Solomon Islands National Forest Resources Assessment: 2011 Update

RAMSI ECONOMIC GOVERNANCE PILLAR

- FINAL REPORT
- 2 MARCH 2012

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Executive summary

Overview

Sinclair Knight Merz (SKM) was commissioned by the Regional Assistance Mission to Solomon Islands (RAMSI), on behalf of the Solomon Islands Government (SIG), to prepare an updated National Forest Resource Assessment. The objectives of this assessment were to:

- Provide independent external estimates on the true remaining and potential economic value of Solomon Islands' forest industry to contribute to predictions of the impact on Solomon Island Gross Domestic Product (GDP), government revenue and local employment opportunities
- Provide a more accurate assessment to SIG of remaining forest stocks available for logging.

The assessment was intended to build on previous work by the two phases of the Solomon Islands Forestry Management Project (SIFMP I and II). The most recent of these assessments (in 2006) warned that outputs from the Solomon Islands forestry sector would dramatically decline from about 2011, with total exhaustion of the primary, commercial forest resource by about 2015. This assertion seems to be contrary to consistent evidence of significant expansion in timber exports since 2006. The apparent conflict between the projections of timber industry decline and its current level of activity are discussed in this report.

This is the final report of the 2011 National Forest Resource Assessment. It uses data from various sources, including: the 2006 and earlier assessments; spatial layers of logging activities; records of log exports and the associated SIG revenue generated; and satellite imagery from which the scale, timing and spatial distribution of logging activities were interpreted.

Solomon Islands timber industry

Solomon Islands' timber industry has two main sectors: the dominant natural forest sector and the smaller plantations sector. The latter includes both industrial-scale plantations operated by corporate interests and smallholder (or village) plantations established and managed by customary landowners. The majority of the timber produced in Solomon Islands, including that from natural forests and industrial plantations, is exported as unprocessed round logs. Only very limited quantities of timber are processed for local use or export. Direct SIG revenue from the timber industry is almost exclusively derived from duties paid on export of logs cut from natural forests.

While Solomon Islands supports an extensive cover of natural forest, only about 30% of the land area (~800,000 ha) was assessed in previous resource assessments to support forests that are suitable for commercial timber production. The largest tracts of commercial natural forests are located in Western, Isabel and Choiseul provinces. Industrial and village plantations comprise less than 36,000 ha in total and are largely confined to Western province.

In the 11 years to 2005, over 7.7 million m^3 of round logs were exported from Solomon Islands, an average of approximately 704,000 m^3/y. Despite the SIFMP II report warning of an imminent crisis in wood supply from commercial forests, log exports have accelerated to an average of 1.45 million m^3/y between 2006 and 2011. Almost 8.7 million m^3 of logs were exported during that period.

Logging in natural forests

Export log production activities have extended from their traditional bases in Western and Isabel Provinces to all other larger provinces. While there is an active timber industry within the smaller Rennell-Bellona and Temotu Provinces, logging activity typically supplies timber for domestic markets.

The unprecedented high rates of logging since 2005 have been sustained by continued utilisation of primary or undisturbed forests, including areas that were previously assessed not to be suitable for commercial production and some that are outside of current logging licence boundaries. Logging has also taken place in natural forests that have previously been logged (secondary forests). This project estimates that logging has taken place on 348,000 ha of primary and secondary commercial forest since 2006 and on almost 17,000 ha of non-commercial forest. Approximately 325,000 ha of primary commercial forest are estimated to remain unlogged.

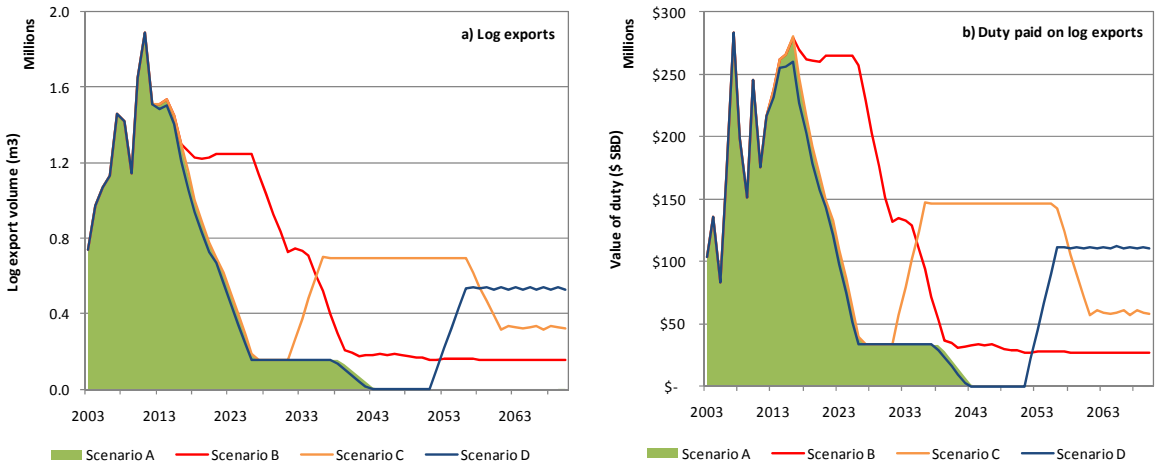
A woodflow model was developed to assess the impacts of future logging activities on Solomon Islands forests. The model incorporates only the seven larger provinces and not Rennell-Bellona and Temotu Provinces. Four scenarios were developed to assess future woodflows and associated revenues for SIG:

