,015	7,683	582	2,341
Tsirang	36,380	27,702	85,650	15,173	7,241	37,210	41.7	26.1	43.4	16,812	37,908	32,952	74,300	8,678	57,948
Wangdue	13,649	7,696	11,080	6,273	2,063	3,629	46.0	26.8	32.8	6,604	4,175	12,943	8,182	5,953	3,384
Western Region															
Chhukha	25,663	27,958	26,913	11,852	8,169	7,914	46.2	29.2	29.4	14,395	11,374	28,214	22,293	2,295	1,045
Ha	3,646	3,646	2,924	2,563	1,200	1,059	70.3	32.9	36.2	2,830	1,601	5,548	3,137	0	722
Paro	6,887	9,705	25,197	3,913	1,971	8,112	56.8	20.3	32.2	4,381	8,348	8,587	16,361	2,818	15,492
Samtse	46,659	50,974	50,992	14,457	9,203	7,141	31.0	18.1	14.0	17,138	11,649	33,590	22,832	4,315	18
Thimphu	5,209	4,471	4,031	2,654	1,402	1,431	50.9	31.4	35.5	3,001	2,003	5,882	3,927	738	440
Bhutan	**280,344**	**280,015**	**457,673**	**19,960**	**15,863**	**59,139**	**7.1**	**5.7**	**12.9**	**25,496**	**61,230**	**49,972**	**120,010**	**329**	**177,658**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A20: Contribution of Sarpang and Samdrup Jongkhar to Total Livestock Population in Bhutan

Livestock Type	Livestock Population								
	BLSS 2003			BLSS 2007			BLSS 2012		
	Bhutan	Sarpang	Samdrup Jongkhar	Bhutan	Sarpang	Samdrup Jongkhar	Bhutan	Sarpang	Samdrup Jongkhar
Cattle	433,500	1,023	148	400,213	29,974	20,184	329,551	23,533	16,273
Buffalo	2,591	0	0	1,914	227	0	745	18	0
Yak	61,093	0	0	66,823	0	0	39,031	0	0
Horse	44,603	0	0	39,201	425	2,397	27,831	519	1,752
Sheep	33,334	66	0	16,764	1,147	0	10,303	373	72
Goat	42,008	244	12	42,892	6,646	816	45,906	5,282	494
Pig	60,564	88	0	31,984	2,813	1,089	20,020	893	1,024
Poultry	280,344	1,209	17	280,015	42,343	11,260	457,673	86,724	8,754

Table A20: Contribution of Sarpang and Samdrup Jongkhar to Total Livestock Population in Bhutan *(continued)*

Livestock Type	Percent Share									Combined Average Share of Sarpang and Samdrup Jongkhar: BLSS 2007 and 2012	Difference: BLSS 2003 Share vs. BLSS 2007 and 2012 Average Share
	BLSS 2003			BLSS 2007			BLSS 2012				
	Sarpang	Samdrup Jongkhar	Total	Sarpang	Samdrup Jongkhar	Total	Sarpang	Samdrup Jongkhar	Total		
Cattle	0.236	0.034	0.270	7.490	5.043	12.533	7.141	4.938	12.079	12.306	12.036
Buffalo	0.000	0.000	0.000	11.836	0.000	11.836	2.368	0.000	2.368	7.102	7.102
Yak	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Horse	0.000	0.000	0.000	1.084	6.116	7.199	1.866	6.297	8.163	7.681	7.681
Sheep	0.198	0.000	0.198	6.842	0.000	6.842	3.622	0.699	4.321	5.581	5.384
Goat	0.580	0.028	0.609	15.495	1.904	17.398	11.507	1.076	12.583	14.991	14.382
Pig	0.145	0.000	0.145	8.796	3.404	12.200	4.461	5.113	9.574	10.887	10.742
Poultry	0.431	0.006	0.437	15.122	4.021	19.143	18.949	1.913	20.862	20.002	19.565

Source: BLSS 2003, 2007, and 2012; and staff estimates.

Table A21: Percent Change and Percent Difference between BLSS and MoAF Data on the Number of Livestock Owned by Households

Livestock Type	MoAF			BLSS[1/]			Percent change (MoAF)		Percent change (BLSS)		Percent difference (BLSS minus MoAF)		
	2003	2007	2012[2/]	2003	2007	2012	2003-07	2007-12	2003-07	2007-12	2003	2007	2012
Cattle	230,963	319,899	304,076	433,500	400,213	329,551	38.5	-4.9	-7.7	-17.7	87.7	25.1	8.4
Buffalo/Others		1,551	740	2,591	1,914	745		-52.3	-26.1	-61.1		23.4	0.7
Yak	33,380	51,500	38,011	61,093	66,823	39,031	54.3	-26.2	9.4	-41.6	83.0	29.8	2.7
Horse	17,058	26,303	22,692	44,603	39,201	27,831	54.2	-13.7	-12.1	-29.0	161.5	49.0	22.6
Sheep	20,416	12,415	9,917	33,334	16,764	10,303	-39.2	-20.1	-49.7	-38.5	63.3	35.0	3.9
Goat	16,402	28,300	39,019	42,008	42,892	45,906	72.5	37.9	2.1	7.0	156.1	51.6	17.7
Pig	33,989	26,966	29,484	60,564	31,984	20,020	-20.7	9.3	-47.2	-37.4	78.2	18.6	-32.1
Poultry	109,085	200,629	549,733	280,344	280,015	457,673	83.9	174.0	-0.1	63.4	157.0	39.6	-16.7

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
2/ MoAF data on horse and sheep are not available in 2012 from data published on the *countrystat.org* website. Data refers to 2013 data from Livestock Statistics 2013.

Sources: For 2003 and 2012; Livestock Statistics and RNR censuses, as published in the countrystat.org website; and for 2007: Livestock Statistics 2007, MoAF; and BLSS 2003, 2007, and 2012.

Table A22: Comparison of MoAF and BLSS Estimates on the Number of Livestock Owned by Households in Bhutan

Livestock Type	MoAF			BLSS[1/]			Margin of Error Based on BLSS			Absolute Difference		
	2003	2007	2012[2/]	2003	2007	2012	2003	2007	2012	2003	2007	2012
Cattle	230,963	319,899	304,076	433,500	400,213	329,551	44,039	20,862	24,231	202,537	80,314	25,475
Buffalo/Others		1,551	740	2,591	1,914	745	1,570	1,031	519		363	5
Yak	33,380	51,500	38,011	61,093	66,823	39,031	59,515	33,234	22,187	27,713	15,323	1,020
Horse	17,058	26,303	22,692	44,603	39,201	27,831	11,968	5,304	5,447	27,545	12,898	5,139
Sheep	20,416	12,415	9,917	33,334	16,764	10,303	19,004	5,575	5,847	12,918	4,349	386
Goat	16,402	28,300	39,019	42,008	42,892	45,906	14,189	6,261	7,976	25,606	14,592	6,887
Pig	33,989	26,966	29,484	60,564	31,984	20,020	11,312	3,576	3,490	26,575	5,018	9,464
Poultry	109,085	200,629	549,733	280,344	280,015	457,673	39,122	31,091	115,912	171,259	79,386	92,060

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
2/ MoAF data on horse and sheep are not available in 2012 from data published on the *countrystat.org* website. Data refers to 2013 data from Livestock Statistics 2013.

Sources: Ministry of Agriculture and Forestry, Bhutan; BLSS 2003, 2007, 2012; and staff estimates.

B. Statistics on Land Ownership

Table A23: Landholding by Land Use Type (in hectares) and Percent Difference between BLSS and MoAF

Land Use Type	MoAF								BLSS[1]/			Percent difference (BLSS minus MoAF)		
	1999	2000	2002	2003	2004	2007	2008	2010[2]/	2003	2007	2012	2003	2007	2012[3]/
Dry land	131,791	76,229	68,133	70,722	71,336	119,840	65,665	68,255	61,758	67,202	74,498	-12.7	-43.9	9.1
Wet land	31,352	21,970	21,790	18,721	24,180	27,718	19,523	31,911	26,353	29,520	34,143	40.8	6.5	7.0
Orchard	5,213	8,652	7,444	6,631	7,946	9,187	9,714	12,384	11,355	11,089	12,499	71.2	20.7	0.9
Others									67,741	98,851				
Total	168,356	106,852	97,367	96,075	103,462	156,746	94,903	112,550	167,206	206,662	121,140	74.0	31.8	7.6

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons. BLSS data presented here were converted from acres to hectares for comparability with MoAF data.
2/ MoAF data in 2010 refer to cultivated agricultural areas (not landholding size).
3/ BLSS 2012 data were compared with 2010 data from MoAF.

Sources: For 1999-2004: RNR censuses and surveys, as published in the countrystat.org website; for 2007: Compendium of RNR Statistics 2008, which were derived from the cadastral database provided by DSLR (Land Commission) in May 2007; for 2008: RNR Census 2009; for 2010: RNR Statistics 2012, derived from the Land Cover Mapping Project (LCMP) 2010, MoAF; and BLSS 2003, 2007, and 2012.

Table A24: Percent Change in Landholding by Land Use Type in Bhutan

Land Use Type	MoAF							MoAF		BLSS[1]/	
	1999-2000	2000-02	2002-03	2003-04	2004-07	2007-08	2008-10[2]/	2003-07	2008-10	2003-07	2007-12
Dry land	-42.2	-10.6	3.8	0.9	68.0	-45.2	3.9	69.5	3.9	8.8	10.9
Wet land	-29.9	-0.8	-14.1	29.2	14.6	-29.6	63.5	48.1	63.5	12.0	15.7
Orchard	66.0	-14.0	-10.9	19.8	15.6	5.7	27.5	38.5	27.5	-2.3	12.7
Total	-36.5	-8.9	-1.3	7.7	51.5	-39.5	18.6	63.1	18.6	23.6	-41.4

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 survey due to security reasons.
2/ MoAF data in 2010 refer to cultivated agricultural areas (not landholding size).

Sources: Staff estimates. Basic data from the Ministry of Agriculture and Forests, Bhutan; and BLSS 2003, 2007, and 2012.

Table A25: Comparison of MoAF and BLSS Estimates on Landholdings by Land Use Type in Bhutan

Land Use Type	MoAF			BLSS[1]/			Margin of Error Based on BLSS			Absolute Difference		
	2003	2007	20102/	2003	2007	2012	2003	2007	2012	2003	2007	2012[3]/
Dry land	70,722	119,840	68,255	61,758	67,202	74,498	7,820	4,161	5,005	8,964	52,638	6,243
Wet land	18,721	27,718	31,911	26,353	29,520	34,143	4,286	2,282	4,094	7,632	1,802	2,232
Orchard	6,631	9,187	12,384	11,355	11,089	12,499	3,254	1,607	2,269	4,724	1,902	115

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons. BLSS data presented here were converted from acres to hectares for comparability with MoAF data.
2/ MoAF data in 2010 refer to cultivated agricultural areas (not landholding size).
3/ BLSS 2012 data were compared with 2010 data from MoAF.

Sources: For 2003: RNR censuses and surveys, as published in the countrystat.org website; for 2007: Compendium of RNR Statistics 2008, derived from the cadastral database provided by DSLR (Land Commission) in May 2007; for 2010: RNR Statistics 2012, derived from the Land Cover Mapping Project (LCMP) 2010, MoAF; BLSS 2003, 2007, and 2012; and staff estimates.

Table A26: Statistics on Agricultural Landholding by Land Use Type[1/] (in hectares)

Statistics	Year	Land Use Type					Total[2/]
		Dry Land		Wet Land		Orchard	
		Operated	Total	Operated	Total		
Total Area	2003	44,652	61,758	23,518	26,353	11,355	167,206
	2007	45,458	67,202	21,423	29,520	11,089	206,662
	2012	53,522	74,498	25,137	34,143	12,499	121,140
Standard Error (Total)	2003	2,956	3,990	2,030	2,187	1,660	28,356
	2007	1,302	2,123	906	1,164	820	16,338
	2012	2,107	2,553	1,719	2,089	1,158	4,253
Coefficient of Variation/Relative Standard Error (Total), %	2003	6.6	6.5	8.6	8.3	14.6	17.0
	2007	2.9	3.2	4.2	3.9	7.4	7.9
	2012	3.9	3.4	6.8	6.1	9.3	3.5
Variance (Total)	2003	8,739,673	15,919,547	4,119,088	4,781,260	2,755,682	804,062,736
	2007	1,695,265	4,507,043	821,186	1,355,377	672,448	266,930,244
	2012	4,440,884	6,520,198	2,955,614	4,363,064	1,340,575	18,083,769
Standard Error of the Difference	2003-2007	3,230	4,520	2,223	2,477	1,852	32,726
	2007-2012	2,477	3,321	1,943	2,391	1,419	16,882
Margin of Error of the Difference	2003-2007	6,331	8,858	4,356	4,855	3,629	64,143
	2007-2012	4,855	6,509	3,809	4,687	2,781	33,089
Absolute Difference (Total)	2003-2007	806	5,444	2,095	3,167	266	39,456
	2007-2012	8,064	7,296	3,714	4,623	1,410	85,522

Notes: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
2/ Total landholding in 2003 includes 'other lands', while in 2007, total landholding includes other lands used for pasture, sokshing, and tseri.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A27: Statistics on Dry Land Operated by Households by *Dzongkhag*[1/] (in hectares)

Region/ *Dzongkhag*	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	2,237	1,484	2,250	1,303	400	702	58.2	26.9	31.2	1,363	808	2,671	1,583	753	766
Sarpang	100	4,591	3,690	39	778	717	38.8	16.9	19.4	779	1,058	1,526	2,073	4,491	901
Trongsa	1,221	1,096	556	584	301	162	47.9	27.5	29.2	657	342	1,288	670	125	540
Zhemgang	1,047	2,055	748	588	454	206	56.1	22.1	27.6	743	498	1,456	977	1,008	1,307
Eastern Region															
Lhuentse	1,622	865	891	1,311	212	272	80.8	24.5	30.5	1,328	345	2,603	676	757	27
Mongar	4,273	3,175	5,007	1,593	493	980	37.3	15.5	19.6	1,667	1,097	3,268	2,149	1,098	1,832
Pemagatshel	1,616	2,071	2,232	917	410	448	56.7	19.8	20.1	1,004	607	1,968	1,190	455	160
S/Jongkhar	31	2,971	2,722	13	519	631	41.3	17.5	23.2	519	817	1,017	1,600	2,940	248
Trashigang	6,578	3,457	3,467	2,305	472	534	35.0	13.7	15.4	2,353	712	4,612	1,396	3,121	10
Trashiyangtse	1,604	1,083	1,064	792	239	251	49.4	22.1	23.6	828	347	1,622	680	521	19
West Central Region															
Dagana	2,919	3,064	3,595	1,209	647	807	41.4	21.1	22.4	1,371	1,034	2,687	2,027	145	531
Gasa	200	284	159	192	78	80	95.8	27.5	50.5	207	112	405	220	84	125
Punakha	334	325	482	177	71	206	53.1	22.0	42.7	191	218	374	427	9	157
Tsirang	3,612	2,783	3,181	1,447	574	783	40.1	20.6	24.6	1,557	970	3,051	1,902	830	398
Wangdue	1,357	1,620	2,345	547	367	586	40.3	22.6	25.0	658	691	1,290	1,355	263	725
Western Region															
Chhukha	4,699	4,216	5,249	1,866	690	1,085	39.7	16.4	20.7	1,989	1,286	3,899	2,520	483	1,033
Ha	592	810	1,148	423	240	346	71.5	29.7	30.1	486	421	953	825	218	338
Paro	1,818	2,926	2,697	1,278	558	619	70.3	19.1	23.0	1,395	833	2,734	1,633	1,109	229
Samtse	7,480	5,461	8,392	2,341	724	1,292	31.3	13.3	15.4	2,450	1,481	4,802	2,903	2,019	2,931
Thimphu	1,312	1,122	3,648	479	282	561	36.5	25.2	15.4	556	628	1,089	1,232	190	2,526
Bhutan	**44,652**	**45,458**	**53,522**	**2,956**	**1,302**	**2,107**	**6.6**	**2.9**	**3.9**	**3,230**	**2,477**	**6,331**	**4,855**	**806**	**8,064**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A28: Statistics on Total Dry Land Owned by Households by *Dzongkhag*[1/] (in hectares)

Region/ *Dzongkhag*	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	4,618	4,968	2,259	2,614	1,401	708	56.6	28.2	31.4	2,966	1,570	5,813	3,078	350	2,709
Sarpang	261	5,502	4,439	70	892	859	26.9	16.2	19.4	895	1,239	1,754	2,428	5,241	1,063
Trongsa	1,713	1,299	1,088	824	337	316	48.1	25.9	29.0	890	462	1,745	905	414	210
Zhemgang	1,753	3,213	2,607	985	696	646	56.2	21.6	24.8	1,206	949	2,363	1,860	1,460	606
Eastern Region															
Lhuentse	2,358	1,239	1,252	1,953	285	354	82.8	23.0	28.3	1,973	455	3,868	891	1,119	13
Mongar	5,565	4,240	6,115	2,057	647	1,157	37.0	15.2	18.9	2,156	1,325	4,227	2,597	1,325	1,875
Pemagatshel	2,357	4,048	4,674	1,341	847	901	56.9	20.9	19.3	1,587	1,237	3,110	2,424	1,691	626
S/Jongkhar	52	6,383	5,297	19	1,099	1,063	37.1	17.2	20.1	1,099	1,529	2,155	2,997	6,332	1,086
Trashigang	8,920	4,522	6,228	3,038	621	909	34.1	13.7	14.6	3,101	1,101	6,077	2,157	4,398	1,706
Trashiyangtse	2,646	1,603	1,602	1,302	366	359	49.2	22.9	22.4	1,353	513	2,651	1,005	1,042	1
West Central Region															
Dagana	3,235	3,669	4,347	1,317	771	932	40.7	21.0	21.4	1,526	1,210	2,992	2,371	434	678
Gasa	587	426	185	564	129	93	96.1	30.3	50.3	578	159	1,133	312	161	240
Punakha	467	566	591	238	120	220	50.9	21.2	37.2	266	250	522	491	99	25
Tsirang	4,111	3,274	3,650	1,636	665	883	39.8	20.3	24.2	1,766	1,105	3,461	2,166	837	376
Wangdue	1,893	2,070	2,965	698	429	731	36.9	20.7	24.7	819	848	1,606	1,661	178	894
Western Region															
Chhukha	7,157	5,774	7,969	2,706	853	1,566	37.8	14.8	19.7	2,837	1,783	5,561	3,495	1,383	2,194
Ha	722	983	1,324	507	272	388	70.2	27.7	29.3	575	474	1,128	930	261	341
Paro	2,515	3,433	3,198	1,557	631	723	61.9	18.4	22.6	1,680	959	3,292	1,880	918	235
Samtse	8,871	6,245	9,232	2,793	821	1,346	31.5	13.2	14.6	2,911	1,577	5,706	3,091	2,626	2,987
Thimphu	1,958	3,744	5,476	654	734	778	33.4	19.6	14.2	983	1,069	1,927	2,096	1,786	1,732
Bhutan	**61,758**	**67,202**	**74,498**	**3,990**	**2,123**	**2,553**	**6.5**	**3.2**	**3.4**	**4,520**	**3,321**	**8,858**	**6,509**	**5,444**	**7,296**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A29: Statistics on Wet Land Operated by Households by *Dzongkhag*[1/] (in hectares)

Region/ *Dzongkhag*	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	343	494	1,944	178	156	574	52.0	31.6	29.5	237	595	464	1,165	152	1,450
Sarpang	111	2,806	2,217	41	516	462	36.9	18.4	20.8	518	693	1,015	1,358	2,695	589
Trongsa	1,065	740	266	511	247	84	48.0	33.3	31.6	567	261	1,112	511	324	474
Zhemgang	764	851	535	462	212	216	60.5	24.9	40.3	508	302	996	593	87	316
Eastern Region															
Lhuentse	1,362	555	775	1,093	146	266	80.3	26.3	34.3	1,103	304	2,162	595	806	220
Mongar	1,004	345	858	533	81	321	53.1	23.4	37.5	539	331	1,057	649	659	513
Pemagatshel	87	91	26	76	38	12	87.5	41.7	48.1	85	40	166	78	4	65
S/Jongkhar	32	596	599	15	156	175	48.5	26.2	29.2	157	235	308	460	564	3
Trashigang	1,736	767	2,006	666	135	897	38.4	17.6	44.7	680	907	1,333	1,778	970	1,239
Trashiyangtse	766	675	1,306	386	169	795	50.4	25.1	60.9	421	812	826	1,592	92	631
West Central Region															
Dagana	1,807	1,327	1,441	776	288	378	42.9	21.7	26.3	828	475	1,622	932	480	113
Gasa	138	151	23	130	76	20	94.1	50.5	88.2	151	79	295	155	13	128
Punakha	1,568	1,637	694	866	340	219	55.2	20.7	31.5	930	404	1,824	792	69	943
Tsirang	2,273	1,750	1,540	1,125	358	384	49.5	20.5	24.9	1,181	525	2,314	1,028	522	211
Wangdue	1,772	2,158	2,111	724	431	446	40.9	19.9	21.1	843	620	1,652	1,214	386	48
Western Region															
Chhukha	1,247	1,049	1,281	396	226	266	31.8	21.6	20.8	456	349	894	685	197	231
Ha	210	125	150	205	55	95	97.4	43.8	63.6	212	110	416	215	85	24
Paro	1,404	1,743	992	764	333	225	54.4	19.1	22.7	834	402	1,634	789	338	751
Samtse	4,312	2,883	4,193	1,528	431	877	35.4	14.9	20.9	1,587	977	3,111	1,915	1,430	1,310
Thimphu	1,518	679	2,181	642	188	360	42.3	27.7	16.5	669	407	1,311	797	839	1,502
Bhutan	**23,518**	**21,423**	**25,137**	**2,030**	**906**	**1,719**	**8.6**	**4.2**	**6.8**	**2,223**	**1,943**	**4,356**	**3,809**	**2,095**	**3,714**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A30: Statistics on Total Wet Land Owned by Households by *Dzongkhag*[1/] (in hectares)

Region/ *Dzongkhag*	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	343	673	2,125	178	207	636	52.0	30.8	29.9	273	669	535	1,312	330	1,453
Sarpang	203	3,313	2,468	62	578	500	30.6	17.5	20.3	581	764	1,140	1,498	3,110	845
Trongsa	1,172	902	502	556	270	154	47.4	30.0	30.6	618	311	1,212	609	271	400
Zhemgang	1,017	1,143	1,175	601	266	395	59.1	23.3	33.7	657	477	1,288	934	126	32
Eastern Region															
Lhuentse	1,424	784	874	1,147	201	282	80.6	25.7	32.3	1,165	347	2,283	680	640	90
Mongar	1,112	522	1,050	576	117	348	51.8	22.4	33.1	588	367	1,153	719	590	527
Pemagatshel	87	433	294	76	281	133	87.5	64.9	45.3	291	311	570	610	346	138
S/Jongkhar	47	1,020	1,106	21	227	258	44.4	22.3	23.3	228	344	447	673	973	86
Trashigang	2,116	1,007	3,383	806	168	1,180	38.1	16.7	34.9	824	1,192	1,615	2,337	1,108	2,376
Trashiyangtse	945	1,048	1,654	477	242	986	50.5	23.1	59.6	535	1,015	1,048	1,990	103	606
West Central Region															
Dagana	2,004	1,526	1,994	842	322	495	42.0	21.1	24.8	901	590	1,766	1,156	477	468
Gasa	187	195	50	158	94	40	84.6	48.3	79.6	184	102	361	201	8	145
Punakha	1,659	2,268	816	899	463	249	54.2	20.4	30.6	1,012	526	1,983	1,031	610	1,453
Tsirang	2,341	1,974	2,168	1,180	403	551	50.4	20.4	25.4	1,247	682	2,445	1,338	367	194
Wangdue	1,909	2,839	2,849	784	569	576	41.1	20.0	20.2	969	810	1,899	1,587	930	10
Western Region															
Chhukha	1,718	1,861	2,285	526	419	454	30.6	22.5	19.9	672	618	1,318	1,212	143	424
Ha	226	199	216	221	72	108	97.6	35.9	49.9	232	129	455	254	27	17
Paro	1,402	2,270	1,511	752	424	333	53.7	18.7	22.0	864	539	1,693	1,057	868	759
Samtse	4,768	3,620	4,817	1,714	522	966	35.9	14.4	20.1	1,792	1,098	3,512	2,152	1,149	1,197
Thimphu	1,674	1,925	2,809	657	349	441	39.2	18.1	15.7	744	562	1,458	1,102	250	884
Bhutan	**26,353**	**29,520**	**34,143**	**2,187**	**1,164**	**2,089**	**8.3**	**3.9**	**6.1**	**2,477**	**2,391**	**4,855**	**4,687**	**3,167**	**4,623**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A31: Statistics on Land Owned by Households Used as Orchard by *Dzongkhag*[1/] (in hectares)

Region/ *Dzongkhag*	Total			Standard Error (Total)			Coefficient of Variation/Relative Standard Error (Total) (%)			Standard Error (Difference)		Margin of Error (Difference)		Absolute Difference (Total)	
	2003	2007	2012	2003	2007	2012	2003	2007	2012	2003-2007	2007-2012	2003-2007	2007-2012	2003-2007	2007-2012
East Central Region															
Bumthang	59	67	7	39	22	5	65.9	32.6	66.4	44	22	87	44	8	59
Sarpang	438	1,532	994	245	387	332	56.0	25.2	33.4	458	510	898	999	1,094	538
Trongsa	89	20	36	61	10	18	69.1	50.6	49.1	62	21	122	40	69	16
Zhemgang	186	418	823	131	124	423	70.6	29.7	51.4	181	441	354	864	233	405
Eastern Region															
Lhuentse	30	13	0	18	7	0	59.7	49.6	100.0	19	7	38	13	17	13
Mongar	65	61	317	45	20	138	68.9	33.1	43.6	49	140	97	274	5	256
Pemagatshel	65	780	639	51	203	174	78.8	26.0	27.3	209	267	410	524	715	141
S/Jongkhar	10	543	1,465	7	122	378	63.2	22.5	25.8	122	398	240	780	533	923
Trashigang	177	17	165	87	8	52	49.4	46.1	31.2	88	52	172	102	159	148
Trashiyangtse	112	27	129	63	13	75	56.7	48.5	58.1	65	76	127	149	85	101
West Central Region															
Dagana	1,222	852	917	524	225	267	42.9	26.4	29.1	570	349	1,117	685	370	64
Gasa	25	8	0	25	5	0	100.0	70.7		26	5	50	10	18	8
Punakha	20	131	26	14	47	11	71.1	35.5	40.8	49	48	95	94	112	105
Tsirang	940	658	935	421	154	289	44.8	23.4	30.9	449	327	879	642	282	276
Wangdue	120	99	102	64	30	45	53.2	29.8	44.3	70	54	138	106	21	2
Western Region															
Chhukha	1,472	1,148	1,107	670	213	312	45.6	18.6	28.1	704	378	1,379	740	324	40
Ha	394	236	463	339	86	246	86.0	36.4	53.0	350	260	686	510	158	227
Paro	1,303	1,120	1,111	664	222	270	51.0	19.8	24.3	700	349	1,372	684	183	9
Samtse	3,774	2,752	2,867	1,435	624	819	38.0	22.7	28.6	1,565	1,030	3,067	2,018	1,023	115
Thimphu	854	605	395	335	142	128	39.3	23.5	32.3	364	191	714	374	250	210
Bhutan	**11,355**	**11,089**	**12,499**	**1,660**	**820**	**1,158**	**14.6**	**7.4**	**9.3**	**1,852**	**1,419**	**3,629**	**2,781**	**266**	**1,410**

Note: 1/ Rural households in Sarpang and Samdrup Jongkhar *Dzongkhags* were excluded from BLSS 2003 due to security reasons.
Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A32: Contribution of Sarpang and Samdrup Jongkhar to Total Agricultural Landholding in Bhutan

Land Use Type	Landholding								
	BLSS 2003			BLSS 2007			BLSS 2012		
	Bhutan	Sarpang	Samdrup Jongkhar	Bhutan	Sarpang	Samdrup Jongkhar	Bhutan	Sarpang	Samdrup Jongkhar
Operated Dry Lands	44,652	100	31	45,458	4,591	2,971	53,522	3,690	2,722
Total Dry Land Owned	61,758	261	52	67,202	5,502	6,383	74,498	4,439	5,297
Operated Wet Lands	23,518	111	32	21,423	2,806	596	25,137	2,217	599
Total Wet Land Owned	26,353	203	47	29,520	3,313	1,020	34,143	2,468	1,106
Orchard	11,355	438	10	11,089	1,532	543	12,499	994	1,465

Table A32: Contribution of Sarpang and Samdrup Jongkhar to Total Agricultural Landholding in Bhutan *(continued)*

Land Use Type	Percent Share									Combined Average Share of Sarpang and Samdrup Jongkhar: BLSS 2007 and 2012	Difference: BLSS 2003 Share vs. BLSS 2007 and 2012 Average Share
	BLSS 2003			BLSS 2007			BLSS 2012				
	Sarpang	Samdrup Jongkhar	Total	Sarpang	Samdrup Jongkhar	Total	Sarpang	Samdrup Jongkhar	Total		
Operated Dry Lands	0.2	0.1	0.3	10.1	6.5	16.6	6.9	5.1	12.0	14.3	14.0
Total Dry Land Owned	0.4	0.1	0.5	8.2	9.5	17.7	6.0	7.1	13.1	15.4	14.9
Operated Wet Lands	0.5	0.1	0.6	13.1	2.8	15.9	8.8	2.4	11.2	13.5	12.9
Total Wet Land Owned	0.8	0.2	1.0	11.2	3.5	14.7	7.2	3.2	10.5	12.6	11.6
Orchard	3.9	0.1	4.0	13.8	4.9	18.7	8.0	11.7	19.7	19.2	15.2

Source: Staff estimates. Basic data from the BLSS 2003, 2007, and 2012.

Table A33: Distribution of Landholdings by Land Use Type and by *Dzongkhag* (in hectares)

Region/ *Dzongkhag*	MoAF								BLSS							
	2008				2010[1/]				2007				2012			
	Dry land	Wetland	Orchard	Total	Dry land	Wetland	Orchard	Total	Dry land	Wetland	Orchard	Total	Dry land	Wetland	Orchard	Total
East Central	**12,450**	**3,063**	**1,703**	**17,216**	**10,812**	**3,834**	**1,315**	**15,961**	**14,982**	**6,029**	**2,038**	**23,049**	**10,393**	**6,269**	**1,861**	**18,523**
Bumthang	4,121	66	43	4,229	2,884	25	12	2,920	4,968	673	67	5,708	2,259	2,125	7	4,392
Sarpang	4,181	1,903	1,350	7,434	3,473	2,088	1,093	6,653	5,502	3,313	1,532	10,347	4,439	2,468	994	7,900
Trongsa	1,221	499	11	1,731	1,205	1,082	0	2,287	1,299	902	20	2,220	1,088	502	36	1,626
Zhemgang	2,927	596	300	3,822	3,251	640	211	4,102	3,213	1,143	418	4,774	2,607	1,175	823	4,604
Eastern	**22,400**	**3,724**	**1,826**	**27,950**	**27,784**	**5,855**	**874**	**34,513**	**22,036**	**4,814**	**1,442**	**28,292**	**25,169**	**8,361**	**2,716**	**36,245**
Lhuentse	1,433	622	11	2,067	4,329	1,576	1	5,905	1,239	784	13	2,036	1,252	874	0	2,126
Mongar	4,066	448	199	4,713	5,304	432	3	5,739	4,240	522	61	4,823	6,115	1,050	317	7,482
Pemagatshel	4,553	140	1,075	5,768	4,333	302	620	5,256	4,048	433	780	5,261	4,674	294	639	5,607
S/Jongkhar	5,067	863	451	6,381	6,732	1,148	249	8,129	6,383	1,020	543	7,947	5,297	1,106	1,465	7,869
Trashigang	5,717	1,098	78	6,893	4,974	1,449	0	6,423	4,522	1,007	17	5,547	6,228	3,383	165	9,777
Trashiyangtse	1,563	553	12	2,128	2,111	949	0	3,060	1,603	1,048	27	2,679	1,602	1,654	129	3,384
West Central	**10,197**	**7,104**	**1,678**	**18,979**	**9,846**	**12,440**	**1,787**	**24,073**	**10,005**	**8,803**	**1,749**	**20,557**	**11,738**	**7,876**	**1,979**	**21,593**
Dagana	4,495	1,718	750	6,962	4,588	1,493	1,456	7,537	3,669	1,526	852	6,047	4,347	1,994	917	7,257
Gasa	221	82	34	337	386	144	0	530	426	195	8	628	185	50	0	235
Punakha	666	1,875	45	2,586	262	5,074	17	5,353	566	2,268	131	2,966	591	816	26	1,432
Tsirang	3,367	1,690	751	5,808	2,867	1,527	314	4,709	3,274	1,974	658	5,907	3,650	2,168	935	6,752
Wangdue	1,448	1,740	98	3,287	1,742	4,202	0	5,944	2,070	2,839	99	5,009	2,965	2,849	102	5,915
Western	**20,618**	**5,631**	**4,508**	**30,758**	**19,813**	**9,781**	**8,408**	**38,002**	**20,179**	**9,874**	**5,860**	**35,913**	**27,198**	**11,638**	**5,943**	**44,779**
Chhukha	6,022	867	1,345	8,234	5,119	1,799	2,323	9,241	5,774	1,861	1,148	8,783	7,969	2,285	1,107	11,361
Ha	1,279	72	178	1,529	2,068	89	625	2,781	983	199	236	1,419	1,324	216	463	2,003
Paro	2,320	1,139	513	3,971	3,562	1,753	1,026	6,340	3,433	2,270	1,120	6,823	3,198	1,511	1,111	5,821
Samtse	10,318	3,318	2,253	15,889	8,151	5,682	3,533	17,366	6,245	3,620	2,752	12,616	9,232	4,817	2,867	16,915
Thimphu	680	235	220	1,135	914	458	902	2,274	3,744	1,925	605	6,273	5,476	2,809	395	8,679
Bhutan	**65,665**	**19,523**	**9,714**	**94,903**	**68,255**	**31,911**	**12,384**	**112,550**	**67,202**	**29,520**	**11,089**	**107,811**	**74,498**	**34,143**	**12,499**	**121,140**

Note: 1/ MoAF data in 2010 refer to cultivated agricultural areas (not landholding size).
Sources: For 2008: RNR Census 2009; and for 2010: RNR Statistics 2012, derived from the Land Cover Mapping Project (LCMP) 2010, MoAF; and BLSS 2007 and 2012.

Table A34: Percent Change and Percent Difference between MoAF and BLSS Data on Landholdings by Land Use Type and by *Dzongkhag*

Region/ *Dzongkhag*	Percent Change (MoAF) 2008-2010				Percent Change (BLSS) 2007-2012				Percent difference (BLSS minus MoAF) 2007 BLSS vs. 2008 MoAF				2012 BLSS vs. 2010 MoAF			
	Dry land	Wetland	Orchard	Total	Dry land	Wetland	Orchard	Total	Dry land	Wetland	Orchard	Total	Dry land	Wetland	Orchard	Total
East Central	**-13.2**	**25.2**	**-22.8**	**-7.3**	**-30.6**	**4.0**	**-8.7**	**-19.6**	**20.3**	**96.8**	**19.7**	**33.9**	**-3.9**	**63.5**	**41.5**	**16.1**
Bumthang	-30.0	-61.8	-72.0	-31.0	-54.5	216.0	-88.8	-23.1	20.6	926.3	55.8	35.0	-21.7	8,401.1	-37.5	50.4
Sarpang	-16.9	9.7	-19.0	-10.5	-19.3	-25.5	-35.1	-23.6	31.6	74.1	13.6	39.2	27.8	18.2	-9.1	18.7
Trongsa	-1.3	116.8	-100.0	32.1	-16.2	-44.3	80.8	-26.7	6.3	80.7	90.1	28.3	-9.7	-53.6		-28.9
Zhemgang	11.1	7.4	-29.7	7.3	-18.9	2.8	96.7	-3.6	9.8	91.8	39.5	24.9	-19.8	83.5	290.0	12.2
Eastern	**24.0**	**57.2**	**-52.1**	**23.5**	**14.2**	**73.7**	**88.4**	**28.1**	**-1.6**	**29.3**	**-21.0**	**1.2**	**-9.4**	**42.8**	**210.7**	**5.0**
Lhuentse	202.0	153.3	-90.9	185.7	1.1	11.5	-99.4	4.4	-13.6	25.9	20.6	-1.5	-71.1	-44.6	-92.3	-64.0
Mongar	30.4	-3.6	-98.5	21.8	44.2	101.0	423.7	55.1	4.3	16.5	-69.6	2.3	15.3	143.0	10,464.1	30.4
Pemagatshel	-4.8	115.3	-42.3	-8.9	15.5	-32.0	-18.1	6.6	-11.1	208.4	-27.4	-8.8	7.9	-2.6	3.1	6.7
S/Jongkhar	32.9	33.0	-44.8	27.4	-17.0	8.4	169.9	-1.0	26.0	18.2	20.4	24.5	-21.3	-3.6	488.5	-3.2
Trashigang	-13.0	32.0	-100.0	-6.8	37.7	235.9	850.6	76.3	-20.9	-8.2	-77.7	-19.5	25.2	133.5		52.2
Trashiyangtse	35.1	71.7	-100.0	43.8	-0.1	57.8	371.5	26.3	2.6	89.6	124.5	25.9	-24.1	74.2		10.6
West Central	**-3.4**	**75.1**	**6.5**	**26.8**	**17.3**	**-10.5**	**13.2**	**5.0**	**-1.9**	**23.9**	**4.3**	**8.3**	**19.2**	**-36.7**	**10.8**	**-10.3**
Dagana	2.1	-13.1	94.3	8.3	18.5	30.7	7.5	20.0	-18.4	-11.1	13.7	-13.1	-5.3	33.5	-37.0	-3.7
Gasa	74.3	76.4	-100.0	57.2	-56.4	-74.4	-100.0	-62.5	92.2	139.0	-77.8	86.4	-52.0	-65.2		-55.6
Punakha	-60.6	170.6	-62.2	107.0	4.4	-64.0	-80.2	-51.7	-14.9	21.0	192.1	14.7	125.5	-83.9	53.1	-73.2
Tsirang	-14.8	-9.6	-58.2	-18.9	11.5	9.8	42.0	14.3	-2.8	16.8	-12.4	1.7	27.3	42.0	197.6	43.4
Wangdue	20.3	141.4	-100.0	80.9	43.2	0.3	2.5	18.1	42.9	63.1	1.7	52.4	70.2	-32.2		-0.5
Western	**-3.9**	**73.7**	**86.5**	**23.6**	**34.8**	**17.9**	**1.4**	**24.7**	**-2.1**	**75.3**	**30.0**	**16.8**	**37.3**	**19.0**	**-29.3**	**17.8**
Chhukha	-15.0	107.5	72.7	12.2	38.0	22.8	-3.5	29.4	-4.1	114.6	-14.7	6.7	55.7	27.0	-52.3	22.9
Ha	61.7	22.8	251.8	81.9	34.7	8.3	96.0	41.2	-23.1	175.2	33.0	-7.2	-36.0	142.7	-25.9	-28.0
Paro	53.6	53.9	100.2	59.6	-6.8	-33.4	-0.8	-14.7	48.0	99.3	118.6	71.8	-10.2	-13.8	8.3	-8.2
Samtse	-21.0	71.2	56.8	9.3	47.8	33.1	4.2	34.1	-39.5	9.1	22.1	-20.6	13.3	-15.2	-18.9	-2.6
Thimphu	34.4	95.1	310.0	100.4	46.3	45.9	-34.7	38.4	450.6	719.7	174.8	452.8	499.1	513.2	-56.2	281.7
Bhutan	**3.9**	**63.5**	**27.5**	**18.6**	**10.9**	**15.7**	**12.7**	**12.4**	**2.3**	**51.2**	**14.2**	**13.6**	**9.1**	**7.0**	**0.9**	**7.6**

Source: Staff estimates. Basic data from the Ministry of Agriculture and Forests, Bhutan and BLSS 2007 and 2012.

References

ADB. 2014. *Key Indicators for Asia and the Pacific 2014*. Manila. http://www.adb.org/publications/key-indicators-asia-and-pacific-2014 (accessed 2 March 2015).

CountrySTAT Food and Agriculture Data Network. http://countrystat.org/home.aspx?c=BTN. (accessed 27 May 2014).

National Soil Services Centre (NSSC) and Ministry of Agriculture and Forests, Policy and Planning Division. 2011. *Bhutan Land Cover Assessment 2010 (LCMP-2010) Technical Report*. http://www.nssc.gov.bt/wp-content/uploads/2013/08/land-cover.pdf. (accessed 11 March 2015).

Royal Government of Bhutan, Gross National Happiness Commission. 2013. *Eleventh Five Year Plan Document, 2013-2018, "Self-Reliance and Inclusive Green Socioeconomic Development"*. http://www.gnhc.gov.bt/wp-content/uploads/2013/11/Eleventh-Five-Year-Plan.pdf (accessed 10 March 2015).

Royal Government of Bhutan, Ministry of Agriculture and Forests, Department of Livestock. *Livestock Statistics 2006,* pp. 4.

Royal Government of Bhutan, Ministry of Agriculture and Forests, Department of Livestock. *Livestock Statistics 2007,* pp. 6.

Royal Government of Bhutan, Ministry of Agriculture and Forests, Department of Livestock. *Livestock Statistics 2013,* pp. iii.

Royal Government of Bhutan, Ministry of Agriculture and Forests, Policy and Planning Division. 2008. *Compendium of RNR Statistics 2008*, pp. 7-8.

Royal Government of Bhutan, Ministry of Agriculture and Forests, Policy and Planning Division. 2010. *RNR Census 2009, Volume: I*, pp. 36, 68-69.

Royal Government of Bhutan, Ministry of Agriculture and Forests, Policy and Planning Division. 2013. *RNR Statistics 2012*, pp. 18, 20, 31, 33-34, 111, 114.

Royal Government of Bhutan, National Statistics Bureau. *National Population Projection*. http://www.nsb.gov.bt/nada4/index.php/catalog/17/download/106 (accessed 18 June 2014).

Royal Government of Bhutan, National Statistics Bureau and World Bank. 2013. *Bhutan Poverty Analysis 2012*. http://www.nsb.gov.bt/publication/files/pub6pg3078cg.pdf (accessed 27 February 2015).

STUDY II

Comparative Analysis of the Socioeconomic and Demographic Characteristics of Rural and Urban Households, Bhutan Living Standards Survey

2003, 2007, and 2012

Introduction

There has been an observed sharp decline in Bhutan's rural population from 79.0% of the total population in 2004 based on surveys conducted by the Ministry of Health, to 66.3% in 2012 based on the 2005 census of population results. Despite this, a substantial portion of the population continues to depend on agriculture as their principal source of income. Based on data from annual labor force surveys of the National Statistics Bureau (NSB) and the Department of Employment under the Ministry of Labor and Human Resources (MLHR), an average of 61.8% of the total employed were engaged in the agriculture sector from 2006 to 2013. However, agriculture was noted to contribute only 15.9% to Bhutan's gross domestic product based on national accounts report in 2014, indicative of low productivity of this sector.

The difference between poverty incidence in the urban and rural areas, in which most residents are engaged in agriculture, is significant, with only 1.7% and 1.8% of urban population classified as poor in 2007 and 2012, respectively, while 30.9% and 16.7% of rural population were poor during the same years. This glaring contrast between the urban and rural areas provides a strong rationale for development to be focused on raising productivity in the rural areas and in the agriculture sector.

Policies that can foster higher growth in the agriculture sector need to be implemented to reduce the disparity between the urban and rural areas. It is in this context that the government's 11th Five-Year Plan (2013–2018) has a strong focus on improving the agriculture sector, also known as the renewable natural resources (RNR) sector. The plan also listed targets and indicators for this sector that need to be monitored. There is thus a need for reliable, timely, and comprehensive data support systems on agriculture and the rural areas, specifically how agriculture and the rural areas are being developed and how population growth, the demand for natural resources and competing food crop use, and the effects of extreme weather and climate change affect future poverty and food security. This will enable critical issues to be examined and appropriate policies to be crafted.

NSB is in charge of coordinating all statistical activities of the government while the Ministry of Agriculture and Forests (MoAF) is responsible for compiling RNR indicators. MoAF conducts RNR censuses every 10 years. With Danish International Development Agency (DANIDA) funds, MoAF carried out the first census in 2000 and the second in 2009 covering agriculture, livestock, and forestry activities. Harvested area and crop production data is estimated annually through a sample survey that is conducted by MoAF. Livestock data, including fisheries, are collected through the livestock census while forestry information is compiled from an administrative reporting system.

In general, the available data for agricultural and rural statistics cover only the economic and environmental sectors while data and information regarding farming households and the rural areas are lacking. These data are also needed to manage food security demands, issues relating to gender and risk and vulnerability. These data can be compiled from the Bhutan Living Standards Survey (BLSS) that NSB conducted in 2003, 2007, and 2012. The BLSS is an important source of relevant information on the economic and social conditions of households in Bhutan. Results of BLSS are useful inputs in the following: compilation of national accounts of the household sector, updating other economic indicators like the consumer price index, and estimation of the country's poverty statistics. Furthermore, BLSS is a major source of information crucial in crafting programs and policies designed to help improve the lives of the people, as well as in objectively assessing the effectiveness of these government policies and programs.

The BLSS 2003 was the first living standards measurement survey conducted in Bhutan and undertaken by NSB under a technical assistance project of Asian Development Bank (ADB) on strengthening the national statistical system. The BLSS 2003 was an improvement from the Pilot Household Income and Expenditure Survey (HIES) conducted in 2000 and followed the Living Standard Measurement Study (LSMS) methodology developed by researchers from the World Bank (WB). A total of 4,007 households were surveyed from an initial sample of 4,200 covering 86 gewogs from 18 dzongkhags and 27 urban settlements, including the towns of Sarpang, Gelephug, and Samdrup Jongkhar. Due to security reasons, the rural area in Sarpang and Samdrup Jongkhar Dzongkhags were not covered in the survey.

The second round of the nationwide living standards survey in Bhutan was conducted in 2007 in collaboration with the United Nations Development Program. Similarly, BLSS 2007 followed the LSMS methodology from the WB. The BLSS 2007 used as sampling frame the results of the Population and Housing Census of Bhutan (PHCB) 2005. Prior to the conduct of PHCB in 2005, household surveys conducted in Bhutan employed area sampling frames based on data provided by key informants or other household listing operations. About 10,000 households were surveyed (a total of 9,798 households), which were selected from a sample of 196 urban blocks and 659 rural chiwogs.

In 2012, the third living standards survey was undertaken by NSB under another ADB technical assistance project. The BLSS 2012 also adopted the 2007 BLSS methodology but added a new module on social capital to measure the various dimensions of social capital and its role in poverty alleviation and maximizing happiness, which was not included in the first two editions of BLSS. The total sample size for BLSS 2012 was set to about 10,000 households to ensure reliable comparability with the BLSS 2007 results and used the survey results for impact evaluation of projects. A total of 8,968 households were surveyed in BLSS 2012.

This paper addresses the data gap in the social dimension of the agricultural statistics by analyzing the three existing rounds of BLSS so that the economic and social conditions of farmers and households that rely on agriculture can be better understood. Profiles of households in urban and rural areas were compared in the succeeding sections. Section 1 presents some demographic characteristics of households and other population characteristics. Statistics on literacy, educational levels, and school attendance are discussed in Section 2 while Section 3 presents a comparison of the health-seeking behaviors between urban and rural households. Section 4 presents the employment status of the population including statistics on labor force participation, unemployment, and employment trends by sectors of employment. Household and per capita consumption expenditures are discussed in Section 5 while statistics on housing, sources of energy used in the households, access to services such as hospitals, schools and others, and use of public transportation systems are presented in Section 6. In Section 7, statistics on asset ownership, sources of credit, and income sources are discussed. In Section 8, statistics on poverty is presented while Section 9 identifies priority areas for government action. Statistical tables are presented in the appendix and referenced in the text with a prefix A.

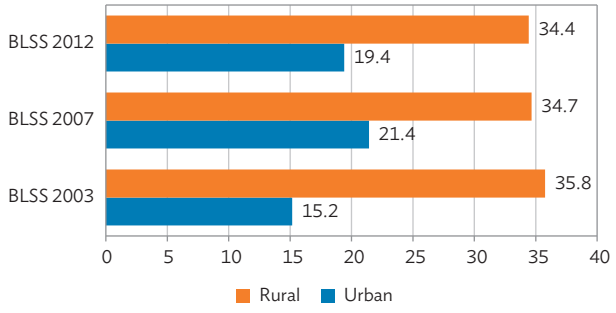
1. Demographic Characteristics

Household Characteristics

There was a slight decline in the average household size in Bhutan from an average of 5.1 in 2003 to 4.5 in 2012. The average household size in the rural and urban areas dropped by 10.4% and 5.1%, respectively, in 2012 from the recorded average household size in 2003. Household size is generally higher in the rural areas than in the urban areas. Table A1 presents the average household size by area across the BLSS years.

In general, there was a slight decline in the proportion of female-headed households in Bhutan, from 31.1% of households in 2003 to 29.3% in 2012. As shown in Figure 1, the proportion of female-headed households was higher in rural areas (about 35%) than in urban areas (about 20% or less) across all the years.

Figure 1: Distribution of Female-Headed Households by Area



Sources: BLSS 2003, 2007, and 2012.

However, there was a higher proportion (more than 60%) of households in the urban areas with younger household heads (aged 20 to 39 years). Younger people tend to look for jobs in the urban areas and thus, are more likely to settle with their families in the urban areas than in the rural areas. Table A3 shows the distribution of households by age of the household head in the rural and urban areas from the three BLSS reports. On the other hand, in the rural areas, almost half of the household heads were aged between 40 to 59 years while about a quarter had household heads aged 60 years and above.

Population Characteristics

From BLSS reports, the estimated total population in Bhutan increased by 15.1% between 2003 and 2007 but decreased by 7.7% between 2007 and 2012. In the 2003 report, population in Bhutan was estimated at 547,178; about 629,700 in 2007; and 581,257 in 2012, as shown in Table A4. The decrease in the estimated population counts from BLSS between 2007 and 2012 is not consistent with the projected population based on the results of the 2005 Population and Housing Census of Bhutan (PHCB) 2005, as shown in Tables 1.1 and 1.2. Based on the projections, the population in Bhutan will continue to increase in the next 15 years or so, although at a decreasing rate. The difference between BLSS and the census results, however, may be due to the de facto nature of the population census where all persons physically present in the country during the census period including foreign, military, and diplomatic personnel and their accompanying household members, and transient foreign visitors to the country are included. On the other hand, BLSS excludes in the analysis visiting members of

Table 1.1: Population Based on the Results of PHCB[1/] 2005 and Population Projections

Area	PHCB	Projected Population[2/]				
	2005	2010	2015	2020	2025	2030
Bhutan	634,982	695,822	757,042	809,397	850,976	886,523
Average Annual Population Growth Rate (Bhutan)		1.85	1.70	1.35	1.01	0.82

Notes: 1/ PHCB refers to Population and Housing Census of Bhutan.
2/ Based on the 2005 Population and Housing Census of Bhutan.
Sources: Results of Population and Housing Census of Bhutan 2005, Office of the Census Commissioner, Royal Government of Bhutan; Results of the Population Projections, National Statistics Bureau.

Table 1.2: Urban and Rural Population Projections in Bhutan: 2006–2015

Area	PHCB	Projected Population									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bhutan	634,982	646,851	658,888	671,083	683,407	695,823	708,265	720,680	733,004	745,153	757,042
Urban	196,111	204,691	213,571	222,753	232,232	242,001	252,038	262,325	272,839	283,544	294,402
Rural	438,871	442,160	445,317	448,330	451,174	453,822	456,227	458,355	460,165	461,610	462,640

Source: Dzongkhag Population Projections 2006-2015. Based on the Results of Population and Housing Census of Bhutan (PHCB) 2005. National Statistics Bureau, Royal Government of Bhutan.

households. There may also be some under coverage in BLSS especially in rural areas which are adjacent to urban areas. This is because some boundaries, although demarcated, are not easily discernable during field work and those people working in urban areas but residing in adjacent rural areas might have been left out.

Urban-rural classifications adopted in PHCB 2005 were based on the classification of the Department of Urban Development and Engineering Services (DUDES) under the Ministry of Works and Human Settlement (MoWHS). The MoWHS classifies an area as 'urban' (*Thromde*) if the following criteria (up to 75%, implying 4 out of the 5 outlined) are met:

a. A minimum population of 1,500 people;
b. A population density of 1,000 persons or more per square kilometer;
c. More than 50 percent of the population should depend on nonprimary activities;
d. The area of the urban center should not be less than 1.5 square kilometers; and
e. Potential for future growth of the urban center particularly in terms of its revenue base.

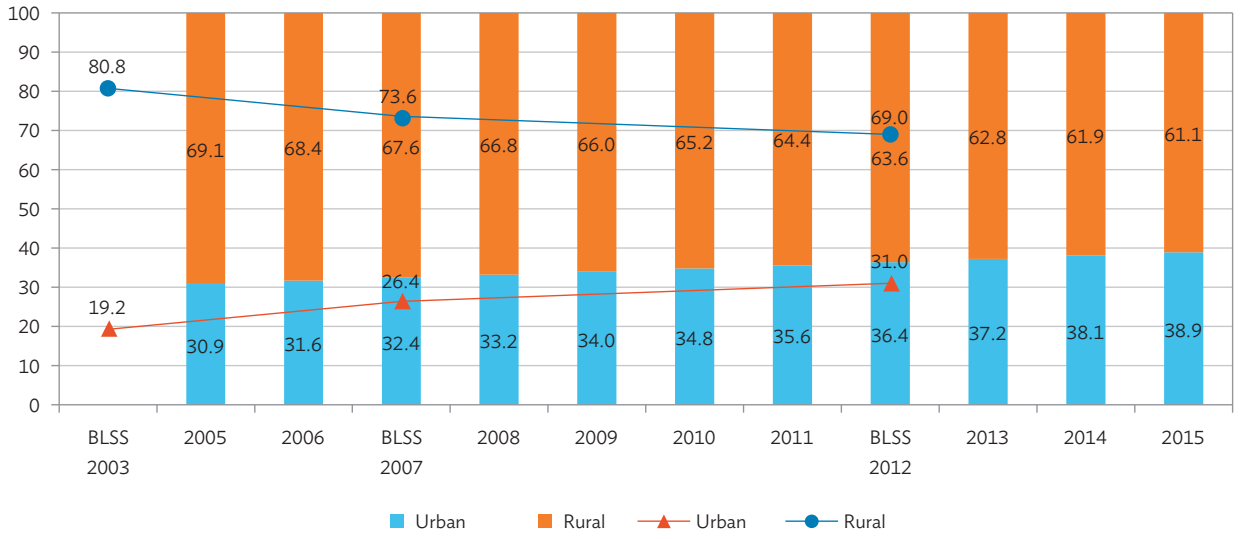
Considering that the sampling frame used in BLSS 2007 and 2012 were based on the results of PHCB 2005, urban-rural definitions in BLSS are consistent with the MoWHS classification.

The 2005 Census shows that urban population was 30.9% of the total population in 2005 while rural population was 69.1%. By 2015, urban population is projected to increase to about 294.4 thousand, with an average annual rate of increase of 4.1% from 2005 and is expected to comprise 38.9% of total population. Figure 2 shows the increasing proportion of urban population between 2003 and 2012 based on BLSS results which is consistent with the increasing trend in urban population based on projected population. However, the estimated proportions of urban population based on the projections for 2007 and 2015 were higher than the BLSS estimates.

Based on BLSS reports, there was a noted increase in the estimated urban population counts between 2003 and 2007, where it grew by 58.0%. Between 2007 and 2012, estimated urban population continued to grow by 8.4%. Correspondingly, there was a decline in the proportion of rural population in Bhutan from 80.8% in 2003 to 69.0% in 2012 based on BLSS results. In terms of population counts from BLSS, estimated rural population dropped by almost 14% between 2007 and 2012. This, however, is inconsistent with the rural population projections, where rural population is expected to increase, albeit minimally, at an annual average rate of 0.5%. In addition, the proportions of rural population based on BLSS 2007 and 2012 were higher than the projected rural population, although both results showed a continuous decreasing trend in rural population.

Based on the 2005 Census, about 111,770 persons from the rural areas migrated to the urban areas while 19,992 persons from the urban areas migrated to the rural areas. In general, net urban migrants were estimated to be 91,778 persons, which was 46.8% of the urban population in 2005. The movement of the population from the rural areas to the urban centers may suggest that more and more people in the rural areas are migrating to the cities and other urban centers to work or find other

Figure 2: Comparison of Population Distribution by Area: Population Projections vs. BLSS Estimates (%)



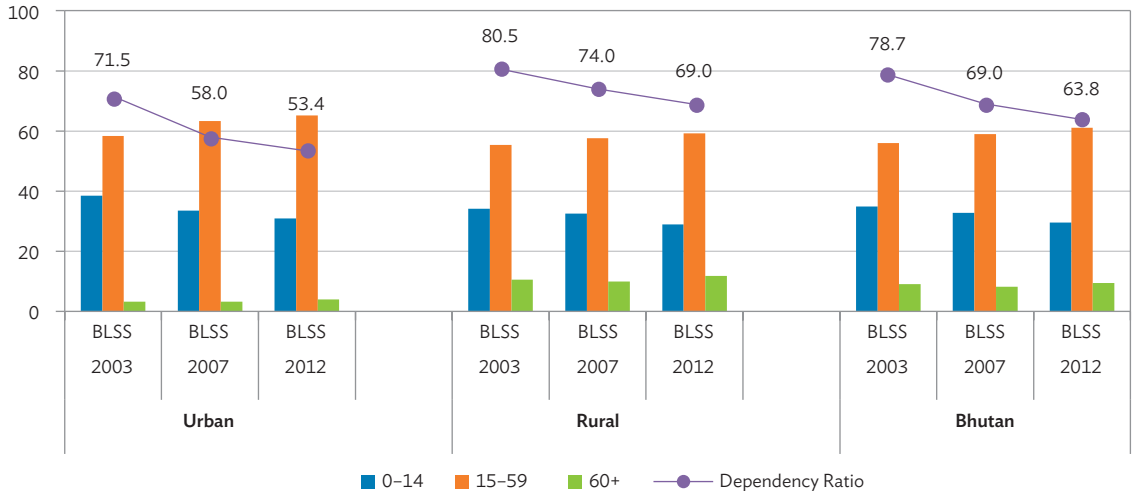
Sources: Dzongkhag Population Projections 2006-2015. Based on the Results of Population and Housing Census of Bhutan (PHCB) 2005. National Statistics Bureau. Royal Government of Bhutan; and BLSS 2003, 2007, and 2012.

sources of livelihood. In fact, based on Table A18 which shows the distribution of employed persons by their employment status in the main occupation, the proportion of employed persons in both the rural and urban areas who worked as paid employees had steadily increased between 2003 and 2012.

In 2003 and 2007, more than half of the population in Bhutan belonged to the "never married" group, which comprised mostly of population less than 15 years old (Table A6). On the other hand, the married population in Bhutan accounted for 40% to 45% of the population in the country over BLSS years.

Bhutan has a relatively young population in which 58.9% are aged below 30 years in 2012 (Table A7). The proportion of younger population (below

Figure 3: Distribution of the Population by Age Group and by Area and Dependency Ratios (%)



Sources: BLSS 2003, 2007, and 2012.

30 years old) was higher in the urban areas with an average of 67.0% from 2003 to 2012. On the other hand, there was a higher proportion of persons 60 years and above who lived in rural areas than in urban areas from 2003 to 2012. Older population comprised 10% to 12% of the rural population compared to an average of only 3.5% in urban areas.

Table A7 also shows that there was a continuous increase in the ratio of male to female in Bhutan over BLSS years, from a male-female ratio of 93:100 in 2003 to 97:100 in 2012. Also, there were more women in the economically productive population age group (15-59 years), with a male-female ratio of 92:100 in 2012. On the other hand, there were more men than women among those in the 60 years and above age group, with a ratio of 111 males for every 100 females by the year 2012.

Generally, dependency ratios in both urban and rural areas had declined from 2003 to 2012. As shown in Figure 3, dependency ratios in urban areas were at 71.5% in 2003 and 53.4% in 2012. Similarly, in the rural areas, dependency ratio in 2003 was at 80.5% and 69.0% in 2012. This clearly shows that dependency ratios are higher in the rural areas than in the urban areas, which may have resulted from the greater number of elderly population in the rural areas (almost 12%) than in urban areas (average of 3.5%). The proportion of working-age population was also higher in the urban areas than in the rural areas. In 2012, more than 65% of the population in the urban areas was between 15 to 59 years, while in the rural areas, the working-age population was 59.2% of the total rural population.

The distribution of the population by age group with the corresponding dependency ratio estimates are presented in Table A8. As shown in the table, there were eight "dependent" persons for every 10 economically productive persons in Bhutan in 2003. By 2012, the number of "dependent" persons dropped to only six for every 10 economically productive individual. This is due to an increasing proportion of the working-age population (56.0% of the population in 2003 and 61.0% in 2012).

The continuous decline in the proportion of population aged 14 years and below may also have contributed to the decline in dependency ratios in the country, despite a slight increase in the proportion of population aged 60 years and above, from 8.1% in 2007 to more than 9% in 2012.

2. Education

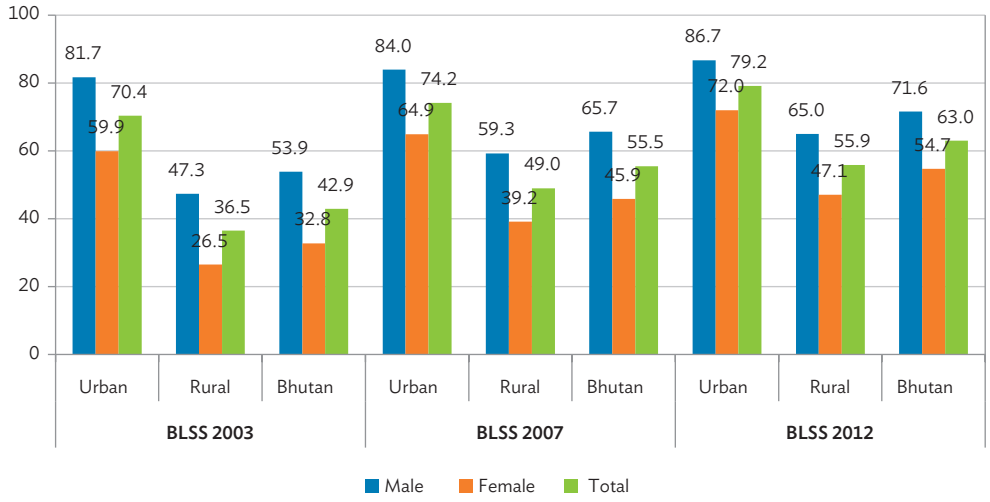
Literacy

Literacy was generally higher in the urban areas than in the rural areas (Figure 4). In 2003, urban literacy was at 70.4% while in the rural areas, literacy was only at 36.5%. Urban-rural disparities in terms of literacy continued until 2012, where urban literacy was at 79.2% while in the rural areas, literacy was at 55.9%.

literacy rates among women in these age groups were still at the 10% level or below. In addition, literacy rate among women in the rural areas in 2003 was estimated at 26.5% compared to almost 60% among women in the urban areas, although, it gradually increased to 39.2% in 2007 and 47.1% in 2012.

Bhutan is lagging behind in adult literacy, compared to other South Asian countries. Based on

Figure 4: Literacy Rate of Population 6 Years and Above by Area and by Gender (%)



Sources: BLSS 2003, 2007, and 2012.

However, there was a significant improvement in literacy among the population in the rural areas, where literacy rates improved by 34.2% from 2003-2007 and by 14.1% from 2007-2012. Women literacy rate in the rural areas also significantly improved between 2007 and 2012, with an increase of more than 20%. However, despite an increase of more than 77% between 2003 and 2012, literacy rate among women in the rural areas remains below 50% by 2012.

The proportion of literate persons in Bhutan was lowest among women in the rural areas who belonged to the 45-49, 50-54, and 55 and above age groups (Table A9). In 2003, women literacy in these age groups ranged from only 1% to 2%. By 2012,

the literacy rate projections by the UNESCO Institute for Statistics presented in Table 2.1, Bhutan's adult literacy rate will reach 64.9% in 2015, in which Bhutan will rank fourth among the six South Asian countries. Bhutan's adult literacy rate will only be slightly higher than Bangladesh and Nepal's literacy rates which are slightly above 60%.