- **Scenario A: One-off utilisation of the primary and current secondary commercial forest area:** in this scenario logging continues in each province at the average rate for 2006-2011, until the entire primary commercial forest and all pre-2006 secondary commercial forests are fully logged. Following completion of this cycle of logging, there is no further logging in secondary forests. This scenario broadly corresponds with the natural forest woodflow modelling undertaken for the 2006 SIFMP II report, although the inclusion of logging in pre-2006 secondary forests provides for a different woodflow outcome.
- **Scenario B: Market driven business as usual logging:** in this scenario logging takes place with little effective control until Solomon Islands' commercial forest resources are exhausted. Logging continues in each province at the average rate for 2006-2011, drawing on remaining primary forests, secondary forests and accessible marginal forest areas. Re-entry logging in secondary forests continues on a 10 year cycle until forest productivity diminishes to very low levels. Forest composition changes in each phase of re-entry logging, with larger trees and those from more valuable species depleted most rapidly.
- **Scenario C: Later re-entry into recovering forests:** this scenario follows Scenario B, except that after utilisation of the current primary and secondary forest resource, timber production in

the subsequent secondary forests is managed on a 25 year harvest cycle. Yield in second and subsequent logging phases is diminished and smaller and lower value logs increasingly contribute to the harvest.

- **Scenario D: Sustainable rotation:** in this scenario timber production moves to the minimum harvest cycle considered to be necessary for sustainable rotations in tropical rainforests (45 years). Yield and log composition in secondary forests are similar to those in primary forests. There is no further logging in non-commercial forests.

The scenarios show (Figure 1) that with continued, short-cycle logging of secondary forests it may be possible to sustain relatively high rates of log export from Solomon Islands through to the end of the 2020s and log exports from at least Western and Choiseul Provinces for at least a further decade. While this pattern would sustain SIG revenues and logging-sector employment for two to three decades, it is anticipated to irreversibly degrade the productive capacity of commercial forests and greatly diminish the value of ecosystem services they provide (e.g. biodiversity, watershed protection, provision of food and traditional medicines, cultural heritage).



Note: 5 year running average is plotted for scenario period (2012-2070)

- **Figure 1 Woodflow and revenue modelling for Solomon Islands natural forests**

Scenarios that allow secondary forests to at least partly recover their previous structure, size and species composition will inevitably lead to a rapid decline in log exports and related revenues from about 2020. This contraction would last for between 10 and 30 years. While the impact on employment and SIG revenues associated with log exports would be significant, these scenarios, particularly scenario D (with a 45 year harvest cycle) would help to sustain, *in the long-term*, forest ecosystems and the goods and services they provide, including timber.

Total projected log exports for the three scenarios that provide for on-going timber production (B-C) range between 33.5 and 45.1 million m^3 to 2070 for scenarios D and C, respectively. Total SIG revenues from duties on log exports were estimated to range between $6.2 and $8.5 billion SBD for

those two scenarios. Net present value (NPV; at 4% discount rate) was estimated to range between $2.8 billion SBD for scenario D and $3.9 billion SBD for scenario B.

Plantations

The total Solomon Islands plantation estate is estimated to comprise some 35,600 ha of land, almost 80% of which is industrial plantation and located in Western Province. The dominant industrial plantation species are *Eucalyptus deglupta* and *Gmelina arborea*, which are used for plywood and other relatively low value industrial applications. Potentially high value species, such as Teak (*Tectona grandis*) and Mahogany (Swietenia macrophylla), are the main species established in village plantations and some areas of industrial plantation.

Future woodflow scenarios were developed for both village and industrial plantations. The industrial plantation scenario assumed no further expansion in the plantation estate (reflecting the limited availability of land with secure tenure) and that existing plantations would be established with the same species at the end of each growth cycle. It was assumed that village plantations would continue to expand at their average 2006-2011 rate (140 ha/y) and, optimistically, that all plantations would be re-established after harvest.

Projected yields for industrial plantations range between 150,000 and 300,000 m^3/y. Yields from village plantations are projected to grow from their current very low levels to stabilise at 80,00-100,000 m^3/y by the 2050s (with a peak of over 185,000 m^3 when the plantations established in the early 2000s are first harvested). Total annual income to plantation owners is projected to exceed $100 million SBD within about 5 years and stabilise at about $200 million SBD/y by the 2050s.

The plantations sector, if maintained, has potential to sustain employment and land owner income following the anticipated decline in the natural forest sector during either the 2030-40s (if a sustainable harvest cycle is adopted) or 2050s (onward; when commercial natural forests are largely exhausted). However, as log exports from plantations are not subject to export duties, they will not help to directly fill projected gaps in SIG revenue.

Key findings

The consultation and analysis undertaken for this project has highlighted several important issues for Solomon Islands' forestry and log export sectors, as follows:

- **The natural forest logging industry is unlikely to crash in the next few years**, despite the acceleration in logging activity since the 2006 Solomon Islands Forest Resource Assessment. Re-entry into secondary forests is projected to sustain significant levels of logging activity for at least another decade and, potentially, at lower levels for several more decades.
- **Current logging industry practices are unsustainable.** Widespread, premature re-entry logging jeopardises future timber resources and the capacity of natural forests to provide

critical ecosystem services, such as protection of water quality, flood mitigation, maintenance of biodiversity, provision of traditional medicines and food production. Repeated, short cycle logging of secondary forests will almost certainly change species composition and structure in ways that permanently run down their productive capacity and ecological functions.

- **Long-term natural forest woodflow and revenue projections are highly uncertain.** Sustained demand from forest products manufacturers in Asia is expected to sustain the current historically high woodflows and revenues over the next several years. However, beyond about five years, uncertainty about the extent and impact of logging and the resilience of forests means that longer term woodflow and revenue projections are highly uncertain.
- **Agencies overseeing Solomon Islands' timber industry are under-resourced.** Key agencies responsible for compliance and monitoring of logging operations and log exports do not have sufficient personnel or logistical resources to undertake their roles effectively. This may contribute to wasteful and damaging logging operations and revenue leakage for SIG. It also means that there is insufficient information and operational control to sustainably manage natural forest resources.
- **Improved data management is required.** Several SIG agencies are involved in gathering, processing and reporting information on log exports and associated SIG revenues. Data held by agencies is often inconsistent and difficult to compare and analyse. Data are vulnerable to loss or corruption due to the lack of integrated information systems.
- **The logging industry faces an uncertain long-term future.** Business as usual logging is anticipated to lead to irreversible loss of productive capacity in natural forests, essential ecosystem services and SIG revenues. Moving the industry to operate on a more sustainable basis will inevitably lead to reductions in employment and revenue from the sector, possibly lasting decades.
- **Industrial and village plantations represent a small, but potentially important timber resource**. They have potential to provide employment and income (for plantation owners, but not SIG) when timber resources from natural forests are not available in future.
- **Stronger SIG policy, more effective implementation and improved interaction between key agencies are required** if Solomon Islands' forests are to be managed sustainably and generate fair returns to landowners, the broader Solomon Islands and Government.
- The majority of Solomon Islands forests are inaccessible to or otherwise unsuitable for commercial timber production. **Such areas are expected to remain largely intact even if the commercial forest resources are irreversibly exhausted by logging**.

Conclusions

Wood production from Solomon Islands' natural forests has accelerated rapidly since 2006 despite the warnings of the previous Forest Resource Assessments that logging rates were already

unsustainable. The country's primary commercial forests are anticipated to be fully logged in most provinces within the next decade.

Licences have been allocated to areas that have previously been logged, despite there being insufficient time for forest stand structure and log size distributions to be restored. Logging in these areas is projected to help sustain the industry for the next decade and possibly longer, but only at a long term and very significant cost to the natural commercial forest resource and the ecosystem goods and services those forests provide to the Solomon Islands community.

Alternatives exist to the current highly exploitative operations of the logging industry. Longer harvest cycles in secondary forests may slow or even avoid irreversible damage to commercial forest ecosystems. However, extending harvest cycles to more sustainable levels will inevitably lead to significant and prolonged reductions in SIG revenue and employment. Opportunities to move to more sustainable harvesting cycles will not remain open indefinitely.

Both industrial and village plantations offer opportunities to offset some of the impacts of future management of commercial native forests on employment and economic activity, although not on SIG revenues. Further investment in strengthening the village plantation sector would be required for it to play a significant, on-going role in the country's timber industry.

Recommendations

The consultation and analysis undertaken in the course of this update of Solomon Islands' national forest resource assessment has raised a range of issues for which recommendations are made for consideration by RAMSI and SIG.

Issue addressed	Recommendations
Institutional support for sustainable forest industry	
Key agencies responsible for compliance and monitoring of logging operations and log exports are insufficiently resourced. Potential consequences include wasteful and damaging logging operations and revenue leakage for SIG.	1. Allocation of resources should be increased to ensure adequate surveillance of log shipments. In the short term (up to 1 year), this should be allocated to relevant SIG units in MoF and C&ED. In the longer-term (beyond 1 year) resources should be allocated to establishing a fully independent log monitoring service such as is operated by SGS for PNG Forests Authority. 2. MoF in-forest monitoring activities should be strengthened to ensure compliance with licence conditions. 3. Donors should re-engage with MoF to support efforts for more sustainable management of Solomon Islands forests and achieve fair returns from their use.
Key agencies responsible for compliance and monitoring of logging operations and log exports do not have sufficient personnel or logistical resources to undertake their roles effectively. Potential consequences include wasteful and damaging logging operations and revenue leakage for SIG.	4. Allocation of resources should be increased to ensure adequate surveillance of log shipments. In the short term (up to 1 year), this should be allocated to relevant SIG units in MoF and C&ED. In the longer-term (beyond 1 year) resources should be allocated to establishing a fully independent log monitoring service such as is operated by