Table 2.1: Projected Adult Literacy Rate of Population 15 years and over, 2015 (%)

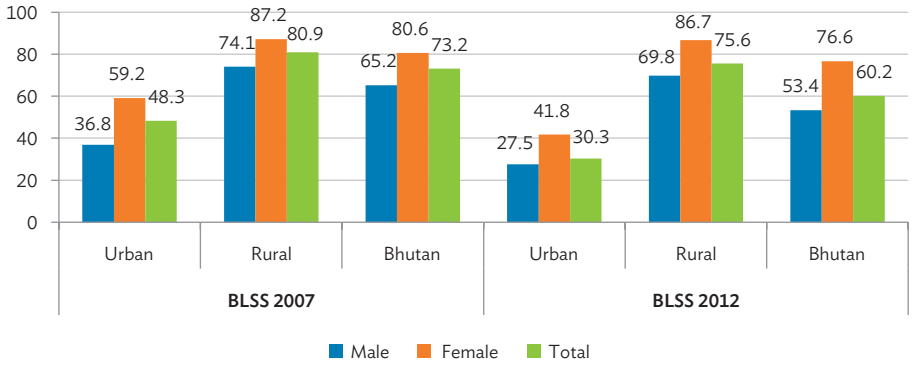
Country	Male	Female	Both Sexes	Rank
Bangladesh	64.6	58.5	61.5	6
Bhutan	73.1	55.0	64.9	4
India	81.3	60.6	71.2	3
Maldives	99.8	98.8	99.3	1
Nepal	76.4	53.1	63.9	5
Sri Lanka	93.6	91.7	92.6	2

Source: UNESCO Institute for Statistics http://data.uis.unesco.org/ (accessed on 18 June 2014).

Educational Level of Household Head

The proportion of household heads without any formal education in Bhutan declined from 73.2% in 2007 to 60.2% in 2012. As shown in Figure 5, the proportion of household heads without formal education was higher in the rural areas than in the urban areas and was also higher among female household heads than male household heads. In fact, in 2012, the proportion of household heads with no formal education in the rural areas (75.6%) was more than double than that in the urban areas (30.3%).

Figure 5: Distribution of Heads of Households with No Formal Education by Area and by Gender (%)



Sources: BLSS 2007 and 2012.

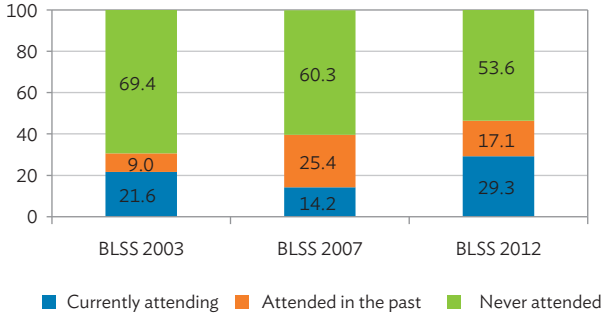
Also, in 2012, the proportion of household heads with formal education accounted for only a quarter of all rural households in Bhutan, compared to almost 70% among urban households. There was a significant increase in the proportion of household heads who were able to finish up to Grade 9-12 level, increasing by more than 140% between 2007 and 2012 (Table A10). In addition, the proportion of household heads who were able to reach educational levels above Grade 12 increased by more than 62% in 2012.

School Attendance

The proportion of the population in Bhutan who were 3 years and older and who were either currently attending school or had attended in the past had steadily grown from 37.1% in 2003 to 47.1% in 2007 and 54.1% in 2012. Among the rural population 3 years old and over, current school attendance increased to more than double in 2012, from only 14.2% in 2007 to almost 30% in 2012 (Figure 6). However, more than half of the rural population in Bhutan still lacked formal education, from 69.4% in 2003 to 53.6% in 2012.

Urban-rural disparities in school attendance were also observed in Bhutan. In 2003, the proportion of rural population 3 years and over currently at school or had previously attended school (30.6%) was less than half the proportion in the urban areas (almost 65%). By 2012, school attendance (either current or in the past) in urban areas was at 71.4%, much higher compared to 46.4% in rural areas. In addition, there was also disparity in school attendance between male and female students between 2003 and 2012. In 2012, more than half (52.1%) of the women in Bhutan never attended school compared to less than 40% among men (Table A11).

Figure 6: Educational Status of Persons 3 Years and Above in Rural Area (%)



Sources: BLSS 2003, 2007, and 2012.

Gross attendance ratios (GAR) were likewise consistently higher in the urban areas than in the rural areas. These were most evident in the secondary education level, where increasing disparities between urban and rural GARs in the higher secondary level were observed from 2003 to 2012. In the urban areas, GAR in the higher secondary level in 2012 was at 95.8%, more than twice the GAR in the rural areas (41.6%). However, urban-rural disparity decreases at the primary level of education. In 2012, primary level GAR was higher in the rural areas than in the urban areas.

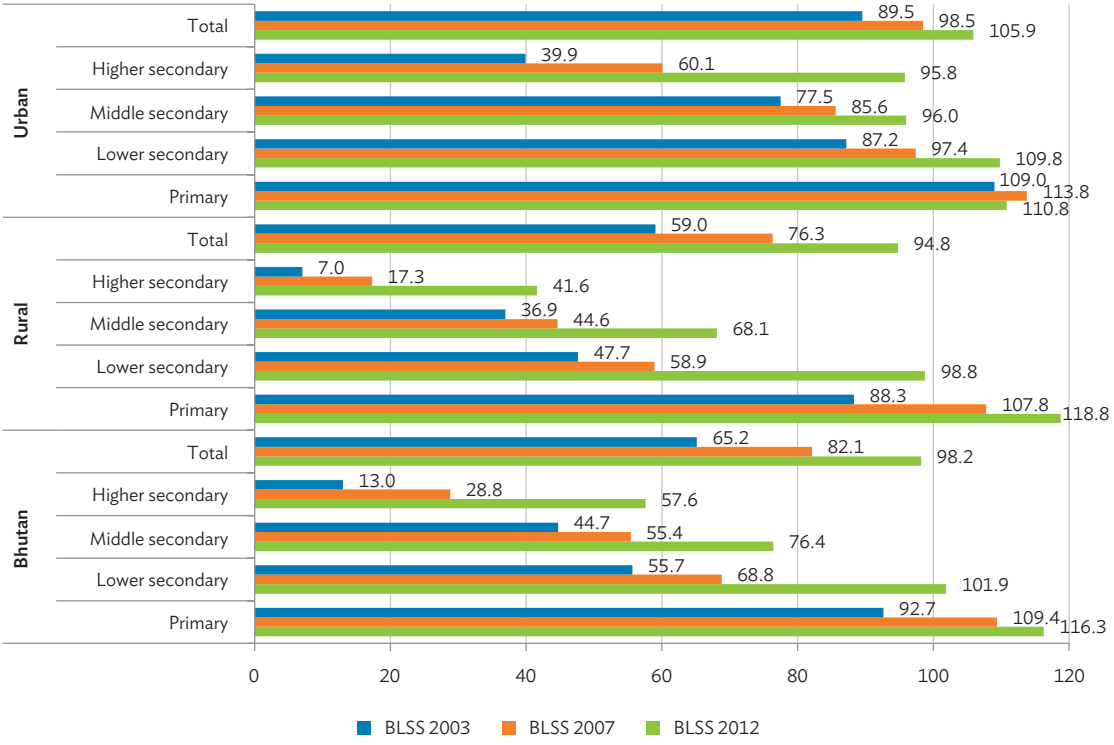
Significant improvements in attendance ratios among students in the rural areas were also observed over the years. Figure 7 shows that higher secondary GAR in the rural areas was only 7.0% in 2003 but increased to 41.6% in 2012. Similarly, GAR in the middle and lower secondary levels also improved, with lower secondary GAR in the rural areas increasing from 47.7% in 2003 to almost 100% (98.8%) in 2012.

In 2007 and 2012, gross attendance ratios in Bhutan at the primary level were above 100%. This means that students outside the official age group attend primary school. In general, there was not much difference in gross attendance ratios between males and females in 2012, unlike in 2003 and 2007, where attendance ratios among males were higher by 21.7% and 7.4%, respectively, than attendance ratios among females (Table A12).

Reason for Nonattendance

Table A13 shows the distribution of school age children who were not in school and the main reason for their nonattendance. In 2003, the top reasons for nonattendance in school were: (1) lack of interest (24.1%) mostly among males, (2) need to work (23.7%) especially among females, and (3) having problems at home (15.1%). In 2007 and 2012, the three main reasons were: (1) children needed to work, (2) they were either too young or too old to attend school,

Figure 7: Gross Attendance Ratios by Area and by Educational Level (%)



Sources: BLSS 2003, 2007, and 2012.

and (3) they cannot afford school fees and education expenses. Households in the rural areas cited the same reasons why children in their households did not attend school during the same years. In addition, from 2003 to 2012, the need to work was consistently in the top three reasons for nonattendance in school among children in the rural areas. However, in the urban areas, not being able to afford school fees was consistently a major reason why children did not attend school. The reasons mentioned rob the young people of the opportunities of having a good education and developing their skills.

3. Health

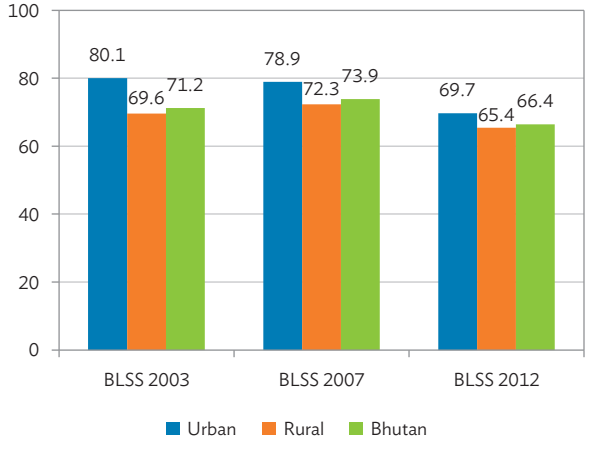
Based on the BLSS 2012 report, 17.1% of the Bhutan population reported being sick or injured four weeks prior to the conduct of the survey (Table A14). Among the people in the rural areas, 18.6% reported to be sick or injured prior to the survey while in the urban areas, 13.9% reported the same.

As shown in Figure 8, nearly one-third (31.7%) of the population in Bhutan who experienced sickness or injury four weeks prior to the survey in 2012 did not seek any medical attention nor visited any health service provider. This proportion was more than double the rate in 2003 and 2007, which ranged only between 14% and 15%. Although majority of the population in Bhutan still visited hospitals or basic health units (BHUs) to get medical attention, the proportion declined from 73.9% in 2007 to 66.4% in 2012. In addition, those who seek healing from traditional practitioners such as *lama*, *pandit* or priests also decreased from 8.2% in 2003 to only 0.1% in 2012. Similar scenarios were observed in both the urban and rural areas where the proportion of those who visit hospitals or BHUs had declined while those who do not seek any medical attention or healing from any health service provider had increased.

Comparing the health-seeking behaviors between urban and rural residents, it was noted that there were more people from the urban areas who visited hospitals or BHUs to get medical services for their illness or injury than among those in the rural areas (Figure 8). The disparity was highest in 2003 where 80.1% of the population from the urban areas visited hospitals or BHUs compared to 69.6% from the rural areas. However, in 2007 and 2012, the difference had declined. On the other hand, the proportion of people who were sick or injured but did not seek any medical service was higher in the rural areas (Figure 9).

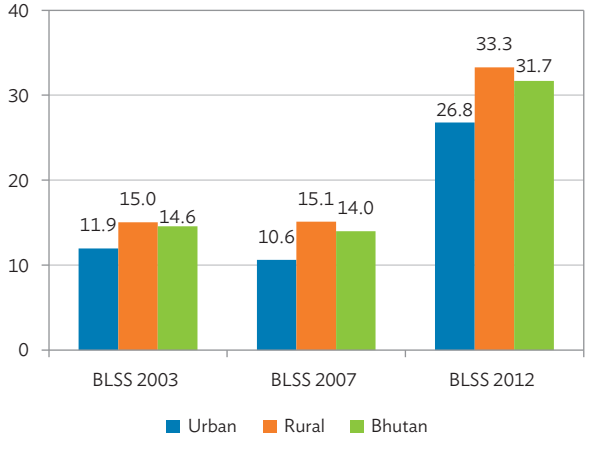
The accessibility of these health facilities may somehow affect the health-seeking behaviors of the population. Since people in the urban areas have greater access to health facilities such as hospitals, BHUs, and outreach clinics (ORCs), they are more able to avail of the different health services offered by these facilities. As presented in Table A30, 97.2% of households in the urban areas in 2012 had access to hospitals and BHUs within an hour, while among households in the rural areas, the proportion was only 69.7%.

Figure 8: Distribution of Persons Who Were Sick or Injured 4 Weeks Before the Survey Who Visited Hospitals or Basic Health Units (BHUs) by Area (%)



Sources: BLSS 2003, 2007, and 2012.

Figure 9: Distribution of Persons Who Were Sick or Injured 4 Weeks Before the Survey Who Did not Visit any Health Facility by Area (%)



Sources: BLSS 2003, 2007, and 2012.

Reason for Not Consulting Health Service Providers

In 2012, a large percentage (96.5%) of the people in Bhutan who were sick or injured prior to the conduct of the survey but did not consult any health service provider expressed that these health consultations were not necessary. The proportion was almost the same among the urban population (95.3%) and the rural population (97.0%), as presented in Table A15.

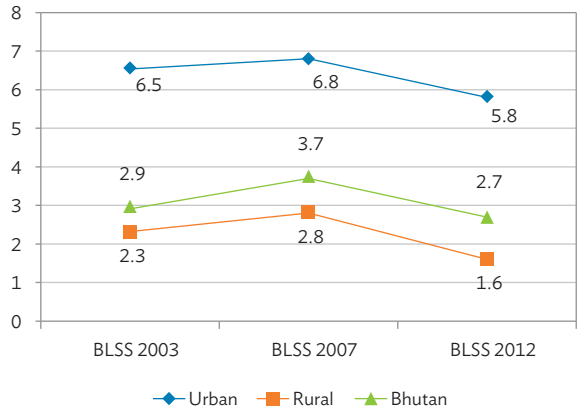
However, the reasons why people from the rural areas did not seek any health assistance when they were sick or injured were somehow different back in 2003 or 2007. For example, in 2003, in addition to having no need for any health consultation (31.3%), people from the rural areas did not avail of any health service because they did not have the time (23.6%), there was no available transportation or the health facilities were too far (21.9%), they had no money (3.3%), or because of other reasons (19.5%). In 2012, the main reason why people from the rural areas did not consult any health care provider is because there was no need for such consultation. This implies that some of the past issues have already been resolved – for example, transportation systems in the rural areas may have been improved in response to the problem of having limited transportation to reach health care facilities. Only 0.4% of persons in the rural areas in 2012 did not consult any health service provider because of limited transportation or health facilities were too far.

4. Employment

Generally, unemployment rates were higher in the urban areas than in the rural areas (Figure 10). In 2012, 5.8% of the total labor force in the urban areas was unemployed while in the rural areas, unemployment rate was only at 1.6%. Similarly, unemployment rates in the urban areas were recorded at 6.5% (2003) and 6.8% (2007), which were higher than rural area unemployment rates at 2.3% (2003) and 2.8% (2007). In terms of the actual number of unemployed persons, there were more unemployed persons in the rural areas than in the urban areas in 2003 and 2007. However, in 2012, the number of unemployed persons in the urban areas (3,815) was higher than in the rural areas (2,912), as shown in Table A17.

Unemployment rates also increased in both urban and rural areas between 2003 and 2007, but declined in 2012. In the rural areas, unemployment dropped by 42.9%, from 2.8% in 2007 to 1.6% in 2012. In general, unemployment in Bhutan went down by 27.0% (from 3.7% in 2007 to 2.7% in 2012).

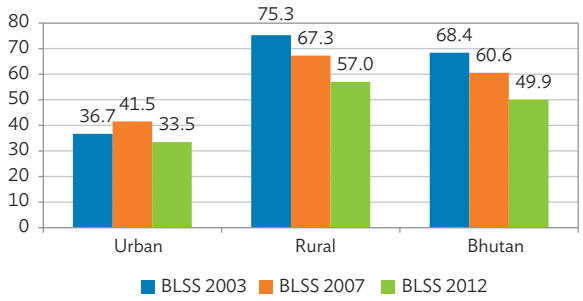
Figure 10: Unemployment Rate Among Population 15 Years and Above by Area (%)



Sources: BLSS 2003, 2007, and 2012.

As shown in Figure 11, more women in the rural areas were part of the labor force than those in the urban areas. Between 2003 and 2012, women labor force participation rates ranged from 33.5% to 41.5% in the urban areas and 57.0% to 75.3% in the rural areas, respectively.

Figure 11: Labor Force Participation Rate Among Women by Area (%)



Sources: BLSS 2003, 2007, and 2012.

Unemployment among women in the urban areas was generally higher than men. For example, in 2012, unemployment among women in the urban areas was at 9.7% and 3.8% among men (Table A17). On the contrary, in the rural areas, unemployment rates among men were slightly higher than among women. However, there was not much difference in the unemployment rates between men and women in the rural areas unlike in the urban areas. For example, in 2012, women unemployment rate was at 1.5% while unemployment rate among men was at 1.7%. Similarly, labor force participation among men and women in the rural areas did not differ much from each other.

There were some categories for employment status in BLSS 2003, which were not in BLSS 2007 or 2012. These include a combined category for 'Employee', which were categorized as 'Regular paid' or 'Casual paid' employee in the other two BLSS editions; and categories for 'Member of cooperative' and 'Collective farmer'.

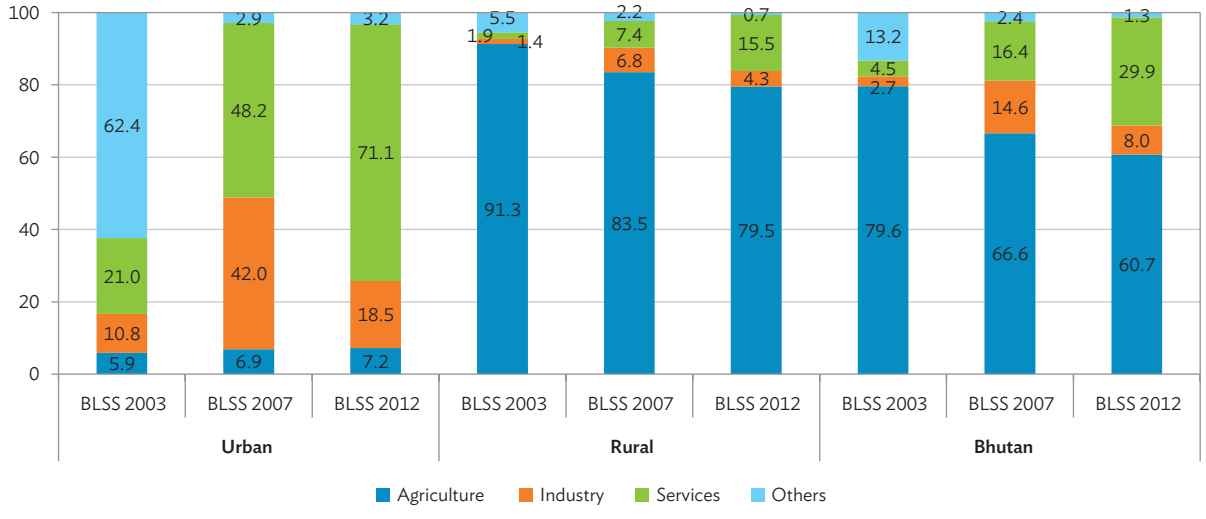
Table A18 shows that in 2003, almost two-thirds (63.1%) of employed persons in the urban areas in Bhutan were classified as 'employees', which refer to individuals hired to provide services to a company in exchange for compensation. In 2012, 73.7% of employed individuals in the urban areas worked as employees, posting an increase of 16.8% from 2003. In

addition, a steady increase in the number of women employees was noted from the BLSS results. In 2012, 61.9% of employed women in the urban areas were hired as employees, which increased by 39.4% from 2007 and by 51.8% from 2003. Consequently, there was a decrease in the proportion of employed women in the urban areas who were unpaid family workers, from 25.9% in 2003 to 10.8% in 2012. In general, unpaid family workers in the urban areas decreased by 42.8% between 2007 and 2012.

On the other hand, in the rural areas, unpaid family workers accounted for majority of employed individuals. In 2012, 57.1% of employed persons in rural Bhutan were unpaid family workers which dropped by more than 20% from the rate of 73.4% of total employed in 2003. Similar to employment trends in the urban areas, there was a decline in the proportion of employed persons working as unpaid family workers in the rural areas and a steady growth among those who worked as paid employees (Table A18). The proportion of employed persons in the rural areas who worked as employees significantly increased between 2003 and 2007, posting an increase of more than 240%. By 2012, paid employees accounted for more than a fifth (21.9%) of all employed persons in the rural areas, with an increase of 74.5% between 2007 and 2012. Also, the proportion of employed women in the rural areas who worked as employees increased steadily from only 1.4% of the total employed women in 2003 to 12.8% in 2012.

Figure 12 shows that in 2012, majority of persons employed in the urban areas worked in the services sector, growing significantly from only 21.0% in 2003. Estimates for 2012 were calculated from available survey data and the employment categories were identified based on Question E8 on the BLSS 2012 Questionnaire. In 2007, nearly half (48.2%) of the employed population in the urban areas worked in the services sector and 42.0% worked in the industry sector. On the other hand, most employed persons in the rural areas worked in the agriculture sector. In 2003, more than 90% of rural employment was related to agriculture which dropped slightly to 83.5% in 2007. Employment in the agriculture sector in the rural areas continued to drop to less than 80% in 2012. Generally, there was a significant decline in employment in the agriculture sector in the whole country from an employment rate of 79.6% in 2003 to a little over 60% in 2012. A boom in the services sector employment, on the other hand, was experienced which increased from a rate of only 4.5% in 2003 to almost 30% in 2012. Also, from Table A19, majority of the employed women in the rural areas worked in the agriculture sector (95.9% in 2003 and 90.3% in 2007).

Figure 12: Distribution of Employed Persons by Area and by Sector of Employment in Main Occupation (%)



Sources: BLSS 2003 and 2007; for 2012, staff estimates based on BLSS 2012.

5. Household Expenditure

Household spending in the urban areas in Bhutan was generally higher than in the rural areas (Figure 13). For example, in 2007, the average monthly household consumption spending by urban households valued at 20,777Nu was almost twice the average spending for rural households (10,829Nu). Correspondingly, individuals living in urban areas spent more than those living in the rural areas, on the average. In 2003, the monthly average per capita food and nonfood spending in the urban areas of 2,982.2Nu was more than twice the per capita expenditure in the rural areas of 1,357.6Nu. Also, the gap between urban and rural per capita spending was even larger in 2007, where per capita expenditure in urban areas was higher by 130.1%. However, in 2012, the gap became smaller; urban spending was still higher by 78.5% than average monthly per capita spending in the rural areas.

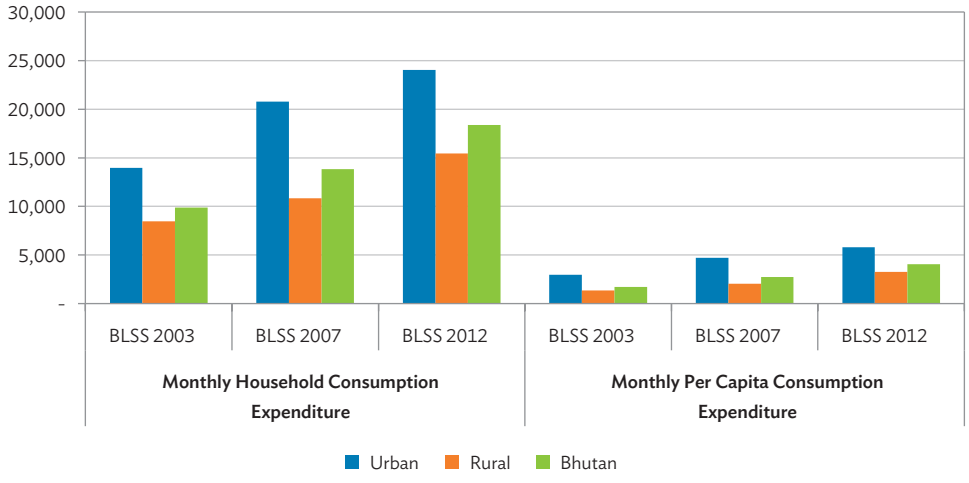
In both the urban and rural areas, average monthly per capita spending continually increased over the years. However, spending among individuals living in the rural areas grew faster than those living in the urban areas. Compared to their average spending in 2003, average monthly per capita spending in the rural areas grew by 139.5% in 2012 while spending in the urban areas grew by 94.6%.

Food Consumption Expenditure

Households in the rural areas spent a larger part of their monthly expenditures on food than households in the urban areas (Table A21). Between 2003 and 2012, food consumption expenditure was 40% to 45% of the average monthly expenditure among rural households. On the other hand, food expenditure covered 31% to 34% of an urban household's monthly expenditure during the same period. However, in terms of the actual value spent on food, the average monthly household consumption spending was higher in the urban areas than in the rural areas. In 2012, the average monthly household spending on food among urban households was 8,140.7Nu and 6,643.8Nu among the rural households.

Dairy products used in processing butter and cheese had the largest share of the average monthly food expenditure among urban households, as shown in Table A22. In 2012, spending on dairy products was one-fifth (20.6%) of an urban household's monthly food expenditure. Rice, other cereals and pulses, and spices and seasonings had a share of about 10% each while vegetables comprised 15.5% of the average urban household food consumption expenditure in 2012. Except for rice and alcoholic

Figure 13: Mean Monthly Household and Mean Monthly Per Capita Consumption Expenditure by Area (Nu)



Sources: BLSS 2003, 2007, and 2012.

beverages, average monthly household spending on all food items in 2012 was higher in the urban areas than in the rural areas.

Similar to urban households, those living in the rural areas spent one-fifth (20.2%) of their food expenditures on dairy products. On the other hand, expenditure on rice was higher in the rural areas than in the urban areas. Rural households spent 17.1% of their monthly household food expenditure on rice compared to only 11.0% for urban households in 2012.

Share in total food consumption expenditure for foods consumed away from home decreased dramatically for both urban and rural households. Consumption of foods outside the home dropped to 3.9% in 2012 from 27.4% in 2003 among households in the urban areas. Meanwhile, among rural households, share from total food consumption for food consumed away from home declined from 26.3% in 2003 to only 1.8% in 2012.

Nonfood Consumption Expenditure

Table A22 presents the average monthly household consumption expenditure on major nonfood items of urban and rural households. In 2003, 20.7% of the monthly nonfood expenditures among urban households were spent on housing expenses, followed by clothes and footwear (13.1%), and health expenses (12.1%). Expenditure on housing had the largest chunk from the average nonfood spending of urban households at 23.0% in 2012. Also, there was a significant increase in the share of transportation and communication expenses from the urban household's monthly nonfood expenditure. In 2012, transportation and communication had the second largest expenditure share at 19.3% from the household's monthly nonfood spending, increasing from 11.0% in 2003.

The share of spending on transportation and communications also increased among households in the rural areas. From a share of 3.5% in 2003, share of transport and communications on monthly nonfood spending among rural households increased to 17.1%, the highest expenditure share in 2012. Among the other nonfood expenditure items with relatively high shares in the average monthly spending of rural households in 2012 include rent or rental value for housing (15.8%), health expenses (14.4%), miscellaneous expenses (14.0%), and clothing and footwear (13.1%). Interestingly, the share of expenditure for energizing homes in the rural areas dropped significantly from a share of 19.0% in 2003 to only 3.6% in 2012.

6. Housing, Household Amenities, and Access to Services

Housing

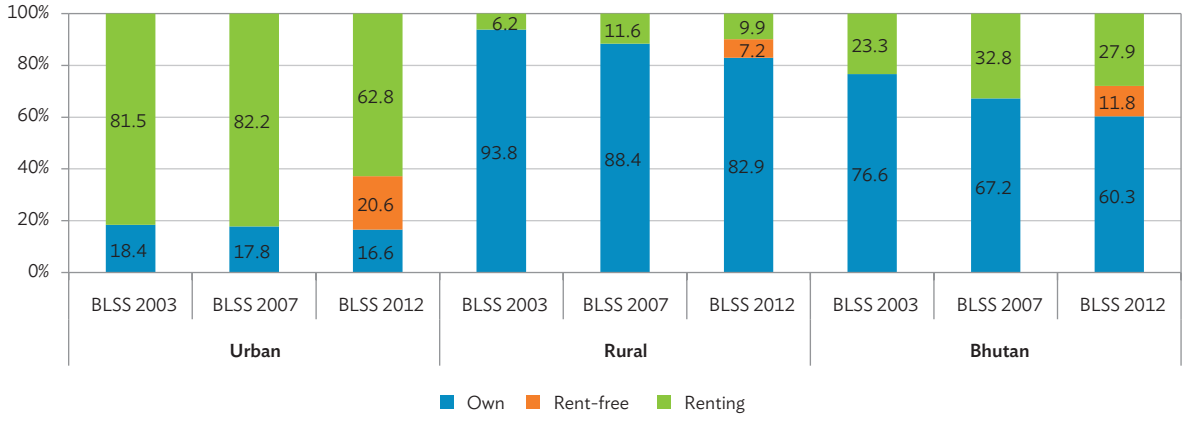
As shown in Figure 14, most of the households living in the urban areas paid rent for housing. In 2012, majority (62.8%) of the urban households paid rent for housing provided by the government or other private entities. In the same year, 20.6% of urban households stayed in rent-free housing units while only less than one-fifth (16.6%) owned their dwelling units. It is worth noting that the proportion of urban households that own their dwelling units has decreased since 2003.

Unlike households in the urban areas, majority of the rural households owned a house or dwelling unit. The proportion of rural households with their own housing or dwelling units, however, had decreased – from 93.8% in 2003 to 88.4% in 2007. In 2012, 82.9% of households in the rural areas had their own housing units while only 9.9% rented.

of lighting in 2003. A large percentage (68.6%) of the rural households used kerosene or gas lamps for lighting in 2003 while only a quarter (24.5%) of the households used electricity. Table A27 shows the increased use of electricity and a reduction in the use of kerosene or gas lamps for lighting among rural households. In 2007, more than half (56.1%) of the households in the rural areas used electricity for lighting, which further increased to 83.1% of rural households in 2012.

As shown in Figure 15, electricity was the most common source of energy for cooking in both urban and rural households in Bhutan. In 2012, nearly all urban households (97.9%) used electricity for cooking while 91.7% used gas (Note: During the BLSS 2012 survey, respondents were asked to provide multiple answers to this item). In the same year, more than 76% of the rural households used electricity for cooking, a significant increase from only 4.5% of

Figure 14: Distribution of Households by Area and by Tenure Status of the Dwelling Unit (%)



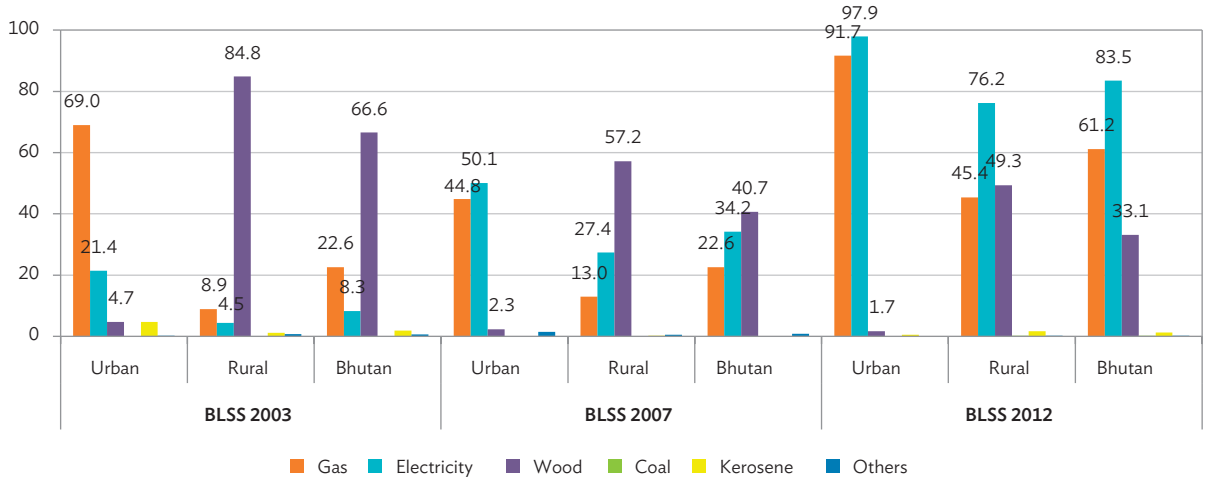
Sources: BLSS 2003, 2007, and 2012.

Household Amenities

Almost all or more than 97% of households in the urban areas used electricity for lighting based on results of the three surveys. In the rural areas, kerosene or gas lamps were the common sources

households in 2003. Likewise, cooking with gas was more common among households in the rural areas. In 2003, only few (8.9%) of the rural households used gas for cooking since most households (84.8%) used wood. In 2012, almost the same proportion of rural households used gas (45.4%) and wood (49.3%) for cooking.

Figure 15: Distribution of Households by Area and by Use and Source of Energy for Cooking (%)

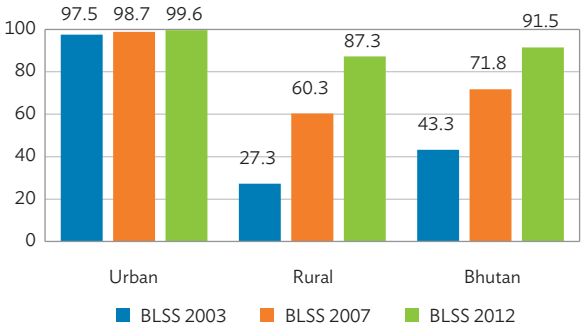


Sources: BLSS 2003, 2007, and 2012.

Nearly half (49.4%) of the households in Bhutan in 2012 did not have heating in their homes, as shown in Table A27. In the urban areas, more than one-third (37.1%) of the households did not have heating while the proportion was 55.7% among rural households. Wood or coal stoves, locally known as *bukhari* were the most common heating sources among the rural households in 2012. On the other hand, among the urban households, electric heaters were more commonly used.

Between 2003 and 2012, there was a significant improvement in providing electricity services to households in the rural areas (Figure 16). In 2003, only less than one-third (27.3%) of rural households had electricity while 68.6% of the households did not have electricity. This is because electricity services are not available in the area. However, in 2012, a large percentage (87.3%) of the rural households had access to electricity services. Electrification among urban households, on the other hand, has been almost 100% since 2003.

Figure 16: Distribution of Households by Area and by Access to Electricity Services (%)



Sources: BLSS 2003, 2007, and 2012.

Access to Services

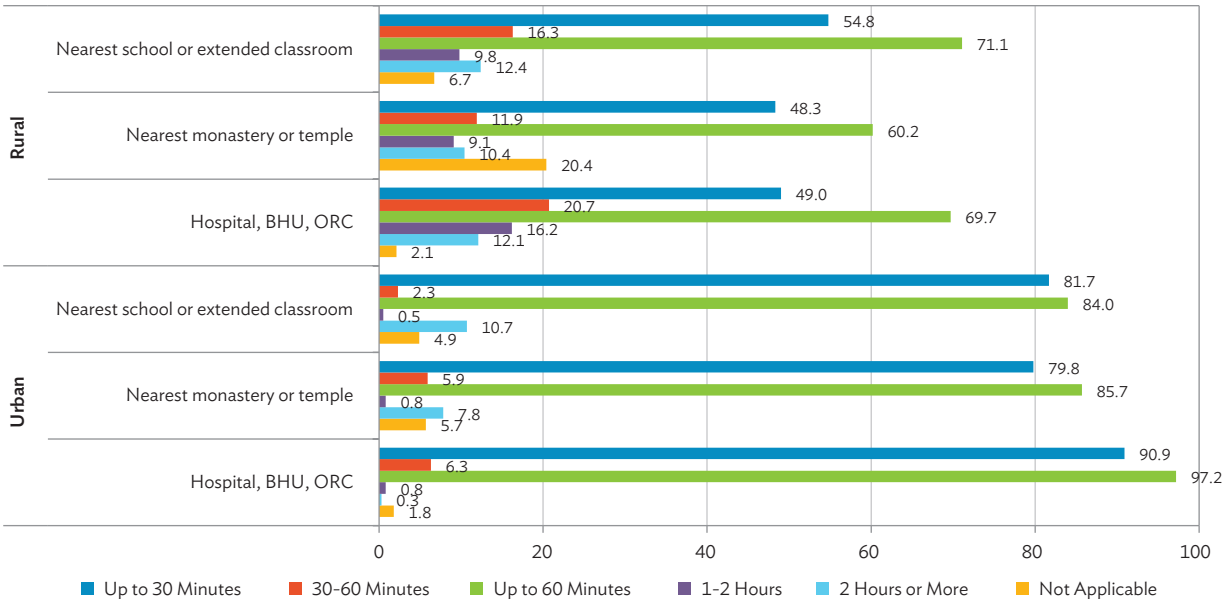
Post offices, police stations, hospitals and other health centers, drugstores, *dzongkhag* headquarters, monasteries or temples, and schools were among the service centers most accessible to households in the urban areas. In 2012, 67.1% (*dzongkhag* headquarters) to 97.2% (hospitals) of urban households could access these centers within one hour, as shown in Table A30.

On the other hand, rural households had greater access to *gewog* headquarters, sources of firewood, tarred and farm roads, and agriculture, livestock and forest extension centers. However, there were more households in the rural areas (ranging from 15% to 30%) that require at least 2 hours of travel time to reach these service centers. In addition, among the service centers less accessible to rural households where households would require at least two hours of travel were petrol stations, bus stations, and ECCD or day-care centers.

Hospitals and health centers, monasteries or temples, and schools were very accessible to households in both urban and rural areas, as shown in Figure 17. Among households in the rural areas, at least 60% indicated that these institutions could be reached within an hour. On the other hand, in urban areas, more than 80% of households could access these institutions in one hour or less time.

owned family cars almost doubled, increasing from 10.2% in 2007 to almost 20% in 2012 (Table A33). In the urban areas, households that owned family transport vehicles increased by almost 50%, while among rural households, the proportion more than doubled between 2007 (4.2%) and 2012 (10.9%).

Figure 17: Distribution of Households by Area and by Time Taken to Reach Selected Nearest Service Centers (%)



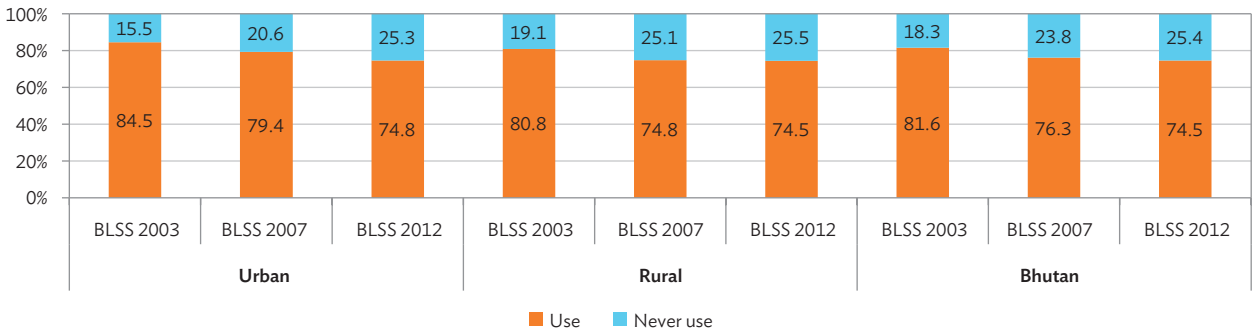
Source: BLSS 2012.

Also, due to increased accessibility of mobile phones, access to public telephone services declined. More than 85% of households in Bhutan indicated that access to public phone services was no longer applicable to them with 88.8% of households in the urban areas and 83.4% in the rural areas.

In 2012, nearly three-fourths (74.5%) of all households in Bhutan used public transportation (Figure 18). However, the use of public transportation among Bhutan households slightly decreased from 2003 to 2012. This may have resulted in part to increased ownership of family transport vehicles among households in the country. Between 2007 and 2012, the proportion of Bhutan households that

The distribution of households according to their assessment of the public transportation system in Bhutan is presented in Table A32. Generally, households in both urban and rural areas were satisfied with how their public transportation system works. In terms of frequency or schedule of the public transportation system, the proportion of households who expressed satisfaction was consistent between 2003 and 2012, where a large percentage (almost 90%) of the households was satisfied. Similarly, in 2012, 77.6% of the households in Bhutan were satisfied in terms of the affordability of transport costs. However, this was lower compared to 88.7% of households that were satisfied with the costs of transport in 2003.

Figure 18: Distribution of Households by Area and by Use of Public Transport (%)



Sources: BLSS 2003, 2007, and 2012.

Also, there were more households in the urban areas that expressed satisfaction with their public transport systems than rural households, both in terms of frequency and costs. This implies that there is room for more improvements in the rural public transportation systems in Bhutan.

7. Assets, Credit, and Income

Asset Ownership

Table A33 shows that the proportion of rural households in Bhutan that own certain types of assets significantly improved between 2003 and 2012. Ownership of assets among rural households from kitchen and laundry appliances to electronic gadgets and other transport or mechanical equipment largely improved in 2012. Most significant improvements were observed in the ownership of electronic gadgets such as mobile phones and computers, as well as entertainment devices such as televisions and DVD players. In 2012, majority (90.7%) of the rural households owned mobile phones compared to less than 1% in 2003. Although only 7.7% of rural households owned computers in 2012, this was an improvement compared to less than 1% ownership in 2003. Ownership of household furniture and kitchen and laundry appliances likewise improved largely for households in the rural areas possibly following the improvements in electrification among households in the rural areas.

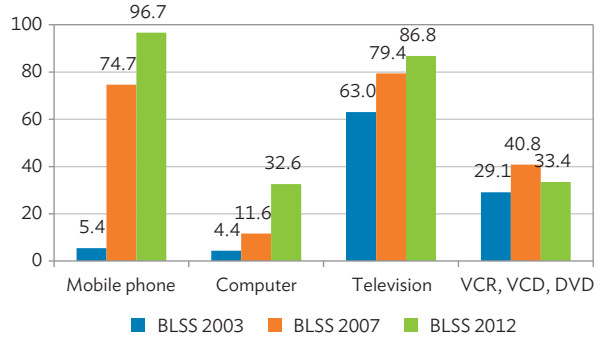
Ownership of electronic devices such as mobile phones and computers likewise increased significantly among the urban households. Figure 19 shows that in 2003, only 5.4% of urban households owned mobile phones while 4.4% owned computers. However, in 2012, households that owned mobile phones jumped to 96.7% while the proportion of urban households that owned computers increased to 32.6%.

Land ownership among households in Bhutan declined from 73.7% of households in 2003 to 66.4% in 2012, decreasing by almost 10% (Figure 20). Although the proportion of landowners in the urban areas increased from 18.9% in 2003 to more than 30% (32.3%) in 2012, there was a decline in land ownership among rural households, from almost 90% rural household landowners in 2003 to 83.5% in 2012.

In addition, there were more rural households who were land owners than urban households. In 2012, only one-third of urban households owned land while almost 85% of rural households were land owners. This is because majority of rural households are employed in the agriculture sector and depend on agriculture as their main source of livelihood. On the contrary, in the urban areas, most households are employed in industries in the urban centers and usually rent spaces for housing, thus, having less need to own land.

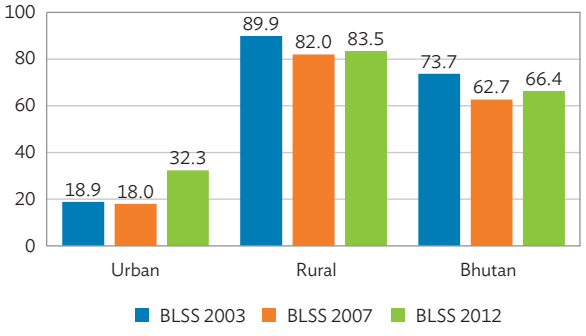
In terms of owning livestock, majority of households in Bhutan, mostly in the rural areas owned cattle and poultry. In 2003, half (50.3%) of the

Figure 19: Distribution of Households that Own Selected Recreation and Telecommunications Assets in Urban Area (%)



Sources: BLSS 2003, 2007, and 2012.

Figure 20: Distribution of Households by Landholding and by Area (%)



Sources: BLSS 2003, 2007, and 2012.

households in Bhutan owned poultry while more than 60% (63.8%) owned cattle (Table A35). However, the proportion of households that owned livestock in the rural areas and in Bhutan, in general, has gradually been declining since 2003. For example, ownership of cattle by rural households dropped to 67.0% in 2012 from 81.6% in 2003. Similarly, household ownership of poultry in the rural areas declined by more than 30% between 2003 and 2012. There was also a large decline in the proportion of households that owned pigs, with the proportion dropping from 29.7% of Bhutan households in 2003 to less than 10% in 2012.

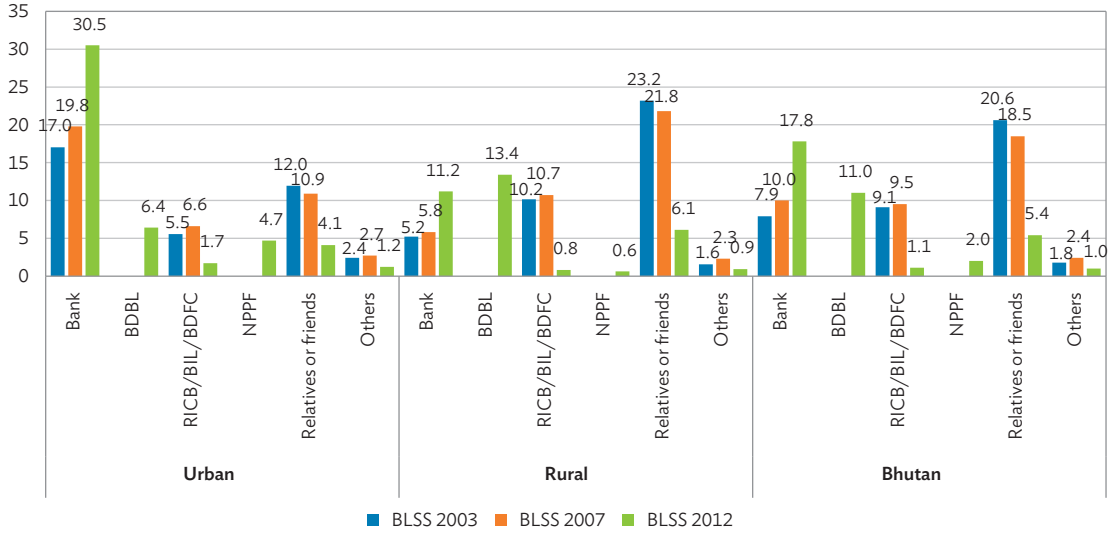
Credit Source

The proportion of households in Bhutan that availed of loans from banks increased from 7.9% in 2003 to 17.8% in 2012 (Figure 21). There was also a shift in credit sources where Bhutan households usually availed of loans. The households who borrowed from relatives or friends were 20.6% (2003) and 18.5% (2007). However, in 2012, the proportion of households who borrowed from relatives and friends dropped to 5.4% while more households shifted to borrowing from more formal sources like banks (17.8%) and other insurance and finance corporations (14.1%).

Among households in the urban areas, borrowing from banks was a common practice. In 2003, 17.0% of urban households borrowed money from banks, which increased to 19.8% of households in 2007. In 2012, 30.5% of urban households availed of loans from banks, while 12.8% borrowed from insurance and other formal financial sources.

On the other hand, borrowing from relatives or friends was a more common practice among households in the rural areas. In 2003 and 2007, more than 20% of rural households borrowed from relatives or friends compared to only 5% to 6% from banks and 10% to 11% from other formal financial sources. However, rural households shifted to more formal sources of loans in 2012, where the proportion of households who borrowed from banks was 11.2%. Meanwhile, households who borrowed from friends or relatives dropped to only 6.1%.

Figure 21: Distribution of Households by Area and by Source of Loan (%)



Sources: BLSS 2003, 2007, and 2012.

Household Income

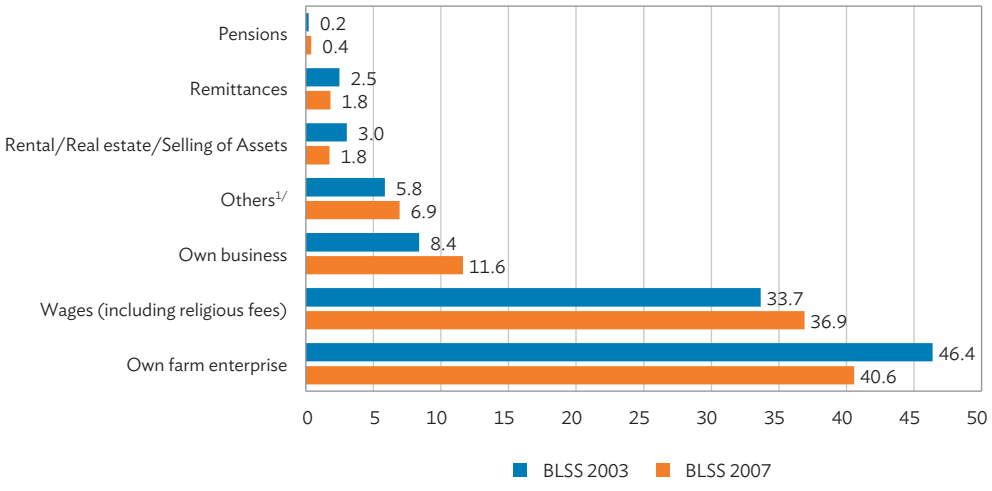
A large proportion of households in Bhutan depend on own farm enterprises as the main source of income for the household as reported in BLSS 2003 and 2007. More than 46% of households in 2003 reported own farm enterprises as their main source of income while 40.6% of households in 2007 reported the same (Figure 22). On the other hand, wages, including religious fees was the second major source of income among households in Bhutan. More than 30% of households in Bhutan (33.7% of households in 2003 and 36.9% in 2007) reported wages or salaries as the main source of income for the household.

In 2003 and 2007, majority of the rural households sourced their income from farm enterprises. Nearly 60% of all households in the rural areas reported farm enterprises as their main income source in both years, as shown in Table A37. On the other hand, wages or salaries were the main source of income for households in the urban areas. In 2003, almost 74% of households in the urban areas obtained their income from wages or salaries. Meanwhile in 2007, the proportion of households was at 68.0%. In addition, the proportion of households that reported own businesses as the main source of income increased in 2007 in both the urban and rural areas.

However, results from BLSS 2012 indicate that income from wages accounted for more than half (57.2%) of the annual average income of households in Bhutan (Figure 23). The share was much higher in the urban areas (64.6%) than in the rural areas (46.8%). Also, income from agricultural activities was 10.3% of the average household income in Bhutan in 2012. Even in the rural areas, the share of income from agricultural activities (23.5%) was less than that of nonagricultural activities (29.7%) from a rural household's annual average income.

Aside from wages and salaries which were major source of income among households in Bhutan in 2012, net income from business was also a major income source among Bhutan households. In 2012, almost 60% of the total household income in the country was from wages and salaries while 18.1% came from net income from businesses (Figure 24). The figure also shows that the share of income from wages and salaries, and businesses was higher in the urban areas while income from real estate and sale of assets, and from agricultural production was higher among rural households.

Figure 22: Distribution of Households by Main Source of Income in Bhutan (%)



Note: 1/ For BLSS 2007, includes inheritance, charity, and scholarship.
Sources: BLSS 2003 and 2007.

Figure 23a: Distribution of Annual Average Household Income by Source in Bhutan (%)

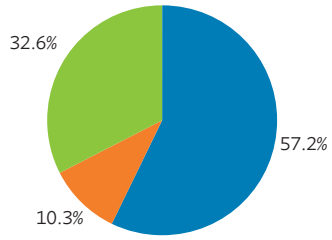


Figure 23b: Distribution of Annual Average Household Income by Source in Urban Area (%)

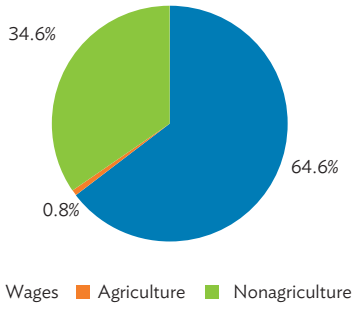
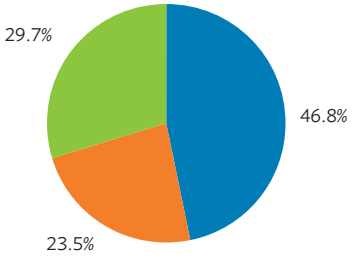
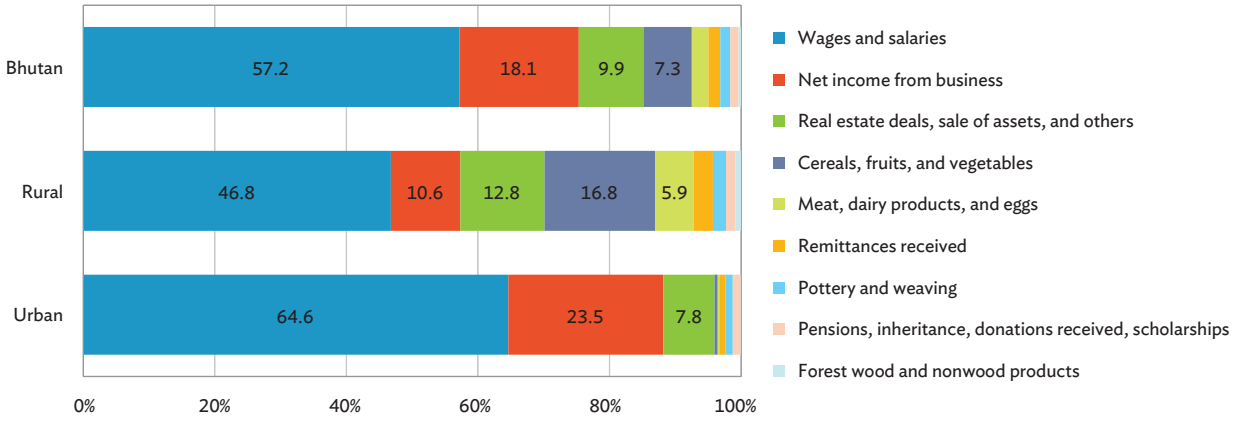


Figure 23c: Distribution of Average Annual Household Income by Source in Rural Area (%)



Source: BLSS 2012.

Figure 24: Distribution of Household Income by Income Source and by Area (%)



Source: BLSS 2012.

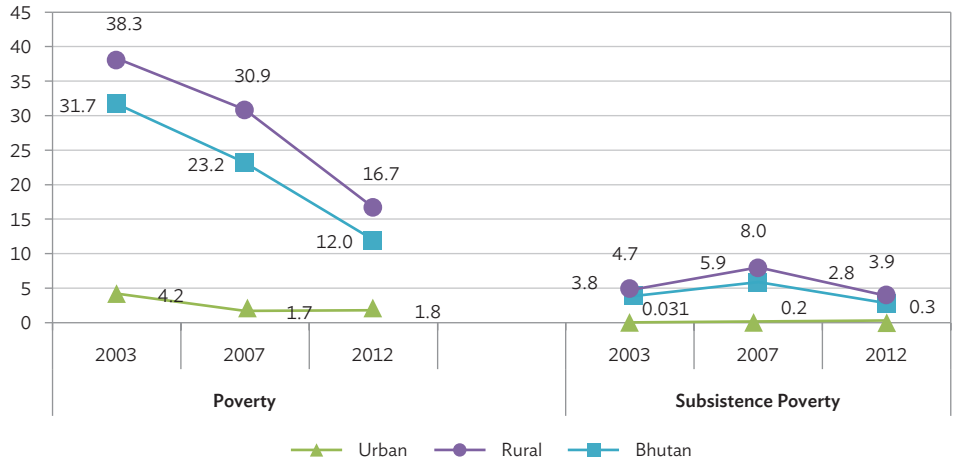
8. Poverty

Poverty incidences in Bhutan were estimated using the results from the three rounds of BLSS. Figure 25 clearly shows the disparity between urban and rural population poverty incidences. In 2003, urban poverty headcount ratio was estimated at 4.2% while subsistence incidence was only at 0.031%. However, in the rural areas, poverty headcount ratio in 2003 was estimated at 38.3%, although subsistence poverty was relatively lower at only 4.7%. Although there was a significant decline in rural poverty between 2003 and 2012, poverty rate in the rural areas remained significantly higher than in urban areas.

reduction in poverty incidences in the country and more particularly, in the rural areas. From a rate of 31.7% in 2003, poverty headcount ratio in Bhutan was reduced by more than a quarter, dropping to 23.2% in 2007. In 2012, Bhutan's poverty was further reduced and was estimated at 12.0%, almost half of the country's poverty incidence in 2007.

The sharp decline in poverty was more significant among the population living in the rural areas, with poverty headcount ratio reduced by almost 20% between 2003 and 2007 and by almost

Figure 25: Population Poverty and Subsistence Poverty Incidence by Area (%)



Source: Poverty Analysis Reports 2003, 2007, and 2012. National Statistics Bureau, Royal Government of Bhutan.

Tables 8.1 and 8.2 present the poverty and subsistence poverty incidences among the population and among households, respectively, in the urban and rural areas of Bhutan. Bhutan statistics on poverty, as presented in the tables show a dramatic

half (reduction of 46.0%) between 2007 and 2012. By 2012, poverty incidence in the rural areas was estimated at 16.7%. On the contrary, population poverty incidence in the urban areas slightly increased by one percentage point from 1.7% in 2007

Table 8.1: Poverty and Subsistence Poverty of Population by Area

Area	Poverty			Subsistence Poverty		
	2003	2007	2012	2003	2007	2012
Urban	4.2	1.7	1.8	0.031	0.16	0.3
Rural	38.3	30.9	16.7	4.7	8.0	3.9
Bhutan	31.7	23.2	12.0	3.8	5.9	2.8

Source: Poverty Analysis Reports 2003, 2007, and 2012. National Statistics Bureau, Royal Government of Bhutan.

Table 8.2: Poverty and Subsistence Poverty of Households by Area

Area	Poverty			Subsistence Poverty		
	2003	2007	2012	2003	2007	2012
Urban	3.0	1.1	1.4	0.02	0.11	0.2
Rural	31.6	23.8	12.4	3.4	5.4	2.6
Bhutan	24.7	16.9	8.6	2.6	3.8	1.8

Source: Poverty Analysis Reports 2003, 2007, and 2012. National Statistics Bureau, Royal Government of Bhutan.

to 1.8% in 2012. Similarly, poverty incidences among households showed a significant decline in the rural areas and in the whole country, in general, but slightly increased among households in the urban areas (Table 8.2).

Subsistence poverty among households and among the population increased between 2003 and 2007 both in the urban and rural areas. In the urban areas, subsistence poverty incidence continued to increase in 2012, although the rates remained lower than subsistence incidences in the rural areas. Subsistence incidence among rural households and rural populations both dropped by almost 50% between 2007 and 2012. A similar reduction in subsistence incidence was noted for the whole country, with population subsistence poverty in Bhutan declining from 5.9% in 2007 to 2.8% in 2012, and subsistence poverty among households declining from 3.8% in 2007 to 1.8% in 2012.

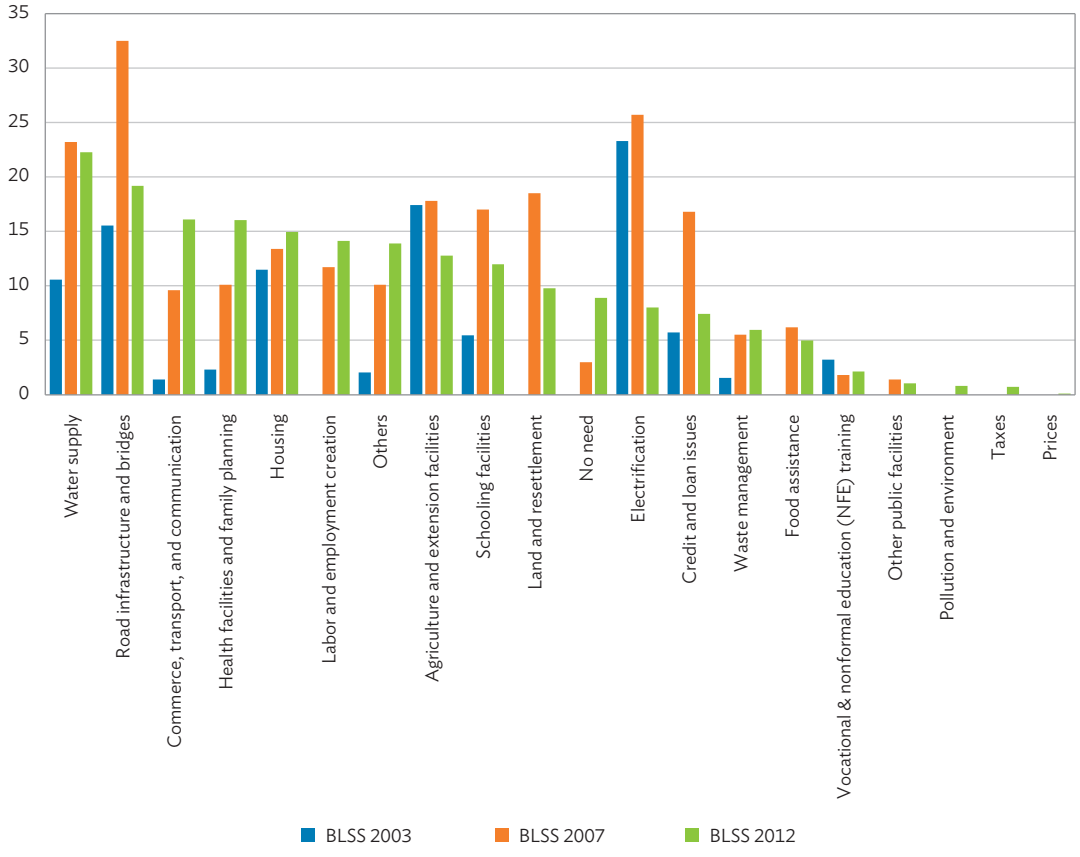
9. Priorities for Government Action

In 2003, households in Bhutan expressed that electrification should be the government's top priority, followed by agriculture and extension facilities and improvements in road infrastructure and bridges (Figure 26). Similarly, in 2007, upgrades in road infrastructure and electrification were still the top concerns of households in the country, with improvements in water supply as the third top priority that need government support. By 2012, some issues on household electrification may have already been addressed since it is no longer a top concern among households in Bhutan. However, the state of their roads and bridges, and water supply systems remain as top concerns, in addition to government support for commerce, transport, and communications.

As shown in Table A41, households in the rural areas responded consistently in all three surveys in which the government should prioritize improvements in road infrastructure and bridges. In 2003, 12.5% of surveyed households in the rural areas agreed that road infrastructure and bridges need to be improved while 44.3% in 2007 and 26.2% in 2012 responded the same. (Note: In BLSS 2007 and 2012, respondents were allowed to provide multiple responses; hence, data presented do not add up to 100%).

It is also notable that housing was consistently a major concern among households in the urban areas. About 12.6% of urban households in 2003, 22.3% in 2007, and 25.1% in 2012 considered support for housing should be one of the government's top priorities. Issues relating to labor and employment creation were also a major concern among urban households, particularly in 2007 and 2012.

Figure 26: Distribution of Households by Welfare Priorities in Bhutan (%)



Sources: BLSS 2003, 2007, and 2012.

Summary

This study has demonstrated that the BLSS can address the social data gaps in agricultural and rural statistics and support the analysis on the economic and social condition of Bhutan's urban and rural households.

The analysis of the three rounds of BLSS shows that rural households in Bhutan have become more prosperous since 2003. The poverty headcount ratio declined in the rural areas from 38.3 in 2003 to 16.7 in 2012. Results also indicate that between 2007 and 2012, the proportion of Bhutan households that owned family cars almost doubled. In the urban areas, households that owned family transport vehicles increased by almost 50%, while among rural households, the proportion more than doubled between 2007 and 2012.

In both urban and rural areas, the average monthly per capita spending has continually increased over the years. However, spending among individuals living in the rural areas grew faster than those living in urban areas. Compared to their average spending in 2003, average monthly per capita spending in the rural areas grew by 139.5% in 2012. Also, ownership of assets among rural households from kitchen and laundry appliances to electronic gadgets and other transport or mechanical equipment largely improved in 2012. The increased ownership of electronic devices and kitchen and laundry appliances among households in the rural areas possibly came after improvements in electricity services in the rural areas were made. Between 2003 and 2012, there were significant improvements in providing electricity services to households in the rural areas – from only less than a third of rural households (27.3%) having electricity in 2003, it increased to 87.3% in 2012. Electricity had become the most common source of energy for cooking and lighting among rural households in Bhutan.

In 2003 and 2007, urban households had easier access to tarred roads than rural households. About 89.1% (2003) and 63.9% (2007) of urban households could access tarred roads within one hour of travel, while only 45.0% (2003) and 50.0% (2007) of rural households, respectively, could reach tarred roads within one hour. On the contrary, rural households had more access to feeder roads than urban households during the same period.

With the addition of a new category of roads, 'farm roads' in BLSS 2012, results indicate that access to tarred roads among urban and rural households, and in Bhutan, in general, decreased between 2003 and 2012, regardless of the time it takes to reach tarred roads. However, access to feeder roads had gone up between 2003 and 2012 in both rural and urban areas. Although in 2012, it would take two hours or more for most people to reach the feeder roads – 58.3% among urban households and 42.9% among rural households. In addition, 76.4% of urban households and 83.6% of rural households had access to farm roads in 2012, that is, regardless of the time it takes for people to reach these roads. Understandably so, it takes a shorter time for people in the rural areas to reach farm roads than those living in urban areas – almost 50% of rural households could reach farm roads within an hour, while 64.4% of urban households would need two hours or more to reach farm roads.

Generally, in Bhutan, majority of the households indicated that they could reach and had access to hospitals and health centers, monasteries or temples, and schools within one hour of travel, based on BLSS 2012 results. About 79.0% of households could reach hospitals and health centers within an hour, 68.8% could reach monasteries or temples while 75.5% could easily access schools in an hour. Access to the post office, police stations, hospitals and health centers, and drugstores also improved between 2003 and 2012.

Similarly, majority of the households in both the rural and urban areas could easily access hospitals and health centers, monasteries or temples, and schools in 2012. Among households in the rural areas, at least 60% indicated that these institutions could be reached within an hour. Access to hospitals among rural households slightly improved, from 52.7% of households having access to hospitals within one hour of travel time in 2003, the proportion increased to almost 70% in 2012. Access by rural households to drugstores and pharmacies, police stations, and post offices likewise increased in the same period.

In the urban areas, more than 80% of households could access the post office, police stations, hospitals and health centers, monasteries or temples, and schools in one hour or less time in 2012. In addition, households in the urban areas had greater access to drugstores and *dzongkhag* headquarters with 76.7% and 67.1% of urban households, respectively, who could reach these services within one hour.

Generally, unemployment rates were higher in the urban areas than in the rural areas. Despite an increase in unemployment between 2003 and 2007 in both the rural and urban areas in Bhutan, unemployment rates had gone down in 2012 at rates which were lower than the recorded unemployment rates in 2003. Also, based on all three rounds of BLSS, unemployment among women in the urban areas was higher than men, while in the rural areas, unemployment among men was slightly higher than among women. Among the employed individuals in the urban areas in 2012, majority worked as employees in the services sector. On the other hand, in the rural areas, most of the employed individuals continued to work in the agriculture sector, based on the three BLSS reports.

Despite significant gains in both rural and urban areas in Bhutan, there are still many aspects that have not progressed. While literacy in the rural areas particularly among women improved significantly, rural women literacy remained to be below 50% in 2012. In addition, the proportion of household heads without formal education remained higher in the rural areas than in the urban areas and was also higher among female household heads than male household heads. In fact, in 2012, only a quarter of household heads in the rural areas had formal education. Lack of formal education among the rural population in Bhutan remain, with more than half (53.6%) of the population having no formal education in 2012, despite dropping from 69.4% in 2003.

School attendance among school children in the rural areas also lagged behind those from the urban areas. This shows that urban-rural disparities in school attendance remain. In 2003, there were 30.6% of rural population 3 years and over currently at school or have previously attended school compared to almost 65% in the urban areas. In 2012, school attendance in the rural areas was at 46.4%, although it improved, it remained below the urban school attendance rate of 71.4%. Gross attendance ratios (GAR) were likewise consistently higher in the urban areas than in the rural areas and were most evident in the secondary education level, where increasing disparities between urban and rural GARs in the higher secondary level were observed from 2003 to 2012. It is also notable that from 2003 to 2012, the need to work had consistently been in the top three reasons for nonattendance in school among children in the rural areas.

Generally, there were more people from the urban areas who visited hospitals or BHUs to get medical services for their illness or injury than among those in the rural areas. The disparity was highest in 2003 where 80.1% of the population from the urban areas visited hospitals or BHUs compared to 69.6% from the rural areas. However, in 2007 and 2012, the difference was slightly reduced.

In terms of public transport systems, more households in the urban areas than rural households expressed satisfaction, both in terms of frequency and costs. This implies that there is room for greater improvements in the rural public transportation systems in Bhutan.

In 2003 and 2007, agriculture and farm enterprises were the main source of income among households in Bhutan, in general, and among rural households, in particular. Meanwhile, wages and salaries were the main source of income among households in the urban areas. However, in 2012, wages and salaries had become the main source of income for both rural and urban households. Majority of the employed persons in the urban areas remained working as paid employees from 2003 to 2012. In 2003, almost two-thirds (63.1%) of employed persons in the urban areas in Bhutan were classified as 'employees'. This increased to 73.7% in 2012, posting an increase of 16.8% from 2003. Consequently, unpaid family workers in the urban areas decreased from 11.6% in 2003 to 5.4% in 2012.

In the rural areas, unpaid family workers accounted for majority of employed individuals from 2003 to 2012. However, similar to employment trends in the urban areas from 2003 to 2012, there was a decline in the proportion of employed persons working as unpaid family workers in the rural areas and a steady growth among those who worked as paid employees. In 2012, more than half (57.1%) of employed persons in rural Bhutan were unpaid family workers. However, this dropped by more than 20% from the rate of 73.4% in 2003. On the other hand, the proportion of employed persons in the rural areas who worked as employees significantly increased from just 3.7% in 2003 to more than a fifth (21.9%) of all employed persons in the rural areas in 2012.

There was also a slight decline in land ownership among rural households, from almost 90% of rural household landowners in 2003 to 83.5% in 2012. Livestock ownership in the rural areas and in Bhutan, in general, has gradually been declining since 2003. More than half (64.1%) of the households in the rural areas in 2003 owned poultry while 81.6% owned cattle. However, in 2012, the proportion of rural households that owned poultry was reduced to 44.0% while household cattle owners dropped to 67.0%.

Based on the 2005 Census, a total of 111,770 migrants moved from the rural areas to the urban areas, while about 20,000 (19,992) moved from the urban to the rural areas. This resulted in net urban migrants of 91,778, which consisted almost half or 46.8% of the urban population in Bhutan in 2005. The movement of the population from the rural areas to the urban centers suggests that more and more people in the rural areas are migrating to the cities and other urban centers possibly to work or find other sources of livelihood. In fact, the proportion of employed persons in both the rural and urban areas who worked as paid employees steadily increased between 2003 and 2012. With the continuing boom in urban migration in Bhutan, support for housing, transportation, and other services need to be improved in the urban centers. Likewise, better access to education and training would help the potential workforce become more competitive in the labor market.

Lastly, improvements in infrastructure particularly of roads and bridges, water supply systems, as well as improved support for commerce, transport and communications were the top areas of concern that the government should prioritize at the national level, based on BLSS 2012 results. In the rural areas, improvements in road infrastructure and bridges were a top concern, while housing and labor and employment creation were the major concerns among urban households.

Appendix: Statistical Tables

Demographic Characteristics

Table A1: Average Household Size by Area

Area	BLSS 2003	BLSS 2007	BLSS 2012
Urban	4.3	4.4	4.1
Rural	5.4	5.3	4.8
Bhutan	5.1	5.0	4.5

Table A2: Distribution of Households by Area and by Gender of Household Head

Area	Gender of Household Head	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Male	20,700	29,600	35,073
	Female	3,700	8,100	8,442
	Total	24,400	37,800	43,515
Rural	Male	53,000	57,300	55,357
	Female	29,500	30,400	29,071
	Total	82,500	87,700	84,427
Bhutan	Male	73,700	87,000	90,430
	Female	33,200	38,500	37,512
	Total	106,900	125,500	127,942

Table A3: Distribution of Households by Area and by Age of Household Head

Area	Age Group of Household Head	BLSS 2003	BLSS 2007	BLSS 2012
Urban	19 or less	129	200	139
	20 – 39	14,869	23,800	25,883
	40 – 59	7,979	12,000	14,741
	60+	1,423	1,800	2,751
	Total	24,400	37,800	43,515
Rural	19 or less	74	300	321
	20 – 39	19,148	25,300	24,754
	40 – 59	39,468	40,800	36,945
	60+	23,810	21,300	22,407
	Total	82,500	87,700	84,427
Bhutan	19 or less	203	500	460
	20 – 39	34,005	49,200	50,637
	40 – 59	47,453	52,800	51,685
	60+	25,228	23,000	25,159
	Total	106,900	125,500	127,942

Table A4: Distribution of the Population by Area

Area	Population			Share (%)		
	BLSS 2003	BLSS 2007	BLSS 2012	BLSS 2003	BLSS 2007	BLSS 2012
Urban	105,277.05	166,300.00	180,287.00	19.24	26.41	31.00
Rural	441,900.95	463,400.00	400,970.00	80.76	73.59	69.00
Bhutan	547,178.00	629,700.00	581,257.00	100.00	100.00	100.00

Table A5: Distribution of the Population by Area and by Relationship to the Household Head (%)

Area	Relation to Head of Household	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Household head	4.45	6.00	7.50
	Spouse	3.54	4.89	5.80
	Son or daughter	8.70	11.02	12.90
	Parent or grandparent	0.22	0.37	0.60
	Brother or sister	0.47	0.97	1.10
	Nephew, niece, or grandchild	0.73	1.30	1.40
	In-law1/	0.45	0.89	1.00
	Other2/	0.68	1.00	0.80
	Total	19.24	26.41	31.00
Rural	Household head	15.08	13.93	14.50
	Spouse	10.80	10.43	11.00
	Son or daughter	33.43	30.57	26.50
	Parent or grandparent	1.75	1.84	2.20
	Brother or sister	1.84	2.02	1.50
	Nephew, niece, or grandchild	11.66	9.54	8.70
	In-law1/	4.84	3.81	3.80
	Other2/	1.36	1.45	0.80
	Total	80.76	73.59	69.00
Bhutan	Household head	19.53	19.93	22.00
	Spouse	14.34	15.32	16.80
	Son or daughter	42.13	41.58	39.40
	Parent or grandparent	1.97	2.19	2.80
	Brother or sister	2.31	2.99	2.60
	Nephew, niece, or grandchild	12.39	10.83	10.00
	In-law1/	5.29	4.70	4.80
	Other2/	2.05	2.45	1.50
	Total	100.00	100.00	100.00

Notes: 1/ Includes father-, mother-, brother-, or sister-in-law.
2/ Includes other relatives, live-in-servants, and other nonrelatives.

Table A6: Distribution of the Population by Marital Status in Bhutan (%)

Area	Marital Status	BLSS 2003	BLSS 2007	BLSS 2012
Bhutan	Never married	53.03	52.30	49.31
	Living together	-	-	0.12
	Married	40.81	41.55	44.87
	Divorced	1.36	1.64	1.85
	Separated	0.64	0.54	0.33
	Widow or widower	4.15	3.99	3.52
	Total	100.00	100.00	100.00

Table A7: Distribution of the Population by Area, by Age Group, and by Gender (%)

Area	Age Group	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	0-4	5.52	5.47	10.99	5.29	5.05	10.34	5.11	5.10	10.21
	5-9	6.55	6.46	13.01	5.65	5.17	10.82	5.07	5.22	10.29
	10-14	6.57	7.93	14.50	5.71	6.61	12.33	5.07	5.28	10.36
	15-19	4.92	6.21	11.13	4.69	6.92	11.61	4.63	5.82	10.45
	20-24	3.16	5.37	8.53	4.75	6.55	11.30	4.69	6.36	11.05
	25-29	4.38	6.07	10.45	5.47	5.95	11.43	5.85	6.44	12.28
	30-34	4.27	3.72	7.99	4.39	4.21	8.60	4.85	4.74	9.59
	35-39	4.18	3.63	7.81	4.03	3.37	7.40	3.83	3.62	7.44
	40-44	2.67	2.35	5.02	2.59	2.16	4.75	2.89	2.43	5.32
	45-49	2.63	1.23	3.86	2.16	1.56	3.73	2.44	1.92	4.35
	50-54	1.40	0.88	2.27	1.68	1.20	2.89	1.63	1.26	2.89
	55-59	0.64	0.59	1.23	1.02	0.60	1.62	1.06	0.75	1.81
	60+	1.63	1.59	3.22	1.50	1.74	3.25	2.02	1.94	3.96
	Total	48.50	51.50	100.00	48.95	51.05	100.00	49.13	50.87	100.00
Rural	0-4	4.31	4.62	8.93	4.68	4.45	9.13	4.24	4.04	8.28
	5-9	6.14	5.79	11.93	5.46	5.37	10.83	4.95	4.70	9.65
	10-14	6.26	6.96	13.22	6.28	6.34	12.62	5.75	5.31	11.06
	15-19	5.69	5.91	11.60	5.61	5.89	11.50	5.49	5.43	10.93
	20-24	3.68	4.30	7.98	4.08	4.49	8.57	4.28	4.70	8.98
	25-29	2.57	3.71	6.28	3.24	3.82	7.06	3.45	4.00	7.45
	30-34	2.41	2.90	5.31	2.76	3.37	6.13	2.86	3.19	6.05
	35-39	2.00	2.98	4.98	2.52	2.83	5.35	2.69	3.23	5.92
	40-44	2.68	2.80	5.48	2.35	2.74	5.09	2.49	2.72	5.22
	45-49	2.75	2.88	5.63	2.40	2.74	5.14	2.44	2.93	5.37
	50-54	2.10	2.38	4.48	2.35	2.44	4.79	2.38	2.65	5.03
	55-59	1.74	1.91	3.65	2.03	1.90	3.93	2.06	2.18	4.24
	60+	5.69	4.84	10.53	5.20	4.70	9.91	6.25	5.57	11.83
	Total	48.02	51.98	100.00	48.94	51.06	100.00	49.35	50.65	100.00
Bhutan	0-4	4.55	4.78	9.33	4.84	4.59	9.43	4.51	4.37	8.88
	5-9	6.22	5.92	12.14	5.51	5.32	10.83	4.98	4.86	9.85
	10-14	6.32	7.14	13.46	6.13	6.42	12.55	5.54	5.30	10.84
	15-19	5.54	5.97	11.51	5.35	6.16	11.51	5.23	5.55	10.78
	20-24	3.58	4.51	8.08	4.24	5.02	9.26	4.41	5.21	9.62
	25-29	2.92	4.17	7.08	3.83	4.38	8.21	4.20	4.75	8.95
	30-34	2.77	3.06	5.83	3.18	3.57	6.75	3.48	3.67	7.15
	35-39	2.42	3.10	5.52	2.92	2.97	5.89	3.04	3.35	6.39
	40-44	2.68	2.72	5.40	2.41	2.60	5.02	2.62	2.63	5.25
	45-49	2.73	2.56	5.29	2.33	2.43	4.76	2.44	2.62	5.06
	50-54	1.96	2.09	4.05	2.18	2.11	4.29	2.15	2.22	4.37
	55-59	1.52	1.66	3.18	1.76	1.56	3.32	1.75	1.74	3.49
	60+	4.91	4.21	9.12	4.22	3.92	8.15	4.94	4.45	9.38
	Total	48.11	51.89	100.00	48.94	51.06	100.00	49.28	50.72	100.00

Table A8: Distribution of the Population by Area and by Age Group, and Dependency Ratios

Area	Age Group	BLSS 2003	BLSS 2007	BLSS 2012
Urban	0-14	38.48	33.49	30.86
	15-59	58.30	63.32	65.19
	60+	3.22	3.25	3.96
	Total	100.00	100.00	100.00
	Dependency Ratio	71.53	58.00	53.41
Rural	0-14	34.08	32.59	28.99
	15-59	55.39	57.55	59.19
	60+	10.53	9.91	11.83
	Total	100.00	100.00	100.00
	Dependency Ratio	80.54	74.00	68.95
Bhutan	0-14	34.93	32.81	29.57
	15-59	55.95	59.01	61.05
	60+	9.12	8.15	9.38
	Total	100.00	100.00	100.00
	Dependency Ratio	78.73	69.00	63.80

Education

Table A9: Literacy Rate of Population 6 Years and Above by Area, by Age Group, and by Gender (%)

Area	Age Group	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	6-9	68.02	69.54	68.78	77.10	76.80	77.00	92.90	95.00	94.00
	10-14	95.86	88.32	91.74	97.70	89.60	93.40	99.30	97.50	98.40
	15-19	93.20	82.14	87.03	96.50	86.50	90.50	98.10	94.30	96.00
	20-24	86.75	63.62	72.19	86.50	76.20	80.50	92.80	83.50	87.50
	25-29	80.36	52.43	64.14	87.20	63.40	74.80	88.20	71.40	79.40
	30-34	83.01	44.77	65.18	81.90	50.30	66.40	85.70	62.90	74.40
	35-39	81.35	38.72	61.53	80.40	40.70	62.40	82.00	53.60	68.20
	40-44	76.62	30.76	55.14	77.60	39.70	60.30	77.40	46.50	63.30
	45-49	82.68	23.42	63.81	74.90	30.50	56.40	79.20	42.30	62.90
	50-54	80.27	18.98	56.65	78.20	19.80	54.10	75.20	29.90	55.50
	55+	48.22	10.63	29.75	57.30	9.50	34.60	56.90	15.20	37.50
	All ages	81.72	59.88	70.42	84.00	64.90	74.20	86.70	72.00	79.20
Rural	6-9	45.57	38.35	42.07	57.50	54.00	55.80	79.50	80.20	79.80
	10-14	76.03	66.44	70.98	88.10	83.00	85.50	97.10	96.10	96.60
	15-19	74.20	52.70	63.25	84.60	74.80	79.60	92.80	88.60	90.70
	20-24	53.39	31.97	41.84	73.60	55.00	63.80	82.40	67.20	74.40
	25-29	50.05	15.75	29.79	64.30	38.30	50.20	72.00	53.40	62.00
	30-34	39.34	10.37	23.51	56.90	23.70	38.60	67.30	38.00	51.80
	35-39	39.20	6.74	19.79	49.00	15.10	31.10	54.00	25.10	38.20
	40-44	35.61	3.41	19.14	42.70	9.90	24.90	51.50	16.50	33.20
	45-49	25.77	2.08	13.65	42.60	5.80	22.90	42.40	10.00	24.70
	50-54	34.31	2.15	17.23	39.40	5.10	22.00	33.70	8.60	20.50
	55+	20.52	0.89	11.18	27.90	2.60	15.80	28.20	3.30	16.20
	All ages	47.34	26.53	36.50	59.30	39.20	49.00	65.00	47.10	55.90
Bhutan	6-9	50.16	44.96	47.62	62.70	59.90	61.30	83.60	85.10	84.40
	10-14	80.00	71.11	75.28	90.50	84.80	87.60	97.70	96.50	97.10
	15-19	77.45	58.59	67.67	87.30	78.20	82.50	94.20	90.40	92.30
	20-24	59.06	39.22	48.00	77.40	62.20	69.10	85.80	73.40	79.10
	25-29	58.80	26.03	39.53	73.00	47.40	59.30	79.00	61.00	69.40
	30-34	52.28	18.42	34.50	66.00	32.00	47.90	75.20	48.00	61.20
	35-39	53.20	13.94	31.14	60.40	22.70	41.40	64.90	34.60	49.10
	40-44	43.48	7.97	25.59	52.60	16.50	33.80	60.40	25.10	42.70
	45-49	36.35	4.05	20.70	50.50	10.00	29.80	53.80	17.40	34.90
	50-54	40.59	3.51	21.48	47.30	7.30	27.70	43.50	12.30	27.70
	55+	22.40	1.59	12.47	31.00	3.30	17.80	32.30	4.90	19.20
	All ages	53.86	32.79	42.90	65.70	45.90	55.50	71.60	54.70	63.00

Table A10: Distribution of Heads of Households by Area, by Educational Attainment, and by Gender (%)

Area	Highest Level Attained	BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total
Urban	None	36.80	59.20	48.30	27.50	41.80	30.30
	Up to Grade 8	27.70	18.70	23.10	28.40	17.90	26.40
	Grade 9-12	15.50	12.60	14.00	26.90	30.50	27.60
	Beyond Grade 12	20.00	9.40	14.60	17.20	9.80	15.70
	Total number of heads of households	29,600	8,100	37,800	35,073	8,442	43,515
Rural	None	74.10	87.20	80.90	69.80	86.70	75.60
	Up to Grade 8	20.00	9.40	14.50	18.40	7.80	14.70
	Grade 9-12	3.40	2.30	2.90	7.10	3.90	6.00
	Beyond Grade 12	2.40	1.10	1.80	4.80	1.70	3.70
	Total number of heads of households	57,300	30,400	87,700	55,357	29,071	84,427
Bhutan	None	65.20	80.60	73.20	53.40	76.60	60.20
	Up to Grade 8	21.90	11.60	16.50	22.30	10.00	18.70
	Grade 9-12	6.30	4.70	5.50	14.80	9.90	13.30
	Beyond Grade 12	6.70	3.10	4.80	9.60	3.50	7.80
	Total number of heads of households	87,000	38,500	125,500	90,430	37,512	127,942

Table A11: Educational Status of Persons 3 Years and Above by Area and by Gender (%)

Area	Educational Status	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	Currently attending	36.21	34.77	35.47	34.40	33.90	34.10	34.50	33.70	34.10
	Attended in the past	37.46	21.71	29.30	41.50	27.00	34.10	43.90	30.90	37.30
	Never attended	26.33	43.52	35.23	24.20	39.20	31.90	21.70	35.40	28.60
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Rural	Currently attending	24.76	18.70	21.62	18.90	9.80	14.20	30.80	27.80	29.30
	Attended in the past	12.12	6.05	8.97	26.80	24.10	25.40	21.80	12.50	17.10
	Never attended	63.11	75.25	69.41	54.30	66.10	60.30	47.40	59.60	53.60
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Bhutan	Currently attending	26.94	21.75	24.25	28.80	26.70	27.70	31.90	29.70	30.80
	Attended in the past	16.95	9.02	12.83	24.80	14.30	19.40	28.60	18.20	23.30
	Never attended	56.11	69.23	62.92	46.40	59.10	52.90	39.50	52.10	45.90
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table A12: Gross Attendance Ratios by Area, by Educational Level, and by Gender (%)

Area	Educational Level	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	Primary	112.57	105.65	109.01	116.70	111.00	113.80	113.00	108.60	110.80
	Lower secondary	90.16	84.84	87.17	98.80	96.20	97.40	112.70	107.20	109.80
	Middle secondary	73.47	81.29	77.52	91.30	81.70	85.60	99.60	93.00	96.00
	Higher secondary	55.20	29.23	39.90	76.40	49.70	60.10	98.70	93.40	95.80
	Total	95.14	84.66	89.53	105.00	92.90	98.50	108.80	103.30	105.90
Rural	Primary	96.30	80.55	88.32	109.90	105.70	107.80	118.40	119.20	118.80
	Lower secondary	52.35	43.29	47.66	56.20	61.60	58.90	92.30	105.90	98.80
	Middle secondary	43.86	29.32	36.93	48.30	40.90	44.60	70.20	66.10	68.10
	Higher secondary	11.82	2.85	7.03	22.10	12.70	17.30	49.50	33.50	41.60
	Total	66.18	52.16	59.04	78.50	74.00	76.30	95.50	94.20	94.80
Bhutan	Primary	99.66	85.86	92.65	111.70	107.10	109.40	116.80	115.70	116.30
	Lower secondary	59.41	52.27	55.65	66.30	71.20	68.80	97.70	106.30	101.90
	Middle secondary	49.15	39.93	44.69	58.10	52.90	55.40	78.40	74.60	76.40
	Higher secondary	18.94	8.06	13.02	34.50	24.00	28.80	62.80	52.60	57.60
	Total	71.74	58.93	65.15	85.10	79.20	82.10	99.40	97.10	98.20

Table A13: Distribution of Children Aged 6-16 Years[1/] Not in School by Area, by Main Reason for Nonattendance, and by Gender (%)

Area	Reason for Nonattendance	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	Poor teaching	...	...	...	-	-	-	0.00	1.10	0.80
	Caring for sick relative	...	...	...	-	-	-	0.00	2.10	1.50
	Problems at home	-	13.97	11.84	11.20	19.20	16.90	0.00	5.30	3.80
	Disability	...	...	...	...	...	...	2.70	4.50	4.00
	Did not qualify	-	11.53	10.69	22.90	6.20	11.00	2.50	5.60	4.70
	Illness[2/]	-	-	10.20	5.80	5.00	5.20	4.90	7.50	6.70
	Needs to work	-	-	8.22	13.10	14.80	14.30	6.30	9.80	8.80
	Others	-	-	10.69	21.10	14.70	16.50	15.10	8.90	10.80
	Not interested	44.59	14.63	22.37	4.30	4.60	4.50	18.90	12.30	14.30
	Too young or old	...	...	...	15.90	9.80	11.50	33.80	12.40	18.80
	Cannot afford	-	27.05	20.07	4.30	22.90	17.60	15.70	30.40	26.10
	Pregnancy	...	...	...	0.00	0.60	0.40	...	...	...
	School is too far	-	-	4.93	1.40	2.30	2.00	...	...	...
Rural	Pregnancy	...	...	...	0.47	0.70	0.70	0.70	0.00	0.40
	Caring for sick relative	...	...	...	0.30	0.10	0.20	0.70	1.70	1.20
	Illness[2/]	-	4.57	0.73	3.10	4.10	3.70	2.40	1.20	1.80
	Disability	...	...	...	...	...	...	3.10	3.00	3.00
	School is too far	2.98	3.58	3.29	8.50	8.80	8.70	1.70	4.40	3.10
	Problems at home	14.54	16.25	15.42	6.30	9.60	8.20	4.10	3.60	3.90
	Did not qualify	9.12	10.17	9.66	8.80	7.40	8.00	6.90	8.10	7.50
	Not interested	29.26	19.49	24.25	11.30	8.20	9.50	11.70	9.10	10.40
	Others	15.51	9.08	12.21	13.50	11.90	12.60	12.30	10.30	11.30
	Needs to work	19.64	30.72	25.32	13.70	14.30	14.10	15.30	19.60	17.50
	Cannot afford	8.94	6.14	7.51	13.10	16.80	15.20	20.80	18.70	19.70
	Too young or old	...	...	...	20.50	17.90	19.00	20.30	20.30	20.30
	Poor teaching	...	...	...	0.20	0.10	0.10	...	...	...
Bhutan	Poor teaching	...	...	...	0.10	0.10	0.10	0.00	0.20	0.10
	Pregnancy	...	...	...	0.60	0.70	0.70	0.60	0.00	0.30
	Caring for sick relative	...	...	...	0.30	0.10	0.20	0.60	1.80	1.30
	Illness[2/]	-	-	1.64	3.40	4.20	3.90	2.70	2.50	2.60
	School is too far	2.82	-	3.45	7.80	7.80	7.80	1.50	3.50	2.60
	Disability	...	...	...	...	...	...	3.10	3.30	3.20
	Problems at home	14.07	15.94	15.07	6.70	11.10	9.30	3.70	4.00	3.90
	Did not qualify	9.08	-	9.76	10.10	7.20	8.40	6.50	7.60	7.10
	Not interested	30.08	18.84	24.07	10.70	7.60	8.90	12.50	9.80	11.00
	Others	15.43	-	12.07	14.20	12.30	13.10	12.60	10.00	11.20
	Needs to work	19.24	27.54	23.68	13.70	14.40	14.10	14.40	17.60	16.10
	Too young or old	...	...	...	20.10	16.60	18.00	21.60	18.70	20.10
	Cannot afford	8.46	-	8.71	12.30	17.80	15.50	20.30	21.20	20.80

Notes: 1/ For BLSS 2003, refers to children aged 7–17 years. For BLSS 2007 and BLSS 2012, refers to children aged 6–16 years.
2/ For BLSS 2003, includes caring for sick relative.
* For BLSS 2003 and BLSS 2007, "-" indicates a sample estimate less than 100 persons. Estimates not sufficiently reliable because of small number of observations.

Health

Table A14: Distribution of Persons Who Were Sick or Injured 4 Weeks before the Survey by Area, and by Gender (%)

Area	Gender	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Male	10.41	12.70	12.50
	Female	13.59	16.40	15.20
	Total	12.05	14.60	13.90
Rural	Male	14.88	14.20	15.60
	Female	16.65	18.00	21.50
	Total	15.80	16.20	18.60
Bhutan	Male	14.02	13.80	14.60
	Female	16.06	17.60	19.50
	Total	15.08	15.70	17.10

Table A15: Distribution of Persons Who Did Not Consult Any Health Service Provider by Area, by Reason Given, and by Gender (%)

Area	Reason for Not Consulting a Health Provider	BLSS 2003			BLSS 2007[1/]			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	No need	80.86	67.79	72.48	82.00	69.00	75.00	95.00	95.50	95.30
	No time	5.25	16.47	12.45	13.60	19.90	17.00	0.40	0.30	0.40
	No money	0.00	0.00	0.00	1.10	2.80	2.00	0.10	0.10	0.10
	No transport/Too far	6.75	0.00	2.42	2.50	4.40	3.50	0.00	0.00	0.00
	No trust	0.00	0.52	0.34	2.90	0.00	1.30	0.00	0.10	0.10
	Other reasons	7.13	15.22	12.31	24.40	40.20	33.00	4.70	4.30	4.50
	Total	100.00	100.00	100.00	126.50	136.30	131.80	100.00	100.00	100.00
Rural	No need	41.89	25.87	31.30	59.80	56.90	58.10	97.00	97.10	97.00
	No time	20.51	25.17	23.59	33.80	30.30	31.80	0.30	0.40	0.40
	No money	3.03	3.37	3.25	6.80	9.00	8.10	0.20	0.00	0.10
	No transport/Too far	19.72	22.98	21.87	28.00	32.60	30.70	0.30	0.50	0.40
	No trust	0.00	0.69	0.46	6.70	2.60	4.30	0.00	0.00	0.00
	Other reasons	14.86	21.92	19.53	23.00	25.20	24.30	2.50	2.40	2.40
	Total	100.00	100.00	100.00	158.10	156.60	157.30	100.00	100.00	100.00
Bhutan	No need	46.08	30.04	35.51	64.20	59.00	61.20	96.40	96.60	96.50
	No time	18.87	24.30	22.45	29.80	28.50	29.10	0.40	0.40	0.40
	No money	2.70	3.04	2.92	5.70	7.90	7.00	0.10	0.00	0.10
	No transport/Too far	18.32	20.69	19.88	23.00	27.70	25.70	0.20	0.30	0.30
	No trust	0.00	0.69	0.45	5.90	2.10	3.70	0.00	0.00	0.00
	Other reasons	14.03	21.26	18.79	23.30	27.80	25.90	3.20	2.90	3.10
	Total	100.00	100.00	100.00	151.90	153.00	152.60	100.00	100.00	100.00

Note: 1/ For BLSS 2007, distribution by gender and by area sums up to more than 100%.

Table A16: Distribution of Persons Who Were Sick or Injured 4 Weeks before the Survey by Area, by Type of Health Service Provider First Visited, and by Gender (%)

Area	Type of Health Service Provider	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	Private doctor/nurse	6.96	4.41	5.48	1.70	2.00	1.90	...	...	...
	Hospital/BHU[1/]	80.53	79.73	80.06	79.10	78.70	78.90	68.80	70.40	69.70
	Pharmacist/chemist	...	...	...	4.40	5.60	5.10	0.00	0.00	0.00
	Dentist	...	...	...	0.00	0.70	0.40	...	...	...
	Retail shop	...	...	...	...	...	...	0.00	0.00	0.00
	Indigenous centers	...	...	...	0.50	0.90	0.80	0.70	0.80	0.80
	Traditional practioner[2/]	1.09	1.28	1.20	2.10	1.30	1.70	0.20	0.10	0.10
	Self	...	...	...	...	...	...	0.00	0.10	0.00
	Others	0.00	1.67	1.32	0.80	0.80	0.80	2.30	2.90	2.60
	None	10.59	12.92	11.94	11.40	10.10	10.60	28.20	25.70	26.80
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Rural	Private doctor/nurse	1.68	2.17	1.94	0.60	1.10	0.90	...	...	...
	Hospital/BHU[1/]	68.79	70.24	69.59	72.90	71.90	72.30	63.40	66.60	65.40
	Pharmacist/chemist	...	...	...	1.40	1.40	1.40	0.00	0.00	0.00
	Dentist	...	...	...	0.40	0.20	0.30	...	...	...
	Retail shop	...	...	...	...	...	...	0.00	0.10	0.00
	Indigenous centers	...	...	...	0.50	0.40	0.40	0.10	0.40	0.30
	Traditional practioner[2/]	10.66	8.49	9.47	7.20	7.20	7.20	0.10	0.10	0.10
	Self	...	...	...	...	...	...	0.00	0.00	0.00
	Others	4.85	3.25	3.97	2.30	2.30	2.30	1.00	0.90	0.90
	None	14.02	15.85	15.02	14.70	15.40	15.10	35.40	31.80	33.30
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Bhutan	Private doctor/nurse	2.44	2.53	2.49	0.90	1.40	1.20	...	...	...
	Hospital/BHU[1/]	70.48	71.77	71.20	74.40	73.60	73.90	64.80	67.60	66.40
	Pharmacist/chemist	...	...	...	2.10	2.40	2.30	0.00	0.00	0.00
	Dentist	...	...	...	0.30	0.30	0.30	...	...	...
	Retail shop	...	...	...	...	...	...	0.00	0.00	0.00
	Indigenous centers	...	...	...	0.50	0.50	0.50	0.30	0.50	0.40
	Traditional practioner[2/]	9.28	7.33	8.20	6.00	5.80	5.90	0.10	0.20	0.10
	Self	...	...	...	...	...	...	0.00	0.00	0.00
	Others	4.27	2.99	3.56	1.90	2.00	1.90	1.30	1.40	1.40
	None	13.52	15.38	14.55	13.90	14.10	14.00	33.50	30.40	31.70
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes: 1/ For BLSS 2012, includes Jigme Dorji Wangchuck National Referral Hospital (JDWNRH), Government regional referral hospital, Government district hospital, Government BHU or outreach clinic (ORC), Other private hospital or clinic, Indian hospital paid by government, Indian hospital paid by self, Thai hospital paid by government, and Thai hospital paid by self.
2/ For BLSS 2012, includes ***lama***, ***pandit*** or priest.

Employment

Table A17: Population 15 Years and Above by Area–Specific and Gender-Specific Labor Activity Status, Labor Force Participation Rate, and Unemployment Rate

Area	Activity Status (no.), Labor Force Participation Rate (LFPR) (%), and Unemployment Rate (%)	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	Employed	23,400	10,800	34,300	39,000	21,400	60,400	42,673	19,544	62,216
	Unemployed	1,000	1,400	2,400	2,200	2,300	4,400	1,706	2,109	3,815
	Inactive	7,000	21,100	28,100	12,500	33,300	45,700	17,652	42,958	60,610
	Total	31,400	33,300	64,700	53,700	56,900	110,600	62,031	64,610	126,641
	LFPR	77.78	36.67	56.63	76.80	41.50	58.60	71.50	33.50	52.10
	Unemployment Rate	4.22	11.18	6.54	5.30	9.50	6.80	3.80	9.70	5.80
Rural	Employed	104,100	113,100	217,200	107,700	106,000	213,600	93,889	82,945	176,833
	Unemployed	3,200	2,000	5,100	3,200	3,000	6,200	1,610	1,302	2,912
	Inactive	31,100	37,800	68,900	39,700	52,800	92,600	43,690	63,537	107,227
	Total	138,300	153,000	291,300	150,600	161,700	312,400	139,188	147,784	286,972
	LFPR	77.52	75.27	76.34	73.60	67.30	70.40	68.60	57.00	62.60
	Unemployment Rate	2.94	1.74	2.32	2.90	2.70	2.80	1.70	1.50	1.60
Bhutan	Employed	127,500	124,000	251,500	146,700	127,300	274,100	136,561	102,488	239,049
	Unemployed	4,200	3,400	7,500	5,400	5,200	10,600	3,317	3,410	6,727
	Inactive	38,100	59,000	97,000	52,200	86,100	138,300	61,342	106,495	167,837
	Total	169,800	186,300	356,000	204,300	218,700	423,000	201,219	212,394	413,613
	LFPR	77.57	68.37	72.76	74.40	60.60	67.30	69.50	49.90	59.40
	Unemployment Rate	3.18	2.64	2.91	3.50	3.90	3.70	2.40	3.20	2.70

Table A18: Distribution of Employed Persons by Area, by Employment Status in Main Occupation, and by Gender (%)

Area	Employment Status	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	Employee	73.92	40.78	63.10	79.74	44.39	67.22	79.30	61.90	73.70
	Regular paid employee	...	...	...	75.13	40.19	62.75	71.60	55.60	66.50
	Casual paid employee	...	...	...	4.62	4.21	4.47	7.70	6.30	7.20
	Member of cooperative	2.01	2.76	2.25	...	...	...	...	...	...
	Unpaid family worker[1/]	4.72	25.87	11.62	3.85	19.63	9.44	3.00	10.80	5.40
	Own account worker	16.16	23.73	18.63	16.15	35.05	22.85	15.30	24.20	18.10
	Employer	0.67	0.75	0.70	0.26	0.47	0.33	1.30	1.00	1.20
	Collective farmer	0.09	0.26	0.15	...	...	...	...	...	...
	Others and unspecified	2.44	5.85	3.55	0.26	0.47	0.17	1.20	2.10	1.50
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Rural	Employee	6.22	1.40	3.69	19.87	5.00	12.55	29.90	12.80	21.90
	Regular paid employee	...	...	...	13.46	3.30	8.43	17.40	6.10	12.10
	Casual paid employee	...	...	...	6.41	1.70	4.12	12.50	6.70	9.80
	Member of cooperative	0.82	1.41	1.13	...	...	...	...	...	...
	Unpaid family worker[1/]	64.79	81.24	73.43	48.56	72.26	60.35	48.30	67.00	57.10
	Own account worker	22.13	13.01	17.34	31.01	22.17	26.64	16.50	16.10	16.30
	Employer	0.12	0.04	0.08	0.19	0.09	0.14	0.40	0.10	0.20
	Collective farmer	1.51	1.26	1.38	...	...	...	...	...	...
	Others and unspecified	4.41	1.63	2.95	0.28	0.38	0.37	4.90	4.00	4.50
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Bhutan	Employee	18.16	4.77	11.48	35.79	11.70	24.59	45.30	22.10	35.40
	Regular paid employee	...	...	...	29.86	9.51	20.39	34.30	15.50	26.30
	Casual paid employee	...	...	...	5.93	2.20	4.20	11.00	6.60	9.10
	Member of cooperative	1.03	1.53	1.28	...	...	...	...	...	...
	Unpaid family worker[1/]	54.20	76.49	65.33	36.67	63.47	49.07	34.10	56.30	43.60
	Own account worker	21.08	13.93	17.51	27.06	24.35	25.79	16.10	17.60	16.80
	Employer	0.22	0.11	0.16	0.20	0.16	0.18	0.70	0.30	0.50
	Collective farmer	1.26	1.18	1.22	...	...	...	...	...	...
	Others and unspecified	4.06	2.00	3.03	0.27	0.39	0.33	3.80	3.70	3.70
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: 1/ For BLSS 2003, refers to "family worker".

Table A19: Distribution of Employed Persons by Area, by Sector of Employment in Main Occupation, and by Gender (%)

Area	Employment Sector	BLSS 2003			BLSS 2007			BLSS 2012		
		Male	Female	Total	Male[1/]	Female	Total	Male	Female	Total
Urban	Agriculture	2.57	12.93	5.85	2.30	13.20	6.90	5.34	11.25	7.20
	Industry	10.66	11.02	10.77	24.00	51.10	42.00	21.03	13.10	18.53
	Services	17.77	28.04	21.02	37.50	30.20	48.20	70.68	71.87	71.06
	Others	69.00	48.01	62.36	1.00	5.50	2.90	2.95	3.78	3.21
	Total	100.00	100.00	100.00	64.80	100.00	100.00	100.00	100.00	100.00
Rural	Agriculture	86.20	95.93	91.27	76.90	90.30	83.50	71.92	88.17	79.54
	Industry	2.56	0.37	1.42	8.30	5.30	6.80	5.97	2.44	4.31
	Services	1.98	1.72	1.85	11.90	2.90	7.40	21.10	9.09	15.47
	Others	9.26	1.98	5.47	2.80	1.60	2.20	1.01	0.30	0.68
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Bhutan	Agriculture	70.84	88.67	79.63	57.40	77.30	66.60	51.14	73.50	60.72
	Industry	4.04	1.30	2.69	16.00	13.00	14.60	10.67	4.47	8.01
	Services	4.88	4.03	4.46	24.20	7.40	16.40	36.58	21.07	29.93
	Others	20.24	6.01	13.22	2.50	2.30	2.40	1.62	0.96	1.34
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes: 1/ For BLSS 2007, distribution of male persons employed in urban areas does not tally to 100%, based on the BLSS 2007 Report.
2/ For BLSS 2012, estimates were calculated based on available BLSS 2012 survey data. The employment sector categories were identified based on responses to Question E8.

Household Expenditure

Table A20: Mean Monthly Household and Mean Monthly Per Capita Consumption Expenditure by Area (Nu)

Area	Monthly Household Consumption Expenditure			Monthly Per Capita Consumption Expenditure		
	BLSS 2003	BLSS 2007	BLSS 2012	BLSS 2003	BLSS 2007	BLSS 2012
Urban	13,974.78	20,777.00	24,046.75	2,982.22	4,718.00	5,804.06
Rural	8,475.42	10,829.00	15,440.07	1,357.58	2,050.00	3,251.02
Bhutan	9,890.07	13,823.00	18,367.32	1,728.10	2,755.00	4,042.89

Table A21: Mean Monthly Household Food and Nonfood Consumption Expenditure by Area (Nu)

Area	Monthly Household Food Consumption Expenditure			Monthly Household Nonfood Consumption Expenditure		
	BLSS 2003	BLSS 2007	BLSS 2012	BLSS 2003	BLSS 2007	BLSS 2012
Urban	4,348.37	6,758.00	8,140.65	9,626.42	14,020.00	15,906.10
Rural	3,452.16	4,849.00	6,643.80	5,023.27	5,980.00	8,796.27
Bhutan	3,689.89	5,423.00	7,152.90	6,200.21	8,399.00	11,214.42

Table A22: Mean Monthly Household Food Consumption Expenditure (Nu) and Share of Major Food Items by Area

Area	Major Food Item	Expenditure (Nu)			Share (%)		
		BLSS 2003	BLSS 2007	BLSS 2012	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Rice	503.01	572.00	893.59	11.57	8.50	10.98
	Other cereals and pulses	296.43	573.00	828.33	6.82	8.50	10.18
	Dairy products	641.50	1,062.00	1,680.56	14.75	15.70	20.64
	Fish	120.15	201.00	208.80	2.76	3.00	2.56
	Meat	366.36	696.00	686.21	8.43	10.30	8.43
	Fruits	135.39	369.00	473.45	3.11	5.50	5.82
	Vegetables	295.00	767.00	1,263.29	6.78	11.30	15.52
	Tea and coffee	72.71	91.00	122.06	1.67	1.40	1.50
	Cooking oil	173.53	299.00	353.59	3.99	4.40	4.34
	Spices and seasonings	190.73	431.00	817.42	4.39	6.40	10.04
	Alcoholic beverages	261.57	150.00	214.34	6.02	2.20	2.63
	Nonalcoholic beverages	100.98	227.00	280.82	2.32	3.40	3.45
	Food consumed away from home	1,191.01	1,319.00	318.20	27.39	19.50	3.91
	All items	4,348.37	6,758.00	8,140.65	100.00	100.00	100.00
Rural	Rice	532.12	747.00	1,136.55	15.41	15.40	17.11
	Other cereals and pulses	249.92	476.00	693.75	7.24	9.80	10.44
	Dairy products	474.68	890.00	1,343.49	13.75	18.40	20.22
	Fish	79.33	151.00	181.48	2.30	3.10	2.73
	Meat	254.20	327.00	518.61	7.36	6.80	7.81
	Fruits	59.67	167.00	213.21	1.73	3.50	3.21
	Vegetables	235.17	462.00	892.60	6.81	9.60	13.44
	Tea and coffee	61.50	80.00	94.21	1.78	1.60	1.42
	Cooking oil	140.31	246.00	337.63	4.06	5.10	5.08
	Spices and seasonings	181.23	351.00	615.56	5.25	7.20	9.27
	Alcoholic beverages	238.05	233.00	337.12	6.90	4.80	5.07
	Nonalcoholic beverages	39.25	79.00	157.80	1.14	1.60	2.38
	Food consumed away from home	906.73	639.00	121.79	26.27	13.20	1.83
	All items	3,452.16	4,849.00	6,643.80	100.00	100.00	100.00
Bhutan	Rice	525.46	694.00	1,053.91	14.24	12.80	14.73
	Other cereals and pulses	260.55	505.00	739.52	7.06	9.30	10.34
	Dairy products	512.97	942.00	1,458.13	13.90	17.30	20.39
	Fish	88.70	166.00	190.77	2.40	3.10	2.67
	Meat	279.49	438.00	575.62	7.57	8.10	8.05
	Fruits	77.62	228.00	301.72	2.10	4.20	4.22
	Vegetables	248.84	554.00	1,018.67	6.74	10.20	14.24
	Tea and coffee	64.11	83.00	103.68	1.74	1.50	1.45
	Cooking oil	147.95	262.00	343.06	4.01	4.80	4.80
	Spices and seasonings	183.40	375.00	684.22	4.97	6.90	9.57
	Alcoholic beverages	241.43	208.00	295.36	6.54	3.80	4.13
	Nonalcoholic beverages	62.05	124.00	199.64	1.68	2.30	2.79
	Food consumed away from home	997.32	844.00	188.59	27.03	15.60	2.64
	All items	3,689.89	5,423.00	7,152.90	100.00	100.00	100.00

Table A23: Mean Monthly Household Nonfood Consumption Expenditure (Nu) and Share of Major Nonfood Items by Area

Area	Major Nonfood Item	Expenditure (Nu)			Share (%)		
		BLSS 2003	BLSS 2007	BLSS 2012	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Tobacco and doma	160.77	187.00	218.20	1.67	1.20	1.37
	Clothing and footwear	1,258.80	1,501.00	1,887.10	13.08	10.70	11.86
	Transport and communications	1,054.72	1,796.00	3,065.15	11.0	12.80	19.27
	Household operations1/	469.49	3,688.00	994.31	4.88	26.30	6.25
	Recreation	323.34	423.00	516.54	3.36	3.00	3.25
	Furnishings and equipment	1,061.19	1,307.00	268.37	11.02	9.30	1.69
	Agriculture input and machinery	...	...	13.44	...	...	0.08
	Miscellaneous expenses	980.85	1,635.00	1,448.69	10.19	11.70	9.11
	Educational expenses	500.32	3,284.00	770.23	5.20	23.40	4.84
	Health expenses	1,167.53	213.00	1,131.85	12.13	1.50	7.12
	Rental value of housing	1,992.50	...	3,652.76	20.70	...	22.96
	Energy for the home	656.91	...	753.79	6.82	...	4.74
	Remittances abroad	....	...	1,185.65	...	...	7.45
	All items	9,626.42	14,020.00	15,906.10	100.00	100.00	100.00
Rural	Tobacco and *doma*	87.62	159.00	261.61	1.74	2.30	2.97
	Clothing and footwear	566.44	645.00	1,147.90	11.28	10.80	13.05
	Transport and communications	174.48	471.00	1,499.75	3.47	7.90	17.05
	Household operations1/	163.19	1,291.00	564.73	3.25	21.50	6.42
	Recreation	86.83	77.00	192.40	1.73	1.30	2.19
	Furnishings and equipment	311.95	370.00	161.56	6.21	6.20	1.84
	Agriculture input and machinery	...	...	132.83	...	...	1.51
	Miscellaneous expenses	864.53	1,111.00	1,227.25	17.21	18.60	13.95
	Educational expenses	64.83	1,668.00	378.02	1.29	27.80	4.30
	Health expenses	1,140.87	212.00	1,268.55	22.71	3.50	14.42
	Rental value of housing	606.49	...	1,385.46	12.07	...	15.75
	Energy for the home	956.04	...	320.25	19.03	...	3.64
	Remittances abroad			255.97			2.91
	All items	5,023.27	5,980.00	8,796.27	100.00	100.00	100.00
Bhutan	Tobacco and doma	104.16	167.00	246.84	1.68	1.80	2.20
	Clothing and footwear	730.54	902.00	1,399.31	11.78	10.80	12.48
	Transport and communications	416.18	870.00	2,032.17	6.71	10.40	18.12
	Household operations1/	233.63	2,012.00	710.84	3.77	24.00	6.34
	Recreation	213.16	181.00	302.64	3.44	2.20	2.70
	Furnishings and equipment	472.27	652.00	197.89	7.62	7.80	1.76
	Agriculture input and machinery	...	...	92.22	...	...	0.82
	Miscellaneous expenses	891.07	1,269.00	1,302.57	14.37	15.10	11.62
	Educational expenses	180.04	2,154.00	511.42	2.90	25.70	4.56
	Health expenses	1,148.27	212.00	1,222.05	18.52	2.50	10.90
	Rental value of housing	922.59	...	2,156.60	14.88	...	19.23
	Energy for the home	888.30	...	467.70	14.33	...	4.17
	Remittances abroad	...	...	572.17	...	...	5.10
	All items	6,200.21	8,399.00	11,214.42	100.00	100.00	100.00

Note: 1/ For BLSS 2007, includes rental value of housing and energy for the home.

Housing, Household Amenities, and Access to Services

Table A24: Distribution of Households by Area and by Type of Dwelling (%)

Area	Type of Dwelling	BLSS 2003	BLSS 2007	BLSS 2012
Urban	House	22.54	29.37	26.30
	Part of a house	33.20	14.29	25.90
	Separate apartment	34.43	46.03	39.30
	Shared apartment	8.61	7.94	8.00
	Others	1.23	2.38	0.50
	Total households (number)	24,400	37,800	43,515
Rural	House	91.39	85.86	85.20
	Part of a house	4.12	5.47	7.40
	Separate apartment	2.55	5.36	4.70
	Shared apartment	0.97	2.17	1.90
	Others	1.09	1.37	0.80
	Total households (number)	82,500	87,700	84,427
Bhutan	House	75.68	68.84	65.10
	Part of a house	10.76	8.05	13.70
	Separate apartment	9.92	17.77	16.50
	Shared apartment	2.62	3.82	4.00
	Others	1.12	1.59	0.70
	Total households (number)	106,900	125,500	127,942

Table A25: Distribution of Households by Area and by Tenure Status of the Dwelling Unit (%)

Area	Tenure Status	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Own	18.40	17.77	16.60
	Rent-free	...	...	20.60
	Renting from government	...	...	14.00
	Renting from public corporation	26.20	26.53	4.00
	Renting from employer	6.00	4.77	1.00
	Renting from private person	41.10	40.85	42.60
	Renting from others	8.20	10.08	1.20
Rural	Own	93.80	88.38	82.90
	Rent-free	...	...	7.20
	Renting from government	...	...	2.50
	Renting from public corporation	2.10	3.64	0.60
	Renting from employer	0.20	0.91	0.10
	Renting from private person	2.80	4.21	6.50
	Renting from others	1.10	2.85	0.20
Bhutan	Own	76.60	67.17	60.30
	Rent-free	...	...	11.80
	Renting from government	...	...	6.40
	Renting from public corporation	7.60	10.52	1.80
	Renting from employer	1.50	2.07	0.40
	Renting from private person	11.50	15.22	18.80
	Renting from others	2.70	5.02	0.50

Table A26: Distribution of Households by Area and by Main Source of Drinking Water (%)

Area	Source of Drinking Water	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Piped water into dwelling	80.54	82.90	87.00
	Neighbor's pipe	4.43	6.20	5.70
	Public outdoor tap	13.71	10.30	6.20
	Well and spring 1/	0.79	0.40	0.40
	Others	0.53	0.30	0.70
Rural	Piped water into dwelling	44.30	46.30	73.30
	Neighbor's pipe	6.57	8.10	8.00
	Public outdoor tap	26.27	32.00	14.70
	Well and spring 1/	17.65	8.70	2.20
	Others	5.21	4.90	1.60
Bhutan	Piped water into dwelling	52.57	57.30	78.00
	Neighbor's pipe	6.08	7.50	7.30
	Public outdoor tap	23.41	25.50	11.80
	Well and spring 1/	13.80	6.20	1.60
	Others	4.14	3.50	1.30

Note: 1/ Includes protected and unprotected wells and springs.

Table A27: Distribution of Households by Area and by Use and Source of Energy (%)

Use and Source of Energy	BLSS 2003			BLSS 2007			BLSS 2012		
	Urban	Rural	Bhutan	Urban	Rural	Bhutan	Urban	Rural	Bhutan
Number of households	24,400	82,500	106,900	37,800	87,700	125,500	43,515	84,427	127,942
Lighting	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Electricity	97.35	24.49	41.11	97.40	56.10	68.50	97.60	83.10	88.00
Kerosene or gas lamps	2.35	68.55	53.45	1.90	37.30	26.70	1.90	11.70	8.40
Candles	-	1.04	0.83	0.20	0.70	0.60	0.10	0.20	0.20
Others	-	5.92	4.61	0.50	5.80	4.20	0.40	5.00	3.40
Cooking 1/	100.00	100.00	100.00	100.00	100.00	100.00	...	...	...
Gas	68.95	8.86	22.56	44.80	13.00	22.60	91.70	45.40	61.20
Electricity	21.44	4.45	8.32	50.10	27.40	34.20	97.90	76.20	83.50
Wood	4.69	84.82	66.55	2.30	57.20	40.70	1.70	49.30	33.10
Coal	...	...	...	...	...	...	0.00	0.20	0.20
Kerosene	4.68	1.13	1.94	-	0.20	0.10	0.50	1.70	1.30
Others	0.25	0.73	0.62	1.50	0.60	0.90	0.10	0.20	0.20
Heating	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
No heating	25.86	22.68	23.40	37.20	44.10	42.00	37.10	55.70	49.40
Bukhari (wood or coal stove)	30.75	1.91	8.49	21.30	29.80	27.30	13.80	31.40	25.40
Electric heater	1.90	0.62	0.92	36.10	3.40	13.20	45.40	7.50	20.40
Kerosene heater	0.30	4.67	3.67	2.70	0.50	1.20	3.20	0.60	1.50
Gas heater	...	...	...	...	...	...	0.30	0.10	0.10
Straw/brush/manure stove	1.89	28.68	22.57	0.70	3.50	2.70	0.20	4.70	3.20
Others	39.30	41.43	40.95	2.00	18.70	13.70	...	...	...

Notes: 1/ For BLSS 2012, column subtotals can be more than 100% due to multiple answers.
* For BLSS 2003 and BLSS 2007, "-" indicates a sample estimate less than 100 households. Estimates not sufficiently reliable because of small number of observations.

Table A28: Distribution of Households by Area and by Access to Electricity Services (%)

Area	Access to Electricity	BLSS 2003	BLSS 2007	BLSS 2012
Urban	**With electricity**	**97.50**	**98.73**	**99.60**
	Grid	97.40	98.16	99.20
	Generator	...	...	0.40
	Solar	...	...	0.00
	Others	-	0.57	...
	Without electricity: Reason	2.50	1.30	0.40
	No need	...	...	0.20
	Too expensive	-	0.20	0.10
	Not available	0.80	0.80	0.10
	Other reasons	1.50	0.40	0.10
Rural	**With electricity**	27.30	60.30	87.30
	Grid	24.50	56.60	82.60
	Generator	...	...	0.30
	Solar	...	...	4.40
	Others	2.80	3.60	...
	Without electricity: Reason	72.70	39.80	13.30
	No need	...	...	0.90
	Too expensive	1.50	3.00	0.90
	Not available	68.60	37.60	9.60
	Other reasons	2.60	8.30	2.00
Bhutan	**With electricity**	43.30	71.80	91.50
	Grid	41.10	69.10	88.30
	Generator	...	...	0.30
	Solar	...	...	2.90
	Others	2.20	2.70	...
	Without electricity: Reason	56.70	28.20	8.90
	No need	...	...	0.60
	Too expensive	1.20	2.13	0.60
	Not available	53.10	26.48	6.40
	Other reasons	2.40	5.96	1.30

Note: For BLSS 2003, "-" indicates a sample estimate less than 100 households. Estimates not sufficiently reliable because of small number of observations.

Table A29: Distribution of Households by Area and by Mode of Transport to the Nearest Service Center (%)

Area/Services	BLSS 2003						BLSS 2007						BLSS 2012							
	On Foot	On Bicycle	On a Motor Vehicle[2/]	On Foot and by Vehicle	Other	Not Applicable	On Foot	On Bicycle	On a Motor Vehicle[2/]	On Foot and by Vehicle	Other	Not Applicable	On Foot	On Bicycle	On a Motorcycle	By Bus	By Car	On Foot and by Vehicle	Other	Not Applicable
Urban																				
Post office	64.04	0.30	17.44	11.05	1.96	5.22	51.60	0.30	26.90	6.60	4.50	10.10	42.00	0.10	0.70	7.60	28.10	5.30	6.30	10.00
Nearest phone	54.86	0.18	3.55	2.26	0.29	38.87	37.80	-	1.10	0.50	0.30	60.30	9.80	0.00	0.00	0.10	1.00	0.20	0.00	88.80
Police station	55.71	0.26	18.09	11.34	1.41	13.18	39.60	0.30	27.20	8.00	4.30	20.60	38.20	0.20	0.50	6.50	26.30	4.80	6.20	17.30
Hospital, BHU, ORC	61.70	0.26	20.49	13.98	2.86	0.71	55.20	0.30	28.40	8.40	7.00	0.70	43.90	0.20	0.50	6.50	33.40	7.20	6.70	1.80
Drugstore or pharmacy	50.14	0.11	15.60	10.93	1.97	21.24	45.70	0.30	26.80	7.60	5.50	14.10	34.10	0.10	0.50	6.20	25.50	5.30	6.10	22.10
Dzongkhag headquarters							27.20	0.30	43.70	12.60	6.80	9.40	20.50	0.10	0.60	11.60	29.60	5.90	8.00	23.60
Gewog headquarters													16.70	0.20	0.40	2.00	11.70	2.10	1.50	65.50
Source of firewood	16.94	-	1.74	2.31	1.19	77.83	13.80	0.00	1.30	1.00	0.80	83.10	8.30	0.00	0.00	0.10	1.30	0.50	0.80	89.10
Tarred road	84.63	-	3.27	1.61	0.20	10.29	61.70	0.10	2.10	0.40	0.10	35.60	73.10	0.10	0.00	0.30	2.30	0.40	0.10	23.60
Feeder road	29.56	0.22	1.73	1.58	0.24	66.67	29.20	0.00	1.10	0.10	0.10	69.50	18.40	0.00	0.00	0.00	1.30	0.20	0.10	80.00
Farm road													10.50	0.00	0.10	0.10	1.50	0.20	0.20	87.40
Food market or shop	67.27	0.24	14.53	12.78	2.15	3.03	65.50	0.20	17.70	6.50	6.00	4.10	60.50	0.10	0.40	3.70	21.00	4.60	4.90	4.90
Bank	56.26	0.41	20.74	14.05	2.36	6.18	47.50	0.30	30.70	9.50	6.30	5.70	39.40	0.20	0.60	7.40	32.40	6.50	7.80	5.70
RNR Center													17.60	0.10	0.30	1.90	9.20	1.20	1.10	68.60
Extension center	31.80	0.16	10.59	6.90	1.79	48.75														
Agricultural extension center[1/]							28.70	0.20	11.50	1.80	1.70	56.10	18.70	0.10	0.20	1.40	7.40	0.90	0.70	70.60
Livestock extension center													19.00	0.00	0.20	1.50	7.70	1.00	0.60	70.00
Forest extension center													21.10	0.10	0.20	1.10	7.50	1.10	0.90	68.10
Nearest monastery or temple							53.20	0.20	21.80	7.60	5.60	11.60	53.50	0.00	0.40	3.80	22.60	4.70	5.00	10.10
Petrol station	44.60	0.41	21.84	11.62	2.88	18.65	34.10	0.40	32.00	6.50	4.00	23.00	29.50	0.20	0.70	5.60	34.20	4.40	6.70	18.80
Bus station	61.11	0.37	18.16	12.71	2.93	4.72	43.60	0.30	28.90	10.30	6.80	10.10	35.10	0.20	0.60	5.90	29.80	5.90	8.30	14.30
Nearest school or extended classroom													65.30	0.10	0.20	2.40	16.30	1.40	2.00	12.30
ECCD or day-care center													28.30	0.10	0.20	3.40	11.80	1.60	2.30	52.30
NFE Center													22.90	0.00	0.20	0.80	4.80	0.40	0.30	70.70
Rural																				
Post office	48.64	0.14	6.05	23.14	0.50	21.52	37.50	0.20	8.30	19.50	1.00	33.50	24.50	0.20	0.40	4.40	19.50	24.60	2.10	24.40
Nearest phone	55.29	-	4.10	17.98	0.42	22.22	59.40	0.10	1.80	7.10	0.30	31.30	7.20	0.10	0.10	1.40	1.80	5.90	0.10	83.40
Police station	38.08	0.09	8.49	31.84	0.77	20.72	27.70	0.20	7.60	24.90	1.10	38.50	22.90	0.20	0.20	4.00	19.40	23.90	2.00	27.40
Hospital, BHU, ORC	79.16	0.05	5.92	13.48	0.61	0.78	69.70	0.20	9.40	18.30	1.50	0.90	67.70	0.10	0.30	2.90	13.70	11.40	1.90	2.10
Drugstore or pharmacy	14.10	0.10	4.91	10.91	0.51	69.47	21.40	0.20	9.70	24.60	1.70	42.40	14.90	0.20	0.30	3.90	14.80	20.10	2.10	43.80
Dzongkhag headquarters							17.60	0.10	18.00	50.40	2.10	11.80	13.40	0.30	0.40	6.40	22.90	36.70	2.60	17.40
Gewog headquarters													69.40	0.10	0.20	1.50	11.80	9.40	1.10	6.30
Source of firewood	94.05	-	1.08	1.06	0.40	3.41	87.40	0.10	0.60	1.20	0.40	10.30	77.20	0.10	0.10	0.10	1.90	0.70	0.70	19.40
Tarred road	82.19	0.05	1.81	8.62	-	7.33	77.30	0.10	1.60	9.80	0.20	11.00	58.10	0.10	0.20	1.20	8.30	14.80	1.00	16.40
Feeder road	55.54	-	0.77	0.93	0.13	42.63	62.20	0.10	0.40	1.10	0.00	36.20	47.50	0.00	0.00	0.40	1.40	2.20	0.00	48.50
Farm road													62.60	0.10	0.00	0.40	1.20	1.40	0.00	34.30
Food market or shop	77.94	0.09	4.75	13.33	0.46	3.42	70.10	0.30	7.90	17.60	1.60	2.50	61.70	0.10	0.20	3.30	11.30	14.80	1.80	6.70
Bank	29.99	-	10.57	35.44	0.65	23.32	16.90	0.10	14.10	37.90	1.40	29.60	17.80	0.20	0.40	4.90	22.40	31.20	2.70	20.40

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Table A29: Distribution of Households by Area and by Mode of Transport to the Nearest Service Center (%)

Area/Services	BLSS 2003						BLSS 2007						BLSS 2012							
	On Foot	On Bicycle	On a Motor Vehicle2/	On Foot and by Vehicle	Other	Not Applicable	On Foot	On Bicycle	On a Motor Vehicle2/	On Foot and by Vehicle	Other	Not Applicable	On Foot	On Bicycle	On a Motorcycle	By Bus	By Car	On Foot and by Vehicle	Other	Not Applicable
RNR Center													57.00	0.10	0.20	1.80	8.30	9.20	0.70	22.80
Extension center	75.34	0.11	5.54	11.68	0.30	7.03														
Agricultural extension center1/							65.60	0.20	6.30	13.50	0.40	14.00	61.30	0.10	0.20	1.30	8.40	8.30	0.80	19.60
Livestock extension center													61.70	0.10	0.20	1.40	8.20	8.20	0.80	19.50
Forest extension center													61.40	0.20	0.20	1.10	8.20	8.40	1.10	19.50
Nearest monastery or temple							82.30	0.20	2.60	3.10	0.30	11.50	79.50	0.20	0.10	1.60	5.50	5.50	0.70	6.90
Petrol station	39.49	0.23	5.97	22.29	0.64	31.37	23.40	0.20	11.10	29.80	1.20	34.30	15.80	0.10	0.40	4.10	20.10	26.40	1.70	31.40
Bus station	55.46	0.05	7.15	24.74	0.96	11.64	27.30	0.10	10.70	35.50	1.60	24.80	20.50	0.20	0.40	4.00	19.60	26.10	2.70	26.60
Nearest school or extended classroom													78.80	0.20	0.10	1.40	5.40	3.60	0.50	10.00
ECCD or day-care center													11.40	0.00	0.00	0.80	5.90	7.10	0.20	74.50
NFE Center													50.40	0.10	0.10	0.50	4.30	2.70	0.00	42.00
Bhutan																				
Post office	52.15	0.18	8.65	20.39	0.83	17.80	41.80	0.20	13.90	15.60	2.10	26.40	30.50	0.20	0.50	5.50	22.40	18.10	3.50	19.50
Nearest phone	55.19	-	3.97	14.39	0.39	26.01	52.90	0.10	1.60	5.10	0.30	40.00	8.10	0.10	0.10	1.00	1.50	4.00	0.10	85.20
Police station	42.10	0.13	10.68	27.17	0.92	19.00	31.30	0.20	13.50	19.80	2.10	33.10	28.10	0.20	0.30	4.80	21.70	17.40	3.50	24.00
Hospital, BHU, ORC	75.17	0.10	9.25	13.59	1.12	0.77	65.30	0.20	15.30	15.30	3.10	0.80	59.60	0.10	0.40	4.10	20.40	9.90	3.60	2.00
Drugstore or pharmacy	22.32	0.10	7.35	10.92	0.84	58.47	28.70	0.20	14.90	19.50	2.80	33.90	21.50	0.10	0.30	4.70	18.40	15.10	3.50	36.50
Dzongkhag headquarters							20.50	0.20	25.70	39.00	3.50	11.10	15.80	0.30	0.40	8.20	25.20	26.20	4.40	19.50
Gewog headquarters													51.50	0.10	0.30	1.70	11.80	6.90	1.20	26.40
Source of firewood	76.47	-	1.23	1.34	0.58	20.38	65.20	0.10	0.90	1.10	0.50	32.20	53.80	0.00	0.00	0.10	1.70	0.60	0.70	43.10
Tarred road	82.75	-	2.14	7.02	-	8.00	72.60	0.10	1.70	7.00	0.20	18.40	63.20	0.10	0.10	0.90	6.30	9.90	0.70	18.90
Feeder road	49.61	0.05	0.99	1.08	0.16	48.11	52.30	0.10	0.50	0.80	0.10	46.20	37.60	0.00	0.00	0.30	1.40	1.50	0.00	59.20
Farm road													44.90	0.10	0.10	0.30	1.30	1.00	0.10	52.40
Food market or shop	75.51	0.12	6.98	13.21	0.85	3.33	68.70	0.30	10.90	14.20	2.90	3.00	61.30	0.10	0.30	3.40	14.60	11.30	2.80	6.10
Bank	35.99	0.12	12.89	30.56	1.04	19.41	26.10	0.10	19.10	29.40	2.90	22.40	25.20	0.20	0.50	5.70	25.80	22.80	4.40	15.40
RNR Center													43.60	0.10	0.20	1.80	8.60	6.40	0.90	38.40
Extension center	65.41	0.12	6.70	10.59	0.64	16.55														
Agricultural extension center1/							54.50	0.20	7.80	10.00	0.80	26.70	46.80	0.10	0.20	1.30	8.10	5.80	0.70	37.00
Livestock extension center													47.20	0.10	0.20	1.40	8.00	5.80	0.70	36.70
Forest extension center													47.70	0.10	0.20	1.10	7.90	5.90	1.00	36.10
Nearest monastery or temple							73.60	0.20	8.40	4.40	1.90	11.50	70.60	0.10	0.20	2.40	11.30	5.20	2.20	8.00
Petrol station	40.66	0.27	9.59	19.86	1.15	28.47	26.60	0.30	17.30	22.80	2.10	30.90	20.50	0.20	0.50	4.60	24.90	18.90	3.40	27.10
Bus station	56.75	0.12	9.66	22.00	1.41	10.06	32.20	0.20	16.10	27.90	3.20	20.40	25.50	0.20	0.40	4.60	23.10	19.20	4.60	22.40
Nearest school or extended classroom													74.20	0.10	0.20	1.70	9.10	2.90	1.00	10.80
ECCD or day-care center													17.20	0.00	0.10	1.70	7.90	5.20	0.90	67.00
NFE Center													41.00	0.10	0.10	0.60	4.40	1.90	0.10	51.80

Notes: 1/ For BLSS 2007, includes Livestock extension center.
2/ For BLSS 2003 and BLSS 2007, includes mode of transportation by motorcycle, bus and car. For BLSS 2007, data are not available in the publication, thus, were computed as residual from 100%.
*For BLSS 2003 and BLSS 2007, "-" indicates a sample estimate less than 100 households. Estimates not sufficiently reliable because of small number of observations.