Issue addressed	Recommendations
	SGS for PNG Forests Authority. 5. MoF in-forest monitoring activities should be strengthened to ensure compliance with licence conditions.
Logging operations are currently being conducted in unlicensed areas and in non-commercial forest. Licences are being granted for areas of non-commercial forest, including steep or high elevation land for which timber production is proscribed under SIG's Code of Logging Practice.	6. Logging licences should only be issued for commercial forest areas, as defined by Code of Logging Practice. 7. Logging licences should not be issued for environmentally sensitive areas within commercial forest estate in accordance with environmental laws.
Information for effective forest management	
Inventory information is lacking from secondary forests. As a result, the impact on future forest productivity and ecosystem service provision of premature logging in secondary forests is unknown. The capacity for informed management is diminished as a result and future woodflow and revenue projections are highly speculative and uncertain.	8. Systematic inventories of secondary forests should be undertaken to assess future growing stock, productive capacity and environmental impact. 9. Information should be used to inform SIG policy on secondary logging and future updates of the Solomon Islands Forest Resource Assessment.
Logging continues at historically high rate and is being conducted in non-commercial forest and non-licence areas. Regular monitoring of logging activity is required to enable effective management of forest resources.	10. Satellite imagery should be acquired for the largely Solomon Islands provinces and an analysis of logging areas conducted at a maximum of two yearly intervals. 11. A forest data management team and information system should be established in association with the national GIS centre.
Key SIG agencies' log export data sets are inconsistent and incompatible. Revenue compliance, monitoring and reporting may be inaccurate as a result.	12. The SIG log export committee should be reinstituted and meet monthly to share data. 13. Data protocols for log shipment reporting should be developed to enable tracking between records held by various agencies and to enable analysis by exporting province, log size and species.
Current exploitative logging practices are expected significantly diminish the provision of ecosystem goods and services by commercial forests. The nature and value of these services is currently not well understood and consequently they are not considered in forest planning or policy.	14. Studies should be conducted to determine the nature and economic value of ecosystem services generated by natural forests and how these might change with repeated, short-cycle logging.
Plantation sector development	
Industrial and village plantations represent a small, but potentially important timber resource. They have potential to provide employment and income (for plantation owners) when timber resources from natural forests are not available in future. Insecure land tenure on customary land limits expansion of the industrial plantations sector.	15. A legislative framework should be developed to provide long-term security of tenure for sustainably-managed industrial plantations. 16. Suitable land for industrial plantations should be identified and negotiations with potential plantations developers initiated. 17. On-going funds should be provided to MoF's smallholder extension activities to ensure the village plantation sector can continue to expand and that plantations provide financial and other benefits to landowners.
Agricultural development	
Agricultural development licences are reportedly being used to clear forests in ways that circumvent forestry licensing and other regulations.	18. Relevant SIG agencies should develop clear and integrated legal guidelines for customary land conversion applications and activities and monitor and enforce compliance.

Contents

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1. Introduction

1.1. Project rationale and aims

Sinclair Knight Merz (SKM) was engaged by the Regional Assistance Mission to Solomon Islands (RAMSI) to assess the current status of Solomon Islands' forestry sector. The assessment provides a comprehensive update of the 2006 National Forest Resource Assessment (SIFMP II). The updated information will be used by Solomon Islands Government (SIG) to develop the forthcoming Medium Term Fiscal Strategy, support its annual budgetary processes and project impacts of current and future forestry activities on the economy, community and natural environment.

The following sections outline the methodology, volume production data to date, and estimated future production trends within the forestry sector.

1.2. Solomon Islands' forestry sector

Solomon Islands' forestry sector comprises two main sub-sectors: the dominant 'natural forest' sub-sector and the 'plantation' sub-sector. The natural forest sub-sector involves the harvesting of timber from primary forests (those not previously subject to commercial forestry operations) or secondary forests (previously subject to timber harvesting) with minimal silvicultural input. The plantation sub-sector is based on two main industrial scale holdings (on Kolombangara) and a myriad of small-scale landholder (or village) plantings distributed across the nation.

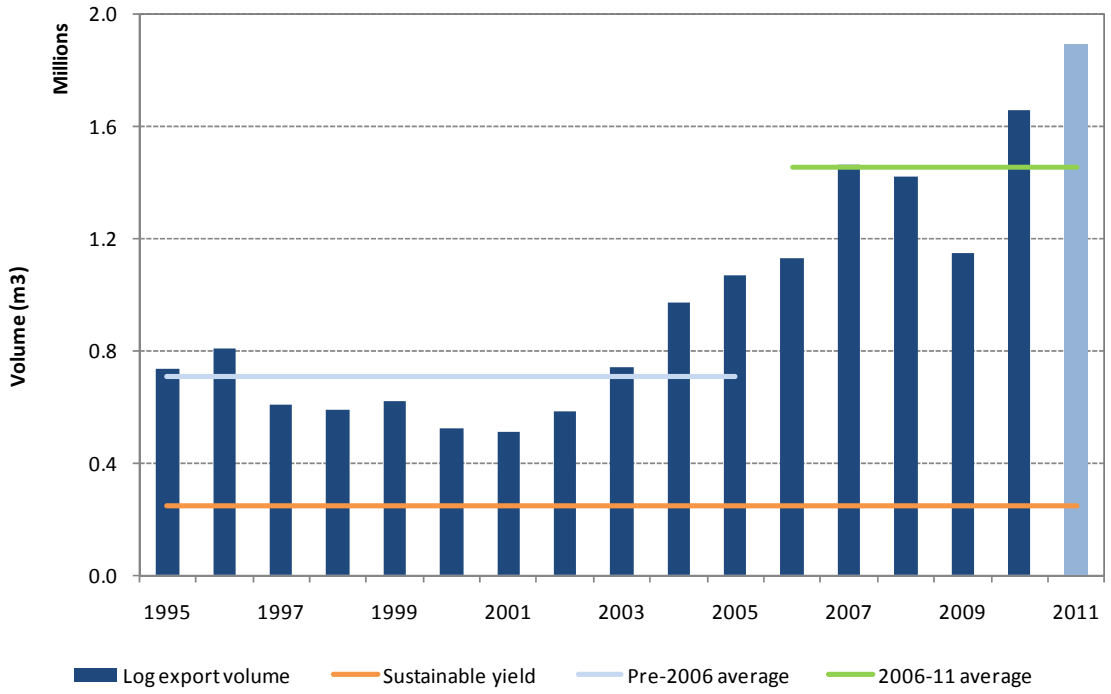
The natural forest sector is characterised by destructive and unsustainable harvesting practices, predominantly undertaken by foreign logging companies working in collaboration with 'local licensees'. They are conducted under 'cost and profit-sharing technology agreements', with limited investment in long-term infrastructure or silviculture. Regeneration is sporadic and there are few protective measures undertaken for the residual forests.

Two private companies, Kolombangara Forest Products Limited (KFPL) and Eagon Pacific Plantations Limited (EPPL) operate Solomon Islands' industrial forest plantations. Both operate on government land in Western Province on long-term fixed estate lease arrangements and have out-grower plantation schemes in close proximity to their respective estates. By comparison with the natural forests, plantations receive significant silvicultural input.

Export of logs from natural forest operations has been a major source of revenue for Solomon Islands landowners, logging companies and governments over the past 40 years. In 2010, the sector represented approximately 8% of the National Gross Domestic Product (GDP) and for

approximately 55% of foreign exchange earnings[1]. Historically logging activities have been concentrated in Western Province but expanded to other provinces during the 1990s.

Log export volumes have escalated during the past decade (Figure 2) in response to rising Chinese demand for raw materials to support infrastructure development. Annual log export volumes since 2006 have averaged approximately 1.45 million m^3, which is almost six times the sustainable yield estimated by SIFMP II (2006).



Source: SI Customs & Excise Division, Ministry of Forests, SIFMP II

Note: Export volume estimate for 2011 based on projection of monthly average of exports to 30 June to year's end

- **Figure 2 Solomon Islands annual log export volumes and 2006 estimate of sustainable yield.**

1.3. Synopsis of the 2006 Assessment Update Report

The 2006 National Forest Resource Assessment Update Report (SIFMP II, 2006) projected that Solomon Islands logging rates would decline rapidly from about 2014-15. This was based on the anticipated exhaustion of the primary forest resource and the expectation that logging would not recommence until the secondary (previously logged) forests were sufficiently mature (predominantly from about 2025 onwards). Industrial and village plantations were projected to expand incrementally, but remain a relatively small resource.

[1] Personal communication: Katherine Tuck, Solomon Islands Ministry of Finance.

The 2006 SIFMP II report warned of the potential dangers of re-logging secondary forests before their expected 45 year harvest cycle is completed. Premature (or re-entry) logging has the potential to damage the residual growing stock and set back the chance of full forest recovery. The structure of forests subjected to repeated cycles of premature logging may become totally degraded, leaving it susceptible to weed invasion and conversion to gardens.

1.4. Current natural forest logging activities

Notwithstanding warnings about the risks of overharvesting in the 2006 SIFMP II report, log exports have accelerated and re-entry logging is taking place. Some 135 new industry operators have been registered in Solomon Islands since 2006 (FIB, 2011).

Considerable economic benefits are being realised through the current timber production operations. However, this rate of production is anticipated to lead to a long-term reduction in the productive capacity of forests, which would have a sustained adverse impact on Solomon Islands' forestry sector and the national economy. A perpetuation of the current exploitative timber production practices may also damage natural environments and contribute to a loss in important ecosystem services that help to underpin local livelihood systems.

2. Approach to the forest resource assessment

This chapter provides a brief outline of the approach and data sources used to update the 2006 SIFMP II forest resource assessment and the assumptions, uncertainties and limitations of the analysis.