Table A30: Distribution of Households by Area and by Time Taken to Reach the Nearest Service Center (%)

Area/Services	BLSS 2003						BLSS 2007				BLSS 2012					
	Up to 60 Minutes	1-2 Hours	2 Hours or More	Not Applicable	Up to 30 Minutes	30-60 Minutes	Up to 60 Minutes	1-2 Hours	2 Hours or More	Not Applicable	Up to 30 Minutes	30-60 Minutes	Up to 60 Minutes	1-2 Hours	2 Hours or More	Not Applicable
Urban																
Post office	94.08	0.54	0.16	5.22	85.30	4.10	89.40	0.30	0.20	10.10	85.90	3.40	89.30	0.40	0.30	10.00
Nearest phone	60.77	0.34	-	38.87	38.90	0.60	39.50	0.10	0.20	60.30	10.70	0.30	11.00	0.10	0.00	88.80
Police station	86.09	0.72	-	13.18	71.40	6.80	78.20	0.80	0.40	20.60	77.80	3.90	81.70	0.60	0.40	17.30
Hospital, BHU, ORC	97.98	1.14	0.17	0.71	91.80	6.60	98.40	0.70	0.20	0.70	90.90	6.30	97.20	0.80	0.30	1.80
Drugstore or pharmacy	77.97	0.73	0.07	21.24	78.70	5.20	83.90	1.10	0.90	14.10	72.60	4.10	76.70	0.60	0.50	22.10
Dzongkhag headquarters					57.40	11.60	69.00	9.10	12.50	9.40	58.50	8.60	67.10	3.50	5.70	23.60
Gewog headquarters											26.30	4.20	30.50	1.10	44.80	23.60
Source of firewood	15.58	6.17	0.43	77.83	4.00	3.90	7.90	4.40	4.60	83.10	2.90	2.00	4.90	1.20	28.40	65.50
Tarred road	89.12	0.31	0.28	10.29	63.40	0.50	63.90	0.20	0.30	35.60	9.60	0.20	9.80	0.10	1.20	89.10
Feeder road	32.88	0.16	0.28	66.67	29.90	0.20	30.10	0.10	0.30	69.50	17.50	0.40	17.90	0.20	58.30	23.60
Farm road											11.30	0.50	11.80	0.20	64.40	23.60
Food market or shop	96.41	0.49	0.07	3.03	91.90	3.50	95.40	0.30	0.20	4.10	19.20	0.60	19.80	0.10	0.20	80.00
Bank	92.51	0.93	0.38	6.18	83.90	6.50	90.40	2.10	1.80	5.70	9.90	0.90	10.80	0.60	1.30	87.40
RNR Center											27.00	2.70	29.70	0.60	65.00	4.90
Extension center	49.97	1.24	0.05	48.75			0.00									
Agricultural extension center[1/]					38.30	4.80	43.10	0.60	0.20	56.10	25.60	2.50	28.10	0.70	66.40	4.90
Livestock extension center											26.10	2.60	28.70	0.60	65.80	4.90
Forest extension center											28.40	2.40	30.80	0.40	64.00	4.90
Nearest monastery or temple					75.10	7.10	82.20	4.60	1.60	11.60	79.80	5.90	85.70	0.80	7.80	5.70
Petrol station	80.13	0.70	0.52	18.65	68.60	6.00	74.60	1.60	0.90	23.00	24.10	2.40	26.50	1.10	3.80	68.60
Bus station	93.84	1.07	0.37	4.72	82.10	6.10	88.20	1.00	0.80	10.10	21.70	2.00	23.70	0.60	5.00	70.60
Nearest school or extended classroom											81.70	2.30	84.00	0.50	10.70	4.90
ECCD or day-care center											44.60	1.60	46.20	0.20	48.80	4.90
NFE Center											27.50	1.00	28.50	0.20	66.40	4.90
Rural																
Post office	27.72	30.45	20.31	21.52	18.10	11.70	29.80	15.00	21.80	33.50	23.00	14.70	37.70	15.80	22.10	24.40
Nearest phone	32.19	28.74	16.85	22.22	32.60	9.40	42.00	9.80	16.90	31.30	5.00	3.30	8.30	4.00	4.40	83.40
Police station	21.09	32.87	25.33	20.72	13.30	9.50	22.80	13.40	25.50	38.50	20.50	13.00	33.50	15.80	23.30	27.40
Hospital, BHU, ORC	52.67	35.96	10.59	0.78	40.20	21.20	61.40	20.50	17.30	0.90	49.00	20.70	69.70	16.20	12.10	2.10
Drugstore or pharmacy	11.80	12.00	6.73	69.47	17.40	10.40	27.80	12.30	17.50	42.40	18.70	10.00	28.70	11.30	16.10	43.80
Dzongkhag headquarters					11.10	12.50	23.60	17.20	47.40	11.80	15.10	12.80	27.90	18.30	36.50	17.40
Gewog headquarters											38.80	15.30	54.10	14.00	14.50	17.40
Source of firewood	66.46	25.78	4.35	3.41	31.60	26.90	58.50	20.20	11.10	10.30	32.70	23.70	56.40	15.90	21.50	6.30
Tarred road	44.96	27.38	20.34	7.33	38.60	11.40	50.00	12.20	26.80	11.00	27.50	11.20	38.70	11.40	30.50	19.40
Feeder road	36.24	10.51	10.61	42.63	34.30	5.90	40.20	6.50	17.20	36.20	33.00	3.80	36.80	3.90	42.90	16.40
Farm road											43.90	5.10	49.00	3.90	30.70	16.40
Food market or shop	45.39	30.97	20.21	3.42	42.00	15.70	57.70	15.80	24.10	2.50	24.60	8.50	33.10	7.70	10.80	48.50
Bank	16.92	30.75	29.01	23.32	13.40	10.70	24.10	14.60	31.80	29.60	10.30	7.70	18.00	12.00	35.70	34.30
RNR Center											32.20	14.20	46.40	14.00	32.90	6.70
Extension center	48.41	29.93	14.63	7.03												
Agricultural extension center[1/]					30.20	18.10	48.30	18.50	19.30	14.00	35.10	14.80	49.90	13.60	29.90	6.70
Livestock extension center											35.60	14.60	50.20	13.70	29.40	6.70
Forest extension center											35.50	14.70	50.20	13.40	29.70	6.70
Nearest monastery or temple					54.10	15.10	69.20	11.60	7.70	11.50	48.30	11.90	60.20	9.10	10.40	20.40

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Table A30: Distribution of Households by Area and by Time Taken to Reach the Nearest Service Center (%)

Area/Services	BLSS 2003						BLSS 2007				BLSS 2012					
	Up to 60 Minutes	1-2 Hours	2 Hours or More	Not Applicable	Up to 30 Minutes	30-60 Minutes	Up to 60 Minutes	1-2 Hours	2 Hours or More	Not Applicable	Up to 30 Minutes	30-60 Minutes	Up to 60 Minutes	1-2 Hours	2 Hours or More	Not Applicable
Petrol station	20.62	26.16	21.85	31.37	14.80	10.10	24.90	13.50	27.30	34.30	12.60	9.60	22.20	13.30	41.70	22.80
Bus station	28.14	34.05	26.17	11.64	18.50	11.40	29.90	15.40	30.00	24.80	15.60	9.60	25.20	14.30	40.90	19.60
Nearest school or extended classroom											54.80	16.30	71.10	9.80	12.40	6.70
ECCD or day-care center											11.40	4.10	15.50	3.60	74.20	6.70
NFE Center											40.40	8.50	48.90	4.30	40.00	6.70
Bhutan																
Post office	42.86	23.63	15.71	17.80	38.30	9.40	47.70	10.50	15.30	26.40	44.40	10.90	55.30	10.60	14.70	19.50
Nearest phone	38.71	22.26	13.01	26.02	34.50	6.70	41.20	6.90	11.90	40.00	6.90	2.30	9.20	2.70	2.90	85.20
Police station	35.91	25.54	19.55	19.00	30.70	8.70	39.40	9.60	17.90	33.10	40.00	9.90	49.90	10.60	15.50	24.00
Hospital, BHU, ORC	63.00	28.02	8.21	0.77	55.70	16.80	72.50	14.60	12.10	0.80	63.20	15.80	79.00	10.90	8.10	2.00
Drugstore or pharmacy	26.89	9.43	5.21	58.47	35.90	8.80	44.70	9.00	12.50	33.90	37.10	8.00	45.10	7.70	10.80	36.50
Dzongkhag headquarters					25.00	12.20	37.20	14.80	36.90	11.10	29.80	11.40	41.20	13.30	26.00	19.50
Gewog headquarters											34.60	11.50	46.10	9.60	24.80	19.50
Source of firewood	54.86	21.31	3.45	20.38	23.30	19.90	43.20	15.40	9.10	32.20	22.50	16.30	38.80	10.90	23.80	26.40
Tarred road	55.03	21.20	15.77	8.00	46.10	8.10	54.20	8.60	18.90	18.40	21.40	7.50	28.90	7.60	20.50	43.10
Feeder road	35.48	8.15	8.26	48.11	32.90	4.20	37.10	4.60	12.10	46.20	27.70	2.70	30.40	2.60	48.20	18.90
Farm road											32.80	3.50	36.30	2.60	42.20	18.90
Food market or shop	57.03	24.02	15.62	3.33	57.00	12.00	69.00	11.10	16.90	3.00	22.80	5.80	28.60	5.10	7.20	59.20
Bank	34.16	23.95	22.48	19.41	34.60	9.40	44.00	10.80	22.80	22.40	10.20	5.40	15.60	8.10	24.00	52.40
RNR Center											30.40	10.30	40.70	9.40	43.80	6.10
Extension center	48.77	23.39	11.30	16.55												
Agricultural extension center[1/]					32.60	14.10	46.70	13.10	13.60	26.70	31.90	10.60	42.50	9.20	42.30	6.10
Livestock extension center											32.40	10.50	42.90	9.20	41.80	6.10
Forest extension center											33.10	10.50	43.60	9.00	41.40	6.10
Nearest monastery or temple					60.40	12.70	73.10	9.50	5.90	11.50	59.00	9.80	68.80	6.30	9.50	15.40
Petrol station	34.19	20.35	16.99	28.47	31.00	8.90	39.90	9.90	19.40	30.90	16.50	7.10	23.60	9.10	28.80	38.40
Bus station	43.13	26.53	20.28	10.06	37.60	9.80	47.40	11.10	21.20	20.40	17.70	7.00	24.70	9.60	28.70	37.00
Nearest school or extended classroom											64.00	11.50	75.50	6.60	11.80	6.10
ECCD or day-care center											22.70	3.20	25.90	2.40	65.60	6.10
NFE Center											36.10	6.00	42.10	2.90	49.00	6.10

Notes: 1/ For BLSS 2007, includes Livestock extension center.
* For BLSS 2003 and BLSS 2007, "-" indicates a sample estimate less than 100 households. Estimates not sufficiently reliable because of small number of observations.

Table A31: Distribution of Households by Area and by Frequency of Use of Public Transportation (%)

Area	Frequency	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Never	15.50	20.60	25.30
	Less than once a month[1/]	34.70		
	Almost everyday		8.40	12.10
	At least once a week	24.70	35.90	32.30
	At least once a month	25.10	35.10	30.40
	Total	100.00	100.00	100.00
Rural	Never	19.10	25.10	25.50
	Less than once a month[1/]	51.90		
	Almost everyday		2.00	2.90
	At least once a week	7.80	23.00	19.60
	At least once a month	21.10	49.80	52.00
	Total	100.00	100.00	100.00
Bhutan	Never	18.30	23.80	25.40
	Less than once a month[1/]	48.00		
	Almost everyday		4.00	6.00
	At least once a week	11.60	26.90	23.90
	At least once a month	22.00	45.40	44.60
	Total	100.00	100.00	100.00

Note: 1/ For BLSS 2003 only.

Table A32: Distribution of Households by Area and by Assessment of Quality of Public Transportation (%)

Area	Quality of Public Transportation	BLSS 2003	BLSS 2007	BLSS 2012
Urban	**Frequency (schedule)**	100.00	100.00	100.00
	Good	77.76	62.67	65.50
	Satisfactory	19.10	33.33	30.90
	Bad	1.77	2.33	2.90
	Don't know	1.41	2.00	0.70
	Affordability (cost)	100.00	100.00	100.00
	Good	60.97	46.33	43.60
	Satisfactory	33.47	47.33	44.20
	Bad	4.79	5.00	9.00
	Don't know	0.77	1.33	3.30
Rural	**Frequency (schedule)**	100.00	100.00	100.00
	Good	54.09	53.12	48.00
	Satisfactory	32.93	32.42	35.60
	Bad	8.00	11.57	14.40
	Don't know	4.96	2.89	2.00
	Affordability (cost)	100.00	100.00	100.00
	Good	39.49	38.51	22.50
	Satisfactory	47.39	44.29	49.90
	Bad	9.32	14.92	19.80
	Don't know	3.81	2.28	7.80
Bhutan	**Frequency (schedule)**	100.00	100.00	100.00
	Good	59.68	56.11	54.00
	Satisfactory	29.67	32.71	34.00
	Bad	6.53	8.67	10.50
	Don't know	4.12	2.51	1.60
	Affordability (cost)	100.00	100.00	100.00
	Good	44.56	40.96	29.70
	Satisfactory	44.10	45.25	47.90
	Bad	8.25	11.70	16.10
	Don't know	3.09	1.99	6.30

Note: Criterion for "Timeliness" of public transport was not included in BLSS 2012.

Assets, Credit, and Income

Table A33: Distribution of Households that Own Assets by Area (%)

Type of Asset	BLSS 2003			BLSS 2007			BLSS 2012		
	Urban	Rural	Bhutan	Urban	Rural	Bhutan	Urban	Rural	Bhutan
Kitchen and Laundry									
Rice cooker	86.57	14.93	31.28	95.60	47.50	62.00	97.70	75.70	83.20
Curry cooker	55.51	4.61	16.23	83.50	33.50	48.50	92.80	61.30	72.00
Water boiler	66.33	6.44	20.10	86.40	29.30	46.50	92.00	53.90	66.90
Refrigerator	43.72	2.62	12.01	60.00	11.30	25.90	75.90	26.60	43.40
Modern stove	70.23	10.11	23.83	50.90	18.50	28.30	46.90	23.70	31.60
Electric iron	41.97	2.57	11.56	44.30	8.00	18.90	44.40	10.90	22.30
Washing machine	10.56	0.67	2.93	12.70	1.70	5.00	25.50	5.40	12.20
Microwave oven	7.97	0.86	2.48	9.20	1.60	3.90	20.50	4.30	9.80
Recreation, Telecommunications, and Cultural									
Mobile phone	5.43	0.73	1.80	74.70	24.10	39.30	96.70	90.70	92.80
Landline	...	...	...	39.00	12.10	20.20	...	...	...
Television	63.00	3.80	17.31	79.40	19.80	37.70	86.80	43.90	58.50
Wristwatch	90.87	70.10	74.84	86.50	67.40	73.20	65.40	42.80	50.50
Radio	72.46	65.58	67.14	60.20	62.80	62.00	49.90	42.00	38.80
VCR, VCD, DVD[1/]	29.09	2.38	8.48	40.80	12.60	21.10	33.40	29.30	36.30
Camera	33.78	5.17	11.70	30.50	8.40	15.10	33.30	8.70	17.10
Computer	4.38	0.13	1.11	11.60	1.80	4.70	32.60	7.70	16.40
Foreign-made bow	6.70	3.56	4.28	6.40	5.60	5.80	7.40	7.00	7.10
Furniture and Fixtures									
Choesham	52.14	40.00	42.77	57.90	48.50	51.30	67.50	56.60	60.30
Sofa set	46.31	3.29	13.11	55.00	10.40	23.80	66.80	27.30	35.30
Heater	47.80	5.56	15.20	52.50	10.00	22.80	61.00	19.10	30.80
Fan	22.91	1.49	6.38	37.30	9.80	18.10	39.60	15.20	22.80
Bukhari	47.58	17.56	24.41	23.40	24.80	24.40	13.80	14.20	22.70
Machinery and Equipment									
Grinding machine	6.05	6.09	6.08	3.80	6.00	5.30	21.60	11.20	12.60
Power chain	...	...	...	...	...	...	8.30	8.00	8.40
Sewing machine	10.56	3.45	5.07	8.10	4.60	5.60	2.80	4.90	6.10
Power tiller	...	...	...	1.60	3.90	3.20	2.80	4.30	3.80
Tractor	...	...	...	1.50	0.90	1.10	2.00	1.70	1.80
Transport Equipment									
Family car	...	...	...	24.30	4.20	10.20	35.50	10.90	19.20
Bicycle	11.04	1.92	4.00	8.60	3.10	4.80	9.40	3.90	5.60
Other vehicle[2/]	19.58	2.19	6.16	5.40	1.80	2.90	7.80	3.70	5.20
Motorbike, scooter	12.44	1.27	3.82	9.10	2.70	4.60	5.00	2.80	3.60

Notes: 1/ For BLSS 2003 and BLSS 2007, includes VCR/VCD only.
2/ For BLSS 2003, includes passenger car and tractor.

Table A34: Distribution of Households by Area and by Landholding (%)

Area	Landholding	BLSS 2003	BLSS 2007	BLSS 2012
Urban	Not a landholder	81.15	82.01	67.70
	Landholder: ≤ 5.0 Acres	15.16	15.34	28.00
	Landholder: > 5 Acres	3.69	2.65	4.30
	Total	100.00	100.00	100.00
Rural	Not a landholder	10.06	18.02	16.50
	Landholder: ≤ 5.0 Acres	76.61	71.38	69.90
	Landholder: > 5 Acres	13.33	10.60	13.60
	Total	100.00	100.00	100.00
Bhutan	Not a landholder	26.29	37.29	33.90
	Landholder: ≤ 5.0 Acres	62.58	54.50	55.70
	Landholder: > 5 Acres	11.13	8.21	10.70
	Total	100.00	100.00	100.00

Table A35: Distribution of Households by Area and by Ownership of Livestock (%)

Area	Livestock	BLSS 2003		BLSS 2007		BLSS 2012	
		None	HHs owning livestock	None	HHs owning livestock	None	HHs owning livestock
Urban	Pig	97.95	2.05	98.41	1.59	99.45	0.55
	Cattle	96.31	3.69	94.71	5.03	96.41	3.59
	Yak	100.00	-	99.74	0.26	99.98	0.02
	Buffalo	100.00	-	100.00	-	100.00	0.00
	Horse	100.00	-	99.47	0.53	99.80	0.20
	Sheep	100.00	-	99.74	-	99.97	0.03
	Goat	99.18	0.82	98.68	1.32	99.46	0.54
	Poultry	95.92	4.08	96.83	2.91	97.38	2.62
Rural	Pig	62.18	37.82	78.91	21.09	86.70	13.30
	Cattle	18.42	81.58	27.71	72.41	33.01	66.99
	Yak	97.33	2.67	97.83	2.28	98.58	1.42
	Buffalo	98.67	1.33	99.32	0.68	99.60	0.40
	Horse	74.15	25.85	80.16	19.95	85.15	14.85
	Sheep	94.05	5.95	96.81	3.19	97.82	2.18
	Goat	85.45	14.55	86.09	13.91	86.74	13.26
	Poultry	35.88	64.12	47.66	52.34	56.01	43.99
Bhutan	Pig	70.35	29.65	84.78	15.22	91.03	8.97
	Cattle	36.20	63.77	47.89	52.11	54.57	45.43
	Yak	97.94	2.06	98.41	1.59	99.06	0.94
	Buffalo	99.06	1.03	99.52	0.48	99.74	0.26
	Horse	79.89	20.11	85.98	14.10	90.13	9.87
	Sheep	95.32	4.77	97.77	2.23	98.55	1.45
	Goat	88.59	11.41	89.80	10.12	91.06	8.94
	Poultry	49.67	50.33	62.47	37.53	70.08	29.92

Note: For BLSS 2003 and BLSS 2007, "-" indicates a sample estimate less than 100 households. Estimates are not sufficiently reliable because of small number of observations.

Table A36: Distribution of Households by Area and by Source of Loan (%)

Area	Source of Loan	BLSS 2003				BLSS 2007				BLSS 2012			
		Money Owed	No Money Owed	Don't Know	Total Households	Money Owed	No Money Owed	Don't Know	Total Households	Money Owed	No Money Owed	Don't Know	Total Households
Urban	Bank	17.03	82.44	0.53	24,400	19.80	79.80	0.50	37,800	30.50	69.00	0.50	43,515
	BDBL									6.40	93.00	0.70	43,515
	RICB/BIL/BDFC	5.54	93.94	0.52	24,400	6.60	92.80	0.60	37,800	1.70	97.50	0.70	43,515
	NPPF									4.70	94.60	0.80	43,515
	Relatives or friends	11.96	86.87	1.18	24,400	10.90	88.30	0.80	37,800	4.10	95.20	0.70	43,515
	Others	2.41	96.50	1.09	24,400	2.70	95.70	1.60	37,800	1.20	98.00	0.80	43,515
Rural	Bank	5.21	94.17	0.61	82,500	5.80	93.80	0.50	87,700	11.20	88.40	0.30	84,427
	BDBL									13.40	86.10	0.50	84,427
	RICB/BIL/BDFC	10.16	89.19	0.65	82,500	10.70	88.80	0.40	87,700	0.80	98.70	0.50	84,427
	NPPF									0.60	98.80	0.50	84,427
	Relatives or friends	23.18	76.15	0.67	82,500	21.80	77.60	0.70	87,700	6.10	93.40	0.50	84,427
	Others	1.57	97.48	0.95	82,500	2.30	95.10	2.70	87,700	0.90	98.60	0.50	84,427
Bhutan	Bank	7.91	91.50	0.59	106,900	10.00	89.60	0.50	125,500	17.80	81.80	0.40	127,942
	BDBL									11.00	88.40	0.50	127,942
	RICB/BIL/BDFC	9.10	90.27	0.62	106,900	9.50	90.00	0.50	125,500	1.10	98.30	0.60	127,942
	NPPF									2.00	97.40	0.60	127,942
	Relatives or friends	20.62	78.59	0.79	106,900	18.50	80.80	0.70	125,500	5.40	94.00	0.60	127,942
	Others	1.76	97.26	0.98	106,900	2.40	95.30	2.30	125,500	1.00	98.40	0.60	127,942

Notes: BDBL - Bhutan Development Bank; RICB - Royal Insurance Corporation of Bhutan; BIL - Bhutan Insurance; BDFC - Bhutan Development Finance Corporation; NPPF - National Pension and Provident Fund.

Table A37: Distribution of Households by Main Source of Income and by Area (%)

Main Source of Income	BLSS 2003			BLSS 2007		
	Urban	Rural	Bhutan	Urban	Rural	Bhutan
Own farm enterprise	1.93	59.52	46.38	2.12	58.27	40.56
Wages (including religious fees)	73.74	21.82	33.7	67.99	23.49	36.9
Own business	15.48	6.28	8.38	18.78	8.55	11.63
Others[1/]	4.34	6.28	5.84	8.20	6.39	6.93
Rental/Real estate/Selling of Assets	2.24	3.28	3.04	1.32	1.94	1.75
Remittances	2.02	2.62	2.48	0.79	2.28	1.83
Pensions	0.26	0.21	0.22	0.53	0.34	0.40
Total	100.00	100.00	100.00	100.00	100.00	100.00

Note: 1/ For BLSS 2007, includes inheritance, charity, and scholarship.

Table A38: Distribution of Household Income by Source of Income and by Area (%), BLSS 2012

Source of Income	Urban	Rural	Bhutan
Wages and salaries	64.64	46.78	57.2
Net income from business	23.54	10.55	18.1
Real estate deals, sale of assets, and others	7.78	12.78	9.9
Cereals, fruits, and vegetables	0.52	16.82	7.3
Meat, dairy products, and eggs	0.23	5.85	2.6
Remittances received	0.94	2.92	1.77
Pottery and weaving	1.12	2.03	1.50
Pensions, inheritance, donations received, scholarships	1.21	1.41	1.29
Forest wood and nonwood products	0.02	0.84	0.36
Total income	100.00	100.00	100.00

Table A39: Annual Average Household Income by Source of Income and by Area (Nu), BLSS 2012

Source of Income	Urban			Rural			Bhutan		
	Cash	In-Kind	Total	Cash	In-Kind	Total	Cash	In-Kind	Total
Wages and salaries	181,752	956	182,707	48,281	415	48,696	93,676	599	94,275
Cereals, fruits, and vegetables	1,453	22	1,474	16,847	665	17,511	11,611	446	12,057
Meat, dairy products, and eggs	634	17	651	5,839	254	6,093	4,068	173	4,242
Forest wood and nonwood products	48	0	48	862	14	876	585	10	595
Pottery and weaving	3,108	64	3,172	2,074	37	2,111	2,426	46	2,472
Remittances received	2,567	96	2,663	2,777	263	3,041	2,706	207	2,912
Pensions, inheritance, donations received, scholarships	1,606	1,808	3,414	1,088	384	1,472	1,264	869	2,133
Real estate deals, sale of assets, and others	21,809	183	21,992	13,160	145	13,305	16,102	158	16,260
Net income from business	66,419	129	66,548	10,949	36	10,985	29,815	68	29,883
Total income	279,397	3,274	282,671	101,876	2,215	104,091	162,254	2,575	164,829

Table A40: Annual Average Household Income by Area and by Source, BLSS 2012

Area	Source (Nu)				Percent of Household Income			
	Wages	Agriculture	Nonagriculture	Total	Wages	Agriculture	Nonagriculture	Total
Urban	182,707	2,174	97,790	282,671	64.6	0.8	34.6	100.00
Rural	48,696	24,480	30,915	104,091	46.8	23.5	29.7	100.00
Bhutan	94,275	16,894	53,660	164,829	57.2	10.3	32.6	100.00

Priorities for Government Action

Table A41: Distribution of Households by Welfare Priority and by Area (%)

Welfare Priority	BLSS 2003			BLSS 2007			BLSS 2012		
	Urban	Rural	Bhutan	Urban	Rural	Bhutan	Urban	Rural	Bhutan
Water supply	4.74	10.31	10.56	15.30	26.60	23.20	20.25	23.32	22.27
Road infrastructure and bridges	0.77	12.50	15.53	5.10	44.30	32.50	5.53	26.23	19.19
Commerce, transport, and communication[1/]	6.16	9.53	1.39	8.00	10.30	9.60	8.75	19.88	16.09
Health facilities and family planning	6.58	9.30	2.30	7.70	11.10	10.10	11.91	18.16	16.03
Housing	12.60	5.98	11.47	22.30	9.60	13.40	25.14	9.69	14.94
Labor and employment creation				25.40	5.80	11.70	29.27	6.33	14.13
Others	12.34	6.13	2.05	11.40	9.60	10.10	9.36	16.21	13.88
Agriculture and extension facilities[2/]	4.91	10.22	17.42	2.60	24.30	17.80	1.96	18.35	12.78
Schooling facilities	5.35	9.98	5.44	9.50	20.30	17.00	7.18	14.46	11.98
Land and resettlement	...	...	...	28.70	14.10	18.50	10.27	9.53	9.78
No need	...	...	...	7.10	1.20	3.00	12.26	7.16	8.89
Electrification	1.41	12.15	23.29	3.70	35.10	25.70	2.90	10.64	8.01
Credit and loan issues	7.46	8.81	5.72	19.00	15.80	16.80	7.34	7.45	7.41
Waste management	19.40	2.23	1.54	12.50	2.50	5.50	12.55	2.55	5.95
Food assistance				3.30	7.40	6.20	2.54	6.23	4.97
Vocational and nonformal education (NFE) training facilities	18.28	2.85	3.22	2.40	1.50	1.80	4.07	1.11	2.12
Other public facilities	...	...	...	2.30	0.90	1.40	1.02	1.06	1.04
Pollution and environment	...	...	...	...	...	...	0.08	1.17	0.80
Taxes	...	...	...	...	...	...	1.89	0.11	0.72
Prices	...	...	...	...	...	...	0.25	0.04	0.11

Notes: 1/ For BLSS 2003, refers to public transport facilities.
2/ For BLSS 2003, refers to agriculture and food assistance.
* For BLSS 2007 and 2012, column totals do not add up to 100% due to multiple responses.

References

Asian Development Bank. 2014. *Key Indicators for Asia and the Pacific 2014*. Manila. http://www.adb.org/publications/key-indicators-asia-and-pacific-2014 (accessed 2 March 2015).

Asian Development Bank and National Statistics Bureau, Bhutan. 2013. *Bhutan Living Standards Survey 2012 Report*.

Ministry of Works and Human Settlement. 2008. *Bhutan National Urbanization Strategy*. http://www.mowhs.gov.bt/wp-content/uploads/2010/11/Bhutan_National_Urbanization_Strategy_2008.pdf (accessed 18 June 2014).

Royal Government of Bhutan, National Statistics Bureau. *Poverty Analysis Report 2003*. http://www.nsb.gov.bt/publication/files/pub10ks2884sy.pdf (accessed 27 February 2015).

Royal Government of Bhutan, National Statistics Bureau. 2007. *Poverty Analysis Report 2007*. http://www.nsb.gov.bt/publication/files/pub4kf7409pu.pdf (accessed 27 February 2015).

Royal Government of Bhutan, National Statistics Bureau and World Bank. 2013. *Bhutan Poverty Analysis 2012*. http://www.nsb.gov.bt/publication/files/pub6pg3078cg.pdf (accessed 27 February 2015).

Royal Government of Bhutan, National Statistics Bureau. *Bhutan Living Standards Survey 2003 Report*.

Royal Government of Bhutan, National Statistics Bureau. 2007. *Bhutan Living Standards Survey 2007 Report*.

Royal Government of Bhutan, National Statistics Bureau. *National Population Projection*. http://www.nsb.gov.bt/nada4/index.php/catalog/17/download/106 (accessed 18 June 2014).

Royal Government of Bhutan, National Statistics Bureau. 2008. *Dzongkhag Population Projections 2006-2015 Based on the Results of Population and Housing Census of Bhutan (PHCB) 2005*. http://www.nsb.gov.bt/publication/files/pub3uu3600pb.pdf (accessed 2 March 2015).

Royal Government of Bhutan, Office of the Census Commissioner. *Results of Population and Housing Census of Bhutan 2005*. http://www.nsb.gov.bt/nada4/index.php/catalog/17/download/103 (accessed 29 April 2014).

UNESCO Institute for Statistics. http://data.uis.unesco.org/ (accessed 18 June 2014).

STUDY III
Examining the Existing Agriculture Data Sources in Lao People's Democratic Republic

1. Background

In Lao PDR, agriculture contributed an average of 30% to GDP from 2008 to 2012 and provided employment to 72% of the country's labor force in 2010. Although rural poverty has been reduced from 49% in 1992 and more recently, to 32% in 2008, it still remains significantly higher compared to urban poverty which declined from 33% in 1992 to 18% in 2008. The significantly higher rural poverty incidence and agriculture being the main source of livelihood in the rural areas are compelling reasons for the government to focus on the development of the agriculture sector. Policies and strategies which foster rapid development in the sector have been given high priority in the government's allocation of resources. It is essential, therefore, to study the vital role of agriculture in reducing poverty and consequently, food security in the rural areas.

Recognizing that timely and reliable statistics are needed to effectively plan, monitor, and evaluate progress in all sectors of society and the economy, the Government of Lao People's Democratic Republic (Lao PDR) ratified a Statistics Law in 2010. It aims to achieve rational and sustained development of the national statistical system. An agriculture census which required a considerable amount of funds and effort was conducted in 2010/2011 by the Ministry of Agriculture and Forestry (MAF), in collaboration with several international agencies. The census aimed to provide reliable and up-to-date benchmark statistical information that would enable the design and implementation of evidence-based agricultural and rural development policies and programs. It could also serve as frame for a comprehensive agricultural statistical data collection and information system.

MAF, through intensive consultations with major stakeholders and with assistance from the Asian Development Bank's (ADB) regional policy and advisory technical assistance 8029: Improving Agricultural and Rural Statistics for Food Security, developed the Lao PDR Action Plan for Improving Agricultural Statistics which was endorsed by the MAF Minister on December 2013. The action plan identified the current major issues based on major stockholders' inputs in the agriculture statistical system and proposed the key activities necessary to address them.

The country action plan puts high priority on accurate and timely data for monitoring major agricultural commodities that are critical to food security. One of its target outcomes is an improvement in the availability, quality, relevance, and timeliness of a comprehensive set of agriculture and rural statistics. While there are several sources for agriculture and rural statistics at present, there are some perceived inconsistencies and duplication in the data among them. These inconsistencies may not be able to provide good support for evidence-based policies and may impede the monitoring of development in the agriculture sector. It is therefore necessary to examine the existing data sources, identify the duplications and inconsistencies and consequently, use the results of the study to propose solutions for minimizing duplication and inconsistencies.

This study aims to compare the different sources of agricultural statistics in Lao PDR. Specifically, it will examine the existing datasets and their corresponding metadata, compare common data series and evaluate their consistency. Section 2 presents the relevant facts about the existing data sets while Section 3 shows the analytical framework used. The results and discussion are presented in Section 4 while the conclusion and recommendations are in Section 5. Statistical tables are presented in the appendix.

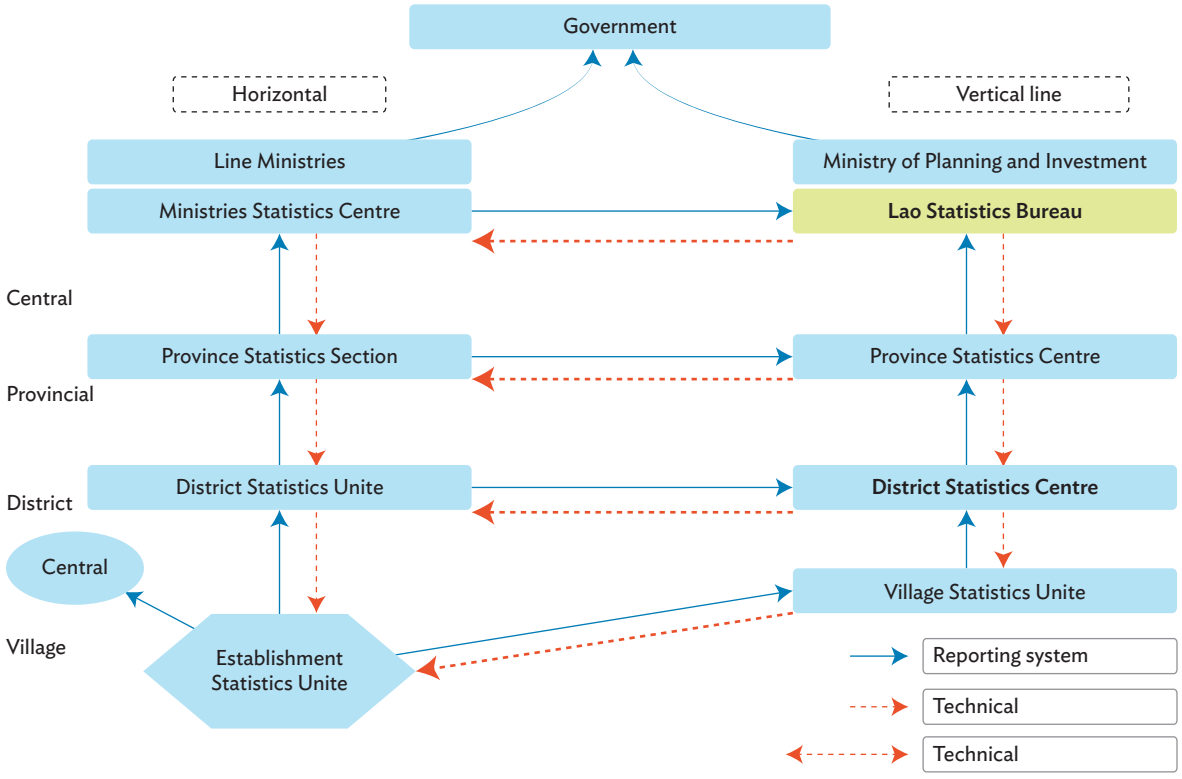
2. Sources of Agricultural Statistics

Four data sources of agricultural statistics were examined in this study: Agricultural Statistics Yearbook (ASY) which contains statistics derived from administrative reporting system of the MAF, Lao Census of Agriculture (CA), Risk and Vulnerability Survey (RVS), and Lao Expenditure and Consumption Survey (LECS).

It is important to note that these data sources come from various units under the Lao National Statistical System, the organizational chart of which is presented in Figure 1. The statistical system of Lao PDR is decentralized involving several institutions, each with its specific assignment. Until 2010, the Department of Statistics (DOS) under the Ministry of Planning and Investment (MPI) was responsible for population censuses and household surveys in the nonagriculture sector, particularly the LECS. The Statistics Law was enacted in June 2010 which upgraded DOS into the Lao Statistics Bureau (LSB), with status equivalent to a subministry of a line ministry. The Statistics Law provides LSB the authority to conduct censuses and surveys, compile national accounts statistics, and provide overall coordination of the system. It also specifies that the line ministries and province, municipality, district and subdistrict offices can conduct sample surveys after receiving technical approval of LSB.

The 2010 Statistics Law essentially divides the national statistical system (Figure 1) into two subsystems: a 'vertical' subsystem composed mainly of LSB and a 'horizontal' subsystem composed of the line ministries' statistics units exemplified by MAF. To support the newly promulgated Statistics Law, a National Statistics Development Strategy that covers 2010-2020 was formulated with four strategic goals: i) improving policy, regulatory, and institutional

Figure 1: Lao PDR Statistical System



Source: Lao Statistics Bureau. 2012.

framework; ii) developing statistical infrastructure; iii) data development and management; and iv) rationalizing investment infrastructure and equipment. The requirements to fulfill these strategic goals are based on three groups of indicators: economic (which includes agriculture), social, and others (which includes environment).

Agricultural Statistics Yearbook

The ASY is the annual publication of the Department of Planning and Cooperation, MAF that compiles agriculture data from the administrative reports. Most of the crop production data and other agricultural data series come from administrative reports in which the government agricultural personnel assess crop production by observing harvests and interviewing key informants (i.e farmers and village heads) in their localities.

The information presented in ASY are mainly collected through the MAF administrative reporting system in which village heads are required to report crop production and area, livestock, fisheries, and irrigation to the district agricultural and forestry office (DAFO) every six months. DAFO officials derive the district summary statistics from the village reports and forward these to the provincial agricultural and forestry office (PAFO). A copy of the DAFO report is also forwarded to the provincial planning office that could eventually go to the LSB which is under the Ministry of Planning and Investment (MPI). PAFOs derive the provincial summary statistics from the DAFO reports and forward a copy to Center for Agricultural Statistics (CAS), MAF. These reports are also forwarded to the provincial planning offices which could eventually go to LSB. Other information are obtained from LSB under the MPI, Department of Meteorology and Hydrology and other agencies.

The ASY aims to provide necessary information relating to crop production, livestock, fishery, forestry, irrigation, and other important information which will be used as basis to monitor the progress of the implementation of the Agriculture and Forestry Plan and to develop policies and plan for agricultural and forestry development.

Lao Census of Agriculture

The CA was undertaken under the overall administration of the Agricultural Census Steering Committee, which was chaired by MAF. The LSB under the MPI provided technical assistance. The CA was identified as one of the highest priorities of the Ministry to provide reliable and up-to-date structural data on the agriculture sector that would enable the implementation of more effective agricultural and rural development policies and programs. Two censuses were conducted by the Ministry – the first was done in 1998/1999 and the most recent in 2010/2011.

Geographically, CA covered the whole of Lao PDR, including urban areas in Vientiane and elsewhere. However, it included private households only; agriculture activities of institutional units such as government farms, private companies, and schools were excluded. It has four main objectives: (i) to provide data on the organizational structure of agriculture, especially for small administrative units (i.e. districts and villages) and other detailed cross tabulations; (ii) to provide data to use as benchmarks for current agricultural statistics; (iii) to provide frames for agricultural sample surveys; and (iv) to provide data on infrastructure and agricultural services at the village level.

The census has three components, each having specific data items: (i) complete enumeration village census (presence of electricity, irrigation, credit and health facilities, agricultural market, public services, soil degradation, weather patterns, and national disasters); (ii) complete enumeration of

household component (agricultural area under temporary and permanent crops, livestock number, agricultural production, ownership of tractors, aquaculture, and main source of income); and (iii) sample farm household component (land tenure, land fragmentation, land use, use of crop inputs, employment of farm population, farm management, and types of fishing activities).

Lao Expenditure and Consumption Survey

The LECS is the largest household sample survey in Lao PDR conducted by the LSB. LECS is considered as the most important survey in statistical data collection in Lao PDR. The survey is conducted every five years – the first of which was carried out in 1992 and the most recent which is publicly-available was conducted from April 2007 to March 2008 (LECS 4). LECS 5 which was conducted in 2012 is still being processed as of this writing.

The results of LECS are used to estimate the expenditure and consumption of households, as well as the production, investment, accumulation and other socioeconomic aspects of the households in the formal and informal sector of the economy. LECS is used for the calculation of important indicators for planning and monitoring of government policies. It is also the most important data source in GDP compilation, including the estimation of agriculture gross value added and poverty incidence estimation. Other agriculture data items in LECS are the farming area operated, main output planted, harvested and output, and number of livestock and poultry.

The survey design for LECS 4 uses the same methodology and sampling technique as used in LECS 3. The sample size of LECS 4 consisted of 8,304 households from 518 villages. The sample villages were the same sample villages in LECS 3 which were selected using probability proportional to size sampling (PPS) with number of households as size measure from the following strata: (i) urban; (ii) rural area with access to road, and (iii) rural area without access to road. In each sample village, 16 households were selected in the sample with eight households from LECS 3 and another eight from the new list of households excluding the eight from LECS 3. The LECS 4 survey report does not provide details on the determination of selection probabilities and final survey weights.

Risk and Vulnerability Survey

The RVS is a food and nutrition security survey conducted from November 2012 to January 2013 by MAF in close collaboration with the Ministry of Health, Care International, Food and Agriculture Organization (FAO), World Food Program (WFP) and UNICEF. This collaboration produced a report which is reflective of their combined expertise and respective institutional mandates. The RVS was conducted to provide insights on the level of food insecurity in the country, determinants of food insecurity, vulnerability to natural hazards and linkages between food insecurity and malnutrition.

The overall aim of RVS was to increase understanding and availability of information for decision-makers working to reduce risk and improve food security. Specifically, it aimed to: (i) provide information on food security, risk and vulnerability, as well as on the linkages between food security and malnutrition; (ii) promote multi-sectoral and multi-agency collaboration on food security risks and vulnerability issues; and (iii) support governmental and nongovernmental capacity building in food security, vulnerability and risk analysis.

The RVS sampling plan was designed to allow statistically representative results at the national and agro-ecological zones, with potential limited extrapolations at the provincial level and to allow for linkages with the CA. A multi-stage sampling design was employed - a strategy intended to reduce operational challenges while prioritizing the poorest districts. In three of the agro-ecological zones, the Northern highlands, Northern lowlands, and the

Mekong corridor, a three-stage sampling plan was employed to allow for prioritization of poor and priority poor districts. In stage one, districts were stratified by province according to their designation as poor or nonpoor. All districts in the poor stratum were selected while a sample of districts from the nonpoor stratum was selected using systematic random sampling. The RVS sample villages were selected as a subsample of the CA 2010/11 sample villages. This was done to maximize the overlap with the CA 2010/11 and also to sufficiently include non-farming households. In CA 2010/11, villages were stratified by urban/rural for the selection of villages. The RVS sample of villages was selected from the CA 2010/11 rural strata (with or without access to road). Systematic random sampling was used to ensure good representation of villages according to road access. Thus, all villages with road access were listed first followed by all villages without road access and a suitable skip interval was applied. Given the strong correlation between poverty and food security, district poverty characteristics were used in the sample design to improve reliability. In each of the sample village, 15 households were selected using systematic random sampling. A total of 4,308 households in 288 villages comprised the final RVS sample.

3. Analytical Framework

Comparative analysis was done to determine the possible differences in agricultural data derived from different sources. Results of this comparison aim to encourage producers of these agricultural statistics to have close coordination to come up with consolidated and harmonized data for informed decision making in the agriculture sector.

The initial phase of comparative analysis was the identification of common agricultural indicators in the four data sources. Appendix Table 1 shows the list of common indicators with the corresponding units of measure identified from CA, ASY, LECS and RVS. Three common indicators were selected in this study: area and production of selected temporary and permanent crops and number of livestock.

Comparison was done for the same period across provinces, regions and national estimates – 2007 data using ASY 2009 (2007 data) and LECS 2007/2008; 2010 data using ASY 2010 and CA 2010/2011; and 2012 data using ASY 2012 and RVS 2012/2013. The specific use, frequency and aggregation level of each dataset were also analyzed.

Temporary crops are crops with less than one year growing cycle. Area and production estimates of five temporary crops were analyzed – major crops such as rice and maize and minor crops such as cassava, sugarcane and tobacco. Permanent crops, on the other hand, are crops with greater than one year growing cycle such as fruit bearing trees. For this study, estimates of area under selected permanent crops such as coffee, tea and rubber were compared.

The percentage differences of the estimates were calculated by comparing the ASY estimates relative to the LECS estimates in 2007, CA estimates in 2010, and RVS estimates in 2012 for each indicator.

Available documentation on data collection instruments including reporting forms, sampling design and questionnaires as well as the data collection processes were studied to identify the possible sources of discrepancies between data sources.

The two sources of discrepancies of estimates are the sampling and nonsampling errors. Sampling errors arise when estimates are derived from probability sample surveys while nonsampling errors abound when the response provided differs from the real value. Possible sources of nonsampling errors are the respondent, interviewer, questionnaire, and collection method or the respondent's record-keeping system. Such errors may be random or they may result in a systematic bias if they are not random.

In probability sample surveys, sampling errors can be estimated while nonsampling errors cannot be estimated unless a validation mechanism is incorporated in the data collection and processing. Nonsampling errors are controlled through careful planning and implementation of survey instruments, operations, data processing and analysis.

4. Results and Discussion

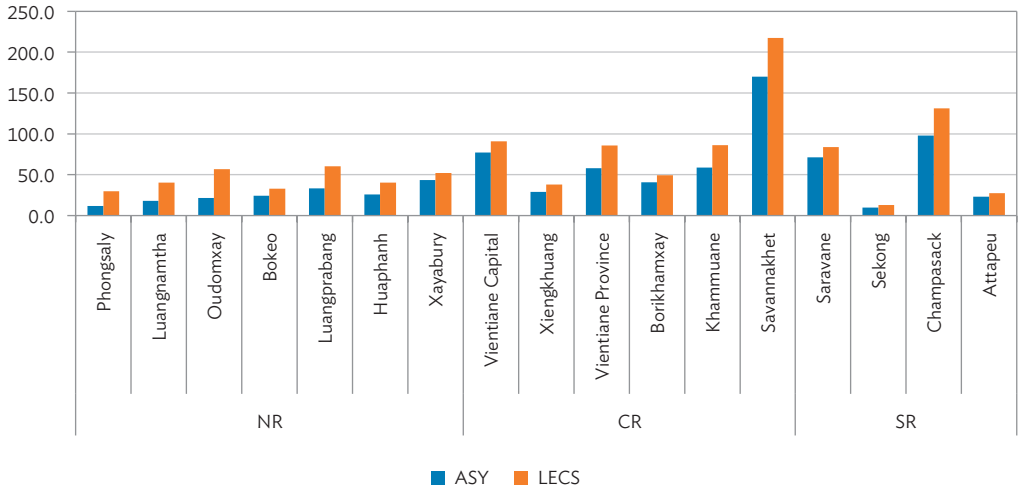
A. Comparison between LECS and ASY, 2007

Rice Area and Production

Figure 2 shows the area planted with rice in Lao PDR estimated from LECS and data from administrative reports compiled in ASY. As shown in the figure, LECS estimates of total area planted with rice by province were generally higher than the area estimates reported in ASY. Nationally, the ASY total area estimates were 40% less than the LECS estimates (Table 2). The difference was largest in the Northern region where the LECS estimate was higher by 76% than the figure reported in ASY. In the Central region which had the largest area planted to rice, estimates from LECS were higher than the data reported in ASY by as much as 31%. The discrepancies became more apparent at the provincial level. Three provinces in the Northern region recorded significantly high differences – Oudomxay (164%), Phongsaly (156%), and Luangnamtha (123%).

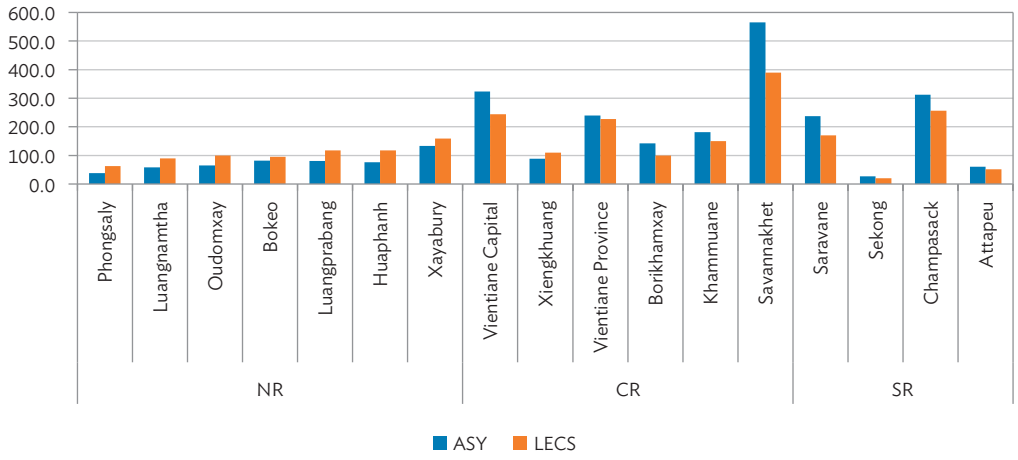
Figure 3 presents the comparison of rice production in 2007 between ASY and LECS. Nationally, there was only a 9% difference in the total production estimates between the two data sources despite the large variations across the regions. In the Northern region, rice production estimate reported in LECS was higher by 40% than the production estimate in ASY. Similarly, LECS estimates of production among the provinces in the Northern region were consistently higher than the figures reported in ASY (Table 2). On the other hand, total rice production was higher in ASY by 22% in the Southern region and 21% in the Central region. Except for Xienkhuang Province, provincial estimates of rice production in the Central and Southern regions based on LECS were lower than the figures reported in ASY. Among the provinces in the Central and Southern regions, Savannakhet Province recorded the highest difference where LECS estimate was lower by 31%.

Figure 2: Area Planted with Rice ('000 ha), 2007



Source: Appendix Table 2.

Figure 3: Rice Production ('000 tons), 2007



Source: Appendix Table 2.

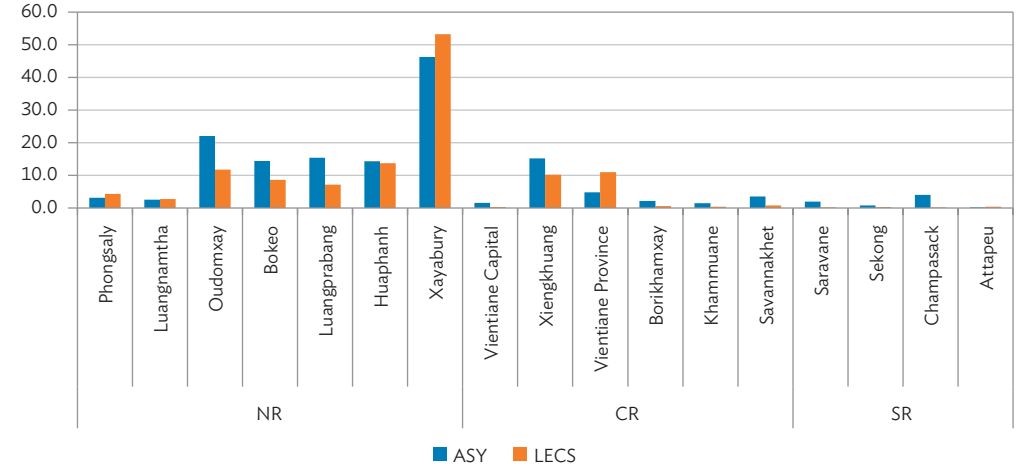
Consequently, total yield was higher by 35% in ASY compared to LECS. ASY estimates of yield were consistently higher in all regions than the figures reported in LECS. Large discrepancies in yield estimates were also observed in all regions,– Central region (40%), Southern region (38%) and Northern region (21%).

Maize Area and Production

Table 4 shows that more than three-fourths of maize is grown in the Northern region. In contrast to rice, area estimate reported in ASY in the Northern region in 2007 was 14% higher than the result published in LECS. The percent difference of area estimates was notably high in the Southern region where the LECS estimate was 82% lower than the figure reported in ASY. As shown in Figure 4, both data sources reported the largest area under maize in Xayabury Province, although the estimates differed by 15%. Almost all provinces in the Central and Southern regions have high percent differences in the area estimates.

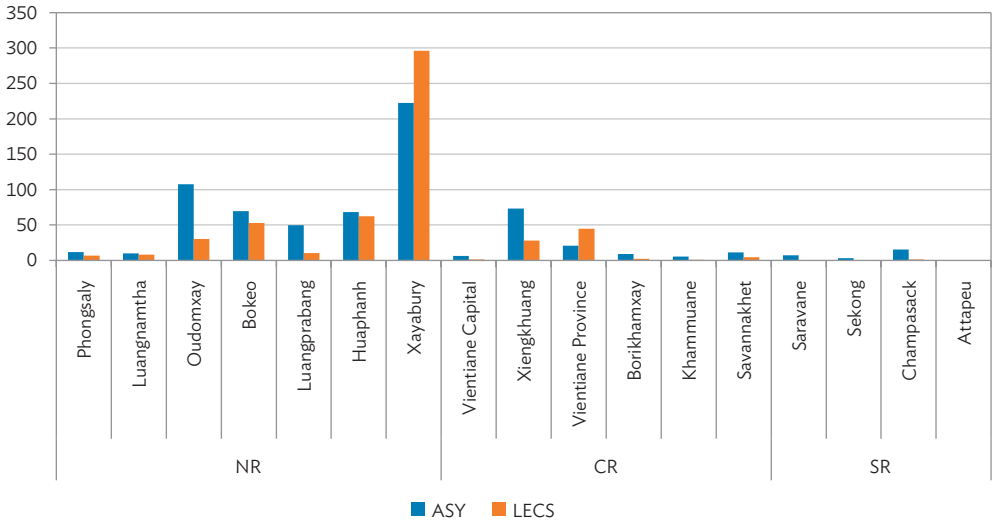
Overall, the percentage differences determined between LECS and ASY for the corn-producing provinces in the country were relatively high (Figure 5). Production estimates in ASY were generally higher than the LECS estimates, except

Figure 4: Area Planted with Maize ('000 ha), 2007



Source: Appendix Table 4.

Figure 5: Maize Production ('000 tons), 2007



Source: Appendix Table 4.

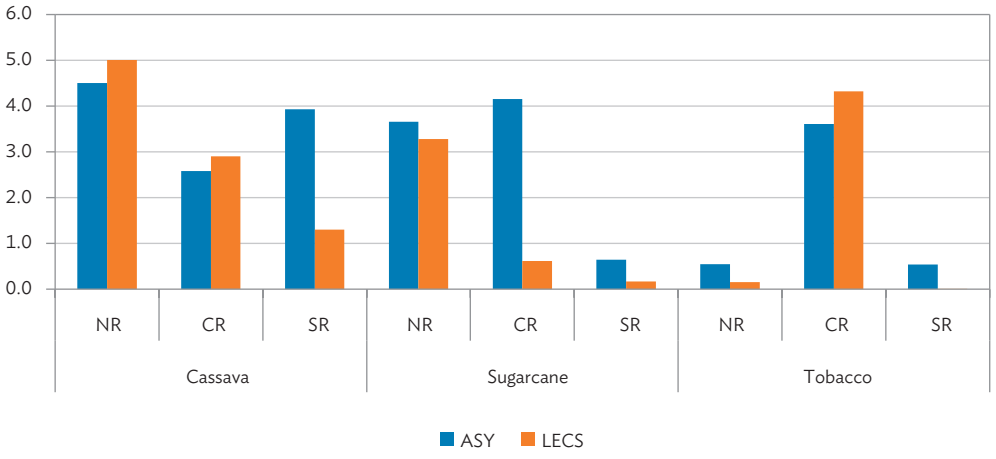
for Xayabury and Vientiane Provinces, where LECS estimates exceeded the ASY figures by 33% and 115%, respectively. Similar to area, production estimates across provinces also differed significantly between the two data sources when looking at the production estimates across provinces.

Nationally, there was only a 3% difference in the yield estimates reported in LECS and ASY. However, the estimates were more varied at the regional and provincial level. LECS and ASY yield estimates in Vientiane Province differed by only 5%. This was in contrast to the area and production estimates where LECS and ASY differed by 127% and 115%, respectively.

Selected Temporary Crops Area and Production

Figure 6 presents the LECS and ASY estimates of area planted under selected temporary crops. Almost half of the total area under cassava was found in the Northern region, where LECS estimate exceeded the figure reported in ASY by 11%. The highest percent difference was observed in the minor-producing Southern region, where the LECS estimate of total area was 63% lower than the figure reported in ASY.

Figure 6. Area Planted to Selected Temporary Crops ('000 ha), 2007



Source: Appendix Table 6.

Although there was only a 16% difference in reported areas, differences of the LECS and ASY provincial estimates went as high as 275% (Table 6).

Total area under sugarcane reported in ASY was 52% higher than the area reported in LECS. LECS estimates for all regions were smaller than the figures reported in ASY. The largest area was in the Central region based on the figures in ASY while the results of LECS show that the Northern region had the highest area under sugarcane in 2007. The difference in the estimates was also markedly high in the Southern region where the ASY estimate of area was 74% higher than the figure reported in LECS.

Both LECS and ASY reported the highest area under tobacco in the Central region. However, the LECS estimate was 16% higher than the figure reported in ASY. Although there was not much difference between data from LECS and ASY (5%) for the total area, the differences in estimates in the Northern and Southern regions were significantly high.

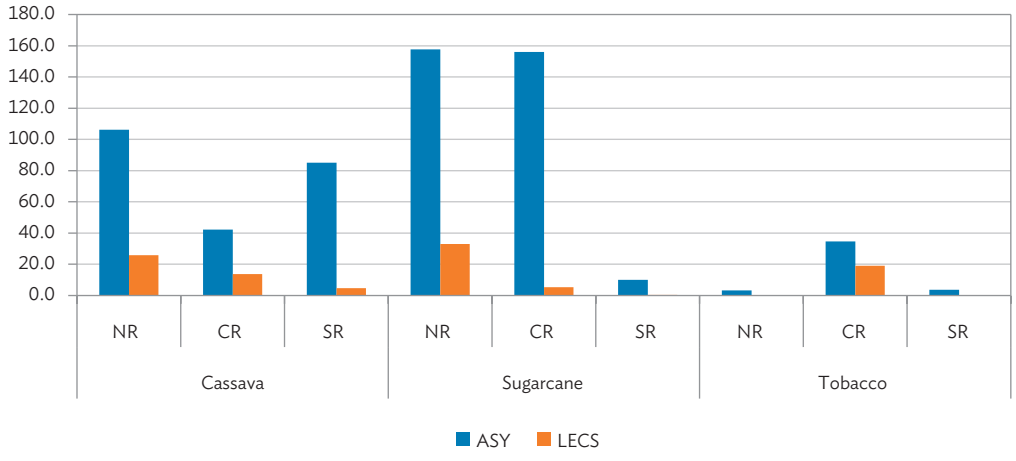
Looking at the percent differences between the LECS and ASY production data for the three selected temporary crops, ASY estimates were significantly higher than the estimates reported in LECS. Total production reported in ASY for cassava was 81% higher than the figure reported in LECS (Table 7). The differences were also consistently high in all three regions – Southern region (94%), Northern region (76%) and Central region (68%).

Production estimates of sugarcane reported in ASY and LECS also differed significantly, with the estimates of Central and Southern regions differing by 97%. Both LECS and ASY reported the highest sugarcane production in the Northern region, although the estimates differed by 79%. On the other hand, tobacco production was highest in the Central region, where ASY estimate of production was 45% higher than the figure reported in LECS. Differences in production in the Northern and Southern regions, both minor producers, were notably high at 99%.