2.1. Key data sources

Three main data sources were used to update the 2006 SIFMP II forest resource assessment, namely:

- Satellite imagery – harvest areas were estimated from interpretation of satellite images. Data from SPOT 5 and Landsat 7 platforms have been used. Resourcing constraints meant that SPOT 5 imagery was only obtained for 2011, except where clouds obscured the view of some islands. In such cases, suitable images from 2008-10 were obtained. New Landsat 7 ETM+ images were obtained for 2005, 2006, 2010 and 2011 and earlier images used in the 2006 update were restored from the project archive.
- Customs log export data – Solomon Islands Customs and Excise Division (C&ED) provided detailed data on log exports from the period April 2008 to September 2011. These were used to estimate the volume of exports and their value to both exporters and (in duties) to the SIG. For 2011 (only) log exports were also classified by species and size. Monthly export summaries for the entire period of this review (2006-11) were also provided.
- Ministry of Forests (MoF) log export data – MoF's Marketing Section provided export shipping data gathered in the granting of Market Price Certificates (MPCs; see Appendix A). These data sets covered the period from 2006-11 and provided details on estimated and actual log export volumes and values. Exports were reported by province for some years (2008-2011).

The analysis also used the tabular and spatial data used in the 2006 SIFMP II forest resource assessment. Some errors in the data reproduced in the 2006 SIFMP II report were identified and corrected during this review.

2.2. Spatial analysis

The main source of imagery for this project was 10 m resolution multispectral SPOT 5 satellite imagery, which was obtained for the major forestry areas. Available (free) Landsat 7 ETM+ imagery was also used to provide full coverage of Solomon Islands and cover for gaps in 2011 SPOT imagery (resulting from cloud cover or gaps in image acquisition). Table 1 and Figure 3 show the combined SPOT 5 and Landsat 7 ETM+ Solomon Islands coverage for the 2011 assessment.

- **Table 1 Satellite imagery availability**

Islands	Central	Choiseul	Guadalcanal	Isabel	Malaita	Makira	Western
Satellite data							
LANDSAT 2005	✓ 14 March 2005	20 April 2005 25 Dec 2005	✓ 14 March 2005 05 May 2005	✓ 05 May 2005 18 Dec 2005	✓ 14/30 March 2005 13 July 2005	✓ 13 July 2005	✓ 04 April 2005 16 June 2005
2006	✓ 03 Jan 2006	X	✓ 01 March 2005 09 April 2006	✓ 03 Jan 2006	✓ 06 Feb 2005 13 May 2006	✓ 06 Feb 2005 13 May 2006	✓ 02 May 2006
2009	X	20 Dec 2010	X	X	X	X	X
2010	✓ 29 April 2010	✓ 20 Dec 2010	✓ 17 Feb 2010 29 April 2010	✓ 7 June 2010 19 March 2010	✓ 29 April 2010	✓ 21 March 2010	✓ 14 June 2010
2011	✓ 7 June 2010	✓ 23 May 2011	✓ 24 March 2011	X	✓ 21 July 2011	✓ 14 April 2011	✓ 23 May 2011 14 April 2011
SPOT 2007	X	X	✓ 06 August 2007	X	X		
	✓ 22 May 2008	✓ 16 Dec 2008	✓ 22 May 2008 23 June 2008	X	X	✓ 13 August 2008	✓ 05 March 2008
2009	X	X	X	X	X		✓ 03 Oct 2009
2010	X	31 Jan 2010	✓ 21 May 2010 01 August 2010	✓ 30 April 2010	X	X	X
2011	X	✓ 19 May 2011 14 June 2011	X	✓ 21/31 July 2011 16 August 2011 06 Sep 2011	✓ 29 March 2011 24 April 2011 21 May 2011	✓ 10 May 2011 10 June 2011	✓ 29 April 2011 14 June 2011 ✓ 26 July 2011 21 August 2011 16 Sept 2011 (2)

SPOT and Landsat images were processed using the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM). Vector data from the 2006 assessment were used to rectify the images during the registration phase.

The spatial layers produced for the 2006 report were used as the base layers for validating the status of the logging areas in this 2011 update. In addition, a GIS layer supplied by MoF showing 'issued licences' was incorporated into the mapping process. This layer showed that some current licences overlapped each other, with previous (recent) licence areas and non-commercial forest areas.

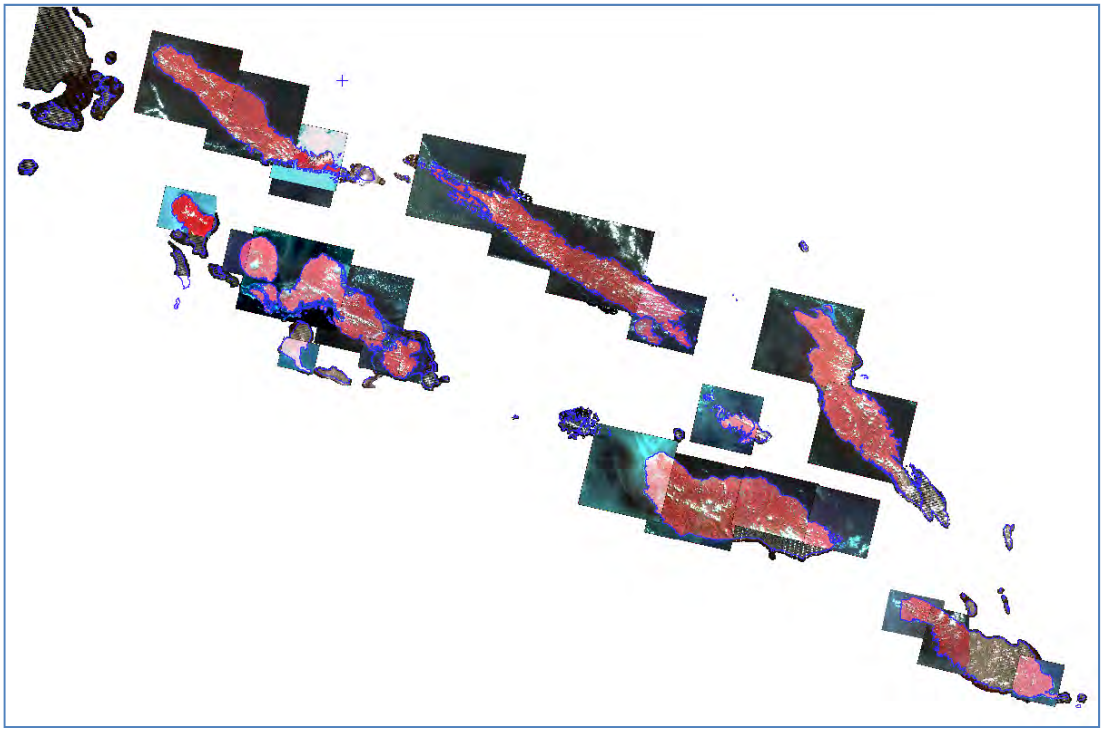


Figure 3 Solomon Islands combined SPOT 5 and Landsat 7 ETM+ coverage

Current and 2006 licence areas were checked for logging activity by spatial analysts viewing the Landsat 7 ETM+ and SPOT 5 imagery. Interpretation of the imagery was undertaken according to rules designed to ensure consistency. The analysis identified logging activities in areas defined in previous work as primary commercial forest (i.e. previously unlogged forest on land below 400 m elevation and 30° slope), as well as in marginal or non-commercial forest (above 400 m elevation and/or 30° slope). It also identified logging in secondary forests and unlicensed areas. The area of logging in each class of land was determined.

Different satellite image spectral band combinations were used to assist in image interpretation. The main combinations used were 4,5,3 or 5,4,3 or 4,3,2 or 3,2,1 for Landsat and 3,2,1 (false colour) for SPOT 5.

Rapid vegetation regrowth (not necessarily of forest trees) means that logging activities conducted in 2006 and 2007 may not have been fully registered from the satellite imagery. Buffers along logging access roads were interpreted to provide a more complete estimate of logging activity in primary forests (only).

Further discussion of the forest logging mapping procedures are presented in Appendix B and the final maps of the logging areas produced for each province are in Appendix C.

2.3. Analysis of log export data

Log export data from the two main detailed sources (MoF and C&ED) had significant gaps that meant that neither could be used directly for the analysis of log exports for the period 2006-2011. MoF records were used as the base data for the analysis because of their longer period of record and reporting of province of origin of the logs (for some years). Some gaps in actual volume exported, FOB (free on board) and duty paid were filled from C&ED data. However, inconsistencies in recording meant that it was not always possible to cross-correlate the shipments. In such cases estimated log export volumes and values that were reported in the MoF data were taken as the actual values.

Gaps in reporting of the province of origin of the log exports were filled from an analysis of the companies involved in the exporting.

Log export volume and value data from the three main data sets (C&ED detailed records and monthly summaries; MoF) were found to differ from each other, although with the exception of 2010, discrepancies in log export volumes were less than 10% of the annual total. The adopted values for log export volumes and values are the averages of the C&ED summary and MoF detailed data sets.

Discrepancies with the data sets have been communicated to key people in various SIG agencies and further work has been recommended to improve the quality of the underpinning data. Appendix D provides a list of key contacts consulted.

Logging areas at the provincial level were estimated using the results of satellite image analysis and interpretation of log export volume data.

2.4. Assumptions and limitations

Remote sensing analysis was limited by satellite image resolution, as well as spatial and temporal coverage. The SPOT 5 imagery was preferred for these analyses; however resourcing constraints limited the purchase of imagery to 2011[2]. Where the SPOT 5 imagery did not provide full coverage, Landsat imagery was used, which meant using imagery of a courser resolution with a subsequent reduction in accuracy. Another limitation was that rapid regrowth in harvested areas made it difficult to identify older logging coupes (pre 2009) in the 2011 SPOT 5 imagery.

Estimates of post-2005 logged areas from interpretation of satellite imagery and log export data at a provincial level were not consistent, with both sources providing higher estimates of logged area for some provinces and lower estimates for others. With significant uncertainties in both types of data, a conservative approach was taken and the adopted value for the post-2005 logged area in each province was the larger of the two estimates.

Uncertainty in image analysis and gaps in log export data limit the accuracy and reliability of this analysis. While efforts have been made to address data quality issues, significant shortcomings remain. Nonetheless, this update of the 2006 Solomon Islands forest resource assessment provides a reasonable estimate of the status of the current and anticipated future status of the resource.