Livestock Population

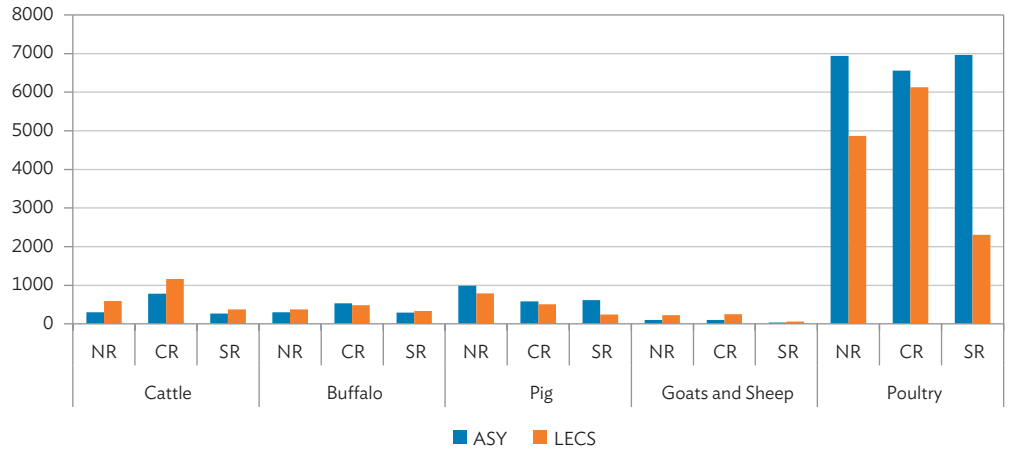
Figure 8 shows the total number of livestock in the Northern, Central and Southern regions in 2007. Results from LECS showed estimates that were higher than the figures reported in ASY for cattle, goat and sheep. The differences were largest for goat and sheep where the regional estimates differed by 138% in the Central region, 123% in the Northern region and 58% in the Southern region.

Figure 7: Production of Selected Temporary Crops ('000 tons), 2007



Source: Appendix Table 7.

Figure 8: Number of Livestock / Poultry ('000 heads), 2007



Source: Appendix Table 12.

On the other hand, total counts of pig and poultry were higher in ASY than the results published in LECS. Highest percent differences were observed in the Southern region where ASY poultry population exceeded the LECS estimate by 67% and the pig population estimate by 60%. Meanwhile, the LECS and ASY total counts of buffalo differed by only 6%. However, there were noted differences between the two data sources when looking at data across provinces (Table 12).

B. Comparisons between ASY, CA and RVS, 2010 and 2012

Rice Area

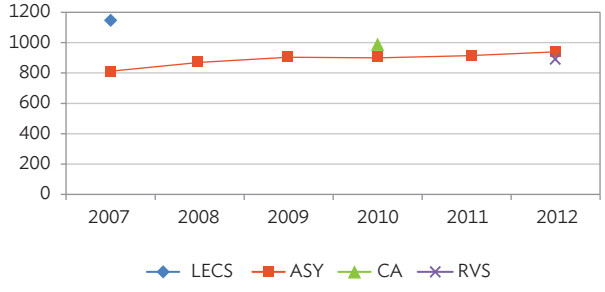
From 2007 to 2012, ASY reported a gradual increase in the total area planted with rice, registering a 16% rise in five years (Figure 9). The CA estimate exceeded the figure reported in ASY in 2010 by 10%. Area estimates in Central and Southern regions from the two data sources recorded a relative difference of less than 10% while the estimates in Northern region differed by 26% (Table 3).

The area estimates reported in RVS and the figure reported in ASY in 2012 did not differ much. Total area under rice based on the data reported in ASY was higher by only 4% than the results published in RVS. Similar to the observation in 2010 between CA and ASY, highest percent difference was observed in the Northern region, where provincial estimates differed by 15% to 64%.

Maize Area

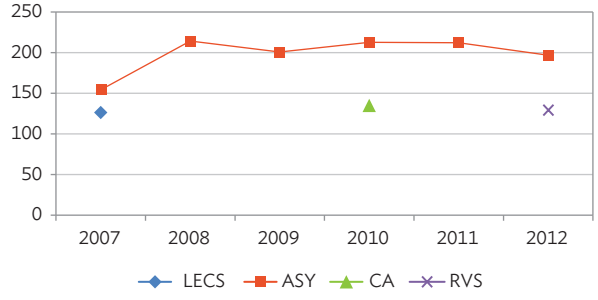
Figure 10 presents the total area under maize from 2007 to 2012. Based on the figures reported in ASY,

Figure 9: Area Planted with Rice ('000 ha), 2007–2012



Source: Appendix Table 3.

Figure 10: Area Planted with Maize ('000 ha), 2007–2012



Source: Appendix Table 5.

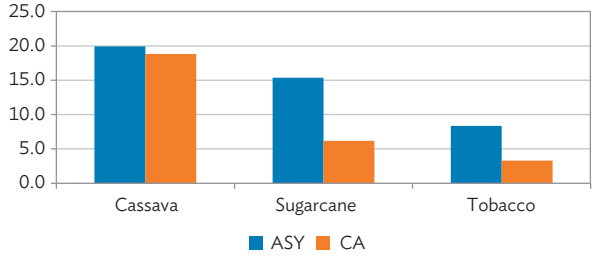
there was a noted increase in the total area planted with maize where it grew by 28%. In contrast to rice, figures reported in ASY exceeded the results published in CA in 2010 by 37%. Among the three regions, the minor maize-producing Southern region had the highest percent difference (86%) in 2010.

Similarly, the result from RVS had a smaller estimate of area under maize in 2012 than the estimate published in ASY. The highest percent difference was likewise observed in the Southern region where the ASY estimate of production was higher by 75% than the corresponding RVS estimate.

Cassava, Sugarcane, Tobacco Area

Figure 11 shows the comparison between area estimates of cassava, sugarcane, and tobacco in 2010 between the data reported in ASY and the results published in CA. Nationally, there was only a 6% difference in the total area under cassava between the two data sources despite the very large variations among the major-producing provinces as shown in Table 8 – Vientiane Capital (58%), Borikhamxay (57%), and Saravane (12%).

Figure 11: Area under selected temporary crops ('000 ha), 2010

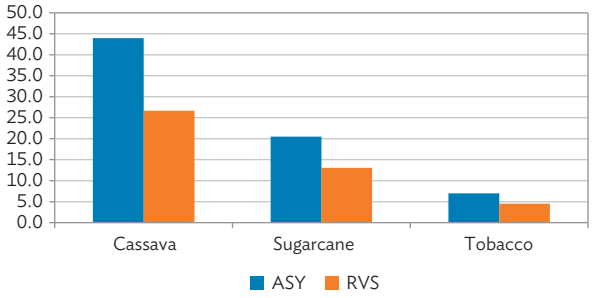


Source: Appendix Table 8, Table 9, and Table 10.

Meanwhile, area estimates for sugarcane and tobacco based on the figures reported in ASY were 60% higher than the data in CA. Differences on the provincial estimates were also considerably high for both crops.

In 2012, the figures reported in ASY exceeded the results in RVS for cassava, sugarcane, and tobacco (Figure 12). Total area reported in ASY for all three crops was 30% more than the corresponding estimates published in RVS. Likewise, there were significant differences in the estimates of the two data sources when looking at data across provinces.

Figure 12: Area under selected temporary crops ('000 ha), 2012



Source: Appendix Table 8, Table 9, and Table 10.

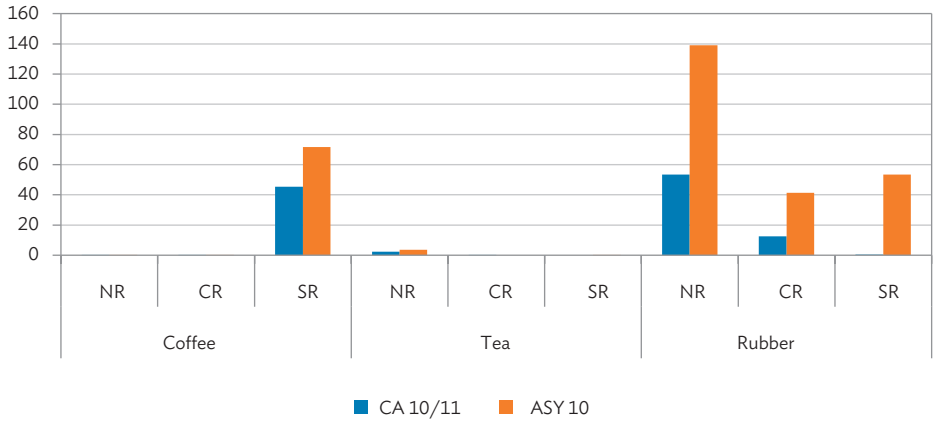
Area under Selected Permanent Crops

Figure 13 shows the comparison between area estimates reported in CA and ASY for selected minor crops such as coffee, tea, and rubber. Most of the coffee plantations are found in the Southern region while tea is most dominant in the Northern region. Estimates from the two data sources, however, differed by 30% both for the two major-producing regions. Rubber, which recorded the largest planted area among the three crops in 2010, registered the highest difference (72%) in total area. There were also noted differences between the two data sources when looking at data across regions (Table 11).

Livestock population

The CA and ASY estimates of total counts of cattle in 2010 had only an 8% difference. However, the variation became more apparent at the provincial level where the percent differences went as high as 74%. Overall, ASY appeared to overestimate the

Figure 13: Area Under Selected Permanent Crops ('000 ha), 2010

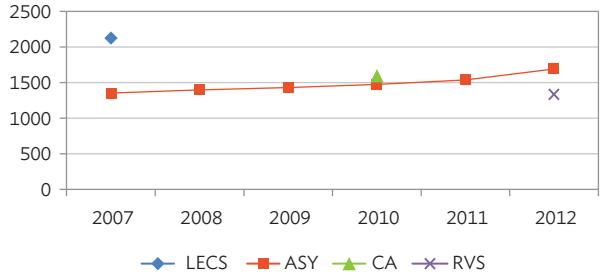


Source: Appendix Table 11.

number of pig (63%), poultry (59%) and buffalo (35%) in 2010. The differences were also consistently high across the regions as shown in Table 15.

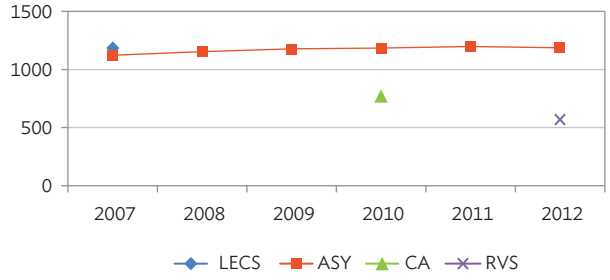
Furthermore, population estimates in ASY were considerably higher than the corresponding estimates in RVS for poultry (64%), pig (61%), buffalo (52%), and cattle (21%) in 2012.

Figure 14: Cattle Population ('000 heads), 2007–2012



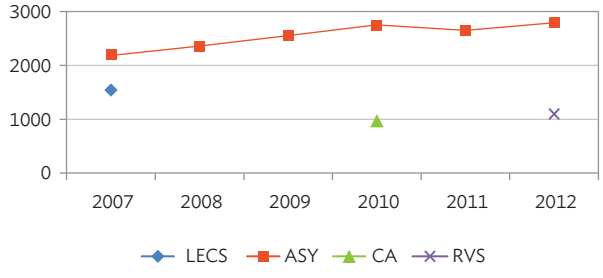
Source: Appendix Table 15.

Figure 15: Buffalo Population ('000 heads), 2007–2012



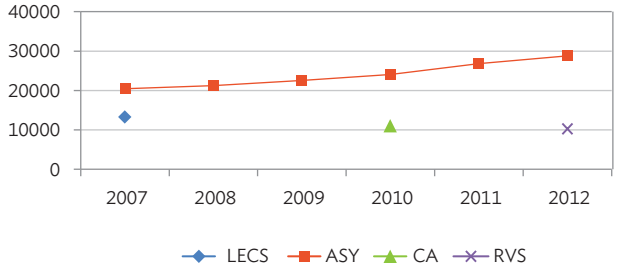
Source: Appendix Table 15.

Figure 16: Pig Population ('000 heads), 2007–2012



Source: Appendix Table 15.

Figure 17: Poultry Population ('000 heads), 2007–2012



Source: Appendix Table 15.

5. Sources of Discrepancies

Some possible factors that contributed to the discrepancies presented in the previous section are discussed below. This discussion is based only on the information that was gathered through available reports, interviews, and meetings. Hence, it cannot determine in absolute terms the true source of discrepancy.

Sampling designs

Both LECS and RVS reports did not present the sampling errors of major characteristics of interest. Since the reporting domains for RVS are the national and agro-ecological region, the sampling errors at the provincial level are expected to be higher than what was set as the tolerable level. Hence, one important factor that could explain the discrepancies involving the comparison with RVS with other data sources at the provincial level is the sampling error.

The sampling design of LECS 4 suggests that the selection probabilities within the sample village would differ since selection probabilities of the LECS 3 sample households would differ from the new set of eight households which were selected from the updated list of households without the LECS 3 sample. However, the survey weights in the LECS 4 data set, show that there were no differences in survey weights among households in a sample village. This implies that that the survey weights may not have been correctly determined. Hence, estimates and sampling errors may not be accurate.

Nonsampling errors

Differences in coverage

While both the administrative reporting system that provides data for ASY and the census of agriculture covered all the villages in both urban and rural areas in Lao PDR, CA only included private households and excluded agriculture activities of institutional units such as government farms, private companies, and schools. The differences in the crop area and production and livestock population estimates may be attributed to the difference in the coverage of CA and ASY. Crops grown or livestock raised by private companies, government farms, and collective households (i.e hotels, research institutions) were excluded in the census report. Also, temporary crops (i.e. rice, maize, cassava, sugarcane, and tobacco) and permanent crops (coffee, tea, and rubber) which are scattered and not planted in a systematic manner or sufficiently dense to permit the area to be measured were not included in the crop area estimates. This explains the very high differences computed for estimates of minor-producing areas under selected permanent crops such as coffee (Central region) and tea (Southern region).

The coverage of the two surveys studied – LECS and RVS also differed since RVS was only administered to sample households in the rural areas while LECS was conducted in both urban and rural areas. Based on the reports, there was no attempt for both the census and surveys to compensate for non-coverage.

Comparison between the ASY 2007 data and LECS 2007/2008 may have also been affected by the changes in provincial boundaries. Xaysomboon Special Region was abolished and the districts within it were assigned to Luangprabang, Xiengkhuang, and Vientiane Province.

Nonresponse

The survey and reports and the insufficient documentation on the administrative reporting system did not discuss nonresponse rates and how nonresponse was compensated, if any. In RVS, a sample of five households per sample village was reserved as substitute for nonresponding households. It was not clear in LECS if such nonresponding sample

households were replaced. Usually, if nonresponse rates are uneven across important groups or classes, an adjustment factor to compensate for nonresponse is incorporated in the survey weight (Maligalig, 2014).

Differences in concepts and definitions

Another major factor to consider is that the questions asked in each exercise were formulated in a different manner. For example, in the administrative report, most of the farmers and village heads reported their cropping intention instead of the actual area planted during the season. On the other hand, the actual area planted was specifically asked in each farming household in the expenditure and consumption survey.

The CA 2010/2011 solicited data over the past twelve months, whereas questions in RVS referred only to the previous season. Since data was collected directly after the main rice harvest, respondents may not have considered crops planted and harvested earlier in the year.

Subjective intervention

During a high-level meeting on the existing data sources for agricultural statistics (Maligalig, 2014), several MAF managers indicated that the differences between CAS and LSB data can be explained by the use of planned figures in place of actual figures. If the actual production statistics at the district level fall short, the common practice was to report the target figures that were determined by the central planning office. Since the summary statistics are not validated as these go up the administrative hierarchy, the size of the measurement error cannot be estimated.

Differences in the timing of data collection

Comparison between CA 2010/2011 and ASY area estimates for rice in 2010 showed large discrepancies in almost all provinces, with all the CA estimates higher than ASY. Data for ASY 2010 were compiled prior to the conduct of CA and hence, there were differences that can be attributed to the reported decline in slash and burn cultivation, particularly in the Northern region. This suggests a shift to other sustainable upland cultivation systems. Slash and burn agriculture used to be a major production system in the upland areas. This subsistence system commonly integrates crop production, animal husbandry, and forestry. The increasing degradation of the resource base prompted the government to transform this perceived harmful system to other sustainable system, particularly for rice, the country's most important upland crop (Roder, 2001).

Another factor that could explain the differences in the area and production estimates in LECS 4 and ASY is the reference period of the estimates. LECS 2007/2008 covered two rice cropping seasons (June to October and December to April). Administrative data reported in ASY, on the other hand, are based on reporting at the beginning of the cropping season, or in some cases, it includes reporting at the middle or end of the cropping season. Furthermore, the census number of livestock refers to the number of animals on the day the household was enumerated in the census. Livestock data from administrative reports may have different reference periods.

Data processing errors

Although we were not able to find any anecdotal evidence of data processing errors, this source of discrepancies should not be discarded since it is not clear whether strict data processing protocols were applied by these four data sources. In the case of the administrative reporting system, the reporting forms was not properly digitized and coded for effective data validation purposes.

6 Conclusions and Recommendations

The results of this study revealed large discrepancies between data reported in the Agricultural Statistics Yearbook from administrative reports and the most recent Census of Agriculture (2010/2011), Risk and Vulnerability Survey (2012/2013), and Lao Expenditure and Consumption Survey (2007/2008). This suggests that there is a need to control for possible sources of discrepancies by developing a system-wide standards, concepts and methods to harmonize data collection and processing.

Likewise, the analysis of the specific use, design, frequency and coverage of each data source suggest the need to develop uniform standards, concepts, and methods to harmonize the data collection system. The study further proposes standardizing the questionnaires and timing of collection of agriculture and rural data to better conduct comparative studies across provinces and over time. Further in-depth study which includes longer data series from administrative reports and the results of the most recent household survey (LECS 5) is likewise suggested.

The design of CA suggests that it can provide better estimates (and sampling error estimates) if objectively conducted. However, because its nature requires substantial financial, technical, and human resources, it can only be conducted once every ten years. Hence, the census cannot be expected to support policy monitoring. On the other hand, RVS lacks institutional mandate and is only possible with the availability of external financing. The analysis also suggests that since LECS was designed for expenditure and consumption, it may be a very inefficient tool to estimate agricultural statistics.

ASY information is available annually and with a shorter time lag. Therefore, it is the best candidate source for developing, monitoring, and assessing agricultural projects and programs. The tradeoff is that ASY is based predominantly on MAF and local government administrative reports that are known to be prone to higher nonsampling errors. These call for steps to check, validate, and improve the quality of information, particularly those that are published in ASY. This study suggests developing probability sample survey strategies that will improve the quality of data collected through administrative reports.

Appendix: Statistical Tables

Table 1: Summary of Common Indicators from Different Sources of Agricultural Statistics in Lao PDR				
Indicator (s)	**Lao Census of Agriculture**	**Agricultural Statistics Yearbook**	**Risk and Vulnerability Survey**	**Lao Expenditure and Consumption Survey**
Area of forest land	Table A1.4: Land use by province, 1998/99 and 2010/11	Table 65: Forest planted area (by province, in ha)		Table 5.6: Agricultural operated land in the last agricultural season by region (ha) - Wet season plots - Dry season plots
Number of growers by province / percent of HH growers by region	Table A1.9: Number of growers for selected temporary crops by province, 2010/11 (rice, maize, cassava and sugarcane)		Percent of households growing selected crops (i.e rice maize, cassava and sugarcane) in 2012 by province	
	Table A1.16: Number of growers for selected permanent crops (rubber) by province, 2010/11		Table 11: Lao Agricultural Census data on number of growers for selected crops (rubber)	
Planted area (temporary crops)	Table A1.10: Area of selected temporary crops planted by province, 2010/11 (rice, maize, cassava, tobacco, sugarcane, watermelon)	Area, yield and production by provinces Table 03: Total rice paddy (rainfed and dry season rice) Table 07: Total maize Table 08: Maize Table 15: Cassava Table 26: Tobacco Table 28: Sugarcane Table 38: Watermelon		
Planted area (rice, by season and land type)	Table 1.12: Area of rice planted by season (total, wet, dry), land type (total, lowland, upland) and province, 2010/11	Table 03: Total rice paddy (rainfed and dry season rice): area, yield and production by provinces Table 04: Lowland rainfed paddy: area, yield and production by provinces Table 05: Dry season paddy: area, yield and production by provinces Table 06: Upland rainfed paddy: area, yield and production by provinces		Table 5.7: Harvested area (ha) and production (tons) of rice (ordinary and glutinous) in the last agricultural season by region -Wet season -Dry season
Planted area (permanent crops)	Table A1.17: Area of selected compact permanent crops by province, 2010/11 (coffee, tea, banana and rubber)	Area, yield and production by provinces Table 20: Coffee Table 21: Tea Table 35: Banana Table 78: Rubber Table 09: Rubber plantation area in Lao PDR (by province, in ha) Table 14: Cash crop investment in Lao PDR (Area by cash crop)		

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Table 1: Summary of Common Indicators from Different Sources of Agricultural Statistics in Lao PDR

Indicator (s)	Lao Census of Agriculture	Agricultural Statistics Yearbook	Risk and Vulnerability Survey	Lao Expenditure and Consumption Survey
Number of farm HHs / percent of HHs owning livestock	Table A1.20: Number of farm households with selected livestock/poultry types by province, 1999 and 2011		Percent of HHs owning at least one of the animal species by province (cattle, buffalo, pigs, poultry) Table 12. HHs that own at least one of each livestock per species (cattle, buffalo, goat, pig, poultry)	
Number of livestock/poultry	Table A1.21: Number of livestock/poultry by type and province, 1999 and 2011(cattle, buffaloes, pigs, goats, local chickens, commercial chickens, ducks)	Livestock population Table 42: Cattle Table 41: Buffalo Table 43: Pig Table 44: Goat and sheep Table 45: Poultry		Table 5.8: Total number of livestock by type of area and by province (number of heads) Table 5.9: Average number of livestock per household by type of area and by province (number of heads) (cattle, buffaloes, pigs, goats, others) Table 5.10 Total number of poultry raised during last 4 weeks by type of area and province (number of heads)
Cattle ownership (size per holding)	Table A1.22: Farm households by cattle herd size and province, 2011 Cattle herd size, percent of cattle holdings (total, 1-2 heads, 3-4 heads, 5-9 heads, 10-19 heads, 20 & over heads)		Percent of HHs by size of livestock herd and province Cattle ownership (no cattle; 1-2 cows; 3-4 cows; >4 cows)	
Buffalo ownership (herd size per holding)	Table A1.23: Farm households by buffalo herd size and province, 2011 Buffalo herd size, percent of buffalo holdings (total, 1-2 head, 3-4 head, 5-9 head, 10-19 head, 20 & over)		Percent of HHs by size of livestock herd and province Buffalo ownership (no buffalo; 1-2 buffalo; 3-4 buffalo; >4 buffalo)	
Pig ownership (size of herd per holding)	Table A1.24: Farm households by pig herd size and province, 2011 Pig herd size, percent of pig holdings (total, 1-2 head, 3-4 head, 5-9 head, 10-19 head, 20 & over)		Percent of households by size of livestock herd and province Pig herd sizes (no pigs; 1-2 pigs; 3-4 pigs; >4 pigs)	
Poultry ownership (flock size per holding)	Table A1.25: Farm households by local chicken flock size and province, 2011 Local chicken flock size, percent of local chicken holdings (total, 1-4 head, 5-9 head, 10-19 head, 20-49 head, 50 & over)		Percent of households by size of livestock herd and province Poultry flocks (no poultry; 1-5 poultry; 6-10 poultry; 11-20 poultry; >20 poultry)	Table 5.11 Average number of poultry per household raised during last 4 weeks by type of area and province (number of heads) (local chickens, commercial chickens, turkey, geese, others)
Number/percent of employed (farm) HH	Table A1.32: Employed farm population aged 10 years and over by main job, sex and province, 2010/11 (farm population aged 10 years and over, employed persons aged 10 years and over, farm/ nonfarm employee, own account or unpaid family worker)			Table 5.1: Main economic activities for population 10+, by province and region (% of population) (paid employee/self-employed; nonfarm activity, own operated farm)

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Table 1: Summary of Common Indicators from Different Sources of Agricultural Statistics in Lao PDR				
Indicator (s)	**Lao Census of Agriculture**	**Agricultural Statistics Yearbook**	**Risk and Vulnerability Survey**	**Lao Expenditure and Consumption Survey**
Percent of villages with different types of irrigation facilities	Table A2.6: Type of irrigation facilities in rural villages by province, village type and land type, 2011 Type of irrigation facility, percent of rural villages (permanent weir, reservoir, pump scheme, gates and dykes, temporary weir, gabions, other irrigation facilities)	Number of irrigation facilities per province and total irrigated areas Tables 50 and 51: Weirs Tables 52 and 53: Reservoirs Tables 54 and 55: Pump scheme Tables 56 and 57: Gates and dikes Tables 58 and 59: Temporary weirs Tables 60 and 61: Gabions	Table 14: Percent of villages with different types of irrigation facilities, CA 2010/11 (weir, reservoir, pump, gates, temporary weir, gabions)	
Percent of rural villages with irrigation, by season	Table A2.9: Selected agricultural characteristics of rural villages by province, village type and land type, 2011 Irrigation (% of rural villages) (wet season, dry season, both wet and dry season)	Table 48: Total irrigated areas Table 49: Wet season irrigated area Table 50: Dry season irrigated area		
Percent of villages with development projects	Table A2.12: Development projects in rural villages by province, village type and land type (% of villages) - by sector (crops, livestock, fisheries, forestry, slash and burn cropping)			Table 5.22: Agricultural practices by province and region, 2007/08 (% of villages) - villages with development project, receiving agri extension workers, with deforestation - agricultural practices mostly used in the villages (shifting cultivation, slash and burn)
Percent/total population of rural villages affected by natural disaster	Table A2.14: Natural disasters in rural villages by province, village type and land type, 2011 Percent of rural villages (floods, droughts, landslides, pests)		Table 9: Hazards and affected population, 1960-2012 Total affected population (floods; drought; storms; disease, outbreaks and epidemics; flash floods/landslides)	

Sources: Lao Statistics Bureau (LSB). *Lao Expenditure and Consumption Survey*, 2008.
Ministry of Agriculture and Forestry (MAF). *Agriculture Statistics Yearbook*, 2009.
MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Census of Agriculture*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table 2: Rice Area, Production and Yield Estimates in 2007

Province	Area ('000 ha)			Production ('000 tons)			Yield (tons/ha)		
	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff
Northern Region	**177.7**	**312.3**	**(76)**	**531.7**	**741.8**	**(40)**	**3.0**	**2.4**	**21**
Phongsaly	11.6	29.7	(156)	37.4	63.0	(68)	3.2	2.1	34
Luangnamtha	18.1	40.4	(123)	57.8	90.0	(56)	3.2	2.2	30
Oudomxay	21.4	56.6	(164)	64.9	99.3	(53)	3.0	1.8	42
Bokeo	24.2	32.9	(36)	82.0	95.3	(16)	3.4	2.9	14
Luangprabang	33.2	60.4	(82)	80.9	117.6	(45)	2.4	1.9	20
Huaphanh	25.6	40.4	(57)	75.5	117.4	(55)	2.9	2.9	1
Xayabury	43.6	52.0	(19)	133.1	159.2	(20)	3.1	3.1	0
Central Region	**433.3**	**567.8**	**(31)**	**1,541.5**	**1,218.8**	**21**	**3.6**	**2.1**	**40**
Vientiane Capital	77.2	91.0	(18)	324.1	243.7	25	4.2	2.7	36
Xiengkhuang	28.8	38.0	(32)	88.0	109.1	(24)	3.1	2.9	6
Vientiane Province	58.0	85.7	(48)	239.7	227.1	5	4.1	2.7	36
Borikhamxay	40.8	49.4	(21)	142.5	99.1	30	3.5	2.0	42
Khammuane	58.6	86.2	(47)	181.4	150.2	17	3.1	1.7	44
Savannakhet	169.9	217.6	(28)	566.0	389.5	31	3.3	1.8	46
Southern Region	**201.6**	**255.0**	**(26)**	**636.8**	**498.4**	**22**	**3.2**	**2.0**	**38**
Saravane	71.4	83.6	(17)	236.8	170.0	28	3.3	2.0	39
Sekong	9.6	12.7	(33)	26.7	20.5	23	2.8	1.6	42
Champasack	97.7	131.3	(34)	312.9	256.1	18	3.2	2.0	39
Attapeu	23.0	27.3	(19)	60.4	51.8	14	2.6	1.9	28
Total	**812.6**	**1,135.2**	**(40)**	**2,710.1**	**2,459.0**	**9**	**3.3**	**2.2**	**35**

Notes: ASY = Agriculture Statistics Yearbook, LECS = Lao Expenditure and Consumption Survey
% Diff = [(ASY-LECS)/ASY]*100%
Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008. MAF. *Agriculture Statistics Yearbook*, 2009.

Table 3: Area Planted with Rice ('000 ha), 2007-2012

Province	LECS 07	ASY 07	ASY 08	ASY 09	ASY 10	ASY 11	CA 10/11	% Diff	ASY 12	RVS 12/13	% Diff
Northern Region	**312.3**	**177.7**	**184.9**	**197.9**	**203.0**	**189.7**	**255.3**	**(26)**	**202.4**	**240.6**	**(19)**
Phongsaly	29.7	11.6	19.5	19.5	18.7	16.9	19.35	(4)	18.6	27.8	(50)
Luangnamtha	40.4	18.1	18.3	17.9	18.6	16.9	28.65	(54)	16.8	25.2	(51)
Oudomxay	56.6	21.4	20.6	25.9	25.2	25.0	41.84	(66)	24.6	40.3	(64)
Bokeo	32.9	24.2	24.7	25.2	27.4	26.8	27.64	(1)	25.9	31.4	(21)
Luangprabang	60.4	33.2	32.9	35.8	35.7	30.0	50.24	(41)	36.7	42.6	(16)
Huaphanh	40.4	25.6	25.3	27.3	29.1	26.9	34.82	(20)	30.1	34.5	(15)
Xayabury	52.0	43.6	43.5	46.3	48.3	47.1	52.75	(9)	49.6	38.7	22
Central Region	**567.8**	**433.3**	**471.0**	**485.2**	**478.0**	**488.2**	**514.0**	**(8)**	**494.2**	**456.7**	**8**
Vientiane Capital	91.0	77.2	76.1	82.2	77.0	77.0	61.47	20	76.5	49.6	35
Xiengkhuang	38.0	28.8	29.0	29.5	29.1	29.6	32.86	(13)	29.7	31.3	(6)
Vientiane Province	85.7	58.0	71.6	69.7	70.2	69.2	70.94	(1)	66.7	78.4	(17)
Borikhamxay	49.4	40.8	41.6	42.3	43.6	42.0	46.99	(8)	44.1	39.5	10
Khammuane	86.2	58.6	63.8	67.2	66.3	69.8	81.76	(23)	71.5	66.7	7
Savannakhet	217.6	169.9	188.9	194.2	191.9	200.6	220.02	(15)	205.8	191.3	7
Southern Region	**255.0**	**201.6**	**214.8**	**221.2**	**218.5**	**236.7**	**217.2**	**1**	**242.4**	**203.9**	**16**
Saravane	83.6	71.4	79.9	84.0	83.5	89.1	81.02	3	87.5	66.6	24
Sekong	12.7	9.6	11.0	10.5	11.8	11.0	12.29	(4)	11.1	14.8	(34)
Champasack	131.3	97.7	102.0	103.9	101.2	112.0	100.71	0	119.6	97.7	18
Attapeu	27.3	23.0	22.0	22.8	22.0	24.6	23.21	(6)	24.2	24.8	(2)
Total	**1,135.2**	**812.6**	**870.7**	**904.3**	**899.4**	**914.5**	**986.6**	**(10)**	**939.0**	**901.2**	**4**

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture, LECS = Lao Expenditure and Consumption Survey, RVS = Risk and Vulnerability Survey
% Diff = [(ASY-CA)/ASY]*100%; % Diff = [(ASY-RVS)/ASY]*100%

Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008.
MAF. *Agriculture Statistics Yearbook*, 2009.
MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Census of Agriculture*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table 4: Maize Area, Production and Yield Estimates in 2007

Province	Area ('000 ha)			Production ('000 tons)			Yield (tons/ha)		
	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff
Northern Region	**118.3**	**101.8**	**14**	**538.8**	**466.7**	**13**	**4.6**	**4.6**	**(1)**
Phongsaly	3.2	4.3	(34)	11.6	6.9	41	3.6	1.6	56
Luangnamtha	2.6	2.8	(8)	10.0	8.3	18	3.8	2.9	24
Oudomxay	22.1	11.8	47	107.4	30.1	72	4.9	2.5	48
Bokeo	14.4	8.7	40	69.5	52.8	24	4.8	6.1	(26)
Luangprabang	15.4	7.2	53	49.8	10.5	79	3.2	1.5	55
Huaphanh	14.3	13.7	4	68.3	62.2	9	4.8	4.5	5
Xayabury	46.3	53.3	(15)	222.3	296.0	(33)	4.8	5.6	(16)
Central Region	**28.9**	**23.4**	**19**	**126.0**	**82.0**	**35**	**4.4**	**3.5**	**20**
Vientiane Capital	1.6	0.3	81	6.5	1.4	79	4.2	4.7	(12)
Xiengkhuang	15.2	10.2	33	73.1	28.0	62	4.8	2.7	43
Vientiane Province	4.8	11.0	(127)	20.7	44.6	(115)	4.3	4.1	5
Borikhamxay	2.2	0.7	69	9.2	2.3	75	4.2	3.4	19
Khammuane	1.5	0.4	73	5.3	1.0	80	3.4	2.5	27
Savannakhet	3.6	0.8	78	11.3	4.7	58	3.1	6.0	(91)
Southern Region	**7.0**	**1.3**	**82**	**26.0**	**2.1**	**92**	**3.7**	**1.7**	**55**
Saravane	2.0	0.2	87	7.0	0.4	95	3.6	1.5	58
Sekong	0.8	0.3	66	3.2	0.3	91	3.8	1.0	74
Champasack	4.1	0.3	93	15.3	1.2	92	3.8	4.3	(15)
Attapeu	0.2	0.5	(145)	0.5	0.3	38	2.6	0.7	75
Total	**154.3**	**126.4**	**18**	**690.8**	**550.8**	**20**	**4.5**	**4.4**	**3**

ASY = Agriculture Statistics Yearbook, LECS = Lao Expenditure and Consumption Survey
% Diff = [(ASY-LECS)/ASY]*100%

Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008.
MAF. *Agriculture Statistics Yearbook*, 2009.

Table 5: Area Planted with Maize ('000 ha), 2007-2012

Province	LECS 07	ASY 07	ASY 08	ASY 09	ASY 10	ASY 11	CA 10/11	% Diff	ASY 12	RVS 12/13	% Diff
Northern Region	**101.8**	**118.3**	**162.8**	**148.5**	**151.5**	**146.8**	**109.11**	**28**	**145.0**	**90.1**	**38**
Phongsaly	4.3	3.2	3.7	4.3	4.4	4.6	3.48	21	4.4	5.9	(34)
Luangnamtha	2.8	2.6	3.8	4.0	6.0	5.4	1.98	67	4.3	0.7	84
Oudomxay	11.8	22.1	23.7	34.5	27.8	20.9	25.39	9	34.3	21.1	39
Bokeo	8.7	14.4	21.7	20.7	20.1	18.5	6.20	69	13.6	2.1	84
Luangprabang	7.2	15.4	18.0	15.7	9.8	12.8	4.69	52	8.9	7.6	14
Huaphanh	13.7	14.3	33.6	12.4	20.4	22.9	12.38	39	18.6	10.8	42
Xayabury	53.3	46.3	58.3	56.9	63.0	61.8	54.99	13	61.0	42.0	31
Central Region	**23.4**	**28.9**	**42.8**	**41.3**	**48.0**	**47.2**	**23.52**	**51**	**44.0**	**37.2**	**15**
Vientiane Capital	0.3	1.6	3.2	1.8	1.8	2.6	0.92	49	2.5	0.6	75
Xiengkhuang	10.2	15.2	23.8	17.2	20.9	21.9	16.08	23	26.0	31.6	(21)
Vientiane Province	11.0	4.8	7.6	12.4	16.8	14.0	4.33	74	6.6	4.0	39
Borikhamxay	0.7	2.2	3.5	3.3	3.3	2.9	1.16	65	3.7	0.2	95
Khammuane	0.4	1.5	1.3	1.1	1.2	1.1	0.39	68	1.5	0.2	85
Savannakhet	0.8	3.6	3.4	5.5	4.0	4.7	0.65	84	3.7	0.6	84
Southern Region	**1.3**	**7.0**	**8.6**	**10.9**	**13.3**	**18.2**	**1.89**	**86**	**7.8**	**1.9**	**75**
Saravane	0.2	2.0	1.9	3.0	5.0	6.8	0.87	83	3.9	0.4	89
Sekong	0.3	0.8	1.4	1.4	0.9	1.0	0.17	81	1.2	0.0	100
Champasack	0.3	4.1	4.9	5.9	7.2	10.0	0.75	90	2.2	1.5	29
Attapeu	0.5	0.2	0.6	0.6	0.2	0.4	0.10	39	0.5	0.0	100
Total	**126.4**	**154.3**	**214.3**	**200.7**	**212.8**	**212.1**	**134.52**	**37**	**196.8**	**129.3**	**34**

ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture, LECS = Lao Expenditure and Consumption Survey,
RVS = Risk and Vulnerability Survey
% Diff = [(ASY-CA)/ASY]*100%; % Diff = [(ASY-RVS)/ASY]*100%

Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008.
MAF. *Agriculture Statistics Yearbook, 2009*.
MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Census of Agriculture*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table 6: Area Planted to Selected Temporary Crops by Province ('000 ha), 2007

Province	Cassava			Sugarcane			Tobacco		
	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff
Northern Region	**4.51**	**5.00**	**(11.03)**	**3.66**	**3.28**	**10.31**	**0.55**	**0.15**	**258.24**
Phongsaly	0.54	0.01	97.79	0.96	1.75	(83.33)	0.02	0.00	
Luangnamtha	1.01	0.80	19.95	1.58	0.65	59.05	0.04	0.00	
Oudomxay	1.40	0.14	89.66	0.74	0.04	94.65	0.15	0.02	606.56
Bokeo	0.00	0.00		0.00	0.00		0.00	0.00	
Luangprabang	1.57	1.20	23.39	0.09	0.58	(579.03)	0.21	0.00	
Huaphanh	0.00	2.81		0.25	0.10	58.39	0.02	0.01	28.79
Xayabury	0.00	0.03		0.06	0.16	(194.49)	0.13	0.12	7.12
Central Region	**2.58**	**2.90**	**(12.57)**	**4.16**	**0.61**	**85.22**	**3.61**	**4.32**	**(16.39)**
Vientiane Capital	0.04	0.00	100.00	1.13	0.00	100.00	0.31	0.50	(39.10)
Xiengkhuang	0.53	1.98	(274.08)	0.13	0.18	(40.70)	0.01	0.00	
Vientiane Province	0.00	0.62		0.09	0.07	19.83	0.31	0.00	
Borikhamxay	1.91	0.30	84.47	0.46	0.25	46.49	1.10	1.70	(35.51)
Khammuane	0.11	0.00	98.47	0.27	0.11	58.13	0.86	2.12	(59.41)
Savannakhet	0.00	0.00		2.08	0.00	100.00	1.04	0.00	
Southern Region	**3.93**	**1.30**	**66.92**	**0.65**	**0.17**	**73.59**	**0.54**	**0.01**	**7,520.02**
Saravane	2.12	0.23	88.97	0.01	0.10	(1,950.20)	0.15	0.00	
Sekong	1.23	1.07	13.28	0.35	0.05	85.89	0.13	0.01	1,734.45
Champasack	0.40	0.00	100.00	0.29	0.00	100.00	0.19	0.00	
Attapeu	0.19	0.00	100.00	0.00	0.02		0.08	0.00	
Total	**11.02**	**9.21**	**16.42**	**8.46**	**4.06**	**51.95**	**4.70**	**4.48**	**4.95**

Notes: ASY = Agriculture Statistics Yearbook, LECS = Lao Expenditure and Consumption Survey
% Diff = [(ASY-LECS)/ASY]*100%
Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008.
MAF. *Agriculture Statistics Yearbook*, 2009.

Table 7: Production of Selected Temporary Crops by Province ('000 tons), 2007

Province	Cassava			Sugar cane			Tobacco		
	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff
Northern Region	**106.27**	**25.80**	**75.72**	**157.70**	**33.02**	**79.06**	**3.29**	**0.04**	**98.83**
Phongsaly	4.00	0.12	97.02	43.00	15.71	63.46	0.15	0.00	100.00
Luangnamtha	23.27	1.45	93.76	84.25	12.95	84.62	0.20	0.00	100.00
Oudomxay	46.00	0.01	99.97	25.80	0.00	100.00	0.80	0.01	99.36
Bokeo	0.00	0.00		0.00	0.00		0.00	0.00	
Luangprabang	33.00	7.19	78.23	1.50	3.14	(109.48)	1.21	0.00	100.00
Huaphanh	0.00	17.00		2.15	0.51	76.33	0.07	0.00	96.22
Xayabury	0.00	0.04		1.00	0.71	29.26	0.86	0.03	96.42
Central Region	**42.17**	**13.65**	**67.64**	**156.10**	**5.29**	**96.61**	**34.64**	**19.07**	**44.96**
Vientiane Capital	0.45	0.00	100.00	46.00	0.00	100.00	3.50	11.15	(218.66)
Xiengkhuang	5.20	9.82	(88.93)	2.60	0.32	87.87	0.06	0.00	100.00
Vientiane Province	0.00	2.61		1.80	0.05	96.99	2.80	0.00	100.00
Borikhamxay	35.70	1.20	96.64	15.40	4.37	71.65	14.38	4.02	72.05
Khammuane	0.82	0.01	98.82	6.23	0.55	91.12	6.60	3.89	41.01
Savannakhet	0.00	0.00		84.07	0.00	100.00	7.30	0.00	100.00
Southern Region	**84.98**	**4.71**	**94.45**	**10.08**	**0.33**	**96.70**	**3.61**	**0.02**	**99.48**
Saravane	53.00	1.90	96.41	0.08	0.15	(105.02)	0.93	0.00	100.00
Sekong	20.04	2.81	85.97	5.20	0.04	99.29	0.60	0.02	96.85
Champasack	9.94	0.00	100.00	4.80	0.00	100.00	1.64	0.00	100.00
Attapeu	2.00	0.00	100.00	0.00	0.14		0.45	0.00	100.00
Total	**233.42**	**44.16**	**81.08**	**323.88**	**38.64**	**88.07**	**41.54**	**19.12**	**53.96**

Notes: ASY = Agriculture Statistics Yearbook, LECS = Lao Expenditure and Consumption Survey
% Diff = [(ASY-LECS)/ASY]*100%
Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008.
MAF. *Agriculture Statistics Yearbook*, 2009.

Table 8: Area Planted with Cassava ('000 ha), 2007-2012

Province	Cassava								% Diff	
	ASY 07	ASY 08	ASY 09	ASY 10	ASY 11	ASY 12	CA 10/11	RVS 12/13	ASY-CA	ASY-RVS
Northern Region	**4.5**	**5.1**	**2.9**	**4.6**	**5.9**	**8.9**	**4.3**	**5.2**	**7**	**42**
Phongsaly	0.5	0.6	0.6	0.7	0.7	0.6	0.7	1.0	2	(58)
Luangnamtha	1.0	1.0	0.4	0.0	0.6	1.1	0.3	0.0		100
Oudomxay	1.4	0.1	0.1	0.1	0.2	0.2	0.1	1.2	(42)	(456)
Bokeo	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.6		(839)
Luangprabang	1.6	2.8	1.8	3.4	3.0	3.4	1.8	1.2	48	63
Huaphanh	0.0	0.6	0.1	0.4	1.4	1.1	1.1	0.9	(210)	19
Xayabury	0.0	0.0	0.0	0.0	0.0	2.5	0.2	0.3		88
Central Region	**2.6**	**4.0**	**6.3**	**10.0**	**18.3**	**32.7**	**11.1**	**14.5**	**(11)**	**56**
Vientiane Capital	0.0	1.3	1.3	2.4	2.9	8.7	3.8	0.7	(58)	92
Xiengkhuang	0.5	0.6	2.2	2.4	2.6	6.1	0.8	0.4	65	93
Vientiane Province	0.0	0.0	0.0	1.4	3.1	2.7	1.6	1.4	(15)	50
Borikhamxay	1.9	1.9	1.8	2.8	7.0	10.2	4.4	10.3	(57)	(1)
Khammuane	0.1	0.2	0.3	0.3	0.4	1.5	0.1	0.0	48	100
Savannakhet	0.0	0.1	0.8	0.7	2.4	3.4	0.2	1.7	67	51
Southern Region	**3.9**	**6.0**	**1.2**	**5.4**	**6.9**	**2.4**	**3.5**	**7.0**	**35**	**(193)**
Saravane	2.1	4.6	0.0	2.8	5.2	1.3	2.5	3.8	12	(194)
Sekong	1.2	0.8	0.8	0.5	0.5	0.6	0.6	2.2	(13)	(253)
Champasack	0.4	0.6	0.4	1.7	0.7	0.2	0.4	1.0	78	(541)
Attapeu	0.2	0.0	0.0	0.4	0.5	0.3	0.1	0.0	75	100
Total	**11.0**	**15.0**	**10.4**	**19.9**	**31.1**	**44.0**	**18.8**	**26.7**	**6**	**39**

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture, RVS = Risk and Vulnerability Survey
% Diff = [(ASY-CA)/ASY]*100%; % Diff = [(ASY-RVS)/ASY]*100%

Sources: MAF. *Agriculture Statistics Yearbook*, 2009.
MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Census of Agriculture*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table 9: Area Planted with Sugarcane ('000 ha), 2007-2012

Province	Sugarcane								% Diff	
	ASY 07	ASY 08	ASY 09	ASY 10	ASY 11	ASY 12	CA 10/11	RVS 12/13	ASY-CA	ASY-RVS
Northern Region	**3.7**	**4.1**	**2.1**	**4.4**	**4.9**	**4.6**	**3.4**	**12.6**	**23**	**(170)**
Phongsaly	1.0	1.5	1.4	1.4	1.6	1.7	1.6	8.9	(9)	(425)
Luangnamtha	1.6	1.9	0.0	2.1	2.2	2.1	1.5	3.3	27	(58)
Oudomxay	0.7	0.3	0.3	0.6	0.6	0.4	0.3	0.3	50	22
Bokeo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Luangprabang	0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.0	100	100
Huaphanh	0.2	0.3	0.2	0.1	0.2	0.2	0.0	0.0	100	100
Xayabury	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.0	100	100
Central Region	**4.2**	**7.1**	**11.3**	**10.4**	**13.2**	**15.2**	**2.7**	**0.5**	**74**	**97**
Vientiane Capital	1.1	0.1	0.1	0.1	0.1	0.2	0.1	0.0	(2)	100
Xiengkhuang	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	10	78
Vientiane Province	0.1	0.0	0.1	0.3	0.4	0.1	0.2	0.2	47	(58)
Borikhamxay	0.5	0.4	0.5	0.6	0.6	2.5	0.2	0.1	75	96
Khammuane	0.3	0.3	0.2	1.3	0.0	0.2	0.0	0.2	100	2
Savannakhet	2.1	6.3	10.3	8.0	11.9	12.1	2.2	0.0	72	100
Southern Region	**0.6**	**0.6**	**0.4**	**0.5**	**6.7**	**0.6**	**0.1**	**0.0**	**90**	**99**
Saravane	0.0	0.2	0.2	0.1	0.2	0.1	0.1	0.0	(2)	100
Sekong	0.4	0.1	0.1	0.2	0.2	0.5	0.0	0.0	100	100
Champasack	0.3	0.3	0.2	0.3	0.2	0.0	0.0	0.0	100	100
Attapeu	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	100	90
Total	**8.5**	**11.9**	**13.8**	**15.4**	**24.8**	**20.5**	**6.2**	**13.1**	**60**	**36**

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture, RVS = Risk and Vulnerability Survey
% Diff = [(ASY-CA)/ASY]*100%; % Diff = [(ASY-RVS)/ASY]*100%

Sources: MAF. *Agriculture Statistics Yearbook*, 2009.
MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Census of Agriculture*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table 10: Area Planted with Tobacco ('000 ha), 2007-2012

Province	Tobacco								% Diff	
	ASY 07	ASY 08	ASY 09	ASY 10	ASY 11	ASY 12	CA 10/11	RVS 12/13	ASY-CA	ASY-RVS
Northern Region	**0.6**	**0.7**	**0.4**	**1.1**	**1.7**	**2.5**	**0.8**	**0.3**	**27**	**90**
Phongsaly	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0		
Luangnamtha	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	100	100
Oudomxay	0.1	0.0	0.0	0.4	0.6	0.7	0.3	0.3	23	65
Bokeo	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	100	100
Luangprabang	0.2	0.5	0.2	0.3	0.7	1.2	0.3	0.0	4	100
Huaphanh	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	100	100
Xayabury	0.1	0.1	0.1	0.2	0.2	0.3	0.1	0.0	23	100
Central Region	**3.6**	**3.6**	**3.9**	**4.6**	**4.3**	**3.8**	**2.1**	**4.2**	**53**	**(10)**
Vientiane Capital	0.3	0.2	0.2	0.3	0.2	0.2	0.1	2.1	59	(1264)
Xiengkhuang	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	100	100
Vientiane Province	0.3	0.4	0.4	0.6	1.0	0.7	0.0	0.6	100	17
Borikhamxay	1.1	1.1	1.3	1.2	0.8	0.8	1.0	0.0	19	98
Khammuane	0.9	1.0	0.6	1.1	1.0	0.9	0.9	1.5	21	(64)
Savannakhet	1.0	0.8	1.4	1.4	1.3	1.2	0.2	0.0	87	100
Southern Region	**0.5**	**1.3**	**0.6**	**2.7**	**1.8**	**0.7**	**0.3**	**0.0**	**87**	**93**
Saravane	0.1	0.1	0.0	0.8	0.3	0.3	0.0	0.0	100	84
Sekong	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	45	100
Champasack	0.2	0.8	0.2	1.6	1.3	0.3	0.3	0.0	83	100
Attapeu	0.1	0.3	0.3	0.1	0.1	0.0	0.0	0.0	100	100
Total	**4.7**	**5.6**	**4.8**	**8.4**	**7.8**	**7.0**	**3.3**	**4.5**	**61**	**35**

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture, RVS = Risk and Vulnerability Survey
% Diff = [(ASY-CA)/ASY]*100%; % Diff = [(ASY-RVS)/ASY]*100%

Sources: MAF. *Agriculture Statistics Yearbook*, 2009.
MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Census of Agriculture*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table 11: Area under Selected Permanent Crops ('000 ha), 2010

Province	Coffee			Tea			Rubber		
	CA	ASY	% Diff	CA	ASY	% Diff	CA	ASY1/	% Diff
Northern Region	**0.13**	**0.16**	**16**	**2.36**	**3.58**	**34**	**53.53**	**139.05**	**62**
Phongsaly	0.05	0.05	(8)	1.94	2.46	21	10.86	16.12	33
Luangnamtha	0.00	0.00		0.00	0.00		17.93	35.09	49
Oudomxay	0.00	0.00		0.16	0.56	72	10.63	34.27	69
Bokeo	0.00	0.00		0.00	0.00		7.74	9.29	17
Luangprabang	0.08	0.11	28	0.07	0.45	84	3.12	30.30	90
Huaphanh	0.00	0.00		0.00	0.11	100	0.06	14.00	100
Xayabury	0.00	0.00		0.20	0.00		3.19	0.00	
Central Region	**0.23**	**0.07**	**(246)**	**0.07**	**0.00**		**12.47**	**41.46**	**70**
Vientiane Capital	0.23	0.00		0.00	0.00		1.33	0.74	(81)
Xiengkhuang	0.00	0.07		0.07	0.00		0.14	1.10	87
Vientiane Province	0.00	0.00		0.00	0.00		4.69	9.74	52
Borikhamxay	0.00	0.00		0.00	0.00		3.11	10.11	69
Khammuane	0.00	0.00		0.00	0.00		2.43	6.74	64
Savannakhet	0.00	0.00		0.00	0.00		0.77	13.03	94
Southern Region	**45.41**	**71.74**	**37**	**0.00**	**0.22**	**100**	**0.51**	**53.53**	**99**
Saravane	10.00	23.74	58	0.00	0.00		0.09	6.30	99
Sekong	5.59	7.52	26	0.00	0.00		0.07	28.28	100
Champasack	29.19	39.94	27	0.00	0.22		0.35	7.30	95
Attapeu	0.62	0.55	(14)	0.00	0.00		0.00	11.65	100
Total	**45.77**	**71.96**	**36**	**2.43**	**3.80**	**36**	**66.51**	**234.04**	**(72)**

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture
% Diff = [(ASY-CA)/ASY]*100%

Sources: MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Census of Agriculture*, 2012.

Table 12: Number of Livestock/Poultry by Type and by Province ('000), 2007

Province	Cattle			Buffalo			Pig			Goat and Sheep			Poultry		
	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff	ASY	LECS	% Diff
Northern Region	**304**	**589**	**(94)**	**297**	**375**	**(26)**	**991**	**792**	**20**	**101**	**225**	**(123)**	**6,936**	**4,865**	**30**
Phongsaly	38	19	50	36	39	(7)	169	79	53	4	2	41	532	365	31
Luangnamtha	26	19	24	23	25	(8)	66	73	(11)	6	1	77	324	334	(3)
Oudomxay	34	41	(19)	37	62	(65)	103	96	7	18	11	39	834	494	41
Bokeo	30	89	(199)	23	45	(93)	50	88	(74)	6	7	(23)	433	597	(38)
Luangprabang	55	128	(130)	58	68	(18)	162	152	6	41	166	(304)	1,274	871	32
Huaphanh	53	91	(73)	66	77	(16)	301	166	45	19	32	(71)	1,758	736	58
Xayabury	68	203	(197)	53	59	(12)	138	138	(0)	7	5	28	1,781	1,468	18
Central Region	**780**	**1,165**	**(49)**	**533**	**484**	**9**	**583**	**509**	**13**	**105**	**248**	**(138)**	**6,555**	**6,127**	**7**
Vientiane Capital	77	178	(130)	16	28	(73)	52	58	(12)	15	29	(88)	808	1,580	(95)
Xiengkhuang	71	153	(116)	46	71	(55)	76	112	(48)	7	16	(128)	900	750	17
Vientiane Province	122	274	(124)	69	95	(37)	94	115	(22)	13	15	(21)	1,557	1,397	10
Borikhamxay	54	112	(106)	44	33	25	58	59	(3)	9	17	(77)	654	545	17
Khammuane	65	123	(89)	74	101	(38)	61	50	17	13	37	(198)	629	467	26
Savannakhet	391	325	17	285	156	45	244	115	53	47	134	(182)	2,007	1,388	31
Southern Region	**269**	**372**	**(38)**	**293**	**331**	**(13)**	**612**	**244**	**60**	**37**	**58**	**(58)**	**6,962**	**2,306**	**67**
Saravane	112	116	(3)	99	86	13	328	114	65	20	25	(24)	2,378	530	78
Sekong	23	10	55	28	20	29	123	30	76	8	9	(6)	553	121	78
Champasack	120	224	(87)	119	167	(40)	137	71	48	6	16	(163)	3,656	1,397	62
Attapeu	14	22	(61)	47	58	(24)	24	29	(21)	3	9	(223)	375	257	31
Total	**1,353**	**2,127**	**(57)**	**1,123**	**1,190**	**(6)**	**2,186**	**1,545**	**29**	**243**	**532**	**(119)**	**20,453**	**13,297**	**35**

Notes: ASY = Agriculture Statistics Yearbook, LECS = Lao Expenditure and Consumption Survey
% Diff = [(ASY-LECS)/ASY]*100%
Sources: LSB. *Lao Expenditure and Consumption Survey*, 2008.
MAF. *Agriculture Statistics Yearbook*, 2009.

Table 13: Number of Livestock/Poultry by Type and by Province ('000), 2010

Province	Cattle			Buffalo			Pig			Poultry		
	CA	ASY	% Diff	CA	ASY	% Diff	CA	ASY	% Diff	CA	ASY	% Diff
Northern Region	**355**	**336**	**(6)**	**212**	**308**	**31**	**542**	**1,348**	**60**	**4,318**	**8,344**	**48**
Phongsaly	14	40	65	20	40	49	68	189	64	311	628	51
Luangnamtha	14	28	51	9	22	59	45	80	43	271	382	29
Oudomxay	31	41	23	21	41	48	71	140	49	564	900	37
Bokeo	45	35	(29)	21	28	28	50	75	34	359	508	29
Luangprabang	66	61	(7)	44	57	23	113	220	49	998	1,769	44
Huaphanh	75	58	(30)	53	66	20	99	439	78	615	1,931	68
Xayabury	111	73	(53)	44	54	19	96	204	53	1,201	2,226	46
Central Region	**958**	**834**	**(15)**	**356**	**545**	**35**	**327**	**664**	**51**	**5,071**	**7,527**	**33**
Vientiane Capital	108	88	(23)	15	19	20	33	67	51	1,149	1,152	0
Xiengkhuang	135	81	(67)	38	50	24	69	85	19	790	958	18
Vientiane Province	192	142	(36)	61	69	12	70	103	32	1,242	707	(76)
Borikhamxay	100	57	(74)	34	45	25	41	64	37	428	1,733	75
Khammuane	110	71	(56)	60	76	21	42	76	45	404	691	42
Savannakhet	313	396	21	148	286	48	73	269	73	1,057	2,286	54
Southern Region	**273**	**304**	**10**	**207**	**332**	**38**	**109**	**740**	**85**	**1,716**	**8,208**	**79**
Saravane	98	127	23	57	126	55	44	389	89	461	2,785	83
Sekong	15	28	47	13	30	57	16	140	88	92	710	87
Champasack	134	131	(2)	100	127	22	30	180	83	888	4,226	79
Attapeu	26	18	(44)	37	48	24	18	31	41	276	486	43
Total	**1,586**	**1,474**	**(8)**	**774**	**1,186**	**35**	**978**	**2,752**	**64**	**11,105**	**24,079**	**54**

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture
% Diff = [(ASY-CA)/ASY]*100%
Sources: MAF. *Agriculture Statistics Yearbook*, 2010.
MAF. *Census of Agriculture*, 2012.

Table 14: Number of Livestock/Poultry by Type and by Province ('000), 2012

Province	Cattle			Buffalo			Pig			Poultry		
	ASY	RVS	% Diff	ASY	RVS	% Diff	ASY	RVS	% Diff	ASY	RVS	% Diff
Northern Region	**409**	**305**	**26**	**298**	**158**	**47**	**925**	**509**	**45**	**8,175**	**3,446**	**58**
Phongsaly	42	10	76	40	12	71	189	55	71	628	237	62
Luangnamtha	20	7	64	18	16	12	85	58	32	406	250	38
Oudomxay	49	19	62	44	16	64	134	52	61	1,477	441	70
Bokeo	54	55	(1)	25	14	42	56	61	(8)	405	341	16
Luangprabang	81	47	41	65	24	63	209	114	45	2,441	736	70
Huaphanh	70	84	(20)	57	43	25	152	94	38	1,040	440	58
Xayabury	94	82	12	48	33	32	99	75	25	1,780	1,001	44
Central Region	**951**	**783**	**18**	**553**	**224**	**60**	**746**	**410**	**45**	**9,517**	**4,800**	**50**
Vientiane Capital	112	100	11	18	26	(46)	126	30	76	3,092	712	77
Xiengkhuang	124	142	(14)	55	15	73	77	65	16	957	524	45
Vientiane Province	167	144	14	72	44	39	103	84	19	1,541	1,437	7
Borikhamxay	58	54	6	45	21	55	66	53	20	727	438	40
Khammuane	85	73	14	73	45	39	98	63	36	390	625	(60)
Savannakhet	404	269	33	289	74	74	275	115	58	2,810	1,064	62
Southern Region	**331**	**249**	**25**	**337**	**188**	**44**	**1,122**	**169**	**85**	**11,087**	**2,028**	**82**
Saravane	146	135	8	126	48	62	773	72	91	5,085	553	89
Sekong	29	18	38	30	12	61	138	28	79	739	79	89
Champasack	140	89	37	133	93	30	180	48	73	4,736	1,232	74
Attapeu	17	9	50	48	35	27	31	20	36	526	164	69
Total	**1,692**	**1,337**	**21**	**1,188**	**570**	**52**	**2,794**	**1,088**	**61**	**28,779**	**10,275**	**64**

Notes: ASY = Agriculture Statistics Yearbook, RVS = Risk and Vulnerability Survey
% Diff = [(ASY-RVS)/ASY]*100%
Sources: MAF. *Agriculture Statistics Yearbook*, 2012.
MAF. *Risk and Vulnerability Survey*, 2013.

Table15: Total Number of Livestock/Poultry ('000 heads), 2007-2012

Livestock	ASY 07	ASY 08	ASY 09	ASY 10	ASY 11	ASY 12	CA 10/11	RVS 12/13	% Diff	
									ASY-CA	ASY-RVS
Cattle	1353	1397	1430	1474	1538	1692	1586	1337	(8)	21
Buffalo	1123	1154	1178	1186	1197	1188	774	570	35	52
Pig	2186	2359	2554	2752	2651	2794	978	1088	64	61
Poultry	20453	21214	22529	24079	26850	28779	11105	10275	54	64

Notes: ASY = Agriculture Statistics Yearbook, CA = Census of Agriculture, RVS = Risk and Vulnerability Survey
% Diff = [(ASY-CA)/ASY]*100%; % Diff = [(ASY-RVS)/ASY]*100%
Sources: MAF. *Agriculture Statistics Yearbook, 2009*.
MAF. *Agriculture Statistics Yearbook, 2010*.
MAF. *Agriculture Statistics Yearbook, 2012*.
MAF. *Census of Agriculture, 2012*.
MAF. *Risk and Vulnerability Survey*, 2013.

References

Asian Development Bank. 2012. *Back to Office Report: Mission to Develop the Lao PDR Action Plan for Improving Agricultural and Rural Statistics*. Manila.

Asian Development Bank. 2014. *Back to Office Report: Mission to Conduct the Training Program and High Level Meeting on Improving Agricultural Data Collection Systems in Lao PDR*. Manila.

Lao Statistics Bureau. 2008. *Lao Expenditure and Consumption Survey*. Vientiane, Lao People's Democratic Republic.

Maligalig, D. 2014. Back to Office Report: Mission to conduct the Training Program and High Level Meeting on Improving Agricultural Data Collection Systems in Lao PDR, ADB. Manila.

Ministry of Agriculture and Forestry. 2013. *Action Plan for Improving Agricultural and Rural Statistics in Lao PDR, 2013-2020*. Vientiane. Lao People's Democratic Republic.

Ministry of Agriculture and Forestry. 2009. *Agriculture Statistics Yearbook*. Vientiane. Lao People's Democratic Republic.

Ministry of Agriculture and Forestry. 2010. *Agriculture Statistics Yearbook*. Vientiane. Lao People's Democratic Republic.

Ministry of Agriculture and Forestry. 2012. *Agriculture Statistics Yearbook*. Vientiane. Lao People's Democratic Republic.

Ministry of Agriculture and Forestry. 2012. *Lao Census of Agriculture*. Vientiane. Lao People's Democratic Republic.

Ministry of Agriculture and Forestry. 2013. *Risk and Vulnerability Survey*. Vientiane. Lao People's Democratic Republic.

Roder, W. 2001. *Slash-and-Burn Rice Systems in the Hills of Northern Lao PDR: Description, Challenges and Opportunities*, Los Baños, Philippines: International Rice Research Institute. 201 p.

Souksavath, P. 2012. *Agricultural Statistics System in Lao PDR. Country Report for the Workshop on Developing the Country Action Plans.* Asian Development Bank. Manila.

STUDY IV
Improving Administrative Reporting System for Agriculture in Lao People's Democratic Republic

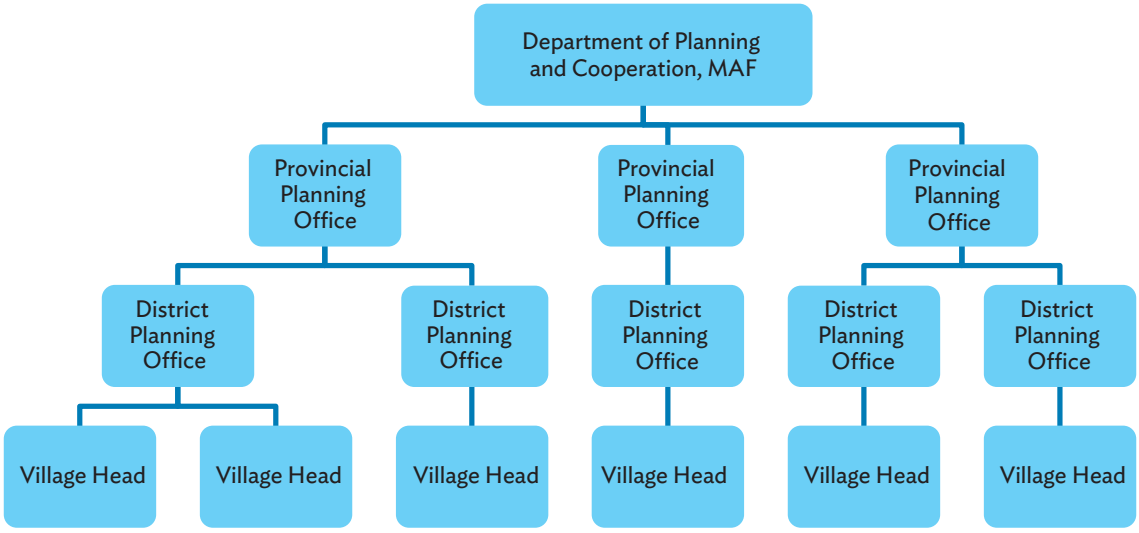
1. Introduction and Background

In a study by the Ministry of Agriculture and Forestry (MAF), Lao Statistics Bureau (LSB) and Asian Development Bank (ADB) in 2015 aimed to examine existing data sources for agricultural and rural statistics, large discrepancies were noted between data reported in the Agricultural Statistics Yearbook (ASY) from administrative reports and the most recent Census of Agriculture (CA, 2010/2011), Risk and Vulnerability Survey (RVS, 2012/2013), and the Lao Expenditure and Consumption Survey (LECS, 2007/2008). [1]

The MAF compiles data from the administrative reporting system to produce ASY and also spearhead the conduct of CA and RVS. It uses data that they gather mostly from administrative reporting system and from CA and RVS to formulate and monitor their agricultural development plans and food security status. These data are also inputs to food balance sheets. Agricultural statistics are also used for resource allocation and determining vulnerable areas that need special interventions. On the other hand, LSB conducts LECS every five years. The LSB uses agricultural data from LECS and ASY for compiling national accounts and balance of payments statistics. In general, national statistical offices prefer to use data they have gathered from the surveys that they conduct and as alternative, the data from the ministry of agriculture that mainly come from administrative reporting systems.

Lao People's Democratic Republic (Lao PDR) is one of many countries in the region that still rely on administrative reporting systems to collect crop, livestock and fisheries production and land use statistics. Figure 1 illustrates the structure of the administrative reporting system. Data are gathered from the village heads by staff of the district offices of the Department of Planning and Cooperation (DoPC), MAF. The district agricultural and planning officers summarize all the data that they have gathered and forward the summary statistics to the respective provincial offices. The provincial agricultural and planning officers then summarize the data that they receive and forward these to the central office of DoPC. The provincial reports are the basis for the preparation by DoPC of yearly bulletins on agriculture and forestry statistics. The

Figure 1: Diagram of the Current Administrative Reporting System for Agricultural Statistics



Source: DoPC, MAF.

1 This is a report on the methodological study to improve the administrative reporting system for agricultural and rural statistics that the Center for Agricultural Statistics (CAS) of the MAF undertook in collaboration with ADB regional policy and advisory project team on improving agricultural and rural statistics for food security.

statistics contained in these bulletins are divided into three main components – crop, livestock, and price statistics. Thus, by and large, the annual national agricultural (including aquaculture, fishery and forestry) statistical database of Lao PDR remains heavily dependent upon an administrative reporting system (MAF, 2012).

The possible causes of discrepancies that were identified by the study mentioned above are differences in coverage, concepts and definition, and timing of data collection. Data processing errors may also arise in processing large survey data. Gaps in the sampling design of LECS were also noted. Maligalig (2014) also reported that several MAF managers indicated in a high level dissemination meeting on the results of the study that the differences between ASY and LECS data can be explained by the use of planned figures in lieu of actual figures. If the actual production statistics at the village level fall short, the common practice was to report the target figures determined by the central planning office. Since the summary statistics are not validated as these go up the administrative hierarchy, the size of the measurement errors cannot be estimated. Analysis at the household level is not feasible since only aggregated statistics are available at the central office. For example, profiling of households which are food-insecure and identification of vulnerable areas cannot be accurately accomplished. Data intensive analysis which can inform policy and in the long term, contribute to better development outcomes may not be forthcoming with only the current administrative reporting system as the main data collection mechanism for agricultural and rural statistics.

The government is aware that inaccurate estimation of staple food production can lead to inappropriate policies and consequently, unfavorable outcomes, including the possibility of a worsening food security level. To support statistical development in Lao PDR, the government has promulgated the Statistics Law that defines the legal framework of the statistical system, established the national statistical system and the LSB as the central agency for statistics. Through the leadership of MAF, the government has vigorously supported the conduct of the 2011 CA.

It is expected that MAF will continue to use the data from their administrative reporting system for monitoring the government's development plan and for resource allocation. This is because the administrative reporting system provides timely data without additional budgetary requirements. Even with many desired features such as the enrichment of data-intensive policy research and better quality estimates, replacing the administrative reporting system with probability sample surveys may not be straightforward in Lao PDR. Surveys are very expensive to conduct compared to the costs of administrative reporting system. Moreover, since survey data go through a rigorous data validation process, estimates and the survey report may not be readily available. The CAS, DoPC, the MAF unit that is responsible for compiling agricultural statistics has only 12 technical staff and may not be able to carry out the conduct and analysis of a nationwide survey. Similar to other countries in the region, agricultural and rural statistics are often not considered core statistics that are given regular budgetary allocation. Hence, surveys as well as censuses can only be conducted when external funding is available. This is not sustainable in the long term and will only promote dependence by countries on external funding.

Since administrative reporting system is known to be more prone to higher nonsampling errors (ADB, LSB, and MAF, 2015) that cannot be estimated, MAF and ADB agreed that it is prudent that an audit sampling procedure should be introduced to improve the quality of data collected from it. This paper presents this procedure which resulted from a methodological study on improving the administrative reporting system that MAF and ADB started to conduct in 2014. Section 2 describes the proposed strategy while Section 3 presents the sampling strategy. The last section presents the conclusions and recommendations for further study and implementation. Statistical tables are presented in the appendix.

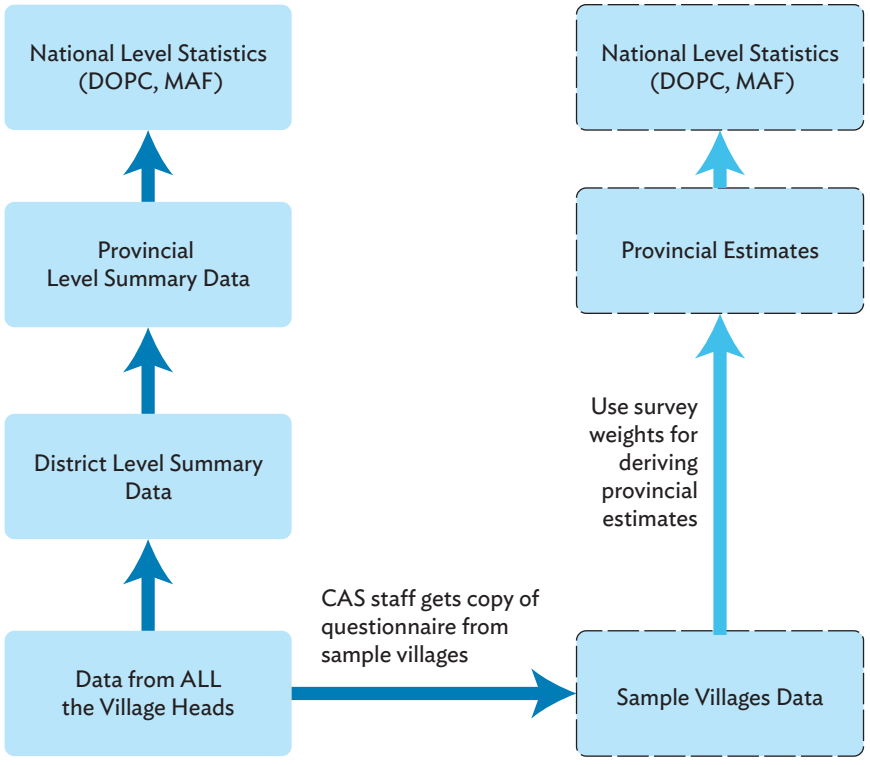
2. Strategy for Improvement

The proposed strategy to improve the administrative reporting system is illustrated in Figure 2. This approach entails that audit sampling be done objectively and that it renders results that could be used to assess the quality of data from the administrative reporting system. Objective audit sampling requires that each sampling unit or in this case, a village, be given a chance of being audited or selected. Operationally, this implies that villages should be selected using probability sampling techniques so that data from all sampled villages can be aggregated to provide provincial and national levels' estimates using appropriate survey weights.

reporting system. The CAS staff then examines closely the areas with large discrepancies and works with respective provincial offices in reducing specific measurement errors. To provide a sound basis for comparison with data from administrative reporting system, the audit sampling procedure should also control for nonsampling errors. To achieve these objectives, the following activities should be undertaken.

- Design a simple village probability selection approach that will be the core of the audit sampling. Considering that the technical skills

Figure 2: Diagram of Proposed Strategy for Improving the Administrative Reporting System for Agriculture



Sources: ADB, LSB, MAF.

The CAS staff retrieves a copy of the sample village level questionnaire or form and consolidates these into a data file, from which estimates at the national and provincial levels can be derived and compared with the results from the administrative

of the 12 CAS staff in the sample surveys are still being honed, a simple probability sample village selection procedure that can easily be implemented and which can give reliable estimates is preferred. So as not to add another

layer of complexity to the estimation process, selection probabilities can be made uniform so that the base weights, which are the inverse of corresponding selection probabilities will also be uniform and need not be tracked to get unbiased estimates.

- Design a village questionnaire that will allow better documentation of data gathered from the administrative reporting system. This study assumed that there were standard reporting forms in Laotian which are used to relay the village summary statistics to the district planning offices. It was found that in the middle of the study, there were no such forms and that data from the village heads were gathered and recorded informally by the district office staff. While CAS is aware that this lax data handling can be a major source of measurement errors, it has very little authority at the time of the study to impose guidelines and protocols to improve the system.

  Since then, the MAF has issued an order to improve the administrative reporting system through the Minister's Decision on the Production, Management, and Publication of Agricultural Statistics. The Decision aims to streamline the mandates of statistical units involved in the collection, compilation, and dissemination of agricultural statistics in Lao PDR. This initiative can be reinforced by designing a village level questionnaire that can capture crop, livestock, and fishery production and which can be digitized. To determine the data items which will be included in the questionnaire, major data users both in government and the private sector can be consulted. Care should be taken to include questions that can identify and measure emerging crops like rubber which was not included in ASY even though there are already 60,000 households cultivating it. The CAS can also study other countries' questionnaire to examine how concepts and definitions are properly applied.

  Sound methods on questionnaire design like keeping the questions and choices simple and clear should be followed in converting the list of data items to questions. Standard definitions and concepts should be applied to ensure consistency across time and space. Moreover, if face-to-face interview will be done, skipping patterns and sequencing of questions should be studied carefully to eliminate confusion and improve interview flow. For self-administered questionnaire, a simpler version that will be easily understood by village heads or key respondents has to be crafted. Lastly, the draft questionnaire should be pretested to further improve the questionnaire.

- Plan data collection activities that will control for nonsampling errors and will implement the probability sampling design well. The major change which is expected to have a significant effect on the quality of estimates is the digitization of village level data. Electronic village level data files will allow district offices to generate summary statistics quickly and accurately. If trained well, they can also look at historical trends of responses as a data validation mechanism. If these data files are shared with the central office, CAS can do better analysis of the responses as well as more in-depth policy analysis. They can drill down to the village level in identifying possible inconsistent or suspect data.

  To digitize the village level data file, the questionnaire has to be designed for such task and a data processing system that includes data validation and preliminary data analysis has to be planned. A decentralized data processing system at the districts is possibly the most suitable and in sync with the administrative reporting system hierarchy. If this is implemented, this will be a new mandate for the district planning office staff. Hence, those who will be involved in

data processing and data validation should be trained.

Furthermore, to improve data quality, uniform definitions and standards must be implemented. The heads of the sample villages who are the respondents of the audit survey and the data processors at CAS must be trained on these concepts and definitions. A manual on these concepts and definitions must be drafted in Laotian and can be used as training material. The respondents must also be informed on the importance of providing accurate and timely data and they must be aware of the risks of falsifying data.

Training on the standard concepts and definitions, the importance of reducing measurement errors and gathering quality data should be given to sampled village heads. The village heads have to appreciate how they can contribute well to maintaining food security and achieving better development outcomes with sound and timely data.

- The reliability of the audit survey results should be evaluated through sampling errors and design effects of major characteristics of interest. The comparative analysis between the statistics from the administrative reporting system and those from the audit survey should be strengthened by an in-depth review of the sampling errors and design effects of major characteristics of interest. These two measures provide an objective view of the reliability of the audit survey results. A sampling error is the square root of the variance of the sample mean while design effect is the ratio of the variance of the mean given the sampling design to the variance of the mean under simple random sampling. The sampling error of a characteristic of interest shows how close the estimate is from the corresponding population parameter. The design effect is indicative of how effective the given sample size is vis-à-vis a simple random sample. These measures will help plan the work load and budget of the next survey rounds.

  The comparative analysis of provincial and national levels estimates from the administrative reporting system and from the "audit survey" will give CAS staff insights on possible sources and location of measurement errors. A dialog between CAS and the leaders of specific areas can be organized to resolve particular data issues. This is also one way of raising the awareness of local stakeholders on the importance of good quality data to inform policy making and monitoring. This process together with the "audit survey" with intensive training of respondents is expected to improve the quality of data of the administrative reporting system in the long term.

- There should be wider dissemination of results of the activities outlined in this section to support and promote the objective of improving the quality of agricultural and rural statistics. The results of the audit sampling, including the sampling errors and design effects and the results of the comparative analysis should be published and disseminated widely. This way, policy makers, data users in the public and private sector and the development community will be aware of the efforts being made by the government in support of statistical development for better policy analysis and development outcomes. Wider dissemination of results will raise public awareness of issues regarding agricultural and rural statistics and in the long-term, the acquisition of adequate resources for statistical development.

3. The Sampling Strategy

Developing an effective sampling strategy is critical to introducing a sound mechanism for validating results from the administrative reporting system. This "audit survey" is similar to a postenumeration survey that is usually done to assess the extent of measurement errors in a census. As indicated in the last section, in order for the "audit survey" to be objective, it should have a probability sampling design. Discussions in a training workshop in which both CAS and LSB staff participated in 2014 and consultations with DoPC management led to the consensus that the sampling design should be simple and easily implemented in the field. With very limited technical staff and heavy work load, this additional function should not entail the application of complex techniques that would need further study. It is, therefore, deemed more viable to design the sample selection such that selection probabilities will be uniform within domain and hence, base survey weight will also be uniform. This approach will simplify the estimation procedures and analysis.

In addition to simple random sampling (SRS), systematic sampling, and a combination of probability proportional size (PPS) selection of primary sampling units (PSUs) with either systematic sample or SRS of ultimate sampling units can also render uniform selection probabilities. To achieve uniform selection probabilities with PPS, however, there are more intervening steps that need to be done like combining small PSUs or deconstructing big ones so that PSU sizes will not vary widely. While SRS is the simplest, the resulting sample villages may not be balanced in terms of administrative or geographic levels within a given domain. In this regard, systematic sampling is preferred than SRS because implicit stratification can be introduced in the former that would ensure a more balanced mix of sample villages. Therefore, systematic sampling was considered for the study and is described in the succeeding subsections.

Since all village level data on many key agricultural variables are available from the census, different ways of systematically selecting villages with probability can be examined and evaluated on the basis of design effects and variance of the mean of the estimates.

a. Constructing the sampling frame of villages

A good sampling frame of villages should contain all eligible units and other auxiliary variables that can be used for stratification measures to further improve the sampling design. These two requirements can be satisfied if the sampling frame of villages was constructed from the second census of agriculture that was conducted in 2010/2011. This census was implemented by the Agricultural Census Office (ACO) established in DoPC and under the overall control of an Agriculture Census Steering Committee. The LSB provided technical assistance. The government and several external donors financed the conduct of the census while Food and Agriculture Organization of the United Nations (FAO) provided technical support (MAF, 2012). The census covered all the 8,662 villages in 143 urban and rural districts in the country. Appendix Table 1 shows the distribution of villages across the districts and provinces. The univariate statistics of the number of households per village are also presented in the table.

The characteristics of interest that are relevant to the audit surveys were extracted from the census village level data files. These include the number of: (a) households, (b) farming households, (c) households growing rice (wet season), (d) households growing rice (dry season), (d) households growing rice (total), (f) cattle, (g) households with cattle and the following areas: (h) rice (wet), (i) rice (dry), and (j) rice (total). Appendix Table 2 shows the summary statistics at the provincial level for these variables.

b. Choice of systematic sample

To objectively determine the appropriate sample size for each domain (province), the estimates of sampling errors and design effects of previous similar surveys and the estimate of the variability of major characteristics of interest are usually the inputs. Although RVS and LECS have both survey weights, these are not similar to the audit survey that is being planned since RVS covers only villages that are considered rural and the survey weights for LECS are not properly defined (ADB, LSB, MAF, 2015). Hence, three different scenarios were considered instead – sampling villages with the following rate: (i) 1 in 5 or 20%, (ii) 1 in 10 or 10%, and (iii) 1 in 20 or 5%.

The general approach is illustrated in Figure 3 and was implemented as follows: To select the sample villages, the census of agriculture was used as the sampling frame. In a given province the villages were sorted by decreasing number of households and grouped into two equal groups. Then for each of the group, the villages were sorted by decreasing number of households growing rice and then further classified into two equal groups. For each of the four groups in a given province, the villages were then sorted by decreasing number of households with cattle and grouped into two equal parts. This implicit stratification approach will result into eight groups with almost equal number of villages in each group for a province.

Since the ordered provincial data file contains all the villages, all the possible sets of systematic sample can be derived following the three sampling rates mentioned above. For example, all the five complete sets of systematic samples drawn with selection probability of 1 in 5 can be identified, their respective averages can be computed and the variance of the mean can be derived as follows:

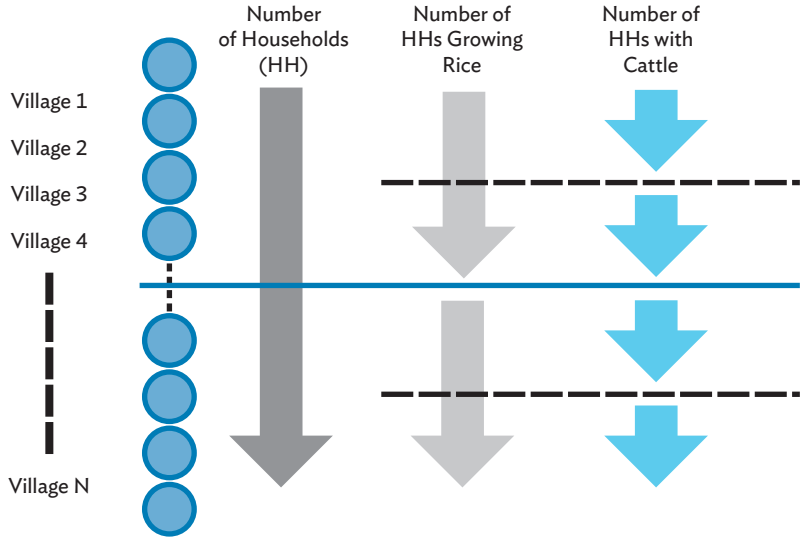
$$\mathrm{Var}_{\mathrm{SYS}}(\bar{x}) = \frac{\sum_{s=1}^{S}(\bar{x}_s - \mu)^2}{S}$$

Where the number of possible systematic samples is $S = 5$, $\bar{x}_s$, is the average for the set of systematic sample s and μ is the population mean. These processes were also done for $s = 10$ and $s = 20$.

c. Evaluation using design effects

To decide which scenario will be adopted for the audit survey, all the possible systematic samples

Figure 3: Systematic Sampling Scheme Diagram



Source: ADB.

for 5%, 10%, and 20% of the total number of villages in each group were studied using the available characteristics of interest from the available data file. The design effect for each characteristic of interest and sampling rate and scenario was computed as:

$$\text{Deff}(\bar{x}) = \frac{\text{Var}_{\text{SYS}}(\bar{x})}{\text{Var}_{\text{SRS}}(\bar{x})},$$

Where the variance of the mean under simple random sampling (SRS) is $\text{Var}_{\text{SRS}}(\bar{x}) = \left(1 - \frac{n}{N}\right)\frac{S_x^2}{n}$ and S_x^2 and is the population variance of characteristic of interest X. In addition, the design effects, coefficient of variation for SRS and systematic sample were also derived as follows:

$$\text{CV}_{\text{SRS}}(\bar{x}) = \frac{\sqrt{\left(1 - \frac{n}{N}\right)\frac{S_x^2}{n}}}{\mu} \times 100$$

$$\text{CV}_{\text{SYS}}(\bar{x}) = \frac{1}{\mu} \times \sqrt{\frac{\sum_{s=1}^{S}(\bar{x}_s - \mu)^2}{S}} \times 100$$

The results of these desk experiments are summarized by province in Appendix Table 3. Design effects of major characteristics of interest of a well-designed probability sample usually range from 1 to 3. Several design effects in the table are within this range and some are even less than one indicating that that particular systematic sample performed better than SRS. From these desk experiments, we concluded that at least 10% of the total villages' systematic sample can provide reliable estimates at the province level. The total sample villages will be 866 or 867. The few technical CAS staff will not be overly burdened in processing their data files.

d. Additional benefits of systematic sample

If villages were sampled one in 10 (10%), there will be a total of 10 sets of systematic samples and if a different set of systematic sample is used every year, all the 8,662 villages in Lao PDR would be covered in 10 years. This means that all the village heads and key informants would be trained in agricultural statistics concepts and definitions and survey processes that are relevant to them to provide good quality data. This also indicates that if adopted, the full set of 10 systematic samples can be considered a rolling census (Durr, 2005) that may replace the census of agriculture if resources for a full census are not available.

The idea of a rolling census emanated from the rolling samples approach that was first proposed and passionately advocated by Kish (1990). Kish observed that periodic surveys like the livestock survey have become more widely utilized. He proposed that rolling samples can be collected in a more frequent basis to replace the periodic surveys that are regularly conducted. When these rolling samples are cumulated, estimates at lower disaggregation level can be derived. Kish concluded that the budget of the rolling samples would be less compared to the combined costs of all the operations of the periodic surveys.[2]

As of this writing, France is the only country yet that has moved to a form of rolling census model, while the United Kingdom's Office of National Statistics has assessed the possible shift to rolling census after 2011 to provide the detailed characteristics of the population that a population register alone cannot provide.

2 This paragraph and the next were taken verbatim from "Designing a Livestock Sample Survey for Viet Nam", another methodological study report under the ADB regional policy and advisory technical assistance on improving agricultural and rural statistics for food security.

4. Conclusions and Recommendations

In general, administrative reporting systems are perceived to render biased statistics because the system does not have any vetting process. However, developing countries with statistical systems that are still maturing prefer to use statistics from administrative reporting system since these are timely and inexpensive. This study explored viable approaches for improving the administrative reporting system for agricultural and rural statistics like controlling for measurement errors and incorporating an "audit survey". These approaches require the support from MAF and major data users like LSB. Moreover, the cooperation of the administrative reporting system hierarchy is also necessary.

This study recommends a set of activities that has not been fully tested yet but is sound in theory. The mechanisms that are being recommended consist of the incorporation of the "audit survey" which is similar to postenumeration surveys for evaluating measurement errors committed in a complete enumeration process, the application of uniform concepts and definitions, the design and implementation of a questionnaire, the digitization of the completed questionnaires, training of respondents and key informants in sampled villages, in-depth evaluation of the reliability of the audit survey, and the comparative analysis between the audit survey and the results of the administrative reporting system.

Systematic sample of villages for the "audit survey" is recommended since it is simple and can be readily adopted by CAS that is still lacking in skilled personnel in sampling and other statistical methods. Moreover, it can easily be turned into rolling census which can be a cost effective alternative to a full census.

To reduce measurement errors due to subjective intervention in generating the summary statistics at district and provincial levels, transparent and objective procedures must be established. This involves the design and implementation of a questionnaire, rather than the usual data collection through telephone or informal face-to-face interviews and the training of respondents and key informants.

Another important change that has to be introduced is the comparative analysis of results from the administrative reporting system and the audit survey. This report must be disseminated to the administrative reporting hierarchy, policy makers and other government agencies to gain support for further improvement to the system. By raising the public awareness of the "audit survey" and the use of probability sample surveys, there could be support within the government to transition or combine survey results and administrative reporting system to improve the quality of agricultural and rural statistics.

It is important to introduce changes in the administrative reporting system that have already been tested and discussed with major data users so that they can be institutionalized. To do this, we need to cultivate the cooperation and understanding of LSB and MAF. The changes should be evolutionary in nature to manage the strong beliefs of policy makers that complete enumeration is the only way to get good agricultural statistics.

The few but dedicated CAS technical staff has already started on the daunting list of activities mentioned above. However, because of their heavy work plan and other commitments, only the sampling strategy has been completed. When the remaining activities in the list are completed, their results are expected to improve the quality of data from Lao PDR's administrative reporting systems. These can also be used by other countries with similar administrative reporting systems to improve theirs.

Appendix: Statistical Tables

Table 1: Distribution of Households in Villages and Districts

Province	District	Number of Villages	Number of Households in Villages				
			Total	Minimum	Median	Mean	Maximum
Vientiane Capital	Chanthabuly	32	11,191	89	315.5	349.7	995
	Hadxaifong	60	16,756	61	246.0	279.3	772
	Mayparkngum	53	8,778	32	138.0	165.6	436
	Naxaithong	56	12,230	67	206.0	218.4	558
	Sangthong	37	5,520	35	132.0	149.2	366
	Sikhottabon	60	19,118	50	261.5	318.6	1,003
	Sisattanak	37	10,801	81	220.0	291.9	870
	Xaysetha	51	18,520	82	351.0	363.1	706
	Xaythany	104	29,410	44	214.0	282.8	1,237
Phongsaly	Boon neua	66	3,849	16	50.5	58.3	216
	Boontai	64	3,845	14	54.0	60.1	238
	Khua	98	4,624	12	42.5	47.2	149
	May	89	4,073	19	42.0	45.8	113
	Nhot ou	79	5,096	12	53.0	64.5	182
	Phongsaly	74	4,258	9	44.5	57.5	289
	Samphanh	71	3,739	21	45.0	52.7	154
Luangnamtha	Long	70	5,797	20	73.5	82.8	429
	Nalae	71	3,842	20	51.0	54.1	134
	Namtha	78	9,231	17	98.0	118.3	379
	Sing	91	6,604	14	64.0	72.6	278
	Viengphoukh	46	3,774	23	68.0	82.0	193
Oudomxay	Beng	59	6,260	30	96.0	106.1	272
	Hoon	94	11,405	33	95.5	121.3	439
	La	43	2,989	25	61.0	69.5	206
	Namor	64	5,931	30	77.5	92.7	263
	Nga	63	4,972	17	64.0	78.9	291
	Pakbeng	55	4,347	32	65.0	79.0	337
	Xay	93	12,364	37	102.0	132.9	422
Bokeo	Huoixai	85	11,340	23	103.0	133.4	772
	Meung	28	2,178	34	68.5	77.8	168
	Paktha	35	3,175	18	73.0	90.7	309
	Pha oudom	88	6,606	18	62.5	75.1	220
	Tonpheung	47	5,201	39	90.0	110.7	411
Luangprabang	Chomphet	68	5,208	20	70.0	76.6	320
	Luangpraban	114	14,378	31	92.0	126.1	361
	Nambak	83	11,744	20	110.0	141.5	593
	Nan	54	5,463	25	82.5	101.2	271
	Ngoi	82	5,490	27	54.0	67.0	384
	Pak xeng	56	3,973	20	61.5	70.9	233
	Park ou	49	5,024	43	95.0	102.5	314
	Phonthong	39	2,655	5	60.0	68.1	161
	Phonxay	61	5,066	33	71.0	83.0	312
	Phoukhoune	40	3,473	23	71.0	86.8	313
	Viengkham	69	4,940	23	67.0	71.6	222
	Xieng ngeun	68	5,774	25	68.0	84.9	301
Huaphanh	Add	78	4,482	17	50.0	57.5	361
	Huameuang	75	4,693	22	47.0	62.6	244
	Sopbao	68	4,346	24	58.5	63.9	251
	Viengthong	69	4,224	19	54.0	61.2	158
	Viengxay	103	5,695	21	42.0	55.3	280
	Xamneua	109	8,780	24	55.0	80.6	567
	Xamtay	160	9,110	10	45.0	56.9	621
	Xiengkhor	59	4,407	23	59.0	74.7	361

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Table 1: Distribution of Households in Villages and Districts

Province	District	Number of Villages	Number of Households in Villages				
			Total	Minimum	Median	Mean	Maximum
Xayabury	Botene	28	3,538	42	112.0	126.4	366
	Hongsa	41	4,716	11	91.0	115.0	442
	Kenethao	47	8,090	30	142.0	172.1	418
	Khop	27	3,752	41	138.0	139.0	275
	Ngeun	22	3,061	49	110.5	139.1	327
	Parklai	71	13,089	40	161.0	184.4	550
	Phiang	51	9,981	58	157.0	195.7	584
	Thongmyxay	13	1,846	52	135.0	142.0	269
	Xayabury	83	12,464	19	117.0	150.2	601
	Xaysathan	21	2,131	47	96.0	101.5	212
	Xienghone	42	5,859	38	136.0	139.5	308
Xiengkhuang	Kham	98	7,612	13	71.0	77.7	384
	Khoune	73	4,900	20	54.0	67.1	199
	Morkmay	25	1,893	29	50.0	75.7	301
	Nonghed	107	5,347	18	43.0	50.0	140
	Pek	111	12,032	17	55.0	108.4	584
	Phaxay	33	2,212	21	64.0	67.0	190
	Phookood	42	4,070	33	94.0	96.9	180
	Thathom	23	2,342	54	87.0	101.8	268
Vientiane	Feuang	44	6,972	38	138.0	158.5	1,064
	Hinherb	43	5,076	31	97.0	118.0	266
	Kasy	51	6,064	36	90.0	118.9	397
	Keo oudom	26	3,492	40	112.0	134.3	424
	Mad	33	3,554	40	96.0	107.7	253
	Meun	22	5,546	55	258.5	252.1	465
	Phonhong	59	11,577	52	192.0	196.2	525
	Thoulakhom	42	10,128	56	215.0	241.1	473
	Vangvieng	64	9,648	26	137.0	150.8	444
	Xanakharm	33	7,438	73	183.0	225.4	622
	hom	39	4,202	28	90.0	107.7	350
	longxan	33	3,989	31	96.0	120.9	468
	viengkham	17	3,546	60	157.0	208.6	509
Borikhamxay	Bolikhanh	46	7,010	43	99.0	152.4	860
	Khamkeuth	64	9,358	51	124.0	146.2	680
	Ngoth Nam	24	1,489	20	50.5	62.0	203
	Pakkading	51	8,368	50	132.0	164.1	496
	Pakxane	59	8,302	54	117.0	140.7	423
	Thaphabath	33	4,800	23	129.0	145.5	379
	Viengthong	46	3,976	19	83.5	86.4	176
Khammuane	Bualapha	77	4,960	13	56.0	64.4	223
	Hinboon	137	11,892	21	67.0	86.8	361
	Mahaxay	69	6,121	25	69.0	88.7	387
	Nakai	29	4,269	46	119.0	147.2	470
	Nhommalath	44	5,599	39	111.5	127.3	234
	Nongbok	55	7,802	37	124.0	141.9	580
	Thakhek	91	15,761	55	141.0	173.2	522
	Xaybuathong	40	4,143	41	83.0	103.6	313
	Xebangfay	45	4,551	23	75.0	101.1	303

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Table 1: Distribution of Households in Villages and Districts

Province	District	Number of Villages	Number of Households in Villages				
			Total	Minimum	Median	Mean	Maximum
Savannakhet	Atsaphangth	38	5,914	48	130.5	155.6	348
	Atsaphone	57	8,301	79	133.0	145.6	298
	Champhone	102	16,051	53	134.5	157.4	442
	KaysonePhom	67	19,054	32	237.0	284.4	947
	Nong	73	3,878	19	50.0	53.1	326
	Outhoomphon	68	12,572	62	166.5	184.9	694
	Phalanxay	54	5,346	29	82.5	99.0	248
	Phine	100	8,362	20	63.0	83.6	260
	Sepone	88	8,155	16	76.5	92.7	336
	Songkhone	95	13,880	48	124.0	146.1	410
	Thapangthon	42	5,315	57	114.0	126.5	232
	Vilabuly	72	5,871	22	63.5	81.5	577
	Xaybuly	53	8,760	40	151.0	165.3	433
	Xayphoothon	40	7,970	72	171.0	199.3	660
	Xonbuly	63	7,892	17	112.0	125.3	401
Saravane	Khongxedone	92	9,269	25	90.0	100.8	296
	Lakhonephen	79	6,567	16	72.0	84.2	393
	Lao ngarm	103	11,371	19	100.0	110.4	336
	Samuoi	54	2,500	12	35.5	46.3	215
	Saravane	128	13,016	16	84.0	101.7	412
	Ta oi	56	3,829	15	61.5	68.4	193
	Toomlarn	37	3,085	15	86.0	83.4	185
	Vapy	56	5,679	24	91.0	101.4	262
Sekong	Dakcheung	80	3,038	4	30.5	38.0	140
	Kaleum	58	1,929	11	27.5	33.3	186
	Lamarm	42	4,664	16	83.5	111.0	410
	Thateng	53	5,388	19	76.0	101.7	333
Champasack	Bachiangcha	45	9,018	47	150.0	200.4	768
	Champasack	77	9,198	35	93.0	119.5	703
	Khong	114	14,167	20	101.0	124.3	435
	Moonlapamok	36	5,128	25	115.0	142.4	479
	Pakse	42	12,287	64	270.5	292.5	678
	Paksxong	88	11,836	25	116.0	134.5	389
	Pathoomphon	68	9,544	30	122.0	140.4	385
	Phonthong	71	14,635	52	166.0	206.1	840
	Sanasomboon	46	11,516	68	213.0	250.3	709
	Sukhuma	56	8,340	35	102.0	148.9	696
Attapeu	Phouvong	15	2,238	27	167.0	149.2	303
	Samakkhixay	28	5,735	100	174.5	204.8	477
	Sanamxay	40	5,487	42	101.5	137.2	686
	Sanxay	45	3,267	19	57.0	72.6	213
	Xaysetha	22	5,987	66	256.5	272.1	612

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Table 2: Mean and Variance of Selected Characteristics Interest by Province						
Characteristics of Interest	N	Mean	Variance	N	Mean	Variance
	Borikhamxay			Khammuane		
Number of Households	323	134.59	9,208.58	587	111.32	6,033.42
Number of Farming Households	323	106.46	5,127.04	587	86.61	3,079.31
Number of Households Growing Rice Wet	323	98.59	4,722.26	587	80.88	2,895.42
Number of Households Growing Rice Dry	323	9.02	424.06	587	12.83	1,092.22
Number of Households Growing Rice Total	323	107.60	5,411.78	587	93.71	4,925.74
Rice Area Wet	323	132.08	10,450.03	587	121.08	13,515.81
Rice Area Dry	323	5.89	228.57	587	9.14	787.42
Rice Area Total	323	137.97	10,997.01	587	130.22	15440.87
Number of Cattle	323	302.13	56,951.13	587	184.00	21271.93
Number of Households with Cattle	323	47.29	1,331.34	587	41.53	810.35
	Savannakhet			Vientiane		
Number of Households	1012	135.99	10,098.63	506	161.45	12,206.08
Number of Farming Households	1012	106.82	4,721.22	506	122.44	5,492.86
Number of Households Growing Rice Wet	1012	102.60	4,398.20	506	110.63	4,831.82
Number of Households Growing Rice Dry	1012	10.33	1,197.82	506	13.62	1,133.92
Number of Households Growing Rice Total	1012	112.93	7,035.93	506	124.25	7,004.19
Rice Area Wet	1012	204.86	41,002.62	506	124.48	11,080.02
Rice Area Dry	1012	9.33	1,005.80	506	8.37	534.23
Rice Area Total	1012	214.19	44,395.85	506	132.85	12,408.13
Number of Cattle	1012	304.89	62,845.60	506	374.90	110,262.95
Number of Households with Cattle	1012	61.06	2,042.47	506	56.62	1,484.78
	Vientiane Capital			Xiengkhuang		
Number of Households	490	270.49	31,147.34	512	79.69	4,628.93
Number of Farming Households	490	84.78	5,885.95	512	68.88	1,743.42
Number of Households Growing Rice Wet	490	68.24	4,906.28	512	65.00	1,500.32
Number of Households Growing Rice Dry	490	35.50	2,670.16	512	0.23	5.04
Number of Households Growing Rice Total	490	103.74	12,556.68	512	65.23	1,508.74
Rice Area Wet	490	98.46	21,549.66	512	61.79	1,825.43
Rice Area Dry	490	25.94	1,996.01	512	0.07	0.74
Rice Area Total	490	124.40	28,455.95	512	61.87	1,829.35
Number of Cattle	490	206.43	57,875.66	512	259.15	35,221.65
Number of Households with Cattle	490	29.47	1,029.30	512	43.54	652.35
	Bokeo			Huaphanh		
Number of Households	283	100.93	6,875.82	721	63.64	2,674.10
Number of Farming Households	283	86.36	3,152.20	721	58.55	1,209.82
Number of Households Growing Rice Wet	283	82.59	2,827.44	721	56.66	1,055.52
Number of Households Growing Rice Dry	283	7.55	392.04	721	8.44	437.03
Number of Households Growing Rice Total	283	90.14	4,221.98	721	65.10	1,852.10
Rice Area Wet	283	92.77	4,279.13	721	46.59	1,324.90
Rice Area Dry	283	5.31	228.36	721	2.46	72.37
Rice Area Total	283	98.08	5,208.87	721	49.05	1,399.62
Number of Cattle	283	153.59	34,775.31	721	102.79	11,339.78
Number of Households with Cattle	283	32.00	862.32	721	22.71	381.55
	Luangnamtha			Luangprabang		
Number of Households	356	82.21	3,220.76	783	93.51	4,343.30
Number of Farming Households	356	72.51	1,799.33	783	75.24	2,446.08
Number of Households Growing Rice Wet	356	65.09	1,399.32	783	66.28	2,140.05
Number of Households Growing Rice Dry	356	4.61	247.76	783	4.52	219.54
Number of Households Growing Rice Total	356	69.71	2,016.14	783	70.80	2,939.54
Rice Area Wet	356	74.74	3,323.94	783	63.52	4,568.34
Rice Area Dry	356	1.99	68.36	783	3.09	115.98

Table 3: CVs and Design Effects by Province

Characteristics of Interest	20%					10%					5%				
	SRS		Systematic			SRS		Systematic			SRS		Systematic		
	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff
Borikhamxay															
Number of Households	113.16	7.90	168.96	9.65	1.49	259.26	11.96	264.07	12.07	1.02	547.03	17.38	345.51	13.81	0.63
Number of Farming Households	63.00	7.46	110.15	9.85	1.75	144.35	11.28	258.67	15.10	1.79	304.57	16.39	269.79	15.43	0.89
Number of Households Growing Rice Wet	58.03	7.73	117.60	10.99	2.03	132.95	11.69	245.88	15.90	1.85	280.52	16.99	267.19	16.58	0.95
Number of Households Growing Rice Dry	5.21	25.32	0.52	7.97	0.10	11.94	38.45	5.83	26.87	0.49	25.19	55.67	13.15	40.47	0.52
Number of Households Growing Rice Total	66.50	7.58	104.99	9.52	1.58	152.36	11.47	266.39	15.17	1.75	321.48	16.66	283.85	15.66	0.88
Rice Area Wet	128.42	8.58	65.07	6.11	0.51	294.21	12.99	269.06	12.42	0.91	620.77	18.86	344.17	14.05	0.55
Rice Area Dry	2.81	28.46	0.04	3.26	0.01	6.44	43.20	2.54	27.16	0.40	13.58	62.58	6.87	44.74	0.51
Rice Area Total	135.14	8.43	63.28	5.76	0.47	309.61	12.76	281.03	12.15	0.91	653.27	18.52	362.26	13.80	0.55
Number of Cattle	699.85	8.76	361.37	6.29	0.52	1603.40	13.25	588.86	8.03	0.37	3383.13	19.25	1397.74	12.37	0.41
Number of Households with Cattle	16.36	8.55	10.55	6.87	0.65	37.48	12.94	18.14	9.00	0.48	79.09	18.80	39.31	13.25	0.50
Khammuane															
Number of Households	41.29	5.77	8.54	2.62	0.21	91.98	8.62	41.28	5.77	0.45	197.77	12.63	91.51	8.60	0.46
Number of Farming Households	21.07	5.30	14.27	4.36	0.68	46.95	7.91	23.94	5.65	0.51	100.94	11.60	48.16	8.02	0.48
Number of Households Growing Rice Wet	19.81	5.50	16.95	5.09	0.86	44.14	8.22	26.99	6.43	0.61	94.91	12.05	53.21	9.02	0.56
Number of Households Growing Rice Dry	7.47	21.30	2.41	12.09	0.32	16.65	31.80	10.04	24.69	0.60	35.80	46.62	32.85	44.69	0.92
Number of Households Growing Rrce Total	33.71	6.20	16.66	4.36	0.49	75.10	9.25	26.95	5.54	0.36	161.46	13.56	48.04	7.40	0.30
Rice Area Wet	92.49	7.94	73.24	7.07	0.79	206.06	11.86	149.97	10.12	0.73	443.04	17.38	367.19	15.83	0.83
Rice Area Dry	5.39	25.39	3.75	21.17	0.70	12.00	37.90	10.64	35.67	0.89	25.81	55.57	21.58	50.85	0.84
Rice Area Total	105.67	7.89	59.15	5.91	0.56	235.40	11.79	139.37	9.07	0.59	506.14	17.28	345.61	14.28	0.68
Number of Cattle	145.57	6.56	37.84	3.34	0.26	324.30	9.79	120.03	5.95	0.37	697.28	14.35	384.15	10.66	0.55
Number of Households with Cattle	5.55	5.67	1.41	2.86	1.98	12.35	8.46	2.30	3.65	0.19	26.56	12.41	6.70	6.23	0.25
Savannakhet															
Number of Households	40.01	4.65	17.89	3.11	0.45	90.01	6.98	28.20	3.91	0.31	188.03	10.08	123.95	8.19	0.66
Number of Farming Households	18.71	4.05	1.90	1.29	0.10	42.08	6.07	4.66	2.02	0.11	87.91	8.78	52.90	6.81	0.60
Number of Households Growing Rice Wet	17.43	4.07	1.48	1.18	0.08	39.20	6.10	4.72	2.12	0.12	81.89	8.82	46.88	6.67	0.57
Number of Households Growing Rice Dry	4.75	21.10	0.28	5.08	0.06	10.68	31.64	3.36	17.75	0.31	22.30	45.74	12.49	34.22	0.56
Number of Households Growing Rice Total	27.88	4.68	1.98	1.24	0.07	62.71	7.01	9.85	2.78	0.16	131.01	10.14	77.86	7.81	0.59
Rice Area Wet	162.47	6.22	9.09	1.47	0.06	365.45	9.33	55.72	3.64	0.15	763.46	13.49	285.89	8.25	0.37
Rice Area Dry	3.99	21.39	0.93	10.36	0.23	8.96	32.07	4.99	23.94	0.56	18.73	46.37	11.72	36.66	0.63
Rice Area Total	175.91	6.19	13.30	1.70	0.08	395.69	9.29	61.53	3.66	0.16	826.64	13.42	334.45	8.54	0.40
Number of Cattle	249.02	5.18	129.64	3.73	0.52	560.13	7.76	246.22	5.15	0.44	1170.17	11.22	793.26	9.24	0.68
Number of Households with Cattle	8.09	4.66	0.74	1.41	0.09	18.20	6.99	1.66	2.11	0.09	38.03	10.10	17.30	6.81	0.45
Vientiane															
Number of Households	96.73	6.09	66.09	5.03	0.68	215.21	9.09	69.59	5.17	0.32	464.12	13.34	233.59	9.46	0.50
Number of Farming Households	43.53	5.39	4.89	1.81	0.11	96.85	8.04	22.33	3.86	0.23	208.86	11.80	105.51	8.39	0.51
Number of Households Growing Rice Wet	38.29	5.59	6.58	2.32	0.17	85.19	8.34	17.86	3.82	0.21	183.72	12.25	78.50	8.01	0.43
Number of Households Growing Rice Dry	8.99	22.01	3.18	13.10	0.35	19.99	32.84	7.10	19.57	0.35	43.12	48.20	19.65	32.66	0.46
Number of Households Growing Rice Total	55.51	6.00	5.72	1.92	0.10	123.49	8.95	23.56	3.91	0.19	266.33	13.13	85.77	7.45	0.32
Rice Area Wet	87.81	7.53	31.38	4.50	0.36	195.36	11.23	60.82	6.27	0.31	421.30	16.49	332.23	14.63	0.79
Rice Area Dry	4.23	24.60	2.26	17.98	0.53	9.42	36.69	3.54	22.48	0.38	20.31	53.88	15.49	47.21	0.76
Rice Area Total	98.33	7.46	33.83	4.38	0.34	218.77	11.14	56.58	5.66	0.26	471.80	16.35	359.33	14.26	0.76

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Table 3: CVs and Design Effects by Province															
Characteristics of Interest	20%					10%					5%				
	SRS		Systematic			SRS		Systematic			SRS		Systematic		
	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff
Number of Cattle	873.80	7.88	363.62	5.09	0.42	1944.11	11.77	1285.70	9.57	0.66	4192.61	17.27	3487.81	15.76	0.83
Number of Households with Cattle	11.77	6.06	4.92	3.92	0.42	26.18	9.04	17.71	7.44	0.68	56.46	13.27	34.48	10.37	0.61
Vientiane Capital															
Number of Households	254.26	5.90	69.42	3.08	0.27	572.09	8.84	244.68	5.78	0.43	1182.33	12.71	534.87	8.55	0.45
Number of Farming Households	48.05	8.18	20.18	5.30	0.42	108.11	12.26	47.87	8.16	0.44	223.43	17.63	101.62	11.90	0.45
Number of Households Growing Rice Wet	40.05	9.27	18.14	6.24	0.45	90.12	13.91	39.75	9.24	0.44	186.24	20.00	86.29	13.63	0.46
Number of Households Growing Rice Dry	21.80	13.15	5.50	6.60	0.25	49.04	19.73	13.16	10.22	0.27	101.36	28.36	39.85	17.80	0.39
Number of Households Growing Rice Total	102.50	9.76	39.93	6.09	0.39	230.63	14.64	76.12	8.41	0.33	476.64	21.04	195.53	13.49	0.41
Rice Area Wet	175.92	13.47	191.18	14.04	1.09	395.81	20.21	376.12	19.70	0.95	818.01	29.05	565.30	24.16	0.69
Rice Area Dry	16.29	15.56	11.13	12.86	0.68	36.66	23.34	14.73	14.80	0.40	75.77	33.55	55.14	28.70	0.73
Rice Area Total	232.29	12.25	267.68	13.15	1.15	522.66	18.38	446.61	16.99	0.85	1080.16	26.42	733.66	21.79	0.68
Number of Cattle	472.45	10.53	156.19	6.05	0.33	1063.02	15.79	694.13	12.76	0.65	2196.91	22.71	1279.81	17.34	0.58
Number of Households with Cattle	8.40	9.84	1.60	4.29	0.19	18.91	14.75	8.65	9.98	0.46	39.07	21.21	22.47	16.09	0.57
Xiengkhuang															
Number of Households	36.34	7.56	23.17	6.04	0.64	81.72	11.35	48.22	8.72	0.59	168.99	16.31	125.57	14.06	0.74
Number of Farming Households	13.69	5.37	4.09	2.94	0.30	30.78	8.06	12.64	5.16	0.41	63.65	11.58	36.21	8.73	0.57
Number of Households Growing Rice Wet	11.78	5.28	3.62	2.93	0.31	26.49	7.92	10.81	5.06	0.41	54.77	11.39	34.55	9.04	0.63
Number of Households Growing Rice Dry	0.04	85.58	0.02	61.58	0.52	0.09	129.17	0.06	107.51	0.69	0.18	184.56	0.16	174.65	0.89
Number of Households Growing Rice Total	11.84	5.28	3.74	2.97	0.32	26.64	7.92	11.52	5.21	0.43	55.08	11.38	35.62	9.15	0.65
Rice Area Wet	14.33	6.13	5.37	3.75	0.37	32.23	9.19	14.54	6.17	0.45	66.64	13.21	20.88	7.40	0.31
Rice Area Dry	0.01	108.31	0.00	91.99	0.72	0.01	164.06	0.01	150.59	0.84	0.03	233.56	0.02	222.70	0.90
Rice Area Total	14.36	6.13	5.47	3.78	0.38	32.30	9.19	14.57	6.17	0.45	66.79	13.21	20.65	7.35	0.31
Number of Cattle	276.52	6.42	52.40	2.79	0.19	621.83	9.62	243.46	6.02	0.39	1285.89	13.84	658.12	9.89	0.51
Number of Households with Cattle	5.12	5.20	1.10	2.41	0.21	11.52	7.80	1.90	3.17	0.17	23.82	11.21	13.57	8.46	0.57
Bokeo															
Number of Households	96.33	9.72	82.55	9.00	0.86	221.27	14.73	127.42	11.18	0.58	466.83	21.41	245.35	15.53	0.53
Number of Farming Households	44.16	7.70	15.12	4.50	0.34	101.44	11.67	19.77	5.15	0.19	214.02	16.94	121.45	12.77	0.57
Number of Households Growing Rice Wet	39.61	7.62	13.85	4.51	0.35	90.99	11.56	16.87	4.97	0.19	191.97	16.78	112.42	12.85	0.59
Number of Households Growing Rice Dry	5.49	31.04	4.97	29.48	0.90	12.62	47.01	7.52	36.29	0.60	26.62	68.32	16.15	53.20	0.61
Number of Households Growing Rice Total	59.15	8.53	32.00	6.28	0.54	135.87	12.94	33.01	6.38	0.24	286.65	18.78	171.73	14.55	0.60
Rice Area Wet	59.95	8.35	3.83	2.11	0.06	137.71	12.65	19.09	4.71	0.14	290.53	18.37	166.84	13.94	0.57
Rice Area Dry	3.20	33.68	2.57	30.16	0.80	7.35	51.01	3.20	33.66	0.44	15.50	74.14	10.22	60.21	0.66
Rice Area Total	72.98	8.71	10.78	3.35	0.15	167.63	13.20	20.99	4.67	0.13	353.66	19.17	203.12	14.54	0.57
Number of Cattle	487.21	14.37	82.42	5.91	0.17	1119.09	21.77	333.58	11.88	0.30	2361.07	31.64	1860.17	28.07	0.79
Number of Households with Cattle	12.08	10.86	2.16	4.59	0.18	27.75	16.46	2.83	5.26	0.10	58.55	23.91	59.68	24.15	1.02
Huaphanh															
Number of Households	14.86	6.06	7.31	4.25	0.49	33.43	9.09	8.54	4.59	0.26	70.57	13.20	35.83	9.41	0.51
Number of Farming Households	6.72	4.43	2.43	2.66	0.36	15.13	6.64	3.35	3.12	0.22	31.93	9.65	17.31	7.11	0.54
Number of Households Growing Rice Wet	5.87	4.27	1.55	2.20	0.27	13.20	6.41	3.52	3.31	0.27	27.86	9.32	16.35	7.14	0.59
Number of Households Growing Rice Dry	2.43	18.46	1.55	14.76	0.64	5.46	27.71	3.67	22.70	0.67	11.53	40.23	5.72	28.36	0.50
Number of Households Growing Rice Total	10.29	4.93	2.45	2.40	0.24	23.15	7.39	5.31	3.54	0.23	48.88	10.74	28.59	8.21	0.58
Rice Area Wet	7.36	5.82	4.61	4.61	0.63	16.56	8.74	7.70	5.96	0.47	34.97	12.69	23.46	10.40	0.67
Rice Area Dry	0.40	25.79	0.14	15.05	0.34	0.90	38.70	0.44	26.84	0.48	1.91	56.20	1.60	51.53	0.84
Rice Area Total	7.78	5.69	4.01	4.09	0.52	17.50	8.53	6.38	5.15	0.36	36.94	12.39	27.10	10.61	0.73
Number of Cattle	63.02	7.72	15.32	3.81	0.24	141.77	11.59	47.04	6.67	0.33	299.27	16.83	236.19	14.96	0.79
Number of Households with Cattle	2.12	6.41	0.40	2.80	0.19	4.77	9.62	0.62	3.47	0.13	10.07	13.97	7.14	11.77	0.71

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Table 3: CVs and Design Effects by Province

Characteristics of Interest	20%					10%					5%				
	SRS		Systematic			SRS		Systematic			SRS		Systematic		
	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff
Luangnamtha															
Number of Households	36.32	7.33	8.77	3.60	0.24	80.42	10.91	19.11	5.32	0.24	169.88	15.85	80.36	10.90	0.47
Number of Farming Households	20.29	6.21	2.03	1.96	0.10	44.93	9.24	4.14	2.81	0.09	94.91	13.43	33.02	7.92	0.35
Number of Households Growing Rice Wet	15.78	6.10	3.61	2.92	0.23	34.94	9.08	8.24	4.41	0.24	73.81	13.20	27.99	8.13	0.38
Number of Households Growing Rice Dry	2.79	36.24	1.93	30.05	0.69	6.19	53.73	4.86	47.62	0.79	13.07	78.38	11.67	73.87	0.89
Number of Households Growing Rice Total	22.73	6.84	9.13	4.33	0.40	50.34	10.18	15.02	5.56	0.30	106.34	14.79	40.69	9.15	0.38
Rice Area Wet	37.48	8.19	11.06	4.45	0.30	82.99	12.20	22.12	6.30	0.27	175.33	17.72	96.77	13.17	0.55
Rice Area Dry	0.77	44.08	0.79	44.65	1.03	1.71	65.35	1.37	58.63	0.80	3.61	95.35	3.32	90.72	0.92
Rice Area Total	38.79	8.12	7.99	3.69	0.21	85.91	12.09	14.94	5.04	0.17	181.48	17.56	96.98	12.84	0.53
Number of Cattle	31.64	14.75	50.16	18.58	1.59	70.07	21.96	88.44	24.67	1.26	148.01	31.90	333.69	48.00	2.25
Number of Households with Cattle	2.33	12.95	1.83	11.49	0.79	5.16	19.28	4.41	17.83	0.86	10.89	28.01	24.06	41.73	2.21
Luangprabang															
Number of Households	22.12	5.03	9.78	3.34	0.44	50.14	7.57	29.07	5.76	0.58	105.82	11.00	56.25	8.02	0.53
Number of Farming Households	12.46	4.69	2.01	1.89	0.16	28.24	7.06	7.92	3.74	0.28	59.60	10.26	15.41	5.22	0.26
Number of Households Growing Rice Wet	10.90	4.98	2.73	2.49	0.25	24.70	7.50	5.35	3.49	0.22	52.14	10.89	10.76	4.95	0.21
Number of Households Growing Rice Dry	1.12	23.40	0.83	20.22	0.75	2.53	35.20	1.57	27.69	0.62	5.35	51.18	2.86	37.43	0.54
Number of Households Growing Rice Total	14.97	5.46	3.53	2.66	0.24	33.93	8.23	6.76	3.67	0.20	71.62	11.95	16.21	5.69	0.23
Rice Area Wet	23.26	7.59	8.84	4.68	0.38	52.73	11.43	58.85	12.08	1.12	111.30	16.61	71.34	13.30	0.64
Rice Area Dry	0.59	24.90	0.28	17.07	0.47	1.34	37.44	0.78	28.52	0.58	2.83	54.46	1.47	39.25	0.52
Rice Area Total	26.19	7.68	10.01	4.75	0.38	59.36	11.57	58.20	11.45	0.98	125.29	16.80	74.51	12.96	0.59
Number of Cattle	70.31	10.18	25.44	6.12	0.36	159.38	15.32	92.38	11.66	0.58	336.39	22.26	223.54	18.14	0.66
Number of Households with Cattle	2.22	7.68	0.31	2.89	0.14	5.03	11.56	1.93	7.17	0.38	10.63	16.80	6.65	13.28	0.63
Oudomxay															
Number of Households	40.69	6.20	3.96	1.94	0.10	91.53	9.30	23.71	4.73	0.26	188.98	13.36	61.57	7.63	0.33
Number of Farming Households	25.45	5.36	3.87	2.09	0.15	57.25	8.04	18.64	4.59	0.33	118.20	11.55	36.90	6.45	0.31
Number of Households Growing Rice Wet	19.53	5.09	1.07	1.19	0.05	43.92	7.63	8.86	3.42	0.20	90.68	10.96	23.00	5.52	0.25
Number of Households Growing Rice Dry	0.45	29.93	0.29	23.74	0.63	1.02	44.89	1.36	51.81	1.33	2.11	64.49	2.07	64.16	0.98
Number of Households Growing Rice Total	21.15	5.16	0.50	0.80	0.02	47.58	7.74	9.10	3.38	0.19	98.22	11.12	20.76	5.12	0.21
Rice Area Wet	54.34	8.14	56.87	8.32	1.05	122.23	12.20	159.92	13.96	1.31	252.35	17.53	227.16	16.64	0.90
Rice Area Dry	0.15	33.68	0.12	29.92	0.79	0.33	50.51	0.37	53.77	1.13	0.68	72.58	0.73	75.24	1.07
Rice Area Total	54.97	8.08	58.85	8.36	1.07	123.65	12.12	164.90	14.00	1.33	255.28	17.41	225.40	16.37	0.88
Number of Cattle	56.09	11.61	18.66	6.70	0.33	126.16	17.41	60.43	12.05	0.48	260.47	25.02	162.73	19.79	0.62
Number of Households with Cattle	2.89	8.72	0.50	3.61	0.17	6.49	13.07	4.30	10.64	0.66	13.40	18.78	7.38	13.94	0.55
Phongsaly															
Number of Households	8.14	5.22	4.39	3.84	0.54	18.31	7.83	8.03	5.19	0.44	38.66	11.38	20.45	8.28	0.53
Number of Farming Households	7.15	5.12	3.65	3.66	0.51	16.08	7.68	6.84	5.01	0.43	33.94	11.15	17.83	8.08	0.53
Number of Households Growing Rice Wet	6.05	5.35	3.51	4.08	0.58	13.61	8.03	7.29	5.88	0.54	28.73	11.66	11.68	7.44	0.41
Number of Households Growing Rice Dry	0.81	55.88	0.46	41.95	0.56	1.83	83.99	1.71	81.29	0.94	3.86	121.76	3.89	122.19	1.01
Number of Households Growing Rice Total	8.70	6.20	3.26	3.79	0.37	19.58	9.30	7.24	5.66	0.37	41.32	13.51	16.45	8.53	0.40
Rice Area Wet	7.97	8.04	7.51	7.81	0.94	17.92	12.06	13.32	10.40	0.74	37.83	17.52	23.50	13.81	0.62
Rice Area Dry	0.03	53.99	0.02	46.27	0.73	0.07	81.16	0.07	82.44	1.03	0.14	117.66	0.15	122.03	1.08
Rice Area Total	8.18	8.07	7.48	7.72	0.91	18.40	12.11	13.26	10.28	0.72	38.83	17.60	23.98	13.82	0.62
Number of Cattle	12.08	14.10	2.04	5.80	0.17	27.17	21.14	13.66	14.99	0.50	57.35	30.72	74.46	35.04	1.30
Number of Households with Cattle	1.11	11.36	0.09	3.18	0.08	2.49	17.04	0.57	8.16	0.23	5.25	24.75	7.28	29.15	1.39

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Table 3: CVs and Design Effects by Province															
Characteristics of Interest	20%					10%					5%				
	SRS		Systematic			SRS		Systematic			SRS		Systematic		
	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff
Xayabury															
Number of Households	88.42	6.10	28.71	3.48	0.32	196.42	9.09	85.04	5.98	0.43	424.82	13.37	252.86	10.30	0.60
Number of Farming Households	66.40	5.83	30.96	3.98	0.47	147.51	8.68	86.91	6.67	0.59	319.04	12.77	160.81	9.06	0.50
Number of Households Growing Rice Wet	54.42	5.88	31.62	4.48	0.58	120.89	8.76	73.96	6.85	0.61	261.47	12.89	150.11	9.76	0.57
Number of Households Growing Rice Dry	6.36	23.15	2.55	14.65	0.40	14.13	34.52	6.12	22.71	0.43	30.57	50.75	20.52	41.62	0.67
Number of Households Growing Rice Total	69.51	6.11	25.10	3.67	0.36	154.42	9.11	67.17	6.01	0.43	333.98	13.40	153.17	9.07	0.46
Rice Area Wet	113.65	9.25	91.97	8.33	0.81	252.49	13.79	242.06	13.50	0.96	546.07	20.28	609.37	21.39	1.12
Rice Area Dry	2.04	27.05	1.80	25.42	0.88	4.53	40.27	3.35	34.67	0.74	9.79	59.28	9.77	59.17	1.00
Rice Area Total	120.62	9.11	87.15	7.75	0.72	267.97	13.58	247.89	13.06	0.93	579.55	19.98	630.43	20.80	1.09
Number of Cattle	515.63	9.31	50.54	2.91	0.10	1145.49	13.87	244.37	6.41	0.21	2477.43	20.40	646.15	10.41	0.26
Number of Households with Cattle	10.96	8.05	1.89	3.35	0.17	24.36	12.00	4.72	5.28	0.19	52.68	17.64	15.22	9.48	0.29
Attapeu															
Number of Households	394.40	13.11	184.85	8.97	0.47	887.41	19.66	460.07	14.15	0.52	1750.17	27.61	956.33	20.35	0.55
Number of Farming Households	304.55	13.76	108.17	8.20	0.36	685.25	20.64	428.60	16.32	0.63	1351.46	28.98	973.38	24.53	0.72
Number of Households Growing Rice Wet	286.80	14.45	55.45	6.35	0.19	645.29	21.68	445.58	18.01	0.69	1272.66	30.44	1090.83	28.11	0.86
Number of Households Growing Rice Dry	6.26	44.89	3.39	33.02	0.54	14.08	67.33	14.12	67.43	1.00	27.77	94.56	30.82	98.19	1.11
Number of Households Growing Rice Total	306.66	14.27	33.18	4.69	0.11	689.98	21.40	398.03	16.25	0.58	1360.80	30.05	984.43	25.48	0.72
Rice Area Wet	509.61	15.88	344.29	13.05	0.68	1146.62	23.82	1057.25	22.87	0.92	2261.39	33.45	1853.84	30.15	0.82
Rice Area Dry	37.11	93.62	24.11	75.47	0.65	83.49	140.43	67.20	125.99	0.80	164.66	197.21	138.17	184.13	0.84
Rice Area Total	647.73	17.12	446.80	14.22	0.69	1457.40	25.68	1412.22	25.28	0.97	2874.32	36.06	2074.33	30.53	0.72
Number of Cattle	1975.23	27.62	3621.65	37.41	1.83	4444.27	41.44	4581.11	42.07	1.03	8765.09	58.19	8965.46	58.54	1.02
Number of Households with Cattle	22.06	23.56	25.89	25.53	1.17	49.65	35.35	61.99	39.50	1.25	97.91	49.64	138.95	58.33	1.42
Champasack															
Number of Households	93.37	5.74	59.42	4.58	0.64	212.00	8.65	82.23	5.39	0.39	447.42	12.57	238.60	9.18	0.53
Number of Farming Households	44.27	5.72	15.69	3.40	0.35	100.51	8.62	27.29	4.49	0.27	212.12	12.52	77.27	7.56	0.36
Number of Households Growing Rice Wet	41.97	7.02	7.56	2.98	0.18	95.28	10.58	11.53	3.68	0.12	201.10	15.38	86.39	10.08	0.43
Number of Households Growing Rice Dry	5.24	19.33	1.25	9.45	0.24	11.91	29.12	4.30	17.50	0.36	25.13	42.31	16.17	33.91	0.64
Number of Households Growing Rice Total	56.60	7.23	5.21	2.19	0.09	128.51	10.89	11.12	3.20	0.09	271.22	15.82	122.40	10.63	0.45
Rice Area Wet	165.73	8.64	42.04	4.35	0.25	376.30	13.02	136.17	7.83	0.36	794.20	18.91	423.98	13.81	0.53
Rice Area Dry	2.98	20.05	0.40	7.31	0.13	6.77	30.21	2.81	19.46	0.42	14.29	43.90	7.30	31.35	0.51
Rice Area Total	173.49	8.36	41.71	4.10	0.24	393.91	12.59	109.61	6.64	0.28	831.36	18.29	398.74	12.66	0.48
Number of Cattle	306.08	8.71	40.79	3.18	0.13	694.95	13.13	159.16	6.28	0.23	1466.73	19.07	457.57	10.66	0.31
Number of Households with Cattle	6.29	7.71	0.72	2.61	0.11	14.28	11.63	2.10	4.46	0.15	30.13	16.89	5.67	7.33	0.19
Saravane															
Number of Households	23.15	5.17	5.05	2.42	0.22	51.61	7.72	11.02	3.57	0.21	110.92	11.32	39.52	6.76	0.36
Number of Farming Households	17.37	5.06	5.36	2.81	0.31	38.73	7.56	11.87	4.18	0.31	83.23	11.08	39.25	7.61	0.47
Number of Households Growing Rice Wet	16.04	5.15	8.37	3.72	0.52	35.77	7.69	17.49	5.38	0.49	76.87	11.27	44.08	8.54	0.57
Number of Households Growing Rice Dry	6.97	19.23	3.34	13.30	0.48	15.55	28.76	15.34	28.56	0.99	33.42	42.10	20.66	33.15	0.62
Number of Households Growing Rice Total	30.77	6.06	20.92	5.00	0.68	68.60	9.05	58.40	8.35	0.85	147.43	13.27	102.95	11.10	0.70
Rice Area Wet	74.19	6.90	54.55	5.91	0.74	165.40	10.30	125.09	8.96	0.76	355.48	15.10	318.63	14.31	0.90
Rice Area Dry	4.26	23.59	4.36	23.86	1.02	9.51	35.27	9.11	34.53	0.96	20.44	51.63	12.73	40.84	0.62
Rice Area Total	89.46	7.08	73.35	6.41	0.82	199.46	10.57	166.33	9.65	0.83	428.68	15.49	368.81	14.39	0.86
Number of Cattle	122.67	6.99	24.39	3.12	0.20	273.48	10.44	118.21	6.86	0.43	587.77	15.29	270.22	10.38	0.46
Number of Households with Cattle	4.22	5.82	0.28	1.51	0.07	9.42	8.69	2.57	4.54	0.27	20.24	12.73	5.90	6.88	0.29

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Characteristics of Interest	20%					10%					5%				
	SRS		Systematic			SRS		Systematic			SRS		Systematic		
	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff	Var	CV	Var	CV	Deff
Sekong															
Number of Households	78.90	13.72	47.33	10.63	0.60	182.04	20.87	146.88	18.75	0.81	367.18	29.61	257.03	24.91	0.70
Number of Farming Households	40.03	11.40	5.05	4.05	0.13	92.36	17.34	29.13	9.74	0.32	186.31	24.59	101.21	18.24	0.54
Number of Households Growing Rice Wet	30.79	10.83	10.85	6.43	0.35	71.03	16.48	34.50	11.48	0.49	143.26	23.36	87.00	18.33	0.61
Number of Households Growing Rice Dry	2.90	36.89	1.64	27.74	0.57	6.70	56.08	1.97	30.44	0.29	13.51	79.58	5.61	51.28	0.42
Number of Households Growing Rice Total	39.55	11.26	7.99	5.06	0.20	91.24	17.13	31.88	10.13	0.35	184.03	24.29	94.82	17.54	0.52
Rice Area Wet	48.63	13.37	35.96	11.50	0.74	112.19	20.36	101.99	19.41	0.91	226.29	28.85	244.25	30.28	1.08
Rice Area Dry	2.74	45.84	0.82	25.06	0.30	6.33	69.69	2.63	44.95	0.42	12.77	98.89	8.06	79.32	0.63
Rice Area Total	58.04	13.66	32.08	10.16	0.55	133.92	20.80	108.50	18.72	0.81	270.12	29.48	283.52	30.50	1.05
Number of Cattle	145.84	19.05	68.13	13.04	0.47	336.47	29.08	290.95	27.04	0.86	678.68	41.10	946.19	49.19	1.39
Number of Households with Cattle	6.53	14.65	4.25	11.84	0.65	15.07	22.35	17.11	23.81	1.14	30.39	31.61	49.98	41.08	1.64

References

Alexander, Charles. 2002. Still Rolling: Leslie Kish's "Rolling Samples" and the American Community Survey. Survey Methodology. Vol. 28, No. 1, pp. 35-41.

Durr, Jean-Michel. 2005. The French New Rolling Census. *Statistical Journal of the United Nations Economic Commission for Europe*. Vol 22.

Kish, Leslie. 1995. Methods for Design Effects. *Journal of Official Statistics*. 11, 55-77.

Kish, Leslie. 1992. Weighting for Unequal *pi* . *Journal of Official Statistics*, 8, pp.183-200.

Kish, Leslie. 1990. Rolling Samples and Censuses. *Survey Methodology*. 16, 1, pp. 63-79.

Kish, Leslie. 1979. Samples and Censuses. *International Statistical Review*, 47, 99-109.

Kish, Leslie. 1965. *Survey Sampling*, New York: John Wiley & Sons.

Maligalig, D. 2015. Administrative Reporting Systems for Agricultural Statistics in Asia. Report presented at the Experts Group Meeting on Agricultural Statistics, Food and Agricultural Organization Headquarters, Rome, Italy, 13-17 April 2015.

Maligalig, D. 2014. *Back to Office Report: Mission to Conduct the Training Program and High Level Meeting on Improving Agricultural Data Collection Systems in Lao PDR*, Asian Development Bank. Manila.

Ministry of Agriculture and Forestry (MAF). 2013. *Action Plan for Improving Agricultural and Rural Statistics in Lao PDR, 2013-2020*. Vientiane. Lao People's Democratic Republic.

Ministry of Agriculture and Forestry (MAF), Lao Statistics Bureau (LSB) and Asian Development Bank (ADB). 2015. Examining Existing Data Sources for Agriculture Statistics in Lao PDR. Methodological Study Report under ADB Technical Assistance on Improving Agricultural and Rural Statistics for Food Security.

STUDY V
Adoption of Agricultural Land Information System (ALIS) in the Philippines for Agricultural Area Estimation

1. Introduction

Food security is a priority program of the Department of Agriculture (DA) of the Philippines. It is one of the agency's most pressing challenges amidst the effects of climate change, demands for natural resources, and competing food crop use. The importance of the agriculture sector in achieving food security demands that its planning, management, and monitoring be based on sound evidence. This in turn requires the sustained availability of comprehensive, reliable, and up-to-date statistical data. That is crucial for policy makers in formulating policies and strategies for the development of the agriculture sector.

Currently, the agricultural statistics production system in the country is based on administrative reporting system. In this system, the reports are filled at the barangay level by observing harvest or by interviewing key informants and progressively summarized at the municipal, provincial, and national levels. Although sustainable and inexpensive, this method is viewed as unreliable and prone to biases and measurement errors. Furthermore, administrative reporting system does not include a validation method that can improve the quality of estimates. On the other hand, censuses and surveys can provide better estimates. These methods, however, require a larger budget and usually take a longer time to process. Due to these data gaps and resource constraints, the Philippines adopted appropriate and sustainable methodologies that will provide timely and reliable estimates for agricultural statistics.

Since the introduction of objective method for estimation of crop statistics, steps have been taken from time to time for the improvement of agricultural statistics in terms of coverage, scope, accuracy, standardization, and coordination (Narain, 2002). The applications of information technology systems have been widely used and documented. There are many studies using remote sensing data for improving the estimates obtained from area sampling. Global Positioning System (GPS) has allowed data collection to be more accurate and consistent than estimating locations or area using paper maps and distance measurement. A Geographic Information System (GIS), on the other hand, has important applications which include monitoring of crops, management of precision farming practices, and area frame survey support (Martinez, 2013).

The challenge of food security and the issues on the reliability of statistical data have been recognized and addressed by Association of South East Asian Nation (ASEAN) member countries through the ASEAN Food Security Information System (AFSIS). AFSIS, one of the interventions of the ASEAN+3 Cooperation Framework, aims to strengthen food security in the region through the systematic collection, analysis, and dissemination of food security-related information. The project was started in 2003 with two phases. Phase 1, which was completed in 2007, focused on data collection, database website development and capacity building activities. Phase II, which is on-going, is a continuation of Phase I activities but with the addition of more analytical studies that would help guide policy makers in strategizing more rapid achievement of food security in the region.

One of the methodologies developed under AFSIS is the Agricultural Land Information System (ALIS). ALIS is a system that provides estimates of areas planted to major crops such as rice, maize, cassava, sugarcane, and soybean using satellite imagery that can be accessed free of charge (e.g. Google map), supporting area sample survey for countries with nondeveloped area survey. ALIS was first adopted and successfully implemented by AFSIS in the provinces of Vientiane, Lao People's Democratic Republic (PDR) and Kandal, Cambodia (Kimura, 2012).

The Bureau of Agricultural Statistics (BAS), an attached agency of DA is mandated to collect, compile, and release official agricultural statistics. In pursuit of its mandated tasks, the agency continues to adopt methodologies that will improve the quality of agricultural statistics. This paper aims to study the use of ALIS for agricultural area estimation. Specifically, it aims to:

apply existing remote sensing technology in estimating agricultural land areas and
estimate total agricultural land area and crop planted area of the pilot province.

The BAS adopted ALIS through the support of Asian Development Bank (ADB) under its regional policy and advisory technical assistance (R-PATA) 8029: Improving Agricultural and Rural Statistics for Food Security. One of the major activities of R-PATA 8029 is to conduct methodological research through special studies and application of affordable data collection strategies for agricultural and rural statistics. The main functions of ALIS which include (1) the development of agricultural land mesh framework, (2) area estimation, and (3) survey support, are directly related to the objectives of R-PATA 8029. The study was also presented by DA during the 12th National Convention on Statistics in October 2013. The convention is the biggest gathering in the country of statisticians, data providers and users as well as other stakeholders of statistics.

The next section presents the conceptual framework of the statistical concepts that were used in deriving and validating the area estimates. Section 3 describes the methodology on the estimation of agricultural land area and crop area. The results and discussion are in Section 4 while the conclusion and recommendation are in Section 5.

2. Conceptual Framework

ALIS was used to compute the estimates of total agricultural land area and crop areas for major crops in the province of Nueva Ecija using Google map which will be explained further in Section 3 of this paper.

The basic computation of this measurement approach was to divide the provincial area into 24,021 meshes and identify the land use for each of the meshes. Sample meshes were then selected using the simple two-stage sampling technique. Data on agricultural land area for the first sample were measured using Google maps and the ALIS software while data for the second sample were validated agricultural land areas from the field survey conducted. Crop area estimates were then derived for the second stage with the estimates based on data from the field survey.

Estimation of total agricultural land area

Estimate of total agricultural land area based on the first sample

Based on the initial agricultural land area measurements from Google maps, the ALIS generated a weighted estimate of the total agricultural land area $\hat{\tau}_{agri1}$ in the province computed as:

$$\hat{\tau}_{agri1} = \sum_{i=1}^{n_1} x_i \cdot \left(\frac{N}{n_1}\right) \quad (1)$$

where x_i is the agricultural land area for the ith sampled mesh based on measurements from Google maps, n_1 is the size of the first sample, and N is the total number of agricultural land meshes in the province.

To measure the accuracy of this estimate, an estimate of the standard error of $\hat{\tau}_{agri1}$ was computed. The estimate of the standard error of $\hat{\tau}_{agri1}$ was computed as:

$$\widehat{SE}(\hat{\tau}_{agri1}) = \sqrt{N(N-n_1)\cdot\frac{s_x^2}{n_1}} \quad where \quad s_x^2 = \frac{1}{n_1-1}\sum_{i=1}^{n_1}(x_i-\bar{x})^2 \quad (2)$$

The coefficient of variation was computed as:

$$CV(\hat{\mu}_{agri1}) = \frac{\widehat{SE}(\hat{\mu}_{agri1})}{\hat{\mu}_{agri1}} \quad (3)$$

where $\hat{\mu}_{agri1}$ refers to the estimated mean agricultural land area while $\widehat{SE}(\hat{\mu}_{agri1})$ refers to the estimate of the standard error of $\hat{\mu}_{agri1}$.

To validate the agricultural land area measurements based on Google maps and to determine the accuracy of these measurements, field verification was done. Agricultural land area measurements from a second set of sample meshes were verified in the field. The second set of sample meshes was selected from the first sample. Based on the result of the field survey and upon completion of the map survey registration in ALIS, a ratio estimate of the total agricultural land area in the province was computed.

Ratio estimate of total agricultural land area

Ratio estimation is a statistical technique that makes use of an auxiliary variable in order to estimate the parameter value of a variable of interest. This statistical technique calls for an auxiliary variable that can be easily measured from the whole population while the response variable is more difficult or more expensive to measure and is usually obtained from a simple random sample of the population.

In this study, the agricultural land area based on measurements from Google maps was used as the auxiliary variable. Using freely available maps from Google and with the use of the ALIS software, agricultural land areas within a province can be easily

measured. On the other hand, validated agricultural land areas from the field can be measured only from selected areas in the province because field surveys require more resources and are usually expensive to conduct.

The ratio estimate of the total agricultural land area $\hat{\tau}_{R,agri}$ was computed as:

$$\hat{\tau}_{R,agri} = r \cdot \hat{\tau}_{agri1} = \frac{\bar{y}}{\bar{x}} \cdot \hat{\tau}_{agri1} = \frac{\sum_{i=1}^{n_2} y_i/n_2}{\sum_{i=1}^{n_2} x_i/n_2} \cdot \hat{\tau}_{agri1} \quad (4)$$

where r is the sample ratio, x_i is the agricultural land area for the ith sampled mesh based on measurements from Google maps, y_i is the agricultural land area for the ith sampled mesh based on the field survey, n_2 is the number of meshes in the second sample, and $\hat{\tau}_{agri1}$ is the estimate of the total agricultural land area based on the first sample.

Similarly, estimate of the standard error of $\hat{\tau}_{R,agri}$ and the coefficient of variation were computed. The estimate of the standard error of $\hat{\tau}_{R,agri}$ was computed as:

$$\widehat{SE}(\hat{\tau}_{R,agri}) = \sqrt{N(N-n_2)\cdot\frac{s_r^2}{n_2}} \quad where \quad s_r^2 = \frac{1}{n_2-1}\sum_{i=1}^{n_2}(y_i - rx_i)^2 \quad (5)$$

while the coefficient of variation was computed as:

$$CV(\hat{\mu}_{R,agri}) = \frac{\widehat{SE}(\hat{\mu}_{R,agri})}{\hat{\mu}_{R,agri}} \quad (6)$$

where $\hat{\mu}_{R,agri}$ refers to the ratio estimate of the mean agricultural land area while $\widehat{SE}(\hat{\mu}_{R,agri})$ refers to the estimate of the standard error of $\hat{\mu}_{R,agri}$.

To compute the overall accuracy of the total agricultural land area estimate and to account for the total variation due to the first and second sampling, the overall standard error and coefficient of variation were computed, respectively, as:

$$\widehat{SE}(\hat{\tau}_{overall}) = \sqrt{\widehat{SE}^2(\hat{\tau}_{agri1}) + \widehat{SE}^2(\hat{\tau}_{R,agri})} \quad (7)$$

and $$CV(overall) = \sqrt{CV^2(\hat{\mu}_{agri1}) + CV^2(\hat{\mu}_{R,agri})}. \quad (8)$$

Estimation of total crop planted area

Furthermore, ALIS generated estimates of total area planted for selected crops $\hat{\tau}_{crop_j}$ based on crop planted areas validated in the field. Planted areas were estimated for crops including rice, corn, cassava, and others. For each crop, estimate of total area planted was computed as:

$$\hat{\tau}_{crop_j} = \sum_{i=1}^{n_2} y_{ij} \cdot \left(\frac{N}{n_2}\right) \quad (9)$$

where y_{ij} is the crop planted area for the ith sampled mesh and the jth crop based on the field survey, n_2 is the number of meshes sampled from the master sample, and N is the total number of agricultural land meshes in the province.

Likewise, the standard error and the coefficient of variation of $\hat{\tau}_{crop_j}$ for each crop were computed. The estimate of the standard error of $\hat{\tau}_{crop_j}$ was computed as:

$$\widehat{SE}\left(\hat{\tau}_{crop_j}\right) = \sqrt{N(N-n_2)\cdot\frac{s_{\bar{y}_j}^2}{n_2}} \quad where \quad s_{\bar{y}_j}^2 = \frac{1}{n_2-1}\sum_{i=1}^{n_2}(y_{ij} - \bar{y}_{.j})^2 \quad (10)$$

while the coefficient of variation was computed as:

$$CV(\hat{\mu}_{crop_j}) = \frac{\widehat{SE}\left(\hat{\mu}_{crop_j}\right)}{\hat{\mu}_{crop_j}} \quad (11)$$

where $\hat{\mu}_{crop_j}$ refers to the estimate of the mean crop planted area of the jth crop while $\widehat{SE}\left(\hat{\mu}_{crop_j}\right)$ refers to the estimate of the standard error of $\hat{\mu}_{crop_j}$.

Comparison of Agricultural Land Area Measurements

Agricultural land area measurements estimated using only Google maps and the ALIS software were compared vis-à-vis the agricultural land area measurements that were validated from the field.

This was done to assess the accuracy of estimates derived using remote sensing technologies, such as the use of Google maps in estimating agricultural statistics, specifically, agricultural land areas.

The difference in agricultural land area measurements was computed as:

$$d_i = x_i - y_i; \quad for\ i = 1,2, \dots, n_2 \qquad (12)$$

where x_i is the agricultural land area for the ith sampled mesh based on measurements from Google maps, y_i is the agricultural land area for the ith sampled mesh based on the field survey, and n_2 is the number of meshes in the second sample.

The appropriate statistical test for paired samples was done after checking necessary assumptions that the population differences, d_i's are normally distributed with mean μ_D and variance σ_D^2; and that the two samples came from normally-distributed populations.

3. Methodology

A. Preparatory work

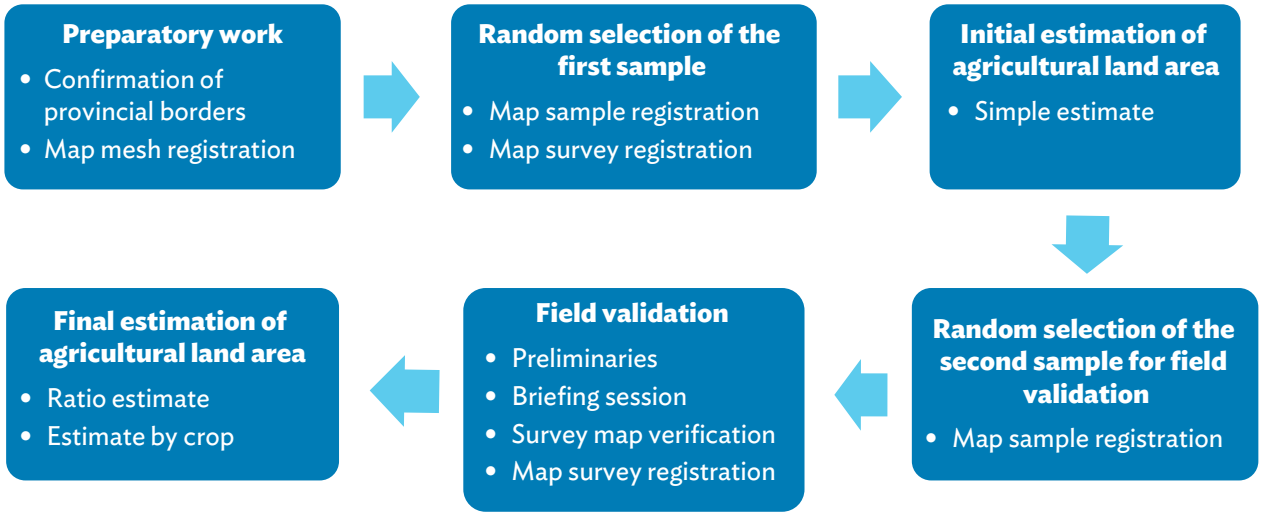
A working group was created by BAS to plan and implement the activities for the adoption of ALIS. Figure 1 shows the workflow for the implementation of ALIS. The province of Nueva Ecija was selected for its pilot implementation in the Philippines. The land area of the province of Nueva Ecija was divided into meshes of size 300m x 300m, wherein each mesh has a designated mesh ID. This was the original mesh file where the initial map mesh registration was done.

Map mesh registration includes the classification of mesh as agricultural area and non-agricultural area. Those identified as agricultural were marked red and registered in a database, while those identified as nonagricultural were excluded. The criteria used in the map mesh classification are presented in Appendix 1. A total of 24,021 meshes were identified as agricultural land areas. map mesh registration took eight days to complete.

B. Random selection of the first sample

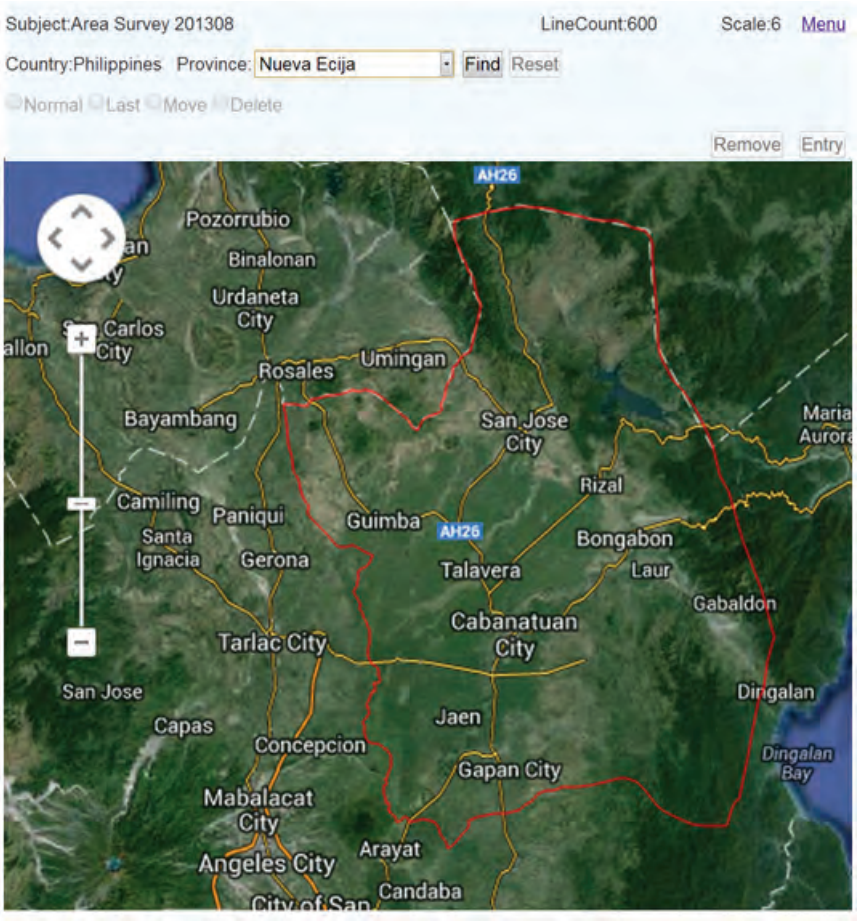
Using the ALIS software, a simple random sample of 5,000 meshes was drawn from the identified agricultural land area meshes as the first sample. Each mesh in the first sample was examined. Borders are drawn to delineate areas with vegetation. The manual inspection of meshes was complete in five days.

Figure 1: ALIS Workflow



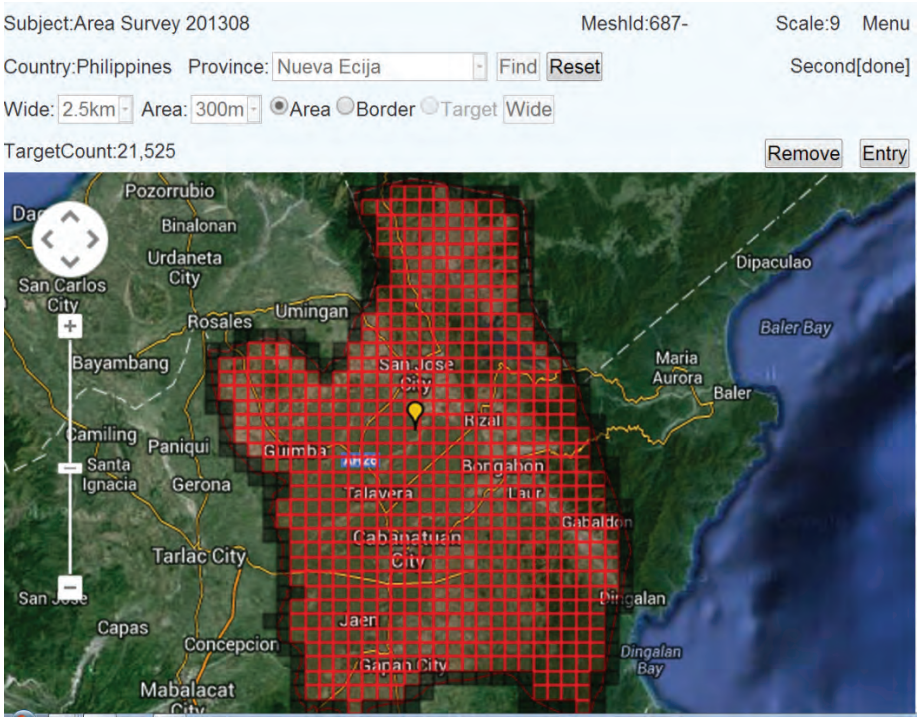
Source: BAS. ALIS workflow.

Figure 2: Provincial Map of Nueva Ecija



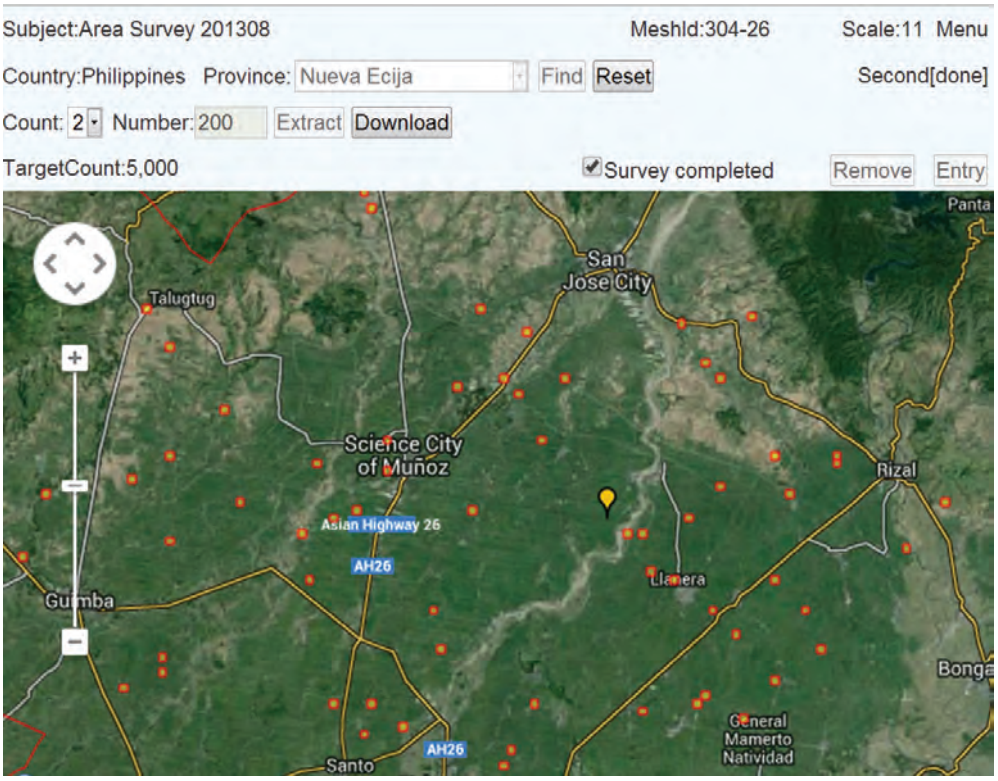
Source: ALIS.

Figure 3: Provincial Map with the 300m x 300m area meshes



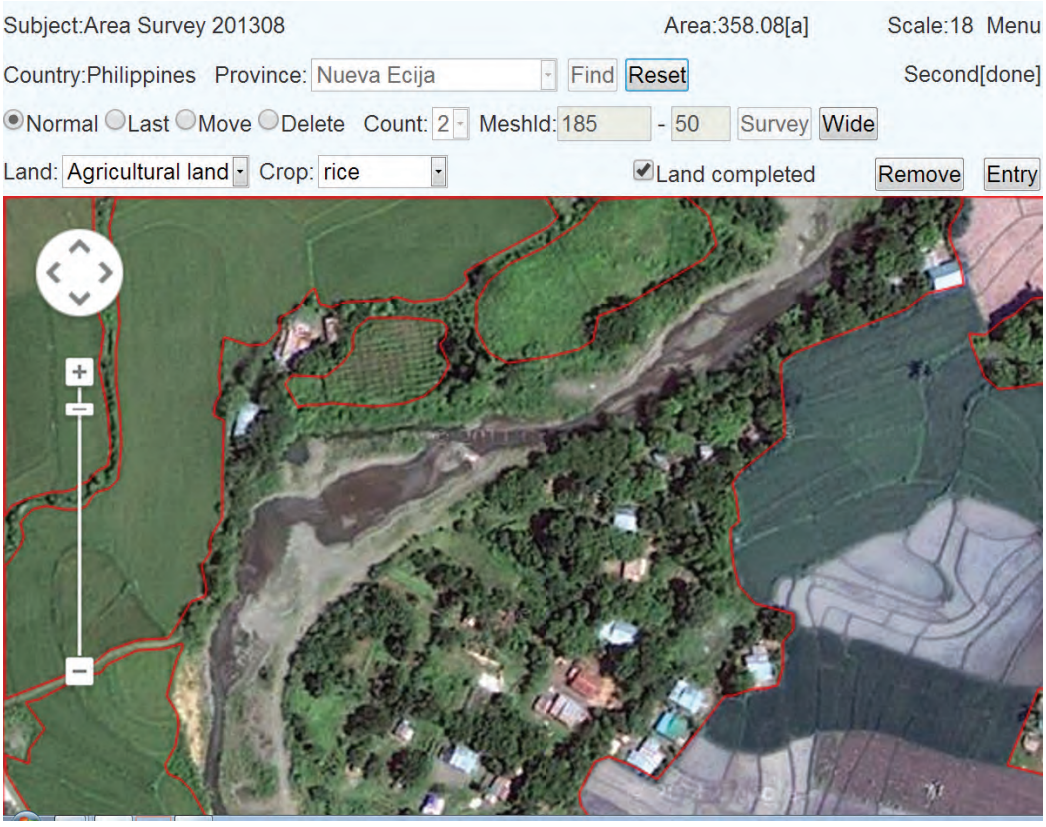
Source: ALIS.

Figure 4: Randomly Selected Sample Meshes



Source: ALIS.

Figure 5: Identification of Agricultural Land in the Area Mesh



Source: ALIS.

C. Initial estimation of agricultural land area

Based on the first sample, ALIS generated a simple estimate of the total agricultural land area in the province. To measure the accuracy of the estimate of the total agricultural land area, an estimate of the standard error and the coefficient of variation of $\hat{\tau}_{agri1}$ were computed.

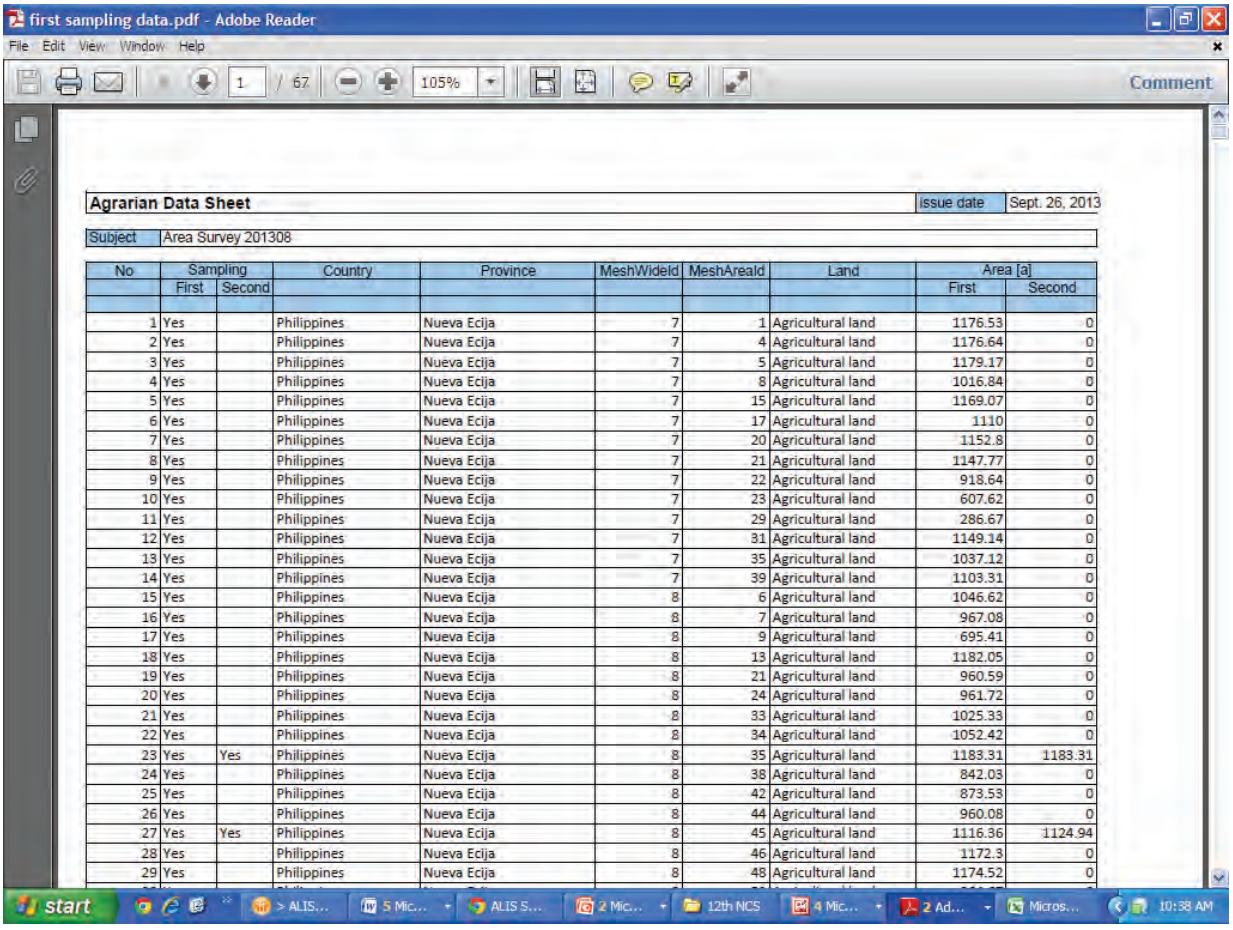
D. Random selection of the second sample for field validation

Two hundred meshes were randomly selected from the first sample. Agricultural land areas identified for these sample meshes were verified in the field survey. Four copies of each of the survey maps were printed on an A3-sized paper as shown in Figure 6 – (a) the survey district map (upper map); and (b) the survey district map containing information on the coordinates of the survey district (lower map).

E. Field validation

Six teams each comprising of three members were deployed to conduct the validation of the 200 sample meshes. The names of BAS Central Office personnel and provincial statistical officers and the corresponding location of their mesh assignments are listed in Appendix 2. Each team was provided with a GPS device to navigate the actual location of the sample meshes. Two copies of the survey maps were provided to each team – one copy (Map A) was used during the survey while the other copy (Map B) was

Figure 6: First Sample Area Estimates


first sampling data.pdf - Adobe Reader

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Agrarian Data Sheet issue date Sept. 26, 2013

Subject Area Survey 201308

No	Sampling		Country	Province	MeshWideId	MeshAreaId	Land	Area [a]	
	First	Second						First	Second
1	Yes		Philippines	Nueva Ecija	7	1	Agricultural land	1176.53	0
2	Yes		Philippines	Nueva Ecija	7	4	Agricultural land	1176.64	0
3	Yes		Philippines	Nueva Ecija	7	5	Agricultural land	1179.17	0
4	Yes		Philippines	Nueva Ecija	7	8	Agricultural land	1016.84	0
5	Yes		Philippines	Nueva Ecija	7	15	Agricultural land	1169.07	0
6	Yes		Philippines	Nueva Ecija	7	17	Agricultural land	1110	0
7	Yes		Philippines	Nueva Ecija	7	20	Agricultural land	1152.8	0
8	Yes		Philippines	Nueva Ecija	7	21	Agricultural land	1147.77	0
9	Yes		Philippines	Nueva Ecija	7	22	Agricultural land	918.64	0
10	Yes		Philippines	Nueva Ecija	7	23	Agricultural land	607.62	0
11	Yes		Philippines	Nueva Ecija	7	29	Agricultural land	286.67	0
12	Yes		Philippines	Nueva Ecija	7	31	Agricultural land	1149.14	0
13	Yes		Philippines	Nueva Ecija	7	35	Agricultural land	1037.12	0
14	Yes		Philippines	Nueva Ecija	7	39	Agricultural land	1103.31	0
15	Yes		Philippines	Nueva Ecija	8	6	Agricultural land	1046.62	0
16	Yes		Philippines	Nueva Ecija	8	7	Agricultural land	967.08	0
17	Yes		Philippines	Nueva Ecija	8	9	Agricultural land	695.41	0
18	Yes		Philippines	Nueva Ecija	8	13	Agricultural land	1182.05	0
19	Yes		Philippines	Nueva Ecija	8	21	Agricultural land	960.59	0
20	Yes		Philippines	Nueva Ecija	8	24	Agricultural land	961.72	0
21	Yes		Philippines	Nueva Ecija	8	33	Agricultural land	1025.33	0
22	Yes		Philippines	Nueva Ecija	8	34	Agricultural land	1052.42	0
23	Yes	Yes	Philippines	Nueva Ecija	8	35	Agricultural land	1183.31	1183.31
24	Yes		Philippines	Nueva Ecija	8	38	Agricultural land	842.03	0
25	Yes		Philippines	Nueva Ecija	8	42	Agricultural land	873.53	0
26	Yes		Philippines	Nueva Ecija	8	44	Agricultural land	960.08	0
27	Yes	Yes	Philippines	Nueva Ecija	8	45	Agricultural land	1116.36	1124.94
28	Yes		Philippines	Nueva Ecija	8	46	Agricultural land	1172.3	0
29	Yes		Philippines	Nueva Ecija	8	48	Agricultural land	1174.52	0

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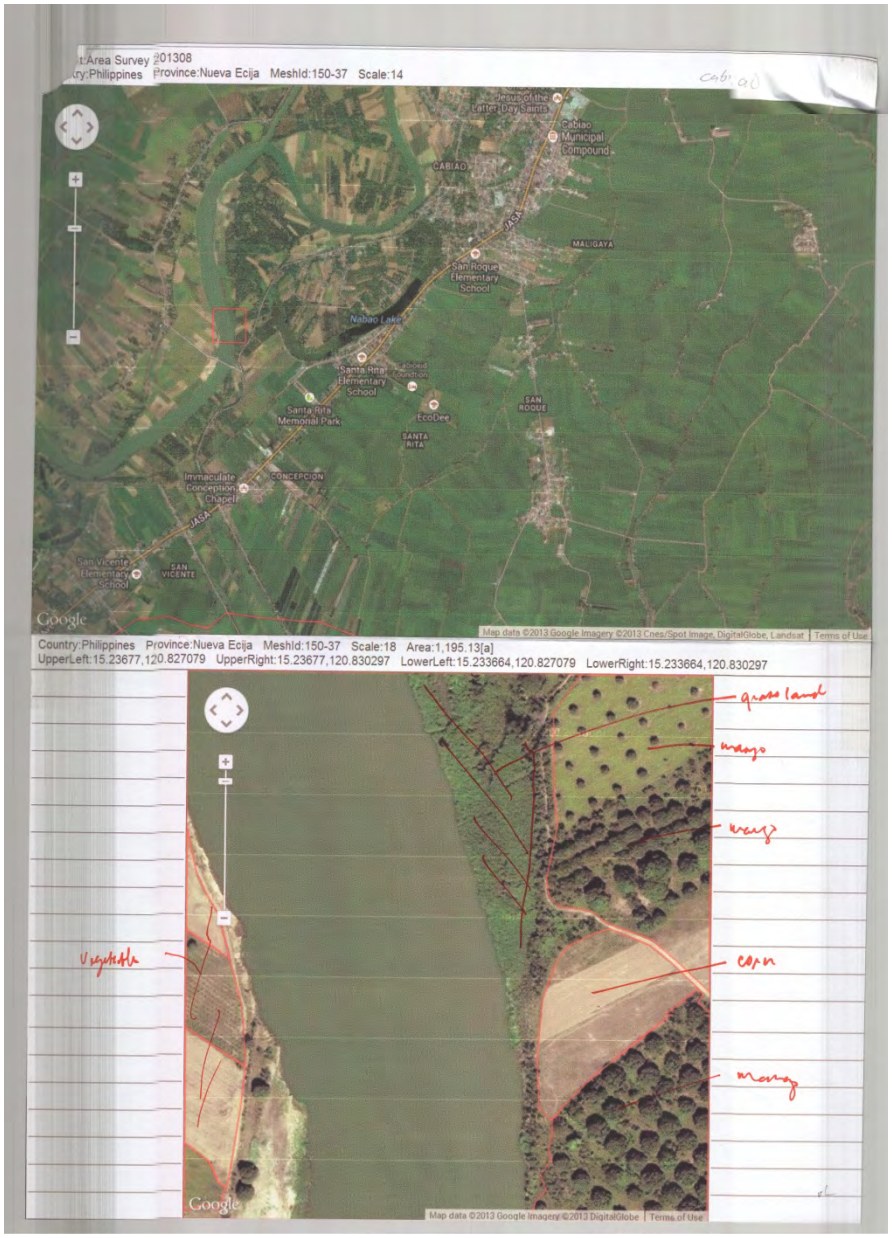
Source: ALIS.

Figure 7: Survey District Map



Source: BAS.

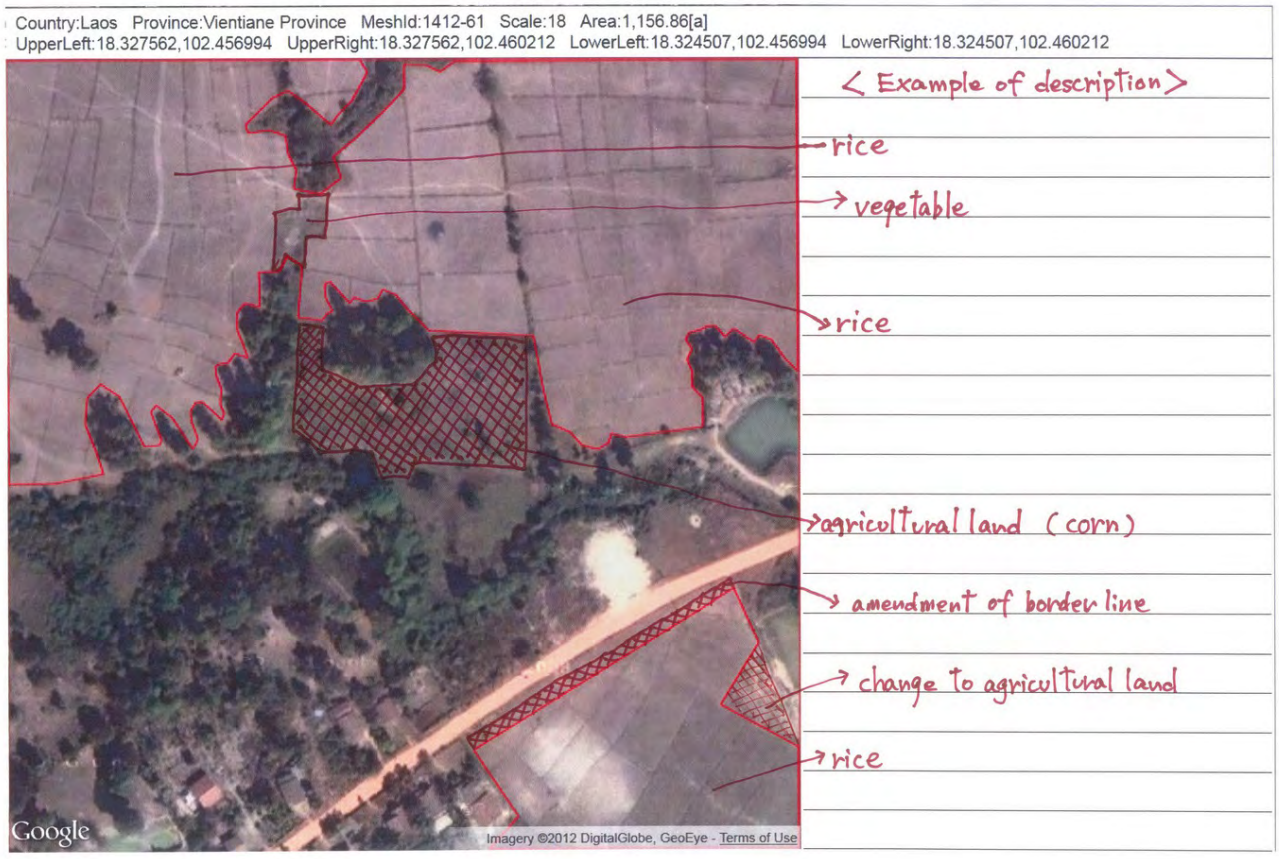
submitted to the regional office with all information from Map A completely transcribed after the survey.

During the survey, the field researchers confirmed the actual topography, crops planted, presence of rivers, road, idle lands, and other infrastructure by visual observation. Borders were drawn to delineate the area planted to a specific crop for those areas with multiple cropping. In cases when visual checking cannot be done, the researchers interviewed the farmers/owners in the area to determine its actual land use.

F. Final estimation of agricultural land area

Based on the result of the field survey and upon completion of the map survey registration in ALIS for the 200 sample meshes, ALIS generated a ratio estimate of the total agricultural land area $\hat{\tau}_{R,agri}$ in the province. Agricultural land area based on measurements from Google map was used as the auxiliary variable. Similarly, estimate of the standard error and the coefficient of variation of $\hat{\tau}_{R,agri}$ were computed.

Figure 8: Survey Sheet



Source: BAS.

Figure 9: Final Agricultural Land Estimates

Estimate Result Sheet | Issue date | Sept. 26, 2013

<<Search Condition>>

Subject	Area Survey 201308
Country	Philippines
Province	Nueva Ecija
Land	Agricultural land
Crop	ALL
ExtractCount	2
Order	Land

<<Agricultural Land Mesh>>

[1]	All Mesh in border line	41,664	mesh	
[2]	All Mesh on border line	9,664	mesh	
[3]	Agricultural Land Mesh in border line	21,525	mesh	
[4]	Agricultural Land Mesh on border line	2,496	mesh	* [4] = ([3] / [1]) * ([2] / 2)
[5]	All Agricultural Land Mesh	24,021	mesh	* [5] = [3] + [4]

<<Sampling Mesh>>

[6]	First sampling	4,928	mesh
[7]	Second sampling	200	mesh

<<Sampling Mesh(uninvestigated)>>

First sampling	0	mesh
Second sampling	0	mesh

<<Agricultural Land Area>>

[8]	First sampling on the monitor	4,545,023.82	a	* Aggregate agricultural land area on the monitor.
[9]	Second sampling on the monitor	184,712.05	a	* Aggregate agricultural land area on the monitor.
[10]	Second sampling in the field	188,126.45	a	* Aggregate agricultural land area in the field.

<<Crop Planted Area>>

[11]	Rice	146,909.72	a
	Cassava	477.87	a
	Maize	277.73	a
	Soybean	0.00	a
	Sugarcane	0.00	a
	Other	40,462.12	a
			a

<<Estimate Agricultural Land Area>>

[12]	Simple Estimate	22,154,224.27	a	* [12] = [8] / [6] * [5]
[13]	Ratio Estimate	22,563,744.83	a	* [13] = [10] / [9] * [12]

<<Estimate Crop Planted Area>>

[14]	Rice	17,644,591.92	a	* [14] = [11] / [7] * [5]
	Cassava	57,394.58	a	
	Maize	33,356.76	a	
	Soybean	0.00	a	
	Sugarcane	0.00	a	
	Other	4,859,702.92	a	
		0.00	a	

1 / 1

Source: ALIS.

To compute the overall accuracy of the estimate, the overall standard error and coefficient of variation were computed. In addition, ALIS generated estimates of total area planted for selected crops including rice, corn, cassava, and others. The standard error and the coefficient of variation for each crop were likewise computed.

To compare the agricultural land area measurements estimated using Google maps vis-à-vis the agricultural land area measurements which were validated from the field, appropriate statistical test for paired samples was done.

4. Results and Discussion

Estimates of total agricultural land area

As shown in Table 1, the total agricultural land area in the province of Nueva Ecija was estimated at 221,542.24 hectares. This was based on agricultural land area measurements estimated using Google maps for the 4,928 meshes selected from 24,021 total meshes created in ALIS. The estimate of total agricultural land area had a standard error of 872.5 hectares and a coefficient of variation of 0.39%. Weighted summary statistics calculated from the sample data are presented in Appendix 3 Table 1.

To evaluate the accuracy of agricultural land area measurements derived using Google maps and ALIS software, 200 meshes from the original sample were randomly selected. From this set of sampled mesh, the initial agricultural land area measurements were either verified or revised based on the researchers' observations in the field.

Table 1: Total Agricultural Land Area Estimates, Province of Nueva Ecija (in hectares)

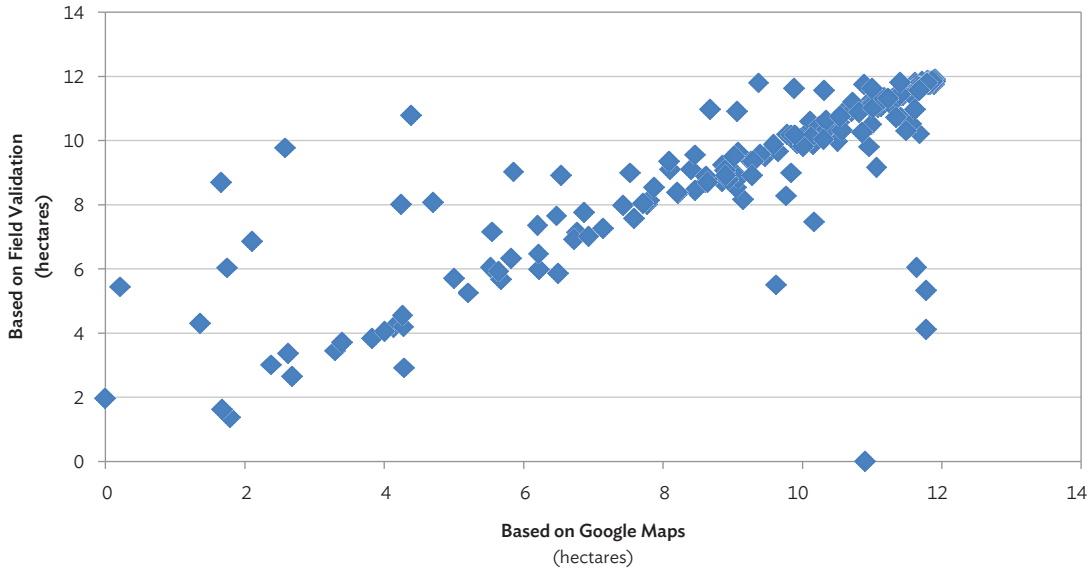
Estimate	Value	Standard Error	Coefficient of Variation	Sample Size
Simple estimate	221,542.24	872.56	0.39%	4,928
Ratio estimate	225,637.45	2,960.24	1.31%	200
Overall measure of precision/variation	3,086.16	1.37%	--	

Source: BAS.

On the other hand, the ratio estimate of total agricultural land area in the province based on data from the 200 sample meshes was 225,637.45 hectares. This has a much higher standard error of 2,960.24 hectares as well as a higher coefficient of variation of 1.31%. However, considering that the size of the first sample is much larger as compared to the number of sample meshes in the second, it is expected that estimates derived from the second sample will have larger standard errors than estimates based on the first sample. As such, the total agricultural land area estimate derived from the first sample seems to be a more reliable estimate than the computed ratio estimate.

A scatterplot of agricultural area measurements from the second sample based on Google maps and the field survey is shown in Figure 1. It shows

Figure 10: Scatterplot of Agricultural Land Area Measurements from Google Maps and Field Validation



Sources: ADB, BAS.

that, although, there is a linear relationship between the agricultural land area measurements from Google maps and the field survey, there were several points wherein large differences between the two measurements were observed. A statistical test comparing data from the paired-samples was then applied to determine if there are significant differences in the agricultural land area measurements derived using the two processes.

Upon testing for normality of the populations from which the samples were taken, as well as the assumption of normality of the differences in the agricultural land area measurements from the two samples, a nonparametric test, the Wilcoxon signed-rank test was done. Results of the normality tests and the Wilcoxon signed-rank test are presented in Appendix 3, Tables 2 and 3, respectively.

Results of the test for differences in agricultural land area measurements based on Google maps and the field survey show that there were significant differences in the measurements derived using the two processes. This implies that measurements of agricultural land areas which are estimated solely based on Google maps differ from the actual agricultural land areas as validated during the field survey. On the average, agricultural land area measurements estimated using Google maps were lower by 0.17 hectares per mesh, as shown in Appendix 3, Table 1. In addition, the total agricultural land area estimated from Google maps differed from area measurements validated in the field by 4,102 hectares, which is only 2% lower than the field-validated total agricultural land area.

Although there were differences noted in the agricultural land area measurements obtained using Google maps vis-à-vis land area measurements that were validated from the field, the differences may be considered acceptable. Hence, the estimate derived from the first sample can be considered a reliable estimate of the total agricultural land area in the province.

Estimates of crop planted areas

Crop planted areas in the province were also estimated for selected crops based on data from the field survey, which was concluded before the end of Q3 2013. Table 2 shows a summary of the estimates of areas planted with rice, maize, cassava, and other crops in the province of Nueva Ecija. Almost 80% of the total agricultural land area in the province was planted with rice, with an estimated planted area of 176,445.92 hectares. Compared with available data on harvested areas from BAS (Appendix 3 Table 4), rice area harvested in the province comprised more than 87% of the total crop harvested areas. Total rice area harvested reached 155,275.00 hectares up to end of Q3 2012 while area harvested with maize reached 6,141.00 hectares during the same period.

Table 2: Crop Planted Area Estimates by Type of Crop, Province of Nueva Ecija (in hectares)

Type of Crop	Value	Share (%)	Standard Error	Coefficient of Variation
Rice	176,445.92	78.09	7,015.47	3.98
Maize	333.57	0.15	225.74	67.68
Cassava	573.95	0.25	430.57	75.02
Others	48,597.03	21.51	5,833.48	12.00

Source: BAS.

Despite comparing the estimated planted areas (based on the conducted field survey) with the data on harvested areas from BAS, it is evident that there is a large difference in the figures pertaining to maize. The estimate of area planted with maize is only 333.57 hectares based on the field survey. However, with a very high coefficient of variation of 67.68%, the crop planted area estimate for maize may not be reliable, similarly for cassava, with a coefficient of variation of 75%. Furthermore, the high coefficients of variation of the planted area estimates for the two crops can be attributed to very few sampled meshes planted with maize and cassava. In general, only the estimate for rice planted areas in the province can be considered reliable with a coefficient of variation of only 4%.

5. Conclusion and Recommendations

An estimate of the total agricultural land area can be derived using ALIS. There are some noted differences in the agricultural land area estimates from Google maps as applied in ALIS and the field survey. Only the estimate for rice planted areas in the province of Nueva Ecija can be considered reliable since the estimate of areas planted to other crops varies considerably. There is certainly a need to further study and improve the use of remote sensing technologies in the country in generating official agricultural statistics, specifically, agricultural land area estimates.

The software design should allow for stratified simple random sampling (SRS) of meshes so that areas planted to other crops can be better estimated. Instead of classifying meshes as agricultural vs. non-agricultural, classification of meshes can be according to types of crops. This will ensure that crops are well-represented and have a better estimate of the planted areas per crop. The software should also be open to inputs from data sources other than Google Earth.

Another round of field validation may be conducted in the pilot province to further assess the level of accuracy of the agricultural land area measurements derived using Google maps by applying the same system in ALIS during another cropping season. The same system may also be applied in other areas to evaluate how effective the system is in estimating total agricultural land areas in other provinces.

Appendix 1: Mesh Classification Guidelines

a. Areas considered as agricultural include:
   - Areas with images of vegetation
   - Areas planted with permanent crops
   - Vacant lot/idle lands (burnt surrounding areas should be considered in classifying the area as agricultural); such areas should be validated in the field survey. This means the information will only be reflected in the meshes included in the second sample.

b. Areas not included as agricultural include:
   - Burnt areas in the forest
   - Household gardens
   - Areas on the map covered by clouds

c. Check with regional/provincial officers in cases when there are areas on the maps that are difficult to classify.

Appendix 2: Team and Mesh Assignments of BAS Personnel

Team No.	Members	Mesh Location
1	Rodrigo N. Labuguen (CO) Juliet Perez (CO) Rey Versula (OC)	Cabiao, San Isidro, Gapan City, San Antonio, Jaen
2	Sharon Rose Estrella (CO) Bernabe Mauyao (OC)	Rizal, Llanera, Pantabangan, San Jose City, Zaragosa, Portion of Sta. Rosa
3	Necita De Guzman (CO) Damaso del Rosario (CO) Isabelita Gamboa (OC)	Cabanatuan City, Aliaga, Gen. M. Trinidad, Talavera
4	Dionisio de Vera (CO) Mary Ann Alcachupas (CO) Girlie de Guzman(OC)	Bongabon, Laur, Gen. Tinio, Peñaranda, Gabaldon, Portion of Sta. Rosa, Palayan City, San Leonardo
5	Nelson Lagniton (CO) Saturly Sovenorio (CO) Priscillano Jove, Jr. (OC)	Muñoz, Talugtog, Lupao, Carrangalan
6	Jessica Astovesto (CO) Jonabel Yu (OC) Aurea Bernardino (OC)	Sto. Domingo, Licab, Quezon, Cuyapo, Nampicuan, Guimba, Sta. Rosa

CO – Central Office
OC – Operation Center

Appendix 3: Statistical Tables

Table 1: Agricultural Land Area Measurements Summary Statistics

Indicator	First Sample (Google Map)	Second Sample		
		Google Map	Field Survey	Difference, d_i
Sample size	4,928	200	200	200
Mean	9.22	9.24	9.41	-0.17
Sum	221,542.21	221,848.32	225,949.27	-4,100.95
Standard deviation	6.31	31.98	28.69	18.90
Variance	39.88	1,022.71	823.33	357.23

Table 2: Test for Normality

Measurement Process	Test Statistic, W*	p-Value
ALIS using Google Maps	0.827184	<0.0001
Field Survey	0.846084	<0.0001
Difference, d_i	0.626106	<0.0001

Note: * – Refers to the Shapiro-Wilk test statistic.

Table 3: Test for Differences in Agricultural Land Area Measurements

Test	Test Statistic, S*	p-Value
Signed Rank	-2516.5	<.0001

Note: * – Refers to the Wilcoxon signed rank test statistic.

Table 4: Area Harvested by Crop Type and Period, Province of Nueva Ecija, 2012

Type of Crop	Period						Annual	Share (%)
	Quarter 1	Quarter 2	Semester 1	Quarter 3	Quarter 4	Semester 2		
Palay (Rice)	23,720.0	103,925.0	127,645.0	27,630.0	148,914.0	176,544.0	304,189.0	87.6
Corn	2,091.0	1,818.0	3,909.0	2,232.0	262.0	2,494.0	6,403.0	1.8
Cassava	...	...	...	...	...	...	84.0	0.0
Others	...	...	...	...	...	...	36,733.5	10.6
Total	**...**	**...**	**...**	**...**	**...**	**...**	**347,409.5**	**100.0**

Source: Bureau of Agricultural Statistics. http://countrystat.bas.gov.ph (accessed 28 September 2013).

References

ALIS Operation Manual

Kimura, S. 2012. Use of Agricultural Land Information System (ALIS) to Support Sampling Area Survey. Food and Agriculture Organization: Presentation at the 24th Session of the Asia Pacific Commission on Agricultural Statistics. Bangkok, Thailand.

Martinez, L. I. 2013. Improving the Use of GPS, GIS and RS for Setting Up a Master Sampling Frame. Food and Agriculture Organization http://www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/GS_SAC_2013/Improved_methodologies_for_master_sampling_frames/Improving_the_use_of_GPS__GIS_and_RS_for_setting_up_a_master_sampling_frame_Lit_review.pdf (accessed 23 September 2013).

Narain, P. 2002. Estimation of Crop Yields Revisited. National Statistical Commission. New Delhi, India http://www.isas.org.in/jsp/volume/vol55/issue3/Prem%20Narian%20.pdf (accessed 19 September 2013).

STUDY VI
Designing a Livestock Probability Sample Survey for Viet Nam

1. Introduction and Background[1]

The agriculture sector provided employment to about 49% of workers in Viet Nam and contributed 19% to the gross domestic product on the average from 2009-2013. Despite its importance though, it had the lowest productivity compared to the services and industry sectors.

The country is reported to have attained the Millennium Development Goal (MDG) to halve poverty incidence earlier than the target 2015 MDG milestone. However, poverty in the rural areas, where agriculture is the main source of livelihood is still significantly higher than in the urban areas, with 36% and 19% classified as poor in 2002 and 2008 in the former and only 7% and 3% of the urban population, poor for the same years. Hence, the Socioeconomic Development Plan, 2011-2015 of the government promotes agriculture as an engine of growth and poverty reduction has become a priority for Viet Nam. Moreover, greater focus and in-depth study on the development of the sector will also enable the country to manage its resources sustainably and achieve food security.

The government recognizes that sound and timely agricultural and rural statistics are needed to craft policies that will promote agriculture as an engine of growth, manage and allocate resources. Both the foremost official agricultural and rural data producers -- General Statistics Office (GSO) and the Ministry of Agriculture for Rural Development (MARD) have been actively pursuing activities that can improve the quality of agricultural and rural statistics (GSO and MARD, 2013). For example, to support the implementation of the Global Strategy for Improving Agricultural and Rural Statistics in Asia and the Pacific, the GSO and the Center for Informatics and Statistics (CIS), MARD collaborated with ADB under a regional policy advocacy technical assistance project to enhance the coverage and quality of agricultural and rural statistics for data intensive analysis and monitoring of policies on food security in the region. The project assisted some countries, including Viet Nam, in developing their own country action plans. The current situation and issues in the compilation of agricultural statistics in Viet Nam were identified and extensively discussed in the November 2012 stakeholders' workshop, which GSO and CIS jointly organized.

The discussions in the stakeholders' workshop became inputs in the country action plan that was reviewed in a high level meeting that was attended by the top management of both GSO and MARD. One of the key activities identified in the country action plan is the adoption of adequate and appropriate data collection methods. In line with this thrust, this paper describes a methodological study on designing a livestock probability sample survey that was jointly undertaken by GSO and CIS with the ADB project team. The next section describes the current agricultural data collection system in Viet Nam with emphasis on the existing livestock survey that GSO conducts. Section 3 presents the overview of the proposed sampling strategy, while Section 4 describes in detail the methodology. The last section provides the conclusion and recommendations based on the results of the study. Statistical tables are presented in the appendix.

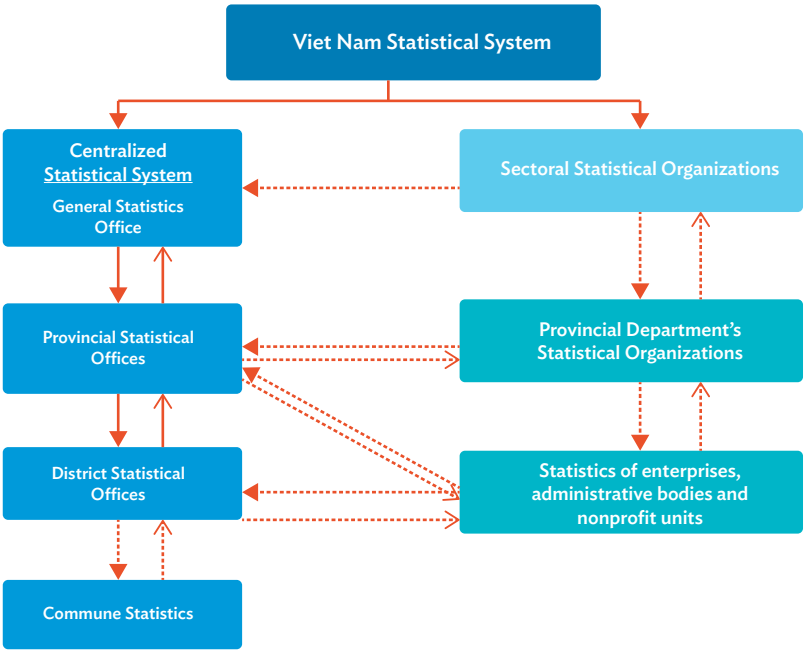
1 This paper was drafted with inputs from a series of training workshops jointly organized by the General Statistics Office and the Ministry of Agriculture and Rural Development under the Asian Development Bank's regional policy advisory technical assistance on improving agriculture and rural statistics for food security in 2014-2015.

2. Viet Nam's Agricultural Statistical System

At present, Viet Nam's national statistical system has a vertical and a horizontal component. The structural organization is shown in Figure 1. The central statistics organization, the GSO, under the Ministry of Planning and Investment comprise the vertical component while the statistical units of ministries and other government agencies that are responsible for the implementation of statistics work according to regulations of the Statistics Law consist of the horizontal component. The GSO is responsible for all the national statistical services. It is vertically organized from central to local administrative levels, ensuring the principle of centralization and unity. At GSO's headquarters central level, there are 16 administrative units including the Agriculture, Forestry and Fishery Statistics Department (DAFF) and nine nonprofit units including the Institute of Statistics Science, College of Statistics. There are 63 provincial statistical offices (PSOs) at the provincial level and 698 District Statistical Offices (DSOs) at the district level. The adjective 'vertical' organization describes the fact that the agency has 6,300 personnel under its administrative, financial and technical control that are distributed from the center, to the provinces, and to the districts. The GSO employs this large cadre to conduct the censuses (population and housing for years ending in 9, agriculture census for years ending in 1 and 6, and economic census for years ending in 2 and 7) and nationwide sample surveys—including agricultural and fishery surveys. Examples of the latter are crops, livestock and fishery surveys conducted two to three times a year. Of GSO's 6,300 personnel, 1,700 are in DAFF.

The DAFF is responsible for collecting, processing and releasing agricultural statistical data. The information provided is used to formulate and monitor the development plans of the agricultural sector. It conducts the Rural, Agricultural, and Fishery Census (RAFC) every five years. Four censuses were conducted in Viet Nam—in 1994, 2001, 2006, and 2011. All the censuses have been conducted with entirely government funding.

Figure 1: Viet Nam's Statistical System's Organization Structure



Source: General Statistics Office.

The census is designed to collect basic information relating to the rural areas, agriculture and fishery with a view to formulate plans, policies and strategies for socioeconomic development for the whole country as well as for each locality. The results serve as the basis for assessing the implementation of some items in the national rural and agricultural programs.

In addition to the RAFC, DAFF also conducts sample surveys on agricultural, livestock, and fishery production. Pertinent details regarding these surveys and the census are summarized in Table 1. Crop yield and production surveys are conducted three times a year, while livestock and fishery surveys are conducted twice annually. The domain of all the surveys is the districts while the ultimate sampling units are either communes, villages, or households. The sample sizes are quite large ranging from almost 10,000 households during the winter season to more than 240,000 households during summer. Most of the questionnaires, however, are quite short with only one page for rice production survey and six pages for the agricultural crop area survey.

Although statistical activities of the MARD are regarded as data/information collection for its own purposes, MARD uses the results of the annual crop production surveys conducted by GSO in planning its activities. On the other hand, MARD supplies data on the production situation of agricultural commodities, industry, trade, population, labor, and other information related to agriculture to the relevant departments of GSO.

The CIS under MARD is the focal point that implements all statistics activities in the agricultural sector. Statisticians of different units of MARD including those under the provincial Department of Agricultural and Rural Development (DARD) and agricultural division of each district have to report to CIS. The organizational structures of these province and district level offices are subsets of the central office of MARD.

The agricultural and rural surveys that are being undertaken by CIS, MARD are summarized in Table 2. The domain of these surveys is national except for the survey on stocks of agricultural, fisheries and forestry products in which the domain is two

Table 1: Summary of Agricultural and Rural Surveys Conducted by GSO

Name of Survey	Sample Size	Domain	No. of pages	Major data items
Agricultural crop area survey	1. Winter season: 4,498 sample communes	District	6	Area planted
	2. Winter spring season: 83,500 sample villages			
	3. Summer autumn season: 31,000 sample villages			
	4. Autumn winter season: 4,550 sample villages			
	5. Autumn season: 83,500 sample villages			
	6. Perennial crop area: 84,000 sample villages			
Rice production, yield survey	1. Winter spring season: 100,000 sample households (HHs)	District	1	Area, production
	2. Summer autumn season: 45,800 HHs			
	3. Autumn winter season: 9,900 HHs			
	4. Autumn season: 85,050 HHs			
Other annual crop production, yield survey	1. Annual crop survey: 191,000 HHs	District	1	Area, production
	2. Winter crop survey: 35,900 HHs			
Perennial crop production, yield survey	172,800 HHs	District	2	Area, production
Livestock survey	at time point: - January 1st : 50,800 HHs	District	2	Pigs, poultry
	- April 1st: 142,000 HHs			
	- July 1st: 50,800 HHs			
	- October 1st: 234,700 HHs			Pigs, poultry, cow, buffaloes
Fishery survey	at time point: - May 1st: 64,500 HHs	District	1	Fish, shrimp,
	- November 1st: 120,700 HHs			
Rural, agricultural and fishery census	Household questionnaire 16.15 million households	Village	8	Employment, qualification, area, number of head of livestock
	Farm questionnaire: 20,028 farms	District	8	Employment, revenue
	Commune questionnaire 9,073 communes	District	12	Infrastructure of commune
Rural household economy questionnaire	75,000 households	District	16	Savings, credit access

Source: DAFF, GSO, correspondence with the ADB project team, 2013.

Table 2: Summary of Agricultural and Rural Surveys Conducted by CIS, MARD

Name of Survey	Frequency	Sample Size	Domain	No. of pages	Major data items
Survey on cost production of some main agricultural-forestry-fishery products	2 years				Cost production of coffee; rubber; tea; cashew; pepper; pork; chicken; beef; sugpo prawn; basa fish; wood
Survey on access levels to technical services in agriculture, forestry and fisheries production	2 years	4850	National	9	Scale, providing type, quality, cost price of the machinery, extension service, fertilizers, plant protection products, market price information
Survey on application of advanced technology in agriculture, forestry and fisheries production	2 years				Scientific and technological advances are applied: scale, type, cost, quality
Survey on inhabitant settlement and arrangement	2 years	4315		9	Population, household scale, infrastructure, investment, production, services
Survey on the structure, fluctuations, production and consumption methods of livestock products	2 years	4680	National	4	Breeding structure of pig, cattle, poultry; slaughter weight
Survey on forest area and reserves (through the census)	5 years				Forest area, forest structure, forest coverage
Survey on methods and organization of aquaculture production	2 years	4665	National	6	Area, yield of primary aquaculture species, aquaculture method, size of breeding and harvesting, time of breeding
Survey on fishing capacity	2 years	3262	National	5	Number of vessels and structures according to capacity and types of fishing, number of vessels operating monthly, average yield according to type of vessel, number of fishing port and its capacity
Survey on rural craft-villages	2 years	3477	National	9	Number of household, number of laborer in villages, output value per laborer, average income per laborer, environmental data, materials and supply situation data
Survey on agro-forestry-fisheries processing	2 years	380	National	8	Scale and capacity of the processing base, processed mass of each type according to VN standard
Survey on capacity of testing the quality standards and food safety in agriculture, forestry and fishery	2 years	350	National	50	Number of testing laboratories, capacity of analysis, human resources
Survey on stocks of agricultural, fisheries and forestry products	2 years	2700	2 areas	5	Amount of agricultural products, forestry products, seafood products stored in local people, business enterprises, processing enterprises
Survey on consumption of some agricultural, fisheries and forestry products and materials in agriculture production	2 years	5200	National	4	Mass consumption of local people, for production purpose, mass of materials (fertilizer, pesticides, electricity)
Survey on management, mining and using irrigation works	2 years	1902	National	6	Real efficiency of the irrigation works compared with designed efficiency, operation cost of the irrigation works, level to meet the irrigation requirements

Source: CIS, MARD, correspondence with the ADB project team, 2013.

specific areas. The CIS conducts their surveys every two years with smaller sample sizes compared to those conducted by DAFF, GSO. The questionnaires, however, are longer.

Unlike GSO, CIS does not have its own personnel in the provinces and districts whose main job descriptions are full time basic data collection; instead, it has one or more staff in each of the 597 districts working part time on data collection. CIS's organization does not have the capacity to plan, conduct and analyze large sample surveys. Therefore, CIS relies on the staff of local government units to collect and compile data from administrative reports or reports from key informants. These reports are summarized progressively up the administrative chain as reflected in Figure 1. Presumably, the data collections are mainly for operational, monitoring and forecasting requirements of MARD, hence, have little redundancy with GSO collections in the agriculture sector.

From discussions in the various training workshops[2] that both DAFF, GSO and CIS, MARD organized to improve their respective agricultural data collection methodology, it was noted that the survey operation processes they are implementing still follow the administrative reporting system in which data collected at the household level are processed and summarized, first at the village level and forwarded to the commune level. The village summary statistics are then summarized by the communes and forwarded to the district level, then

2 GSO and CIS, MARD jointly organized four training workshops from 2014 to 2015: (i) Basic Course on Sample Survey Concepts and Analysis, 10-13 February 2014; (ii) Intermediate Course on Probability Sample Survey, 3-7 March 2014; (iii) Workshop on Designing Survey Instruments and Planning Survey Operations, 13-16 October 2014; and (iv) Workshop on Questionnaire Design and on Survey Operations Planning and Budgeting, 5-9 January 2015.

to the provincial level and finally, the national level as indicated in the organizational structure in Figure 1. Hence, data that are kept at the national level are only those that come from the provinces and possibly, the district level.

The work flow described above digresses from the standard survey operations and data processing protocols in which even if the validation and processing of surveys is decentralized to the field offices, the micro data are consolidated in the central office and are analyzed collectively. On the other hand, GSO only collects summary data derived from their surveys from the district offices. These summary data are consolidated in the central office. Hence, more in-depth analysis at various disaggregation levels is not possible. Computations of sampling errors of major characteristics of interest, design effects and intra-class correlations for assessing the quality of survey estimates and which can also be used for planning the next survey rounds are also not possible.

It is worth noting that an important source of inaccuracy or more precisely, bias in the official statistics, which came out several times in the lively discussions in the stakeholders' workshop is subjective intervention. This pertains to the tendency of political leaderships, particularly at the local government levels, to subject the statistics to their assessment and review, hence possible revision. While the sectoral indicators coming from the ministries are more susceptible to this type of bias, it was noted that not even the indicators from sample surveys are immune from these subjective revisions. All the participants in the workshop agreed that it has significant but immeasurable effect on the quality of agricultural statistics.

To better understand the compilation of agricultural survey data and the effects of the subjective intervention so that changes in the methodology can be implemented to improve the quality of agricultural and rural statistics that are being produced, a closer look at the current livestock survey processes was undertaken, the highlights of which are presented in the next section. The inputs in the discussion in the next section are the information provided by DAFF, GSO to the ADB project team and those that were reported during the training workshops organized by DAFF, GSO and CIS, MARD.

3. The Current Livestock Survey

GSO Livestock Survey

The GSO Livestock Survey (GLS) collects livestock production data from various units that raise livestock – from the urban and rural households and farm enterprises. The DAFF, GSO consolidates data from RAFC and other information from the district statistics offices that coordinate closely with the officers in the communes in order to collect information and make the following lists:

a. List of farms, undersized farms engaged in raising pig and poultry are made 2 times yearly, before the 1st April and 1st October surveys are done. The list of pig and poultry is separate.
b. List of rural households engaged in raising pig and poultry are made 2 times yearly, before the 1st April and 1st October surveys are done. This list is used to calculate the rate of households engaged in raising pig or poultry of all sample villages.
c. List of urban households engaged in raising pig and poultry are made 2 times yearly, before the 1st April and 1st October surveys are done. In urban areas, each ward or group according to geographic location is required to make a list of households engaged in raising pig and poultry.

The province is considered the domain of the survey, contrary to the summary in Table 1 in which district is declared to be the domain. To select sample villages, all districts in a province are considered as strata. From each stratum or district, a sample of villages is selected systematically. Prior to data collection, a list of households raising livestock in the sampled village is prepared by the village head. According to GSO, the office allocates some funds in the preparation of such lists. From this list, a random sample of households (about 20) is selected.

The one-page GLS questionnaire consists of data items only on livestock production (i.e. number of heads, number sold, type of breeds, consumed by the households, etc.). To develop this questionnaire, GSO consults with the subject matter specialist at the Department of Agriculture of GSO and also iteratively sends the draft questionnaire to field offices for further comments until it is finalized.

To collect data, enumerators visit the heads of household/farm (or person who has good understanding of the situation[3]), observe and count heads of livestock and then fill out the questionnaire. Most of the enumerators are existing personnel from both the Agriculture Office and Statistics Office at the provincial and district level. The supervisors are the statisticians in the sampled communes (group of villages).

The completed questionnaires are processed at the district/province statistics office using CSPro, a data entry software developed by the United States Bureau of Census. The district statistics offices then transmit the data file to the provincial offices in which the data files are consolidated and summarized for final transmission to GSO within one month of data collection.

Provincial offices summarize the data using the following guidelines:

- Separate frequency distributions of units owning specific animals (pigs, poultry, etc.) should be presented for each type of units (enterprise, cooperatives, farms, undersized farms, households) and administrative area level (district, province, country).

3 During the discussions in training workshops mentioned above, other topics or questions were raised on the appropriate respondent for the forthcoming fisheries and aquaculture surveys in which only village heads or commune leaders will be the main respondents. The workshop participants agreed after lively discussions that there are specific items that possibly the village or commune head may not be able to provide accurate information. Hence, it would be more appropriate for the household head or the person in the household who is knowledgeable about the specific activity to be the main respondent.

- Frequency distribution for households raising pigs should be across the following groups: (i) households that own under 10 heads; (ii) households that own 10-19 heads; and (iii) households that have 20-29 heads. For poultry, the following are the groupings: households with poultry (i) under 50 heads; (ii) 50-499 heads; and (iii) 500-999 heads. For other types of fowls, there are two groups: households raising (i) under 1000 heads; and (ii) 1000-9999 heads.
- To calculate the number of heads of a specific animal by size of the unit raising the animal, the following formulas[4] are used:

$$\text{Number of heads of specific animal at survey time} = \text{Average number of heads of specific animal of samples at survey time (a)} \times \text{Total number of units keeping specific animal at survey time (b)} \quad (1)$$

where (a) is computed as the average of the number of heads of a specific animal being raised by sampled units (households, or farms or enterprises).

- The total number of units that are raising a specific animal at survey time will be calculated as follows:
  - For undersized farms, cooperatives and farm enterprises, complete enumeration is done since the list is quite comprehensive. The total number of undersized farms is the total count of the units. However, since undersized farms will be listed only two times while estimates will be reported every quarter, the total counts for 1st January report will be the same as that of the 1st October count while the total count for the 1st July report will be the same as the 1st April count.
  - For households in the rural areas, the formula used is:

$$\text{Total number of HHs in rural areas that are raising a specific animal at survey time} = \text{Total number of HHs in rural areas at survey time} \times \text{Rate of number of sample HHs which are raising a specific animal at survey time (\%) (b)} \quad (2)$$

where b is computed as the percentage of households in the sample that are raising a specific animal.

After the estimation of indicators is done at the provincial level, the results are reviewed through a process of consultations with heads of communes and key informants to validate the results. The GSO does not compute sampling errors for the agricultural and rural surveys that it conducts.

CIS, MARD Livestock Survey

The CIS, MARD also conducts a Livestock Survey (CLS) which covers only 12 provinces as recommended by an "expert" group from the MARD Livestock Department. In each province, a sample of three communes is selected using the results of the RAFC 2012. One commune is randomly selected from three groups defined by the number of livestock raisers (high, medium, low). The selected communes are reviewed by subject matter specialists.

In each sample commune, three villages are selected either randomly or as suggested by the subject matter experts. In each sampled village, a list of livestock growers is prepared based on interviews with the village head. From this list, a sample of households is systematically selected.

The questionnaire is developed through a series of consultation meetings between the Livestock Department and CIS.

Provincial staff of the DAFF the communes' animal health officer acts as enumerators and supervisors. The CIS staff conducts spot checks for about 3% of the sample households to verify if the interview really took place and to validate the given responses.

4 These formulas were taken verbatim from the technical documentation on the current livestock survey design *Issued with Decision no. 882/QĐ-TCTK dated August 28th 2013 of General Director of General Statistic Office.*

All the completed questionnaires are processed, validated and analyzed in the CIS, MARD office. Questionnaires with suspect data are sent back to the field for validation and verification. The CIS, MARD uses the same formulas (1) and (2) that GSO uses for computing indicators. Survey weights are not computed and incorporated in the estimation process. Similar to GSO, sampling errors are also not computed.

4. Proposed Activities for Improving the Data Collection Methodology

The study of the two livestock surveys in the previous section showed the desire of both DAFF, GSO and CIS, MARD to improve the quality of agricultural and rural statistics. Both institutions have opted to use sample surveys to supplement the traditional administrative reporting systems for compiling agricultural and rural statistics. To contribute to this driving force for improving agricultural and rural statistics, the following activities and/or changes in the current methodology are being proposed:

- Streamline the sampling design to reduce measurement errors and achieve an effective survey operation. For GLS, which is administered by GSO quarterly, the total sample size ranges from about 50,000 to more than 240,000. In general, larger sample size reduces sampling errors but without very well trained enumerators, supervisors and data processors, nonsampling errors are also magnified. Unlike sampling errors, nonsampling errors cannot be measured. These can only be controlled by carefully implementing mechanisms including intensive training of enumerators and supervisors, application of uniform and consistent definitions and concepts, use of appropriate and accurate sampling frame and incorporating checks and balances in the survey operations. These mechanisms are better applied and monitored if the sample size is kept to a manageable level. Moreover, the participants in the above mentioned training workshops agreed that sampling design should be kept simple so that it can be easily implemented and reviewed. Corresponding estimators should be made simple.
- One common observation for both GLS and CLS is that survey weights are not used to derive the estimates of population parameters. The inclusion of the inverse of the selection probability of an ultimate sampling unit as a multiplier to the value of a characteristic of interest is necessary to derive standard unbiased estimators. In both surveys, the survey weights are not computed and incorporated; hence, the tacit assumption that all population units are given equal selection probabilities. However, this may not be possible, given that the number of households cannot be uniform across all villages in a domain.
- The new sampling design can be developed such that it will render equal probability of selection across all sampling units, and hence, eliminating the use of at least the base survey weight (equals the inverse of selection probability).
- One positive change that was instituted in GLS is to set the provinces as reporting domains instead of districts. If the sampling design is streamlined and appropriate techniques are implemented, then the total sample size will be greatly reduced and consequently, measurement errors will also be reduced.
- Design a questionnaire that will allow compilation of official indicators as well as support for data-intensive policy analysis. In general, a well-designed survey is not inexpensive to implement. Hence, to make it more cost effective, its usage should be extended. This can be done by ensuring those data items that are relevant in analyzing critical and current issues and those that are needed for resource allocation and informed interventions are included. In the case of livestock surveys, additional data items like breed, relevant husbandry practices, uses of livestock product (for market, consumption, breeding) to name a few should be considered for inclusion in the questionnaire. Ultimately, the decision of what data items to include should be with the survey

data owners but it is a prudent approach to consult with data users, similar to the practice that CIS, MARD has implemented. Other countries like Indonesia, the Philippines, and Thailand consult not only their major users in government but also those in the private sector and the academe.

- Well-tested principles on questionnaire design like keeping the questions and choices simple and clear should be observed in translating the final data items to questions. Standard definitions and concepts should be applied. Moreover, skipping patterns and sequencing of questions should be studied carefully to eliminate confusion and improve interview flow. Lastly, the draft questionnaire should be pretested and the results should be examined to further enhance the efficacy of the questionnaire.
- It will also be a good collaborative activity for CIS, MARD and DAFF, GSO to consolidate their respective livestock surveys into one comprehensive survey to reduce duplication of efforts and ensure consistent estimates and analysis between the two major agricultural data producers.
- Draw up a survey operations plan that will control for nonsampling errors and will implement the probability sampling design well. Enumerators, supervisors and data processors should be trained on the objective of the survey, uses of data derived from the survey, definitions and concepts that are applied in the questionnaire, implementation of the sampling design and their respective roles and responsibilities. The intensive training will enable them to undertake their responsibilities and avoid possible measurement errors.
- While the selection of all primary sampling units is usually done at the central office, the selection of ultimate sampling units can be done in the field. In the case of GLS, the commune statisticians select the households from a list that have been drawn with the assistance of the village heads. If this approach is continued to be practiced, it will be prudent to write a detailed procedure that the commune statisticians can follow. This procedure should also be part of the training of enumerators and supervisors. As a check, the commune statisticians should be enjoined to send back to GSO the list of households that they selected and also, the comprehensive list of households from which the sample was drawn. The list of sampled households can then be compared to the processed and validated survey data files that GSO will also receive from the provincial offices as another form of data validation – completeness checks. To check if the target selection probability has been properly applied, the ratio of total number of sample households and the total number of eligible households should equal the target selection probability.
- It is necessary that the basic principle of probability sampling to ensure that all eligible population units are given a chance of being selected in the sample is properly applied. If it is so, then the statistics derived from the sample can be generalized for the whole population and conclusions resulting from inferential analysis on the sample will also apply for the whole population. If the implementation of this basic principle is flawed, then the estimates derived from the sample are not representative of the whole population.
- Designated supervisors should observe some of the interviews that the enumerators in his/her group are doing to check if they follow the survey operations guidelines. They should also examine the completed questionnaires for possible data inconsistencies and/or incomplete or missing data items.
- In addition to the manual edits that are usually done by supervisors, there are data entry software applications that allow automated data validation checks and that generate data validation reports. CSPro, the data entry software that GSO uses, has this feature. The

GSO should use this feature extensively so that data files are validated well. To maintain consistency across provincial or district data processing centers, a standard data entry program should be developed and tested before it is deployed to all the data processing centers.

- Other cost effective measures must be studied for implementation. In GLS, most of the comprehensive lists of eligible population units (farm enterprises, undersized farms, cooperatives, households) are constructed every survey round. While the approach taken is perceived to be economical with village heads providing the lists, it may not yield accurate comprehensive lists. A mechanism to vet the list should be put in place to upgrade the reliability of the lists, which in standard survey parlance, are actually the sampling frames.
- For sampling households, there are two sampling frames needed. The sampling frames of villages can be drawn from the RAFC 2012. The list of households can be done through listing operations only on villages in the sample. Listing all households for all villages is not necessary.
- If the number of trained enumerators and supervisors is not adequate, the survey period can be expanded over three months of a quarter. This means that primary sampling units (PSUs) in the sample can be randomly assigned into three almost equal groups such that only one group will be enumerated in a month. This approach spreads the work load of enumerators and supervisors over a quarter and reduces the demand for more enumerators and supervisors. The choice and recruitment of better enumerators and supervisors will be more likely.
- The list of farm enterprises is usually drawn from registration of enterprises. The undersized farms, however, may not be registered. If this is so, the list of undersized farms can also be drawn from selected villages, assuming that undersized farms do not straddle in more than one village. This idea can be verified with the administrative reporting hierarchy. If applicable, the sampling scheme for undersized farms will be similar to those for households. Listing operations for these two types of units do not have to be done independently to save costs.
- Unbiased estimators should be used in deriving indicators and in inferential analysis. This requires the use of survey weights. That is, for a given domain with H PSUs, the total and mean of a characteristic of interest, X, are computed, respectively as:

$$x = \sum_{h=1}^{H} \sum_{i=1}^{n_h} w_{hi} x_{hi}$$

$$\bar{x} = \frac{\sum_{h=1}^{H} \sum_{i=1}^{n_h} w_{hi} x_{hi}}{\sum_{h=1}^{H} \sum_{i=1}^{n_h} w_{hi}}$$

where w_{hi} is the survey weight, x_{hi} is the observed value of X for the i^{th} sampled unit and h^{th} PSU, and n_h is the sample size for the h^{th} PSU. These formulas will be simplified if the selection probabilities across all sampled units in a given domain are uniform, say n/N where n is the total sample size and N is the total population units in the given domain, in which case, w_{hi} will be constant. Therefore, the sample mean defined above will become a simple average or unweighted average of all the sampled units and the total will just be the product of N and the simple average. Simple random sampling renders equal probability of selection. There are also other sampling designs that will provide uniform selection probabilities.

- The reliability of survey results should be evaluated through sampling errors and design effects of major characteristics of interest. The current practice to consult with key informants and leaders for validating survey results should be strengthened by an in-depth review of the sampling errors and design effects of major

characteristics of interest. These two measures provide an objective view of the reliability of the survey results.

- A sampling error is the square root of the variance of the sample mean while the design effect is the ratio of the variance of the mean given the sampling design to the variance of the mean under simple random sampling. The sampling error of a characteristic of interest shows how close the estimate is from the corresponding population parameter. The design effect is indicative of how effective the given sample size is vis-à-vis a simple random sample. These measures will help plan the work load and budget of the next survey rounds.
- Microdata or household level data should be consolidated in the central office. The GSO is now in transition from the practice of keeping microdata at district offices with only the summary statistics being forwarded to the central office, to consolidating all data files at the central office. A consolidated survey data file will enable the computations of sampling errors, design effects and other measures for evaluating the reliability of survey results. It will also allow the central office staff to validate the computations of indicators or summary statistics reported by administrative units. Moreover, if anonymized versions of consolidated data files are generated, these can be shared with the academe and researchers to support policy analysis for better development outcomes. By sharing the survey data with external users, public awareness and support for statistical development will be enhanced.
- The International Household Survey Organization (www.ihsn.org) has good software for consolidating, archiving and cataloguing microdata. Its Accelerated Data Program (ADP) that is being implemented by the Partnership in Statistics for the 21st Century (PARIS21) has helped many countries in the region in organizing and documenting their data. In fact, ADB and PARIS21 have jointly sponsored a workshop to catalogue surveys and administrative reporting systems for agriculture in Bhutan.

5. The Proposed Sampling Strategy

Developing an effective sampling strategy is critical in improving the livestock survey. Discussions in various training workshops and consultations led to the consensus that the sampling design should be simple and easily implemented in the field. Since selection probabilities and survey weights have not been applied in previous agriculture surveys, it is prudent to design the sample selection such that selection probabilities will be uniform within domain and hence, base survey weight will also be uniform. This approach will simplify the estimation procedures and analysis.

In addition to simple random sampling (SRS), systematic sampling and a combination of probability proportional to size (PPS) selection of PSUs with either systematic sample or simple random sampling of ultimate sampling units can also render uniform selection probabilities. To achieve uniform selection probabilities with PPS, however, there are more intervening steps that need to be done like combining small PSUs or deconstructing big ones so that PSU sizes will not vary widely. While SRS is the simplest, the resulting sample villages may not be balanced in terms of administrative or geographic levels within a given domain. In this regard, systematic sampling is more viable than simple random sampling because implicit stratification can be introduced in the former that would better ensure more balanced sample villages. Therefore, systematic sampling was considered for the study and is described in the succeeding subsections. Since households are predominantly the units that raise livestock and are widespread across the country, the sampling design studied focused on selecting households.

a. Sampling Frames

In the current livestock survey, there are four population units raising livestock that need to be studied—cooperatives, farm enterprises, undersized farms and households. Cooperatives and farm enterprises are formal production units that are usually registered so that the sampling frames for these two types of units will be lists or databases of regulatory agencies for cooperatives and farm enterprises. If this is so, then selecting cooperatives and farm enterprises can be done using these lists. If there are no undersized farms that belong to more than one village, then the sampling frame of villages for surveying households can also apply for the undersized farms.

The RAFC 2012 is the best candidate for the sampling frame for selecting villages. If there is a consolidated data file of the RAFC 2012, then all village level data on many key variables are available so that different ways of selecting villages with probability can be examined and evaluated on the basis of design effects and variance of the mean of the estimates.

Table 3 presents the summary statistics at the district level of the available data file for the study which consisted of two provinces – Bac Giang and Binh Dinh. A closer look at the data file shows that the RAFC 2012 data for the villages may not at all be complete. There are only 140 villages for Bac Giang and 149 for Binh Dinh. The GSO website shows that there are 204 and 126 communes, respectively for Bac Giang and Binh Dinh. Since communes consist of several villages, the combination of these two sets of information show that the available data file is not a comprehensive sampling frame for the two provinces, which is needed to ensure that all eligible households in Viet Nam have a chance of being selected for the livestock survey.

If this data file is used in designing the sample selection, then many villages and households in these villages will not have a chance of being selected. A good sampling frame ensures not only that all eligible units are listed but also that good stratification measures and auxiliary variables are available for planning the sample selection.

Table 3: Village Summary Statistics for Biac Giang and Binh Dinh, Viet Nam

Province ID	District ID	Number of Villages	Number of Households				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	2301	49	171.5	191.8	417
	215	19	2851	63	126.0	150.1	356
	216	25	2887	48	101.0	115.5	262
	218	20	2814	44	109.5	140.7	379
	219	23	2487	21	109.0	108.1	227
	220	15	2174	18	109.0	144.9	566
	223	26	9630	38	363.0	370.4	620
Binh Dinh (Province 52)	540	4	1415	44	378.5	353.8	614
	542	9	1146	23	94.0	127.3	417
	543	21	7720	202	337.0	367.6	735
	544	19	5447	36	252.0	286.7	650
	545	19	4891	109	248.0	257.4	446
	546	8	1492	55	223.0	186.5	279
	547	16	8004	50	467.5	500.3	906
	548	19	8785	92	446.0	462.4	1000
	549	12	4380	164	361.0	365.0	654
	550	17	8059	210	425.0	474.1	918
	551	5	748	68	87.0	149.6	319

Source: Authors' computations from the Rural, Agriculture and Fishery Census 2012 data file provided by the General Statistics Office.

Since GSO is still consolidating its data holding in the central office and demonstrating how to design and evaluate systematic sampling, the available data file will be considered comprehensive for the succeeding analysis. The characteristics of interest that are relevant to the livestock surveys are the number of: (a) households; (b) households owning pigs; (c) households owning chicken; (d) households owning ducks; (d) households owning swans or geese; (f) pigs owned; (g) chickens owned; (h) ducks owned; (i) swans or geese owned. Table 4 shows the summary statistics at the provincial level for these variables.

b. Choice of systematic sample

To objectively determine the appropriate sample size for each domain (province), the estimates of sampling errors and design effects of previous similar surveys and the estimate of the variability of major characteristics of interest will be used. These estimates are not available since sampling errors and design effects are not computed. Moreover, the data file of the census is also not complete. In order to continue the study, three scenarios were considered instead—sampling villages with the following rate: (i) 1 in 5; (ii) 1 in 10; and (iii) 1 in 20.

Table 4: Summary Statistics for Livestock Characteristics at the Provincial Level

Characteristics	No of Villages	Mean	Variance
Biac Giang (Province 24)			
Number of Households	140	179.60	23754.43
No. of HH Owning Pigs	140	85.82	7089.67
No. of HH Owning Chicken	140	114.93	10194.34
No. of HH Owning Ducks	140	25.28	1248.04
No. of HH Owning Swans or Geese	140	5.21	75.96
Number of Pigs Owned	140	441.94	204135.43
Number of Chickens Owned	140	8154.77	181272436.84
Number of Ducks Owned	140	965.44	2724353.62
Number of Swans or Geese Owned	140	228.05	328191.24
Binh Dinh (Province 52)			
Number of Households	149	349.58	45198.98
No. of HH Owning Pigs	149	126.13	9575.29
No. of HH Owning Chicken	149	195.23	15621.84
No. of HH Owning Ducks	149	16.84	372.92
No. of HH Owning Swans or Geese	149	16.21	676.29
Number of Pigs Owned	149	701.05	907754.49
Number of Chickens Owned	149	4937.22	29072048.93
Number of Ducks Owned	149	1924.00	8583407.35
Number of Swans or Geese Owned	149	130.22	47181.71

Source: Authors' computations from the Rural, Agriculture and Fishery Census 2012 data file provided by the General Statistics Office.

Figure 2 diagrams the general approach that was followed: To select the sample villages, the census listing of all villages was used. In a given province, the villages were sorted and grouped into two equal groups according to the number of households. Then for each of the group, the villages were sorted and further classified into two equal groups according to the number of households owning cattle. For each of the four groups, the villages were then sorted and grouped into two equal parts according to the number of households owning chicken. This stratification approach will result into eight groups with almost equal number of villages in each group for a province.

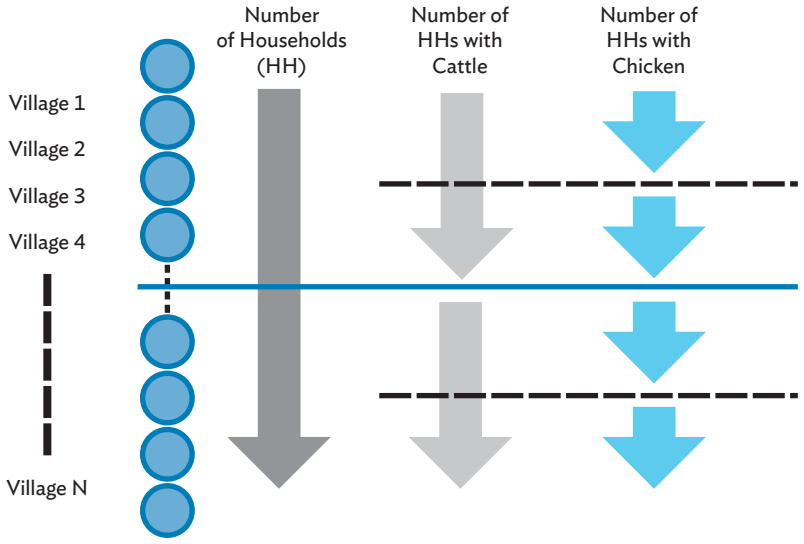
c. Evaluation using design effects

All the possible systematic samples for 5%, 10%, and 20% of the total number of villages in each group were studied using the available characteristics of interest from the available data file. The design effect for each characteristic of interest and sampling rate was computed as:

$$\text{Deff}(\bar{x}) = \frac{\text{Var}_{\text{SYS}}(\bar{x})}{\text{Var}_{\text{SRS}}(\bar{x})},$$

where $\text{Var}_{\text{SRS}}(\bar{x})'\,(\bar{x}) = \left(1 - \frac{n}{N}\right)\frac{S_x^2}{n}$ and S_x^2 is the population variance of characteristic of interest X.

Figure 2: Systematic Sampling Scheme Diagram



Since the ordered provincial data file contains all the villages, all the possible sets of systematic sample can be derived following the three sampling rates mentioned above. For example, all the five complete sets of systematic samples drawn with selection probability of 1 in 5 can be identified, their respective averages can be computed and the variance of the mean can be derived as follows:

$$\text{Var}_{\text{SYS}}(\bar{x}) = \frac{\sum_{s=1}^{S}(\bar{x}_s - \mu)^2}{S}$$

where S = 5, $\bar{x}_s$ is the average for the set of systematic sample s and μ is the population mean.

In addition to the design effects, the coefficient of variation for SRS and systematic sample were also derived as follows:

$$\text{CV}_{\text{SRS}}(\bar{x}) = \frac{\sqrt{\left(1 - \frac{n}{N}\right)\frac{S_x^2}{n}}}{\mu} \times 100$$

$$\text{CV}_{\text{SYS}}(\bar{x}) = \frac{1}{\mu} \times \sqrt{\frac{\sum_{s=1}^{S}(\bar{x}_s - \mu)^2}{S}} \times 100$$

The results of these desk experiments are summarized in Table 5. Design effects of major characteristics of interest of a well-designed

systematic sample usually range from 1 to 3. Many of the design effects in Table 5 are within this range and some are even less than one indicating that that particular systematic sample performed better than SRS. From these desk experiments, we concluded that at least 10% of the total villages' systematic sample can provide reliable estimates at the province level.

d. Additional benefits of systematic sample

The use of systematic sampling described above also offers additional cost-effective benefit. If villages are sampled one in 10 (10%), and hence, there will be a total of 10 sets of systematic samples, then if a different set of systematic sample is used every year, all the villages in Viet Nam would be surveyed in 10 years. This is an example of a rolling census (Durr, 2005) that may be implemented if resources for a full census are not available.

The idea of a rolling census emanated from the rolling samples approach that was first proposed and passionately advocated by Kish (1990). Kish observed that periodic surveys like the livestock survey have become more widely utilized. He proposed that rolling samples can be collected in a more frequent basis to replace the periodic surveys that are regularly conducted. When these rolling samples are cumulated, estimates at lower disaggregation level can be derived. Kish concluded that the budget of the rolling samples would be less compared to the combined costs of all the operations of the periodic surveys.

As of this writing, France is the only country yet that has moved to a form of rolling census model, while the United Kingdom's Office of National Statistics has assessed the possible shift to rolling census after 2011 to provide the detailed characteristics of the population that a population register alone cannot provide.

Table 5: Design Effects of Various Systematic Samples

Characteristics	Population Mean	1 in 5			1 in 10			1 in 20		
		SRS	Systematic		SRS	Systematic		SRS	Systematic	
		CV ($\bar{x}$)	CV ($\bar{x}$)	Deff	CV ($\bar{x}$)	CV ($\bar{x}$)	Deff	CV ($\bar{x}$)	CV ($\bar{x}$)	Deff
Biac Giang (Province 24)										
Number of Households (HH)	179.60	14.51	6.22	0.18	21.76	8.76	0.16	31.61	31.18	0.97
No. of HH Owning Pigs	85.82	16.58	10.12	0.37	24.88	11.88	0.23	36.14	28.44	0.62
No. of HH Owning Chicken	114.93	14.85	7.35	0.25	22.27	8.16	0.13	32.36	26.07	0.65
No. of HH Owning Ducks	25.28	23.62	26.54	1.26	35.43	34.38	0.94	51.48	47.09	0.84
No. of HH Owning Swans or Geese	5.21	28.29	11.42	0.16	42.44	29.68	0.49	61.66	62.02	1.01
Number of Pigs Owned	441.94	17.28	13.50	0.61	25.92	16.86	0.42	37.66	37.01	0.97
Number of Chickens Owned	8154.77	27.91	19.71	0.50	41.86	27.72	0.44	60.82	51.05	0.70
Number of Ducks Owned	965.44	28.90	23.89	0.68	43.35	39.34	0.82	62.98	61.04	0.94
Number of Swans or Geese Owned	228.05	42.46	35.11	0.68	63.69	47.78	0.56	92.54	82.32	0.79
Binh Dinh (Province 52)										
Number of Households	349.30	9.93	4.87	0.24	14.89	11.33	0.58	22.44	26.06	1.34
No. of HH Owning Pigs	126.15	12.66	9.52	0.57	19.00	17.71	0.87	28.63	34.91	1.50
No. of HH Owning Chicken	195.21	10.45	4.55	0.19	15.68	10.86	0.48	23.62	25.99	1.22
No. of HH Owning Ducks	16.83	18.72	8.79	0.22	28.08	29.05	1.07	42.32	43.24	1.05
No. of HH Owning Swans or Geese	16.22	26.16	19.22	0.54	39.29	27.76	0.50	59.20	46.70	0.62
Number of Pigs Owned	700.29	22.20	22.88	1.06	33.28	29.17	0.77	50.15	58.81	1.39
Number of Chickens Owned	4932.41	17.84	15.96	0.80	26.74	20.73	0.60	40.30	44.46	1.22
Number of Ducks Owned	1927.75	24.80	25.48	1.06	37.29	40.46	1.19	56.19	59.75	1.15
Number of Swans or Geese Owned	130.13	27.23	23.69	0.76	40.84	30.95	0.57	61.55	49.49	0.64

Source: Authors' computations from the 2012 Rural, Agriculture and Fishery Census data file provided by the General Statistics Office.

6. Conclusions and Recommendations

This study contributes to the global and the government's initiative in improving the data compilation methods for agricultural and rural statistics in Viet Nam. The government has established legal framework to support this initiative and its two main agricultural and rural data producing agencies – GSO and MARD have already developed data collection methods that include sample surveys to supplement the administrative reporting system. The meta-data of these surveys, however, still reflect the vestiges of the administrative reporting system – large sample sizes and short but frequent questionnaire that are easily summarized at lower administrative levels.

Although there are well-tested and objective procedures for determining the appropriate sample sizes, these cannot be applied because the required microdata for this purpose are not consolidated. Likewise, the reliability of survey data cannot be ascertained because sampling errors and design effects cannot be derived. Large sample sizes are expected to reduce the sampling errors but concomitantly, magnify non-sampling errors and hence, total survey error may remain larger than desired. Unlike sampling errors, nonsampling errors cannot be estimated. These are only controlled through careful implementation of the sampling strategy, adoption of a well-designed and tested questionnaire, hiring of trained enumerators, supervisors and data processors, among others.

To reduce and in the long term, eliminate the subjective intervention in surveys, transparent and objective survey operations and processing procedures must be established. The activities needed for this purpose are parts of the proposed activities discussed in Section 4. The GSO has already started consolidating its data holding at the central office as of this writing. This is an important step that will enable the computations of sampling errors and designed effects that can be used for improving sampling design and operations plan of surveys. Unbiased estimators that use the appropriate survey weights can also be derived. However, not all the activities can be accomplished or initiated in a short term because they may need further methodological studies similar to this one. In turn, the new activities and methodological studies would require more training of staff to obtain good results.

Some activities like documentation and archiving of survey data can also be facilitated with the assistance of international organizations that possess tools and expertise. Others like the enhancement and harmonization of the livestock survey questionnaire can be achieved in coordination with MARD and other relevant government agencies. The training workshops that were jointly organized by GSO and CIS, MARD for this study attest to the strong coordination between these two agencies. Hopefully, this strong coordination will continue so that their respective livestock surveys can be harmonized and administered on the same sample to conserve resources and support policy analysis and monitoring.

The results of the desk experiments support the adoption of systematic sampling of villages for the livestock survey. This conclusion, however, was made on the basis of an incomplete data file of the RAFC 2012. Should the full set of data become available, the desk experiments should again be undertaken to verify if the same conclusion still holds.

Another assumption that was made for the desk experiments is the complete enumeration of eligible households in the sampled villages. Research has shown that sampling units in a cluster share similar characteristics and hence, complete enumeration may render many common responses. To be more cost-effective, households need to be sampled and more villages or PSUs be included in the sample. If this approach is considered, then households in

sampled villages should be sampled using uniform sampling rate so that the selection probabilities of households across sampled villages in a domain will remain constant.

Data compilation methods for statistics in general and for agricultural and rural statistics, in particular, will surely evolve as statistical research and technology develop further. Viet Nam needs to be vigilant of issues and results that are relevant in improving their data collection systems and products. Working with the academe, other government agencies and development organizations by sharing their microdata and participating in various fora will help them keep abreast. Furthermore, intensive use of agricultural and rural statistics for policy making and resource allocation will bring about more changes to the methodology and greater improvement in the quality of data.

Appendix: Statistical Tables

Table A1: Summary Statistics of Relevant Characteristics of Interest by Province

Province ID	District ID	Number of Communes	No. of HH Owning Pigs				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	710	0	52.5	59.2	145
	215	19	1379	18	71.0	72.6	157
	216	25	1696	4	63.0	67.8	169
	218	20	1133	9	36.0	56.7	153
	219	23	1102	8	38.0	47.9	122
	220	15	965	5	47.0	64.3	217
	223	26	5030	29	227.5	193.5	498
Binh Dinh (Province 52)	540	4	329	1	70.0	82.3	188
	542	9	510	6	44.0	56.7	153
	543	21	3456	7	177.0	164.6	310
	544	19	3312	9	124.0	174.3	364
	545	19	2215	12	106.0	116.6	275
	546	8	629	23	60.0	78.6	151
	547	16	2597	16	125.5	162.3	529
	548	19	2125	12	70.0	111.8	451
	549	12	1743	16	121.0	145.3	364
	550	17	1701	14	121.0	100.1	182
	551	5	176	10	20.0	35.2	88
Province ID	District ID	Number of Communes	No. of HH Owning Chicken				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	647	0	55.5	53.9	118
	215	19	1837	28	77.0	96.7	196
	216	25	2168	40	85.0	86.7	173
	218	20	1938	24	65.0	96.9	204
	219	23	1659	14	64.0	72.1	134
	220	15	1367	12	59.0	91.1	330
	223	26	6474	34	301.0	249.0	516
Binh Dinh (Province 52)	540	4	582	14	112.0	145.5	344
	542	9	680	7	49.0	75.6	205
	543	21	4281	25	224.0	203.9	383
	544	19	3205	22	146.0	168.7	383
	545	19	3674	85	174.0	193.4	307
	546	8	955	37	107.5	119.4	230
	547	16	4694	24	257.0	293.4	658
	548	19	4834	53	260.0	254.4	715
	549	12	2626	51	177.0	218.8	467
	550	17	3204	31	201.0	188.5	327
	551	5	354	20	62.0	70.8	182
Province ID	District ID	Number of Communes	No. of HH Owning Ducks				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	92	0	4.5	7.7	32
	215	19	571	0	16.0	30.1	102
	216	25	830	1	23.0	33.2	114
	218	20	316	0	9.5	15.8	90
	219	23	354	0	9.0	15.4	57
	220	15	366	0	10.0	24.4	137
	223	26	1010	0	11.5	38.8	282
Binh Dinh(Province 52)	540	4	46	0	7.5	11.5	31
	542	9	41	0	2.0	4.6	19
	543	21	528	3	19.0	25.1	61
	544	19	540	0	22.0	28.4	98
	545	19	147	0	6.0	7.7	32
	546	8	30	0	3.5	3.8	9
	547	16	285	0	13.0	17.8	44
	548	19	350	1	11.0	18.4	96
	549	12	193	4	8.0	16.1	103
	550	17	339	3	17.0	19.9	46
	551	5	10	0	2.0	2.0	5

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Table A1: Summary Statistics of Relevant Characteristics of Interest by Province *(continued)*

Province ID	District ID	Number of Communes	No. of HH Owning Swans or Geese				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	13	0	0.5	1.1	6
	215	19	196	0	6.0	10.3	49
	216	25	140	0	3.0	5.6	44
	218	20	67	0	1.0	3.4	25
	219	23	54	0	0.0	2.3	14
	220	15	127	0	2.0	8.5	37
	223	26	132	0	1.0	5.1	30
Binh Dinh(Province 52)	540	4	37	0	6.5	9.3	24
	542	9	93	0	1.0	10.3	49
	543	21	937	4	22.0	44.6	130
	544	19	290	0	9.0	15.3	52
	545	19	48	0	2.0	2.5	11
	546	8	57	0	4.5	7.1	17
	547	16	331	0	8.0	20.7	132
	548	19	307	0	6.0	16.2	110
	549	12	97	1	6.5	8.1	19
	550	17	209	1	8.0	12.3	44
	551	5	9	0	2.0	1.8	4
Province ID	**District ID**	**Number of Communes**	**Number of Pigs Owned**				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	3520	0	201.5	293.3	942
	215	19	8538	101	354.0	449.4	1067
	216	25	11410	68	318.0	456.4	2576
	218	20	6422	14	173.5	321.1	2618
	219	23	6173	20	159.0	268.4	1078
	220	15	3616	30	199.0	241.1	675
	223	26	22192	174	985.5	853.5	1840
Binh Dinh(Province 52)	540	4	1242	3	224.5	310.5	790
	542	9	1520	13	109.0	168.9	573
	543	21	17146	18	698.0	816.5	1997
	544	19	36276	18	1441.0	1909.3	5483
	545	19	6040	43	263.0	317.9	604
	546	8	1991	49	251.0	248.9	571
	547	16	14083	64	753.5	880.2	3129
	548	19	9242	42	324.0	486.4	2125
	549	12	10497	31	421.0	874.8	4490
	550	17	5638	57	361.0	331.6	697
	551	5	781	37	88.0	156.2	496
Province ID	**District ID**	**Number of Communes**	**Number of Chickens Owned**				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	16428	0	1062.0	1369.0	6000
	215	19	516702	992	18158.0	27194.8	106881
	216	25	155492	1264	3897.0	6219.7	22965
	218	20	136417	456	2793.5	6820.9	42142
	219	23	72703	355	2933.0	3161.0	7070
	220	15	38927	463	1434.0	2595.1	11597
	223	26	204999	752	7685.0	7884.6	25342
Binh Dinh (Province 52)	540	4	10768	254	2254.0	2692.0	6006
	542	9	9613	76	525.0	1068.1	3584
	543	21	68795	343	2964.0	3276.0	8055
	544	19	104499	151	4208.0	5499.9	14497
	545	19	83570	1388	3119.0	4398.4	24730
	546	8	15031	354	1469.0	1878.9	5079
	547	16	102317	269	5630.5	6394.8	13021
	548	19	134419	679	6476.0	7074.7	22979
	549	12	66313	491	3879.5	5526.1	18100
	550	17	135329	1655	5669.0	7960.5	44916
	551	5	4992	169	302.0	998.4	3451

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Table A1: Summary Statistics of Relevant Characteristics of Interest by Province *(continued)*

Province ID	District ID	Number of Communes	Number of Ducks Owned				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	4627	0	110.0	385.6	1570
	215	19	20263	0	656.0	1066.5	4120
	216	25	34597	20	684.0	1383.9	15700
	218	20	17327	0	362.0	866.4	5777
	219	23	8822	0	270.0	383.6	1420
	220	15	11493	0	172.0	766.2	4721
	223	26	38033	0	1444.0	1462.8	5003
Binh Dinh(Province 52)	540	4	2541	0	343.0	635.3	1855
	542	9	3342	0	24.0	371.3	1711
	543	21	32530	42	1020.0	1549.0	5256
	544	19	28027	0	1209.0	1475.1	5286
	545	19	24349	0	300.0	1281.5	8599
	546	8	708	0	25.0	88.5	438
	547	16	32187	0	597.5	2011.7	8938
	548	19	77742	6	2477.0	4091.7	19855
	549	12	30294	394	969.0	2524.5	16630
	550	17	52625	15	2120.0	3095.6	10045
	551	5	2331	0	9.0	466.2	2308
Province ID	District ID	Number of Communes	Number of Swans or Geese Owned				
			Total	Minimum	Median	Mean	Maximum
Biac Giang (Province 24)	213	12	321	0	3.0	26.8	125
	215	19	11047	0	254.0	581.4	2200
	216	25	8486	0	82.0	339.4	5240
	218	20	3527	0	30.0	176.4	1360
	219	23	1014	0	0.0	44.1	250
	220	15	3139	0	21.0	209.3	1635
	223	26	4393	0	10.0	169.0	1200
Binh Dinh(Province 52)	540	4	197	0	25.0	49.3	147
	542	9	602	0	7.0	66.9	420
	543	21	5442	11	199.0	259.1	783
	544	19	2873	0	128.0	151.2	537
	545	19	260	0	5.0	13.7	104
	546	8	284	0	33.0	35.5	88
	547	16	3989	0	88.5	249.3	1535
	548	19	2616	0	45.0	137.7	1098
	549	12	1034	7	62.0	86.2	234
	550	17	2063	4	71.0	121.4	479
	551	5	43	0	6.0	8.6	19

Table A2: Sample Means of Relevant Characteristics of Interest by Province: 1 in 5 Systematic Sample

Province	Sample	Number of Households	Number of Households Owning Pigs	Number of Households Owning Chicken	Number of Households Owning Ducks	Number of Households Owning Swans or Geese	Number of Pigs Owned	Number of Chickens Owned	Number of Ducks Owned	Number of Swans or Geese Owned
Total	Sample1	275.0	115.6	161.5	26.6	13.0	710.6	6040.1	1610.9	177.4
	Sample2	264.2	107.7	154.3	21.0	9.6	600.1	6202.5	1525.7	152.0
	Sample3	279.6	101.1	154.3	19.7	8.6	447.9	6611.2	1033.8	164.9
	Sample4	264.3	93.6	151.4	16.7	11.1	555.1	7241.3	1176.3	147.1
	Sample5	252.9	115.1	160.2	20.7	12.1	563.6	6382.4	1960.1	248.0
Biac Giang (Province 24)	Sample1	175.1	86.3	107.1	35.3	5.2	447.6	6151.0	944.9	161.5
	Sample2	173.2	81.2	117.3	27.2	5.4	370.8	6497.3	812.2	198.9
	Sample3	188.0	88.1	120.4	24.3	5.0	388.9	9098.5	796.8	218.3
	Sample4	165.2	73.6	103.5	14.3	4.3	463.4	10400.5	858.4	178.0
	Sample5	196.5	100.0	126.3	25.3	6.1	539.1	8626.5	1415.0	383.5
Binh Dinh(Province 52)	Sample1	368.2	142.9	212.3	18.5	20.4	956.1	5936.6	2232.5	192.1
	Sample2	349.1	132.5	188.9	15.3	13.4	814.2	5927.3	2191.7	108.2
	Sample3	365.2	113.3	185.9	15.4	12.0	503.0	4289.6	1255.0	115.0
	Sample4	356.7	112.4	196.1	18.8	17.5	640.8	4292.8	1473.1	118.2
	Sample5	307.3	129.7	192.8	16.2	17.8	587.4	4215.7	2486.4	117.1

Table A3: Sample Means of Relevant Characteristics of Interest by Province: 1 in 10 Systematic Sample

Province	Sample	Number of Households	Number of Households Owning Pigs	Number of Households Owning Chicken	Number of Households Owning Ducks	Number of Households Owning Swans or Geese	Number of Pigs Owned	Number of Chickens Owned	Number of Ducks Owned	Number of Swans or Geese Owned
Total	Sample1	305.0	111.2	165.0	19.5	11.1	635.6	4567.3	1318.7	171.8
	Sample2	273.3	88.8	137.3	25.4	10.3	483.2	6049.5	2124.0	203.7
	Sample3	256.7	84.3	138.1	20.0	10.2	369.2	6955.0	968.6	194.5
	Sample4	258.7	89.3	141.3	17.3	14.6	539.2	8083.3	1167.8	189.3
	Sample5	269.9	123.7	165.0	17.7	12.5	654.9	7580.8	1896.2	309.1
	Sample6	245.0	119.9	158.0	33.7	15.0	785.6	7513.0	1903.1	183.0
	Sample7	255.1	126.6	171.4	16.7	8.9	717.1	6355.5	927.4	100.3
	Sample8	302.6	118.0	170.4	19.3	7.0	526.7	6267.4	1099.1	135.3
	Sample9	269.8	98.0	161.4	16.0	7.7	571.1	6399.3	1184.9	104.8
	Sample10	235.2	106.2	155.1	23.9	11.6	469.1	5141.2	2026.2	184.6
Biac Giang (Province 24)	Sample1	180.9	88.1	107.6	26.6	5.8	412.1	4050.1	868.1	179.0
	Sample2	182.1	71.9	109.1	33.7	6.5	331.1	5399.3	1042.1	270.3
	Sample3	202.5	84.1	117.4	29.9	7.5	394.4	10109.5	924.6	261.3
	Sample4	170.6	70.8	104.3	12.9	5.4	460.6	12308.4	685.2	228.4
	Sample5	212.7	105.2	128.9	25.4	7.1	623.2	10158.5	2006.7	515.9
	Sample6	169.4	84.4	106.6	44.0	4.6	483.0	8252.0	1021.6	144.1
	Sample7	164.4	90.5	125.5	20.7	4.4	410.4	7595.4	582.2	127.5
	Sample8	173.4	92.2	123.4	18.6	2.4	383.4	8087.6	668.9	175.4
	Sample9	159.8	76.4	102.7	15.8	3.2	466.1	8492.6	1031.6	127.6
	Sample10	180.3	94.7	123.8	25.2	5.1	454.9	7094.5	823.2	251.1
Binh Dinh (Province 52)	Sample1	420.8	132.8	218.7	12.9	16.0	844.2	5050.0	1739.2	165.0
	Sample2	358.4	104.7	163.6	17.7	13.8	625.1	6656.4	3133.8	141.6
	Sample3	307.3	84.5	157.5	10.7	12.7	345.6	4010.7	1009.5	132.2
	Sample4	340.9	106.5	175.9	21.4	23.2	612.5	4140.0	1618.2	152.9
	Sample5	323.3	140.9	198.8	10.4	17.5	684.5	5175.0	1793.1	116.1
	Sample6	315.6	153.1	206.0	24.1	24.7	1068.0	6823.3	2725.9	219.3
	Sample7	339.8	160.3	214.2	12.9	13.1	1003.3	5198.3	1249.6	74.9
	Sample8	423.1	142.1	214.3	20.1	11.3	660.4	4568.5	1500.5	97.9
	Sample9	372.5	118.2	216.3	16.3	11.8	669.0	4445.5	1328.0	83.5
	Sample10	290.1	117.6	186.4	22.5	18.1	483.3	3187.9	3229.1	118.1

Table A4: Sample Means of Relevant Characteristics of Interest by Province: 1 in 20 Systematic Sample

Province	Sample	Number of Households	Number of Households Owning Pigs	Number of Households Owning Chicken	Number of Households Owning Ducks	Number of Households Owning Swans or Geese	Number of Pigs Owned	Number of Chickens Owned	Number of Ducks Owned	Number of Swans or Geese Owned
Total	Sample1	415.1	156.1	211.5	24.3	18.1	897.6	5726.4	1575.6	286.9
	Sample2	362.8	118.7	171.7	26.3	15.3	737.5	7972.7	1240.3	264.9
	Sample3	342.5	107.1	164.6	17.8	12.0	441.4	9197.5	1169.7	189.7
	Sample4	247.9	91.9	137.9	18.0	12.7	679.3	5250.7	1591.1	149.0
	Sample5	284.1	106.6	147.4	15.3	5.3	559.4	6096.5	1284.1	75.9
	Sample6	246.9	100.9	136.9	18.9	15.8	480.5	3860.5	1139.9	151.3
	Sample7	209.6	87.2	130.1	19.6	6.3	406.5	3463.1	871.3	95.5
	Sample8	265.1	96.9	138.3	20.1	8.5	341.1	4646.4	1389.5	152.7
	Sample9	213.6	75.9	128.5	10.4	3.9	346.7	4410.5	981.1	45.5
	Sample10	171.0	85.6	119.1	19.9	8.1	357.4	3217.1	1504.9	102.6
	Sample11	187.0	63.1	115.3	14.3	3.6	354.9	3325.4	1043.4	48.4
	Sample12	177.4	56.9	100.4	24.4	4.9	210.7	3988.9	3070.9	138.2
	Sample13	164.9	59.8	109.8	22.3	8.3	291.8	4552.2	753.1	199.6
	Sample14	270.2	86.5	145.0	16.5	16.7	389.0	11118.4	714.2	232.6
	Sample15	254.8	142.0	183.9	20.1	20.2	757.3	9171.2	2552.1	559.0
	Sample16	242.9	140.4	180.6	49.6	14.1	1112.5	11426.4	2720.9	216.9
	Sample17	303.9	168.9	215.6	13.5	11.6	1049.9	9454.5	987.5	105.4
	Sample18	342.6	140.6	204.8	18.6	5.4	725.5	8004.1	787.9	116.6
	Sample19	330.1	121.6	196.7	22.1	11.7	811.5	8530.1	1403.3	168.2
	Sample20	299.4	126.8	191.1	27.8	15.1	580.8	7065.3	2547.5	266.6
Biac Giang (Province 24)	Sample1	257.6	128.0	154.7	34.4	10.3	632.9	6138.6	1164.3	315.6
	Sample2	240.0	98.1	148.1	33.4	11.0	446.4	5782.9	874.7	326.4
	Sample3	280.3	101.4	141.6	22.6	8.1	368.0	14067.9	1031.4	226.9
	Sample4	227.9	81.1	117.9	9.1	2.6	566.6	6886.0	669.7	177.0
	Sample5	229.1	93.1	102.9	21.1	2.6	479.4	6628.6	829.4	102.1
	Sample6	201.0	71.0	94.0	23.9	2.4	442.3	3650.7	853.7	41.4
	Sample7	151.9	77.1	116.0	29.4	5.1	370.1	5302.4	736.0	144.6
	Sample8	132.0	82.1	104.1	16.1	3.1	295.9	5519.6	771.4	169.7
	Sample9	113.9	51.4	79.6	10.7	1.3	207.1	4509.3	502.6	41.3
	Sample10	109.1	63.1	81.9	25.6	4.1	256.6	3737.1	404.6	114.9
	Sample11	104.1	48.1	60.4	18.7	1.3	191.4	1961.6	572.0	42.4
	Sample12	124.1	45.6	70.1	34.0	2.0	215.9	5015.7	1209.6	214.1
	Sample13	124.7	66.7	93.3	37.3	6.9	420.9	6151.1	817.9	295.7
	Sample14	113.4	60.4	90.7	16.6	8.3	354.6	17730.7	700.7	279.7
	Sample15	196.3	117.3	154.9	29.7	11.7	767.0	13688.4	3184.0	929.7
	Sample16	137.7	97.9	119.3	64.1	6.7	523.7	12853.3	1189.6	246.7
	Sample17	176.9	103.9	135.0	12.0	3.6	450.6	9888.3	428.4	110.4
	Sample18	214.9	102.3	142.6	21.0	1.7	471.0	10655.6	566.4	181.0
	Sample19	205.7	101.3	125.9	20.9	5.1	725.1	12475.9	1560.6	213.9
	Sample20	251.4	126.3	165.7	24.9	6.1	653.3	10451.9	1241.9	387.4
Binh Dinh (Province 52)	Sample1	552.9	180.6	261.1	15.5	24.9	1129.3	5365.8	1935.5	261.8
	Sample2	470.3	136.6	192.4	20.1	19.1	992.1	9888.9	1560.1	211.0
	Sample3	396.9	112.1	184.8	13.6	15.4	505.6	4936.0	1290.6	157.3
	Sample4	265.5	101.3	155.5	25.8	21.5	778.0	3819.8	2397.4	124.5
	Sample5	332.1	118.4	186.4	10.3	7.6	629.4	5630.9	1682.0	53.0
	Sample6	287.1	127.0	174.5	14.5	27.5	513.9	4044.0	1390.3	247.4
	Sample7	260.1	96.0	142.5	11.0	7.4	438.3	1853.6	989.8	52.6
	Sample8	381.6	109.9	168.3	23.5	13.1	380.8	3882.4	1930.4	137.9
	Sample9	300.9	97.4	171.4	10.1	6.1	468.8	4324.1	1399.8	49.3
	Sample10	232.9	108.0	156.3	14.3	12.1	458.3	2697.0	2605.1	90.3
	Sample11	269.9	78.1	170.1	9.9	5.9	518.4	4689.1	1514.9	54.4
	Sample12	230.6	68.1	130.7	14.9	7.7	205.6	2962.1	4932.3	62.3
	Sample13	205.0	52.9	126.3	7.3	9.7	162.7	2953.3	688.3	103.6
	Sample14	427.0	112.6	199.3	16.4	25.1	423.4	4506.0	727.7	185.4
	Sample15	313.3	166.7	213.0	10.6	28.7	747.6	4654.0	1920.1	188.3
	Sample16	348.1	182.9	242.0	35.0	21.6	1701.3	9999.6	4252.3	187.1
	Sample17	430.9	233.9	296.1	15.0	19.6	1649.1	9020.7	1546.6	100.3
	Sample18	470.4	178.9	267.0	16.1	9.1	980.0	5352.7	1009.3	52.1
	Sample19	454.4	142.0	267.6	23.3	18.3	897.9	4584.3	1246.0	122.6
	Sample20	347.3	127.3	216.6	30.7	24.1	508.3	3678.7	3853.1	145.9

References

Durr Jean-Michel. 2005. The French New Rolling Census. *Statistical Journal of the United Nations Economic Commission for Europe*. Vol 22.

General Statistics Office (GSO). 2013. Livestock Survey Design. *Issued with Decision no. 882/ QĐ-TCTK dated August 28th 2013 of General Director of General Statistic Office*.

General Statistics Office (GSO) and Ministry of Agriculture and Rural Development (MARD). 2013. *Action Plan for Improving Agricultural and Rural Statistics in Viet Nam 2013-2018*. Hanoi, Viet Nam.

Kish, Leslie. 1995. Methods for Design Effects. *Journal of Official Statistics*. 11, 55-77.

Kish, Leslie. 1992. Weighting for Unequal *pi* . *Journal of Official Statistics*, 8, pp.183-200

Kish, Leslie. 1990. Rolling Samples and Censuses. *Survey Methodology*. 16, 1, pp. 63-79.

Kish, Leslie. 1979. Samples and Censuses. *International Statistical Review*, 47, 99-109.

Kish, Leslie. 1965. *Survey Sampling*, New York: John Wiley & Sons.

Maligalig, D. 2015. Administrative Reporting Systems for Agricultural Statistics in Asia. Report presented at the Experts Group Meeting on Agricultural Statistics, Food and Agricultural Organization Headquarters, Rome, Italy, 13-17 April 2015.

Maligalig, D. 2014. Back-to-Office Report on the Training Program on Improving Agricultural Data Collection Systems, Hanoi, Viet Nam. 13-17 October 2014

Maligalig, D. 2014. Back-to-Office Report: Short Course on Sample Survey Design, Hanoi, Viet Nam, 10-14 February, 2014

Pacificador, Jr., Arturo. 2015. Report on Workshop on Questionnaire Design and Survey Operations Planning and Budgeting. Hanoi, Viet Nam. 5-9 January 2015.

Annex

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Results of the Methodological Studies for Agricultural and Rural Statistics

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ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to the majority of the world's poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

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