Given the small areas of commercial forest and limited log export from Rennell-Bellona and Temotu, neither province has been considered in this analysis.

[2] There were exceptions to this general rule. Locations where cloud coverage and other availability issues precluded image analysis, Spot5 imagery was purchased for earlier years (2008-10).

3. Natural forests

3.1. Current status of forests

Previous forest resource assessments (URS, 2003; SIFMP II, 2006) classified the natural forests of Solomon Islands into two main groupings:

- Commercial forests – productive forest areas located in accessible terrain and more than 1 km from a village
- Non commercial forests – forests of marginal productivity, with poor access, located within a 1 km radius of a village, above 400 m in elevation and/or growing on slopes exceeding 30°.

High slope areas (15-30°) within identified commercial forest areas were assumed to be less productive than lower slope areas. The Solomon Islands Code of Logging Practice prescriptions specify that timber production is to be excluded from riparian buffer areas within commercial forests.

For this analysis, forests have been further divided into 'primary' and 'secondary' classes. Primary forests are those natural forests that have not been disturbed by commercial timber production operations. Secondary forests are the forests that result from such operations. They have quite different structure to primary forests in that they have few or no large trees. With time and protection from logging, secondary forests should be able to return to a similar structure to primary forest areas. The SIFMP II 2006 report suggested that secondary forests should not be relogged for at least 45 years after the initial harvest, although research in tropical rainforests (not necessarily in Solomon Islands) suggests that periods ranging between 45 and 500 years may be required for logged forests to recover to a similar species composition, biomass and timber volume (Shearwater *et al.*, 2012).

Log export data and satellite images were used to provide an analysis of the current status of forests at a provincial level (Table 2). The majority of the nation and each of the provinces comprise either historically cleared land or non-commercial forest. Commercial forests comprise 30% of Solomon Islands' land area on average. Although extensively forested, less than 20% of Guadalcanal, Makira and Malaita provinces support commercial forests. Over 40% of Choiseul, Isabel and Western provinces' land area supports commercial forests[3].

Over half of the nation's primary commercial forest resource has already been subject to timber production (475,800 ha of 800,500 ha). Timber production was historically concentrated in

[3] There is a significant discrepancy between the area of commercial forest flagged in Table 3-1 of the SIFMP II, 2006 report and spatial layer supporting that study. That table actually reports the "effective area" of commercial forest rather than the actual area, as discussed in footnote #2 to Table 2.

Western and Isabel provinces (158,900 ha and 95,800 ha of primary forest logged, respectively), but has extended to other provinces during the past decade. Post 2005 timber production activities have been concentrated in these provinces and Guadalcanal, Western, Makira and Choiseul provinces (Table 2). The majority of remaining undisturbed primary commercial forests are located in Choiseul, Isabel and Western provinces.

Previous National Forest Assessment reports (1995, 2003 and 2006) argued the case for primary forests to be given sufficient time to recover from logging. The concept of a 45-year harvest cycle was introduced into wood flow modelling to assess the implications of Solomon Islands adopting what was considered to be ecologically sustainable forestry rotations.

This assessment has identified that logging has recommenced in over half of the secondary forest areas resulting from logging prior to 2006 (~145,000 ha). These areas are only part way through their 45 year recovery rotation. The majority of this premature re-entry logging has taken place in Isabel and Western provinces (estimated to be 68,200 ha and 38,700 ha, respectively; Table 2).

Logging has been identified in non-commercial forest areas (almost 16,800 ha since 2005; Table 2). The majority of this logging is licensed, despite logging not being permitted under the Solomon Islands Code of Logging Practice (due to steep slopes, high elevation and/or marginal productivity). Logging has also been detected outside of the boundaries of logging licence areas (36,100 ha since 2005; Table 2).

At present there are no known conservation reserves that formally protect natural forests from timber production. There are currently approximately 35,600 ha of industrial or village forest plantations in Solomon Islands (Table 2).

- **Table 2 Current commercial forest area (ha[1]) by logging status and province**

		Non-commercial forest		Commercial forest[2]			Plantations[5]	
Province	Total area	Unlogged or cleared land	Logged: 2006-11	Unlogged: 2011	1° forest: logged pre 2006[3]	1° forest: logged 2006-11[4]	2° forest logged 2006-11[4]	Industrial	Village
Central	68,500	51,600	400	16,400	6,000	7,600	2,800	1,400	100
Choiseul	330,200	164,500	1,100	164,500	123,800	18,600	22,200	100	400
Guadalcanal	538,700	443,300	6,800	88,500	2,000	37,600	49,000	14,300	300
Isabel	422,800	247,500	100	175,200	79,400	68,800	27,100	68,200	300
Makira	329,100	275,800	1,300	52,000	6,100	9,000	36,900	13,400	100
Malaita	413,800	343,900	3,900	66,000	28,600	10,400	27,000	9,000	1,300
Western	551,500	310,600	3,000	237,800	78,900	120,700	38,200	38,800	25,900
National	2,808,200	1,837,300	16,800	800,500	324,700	272,700	203,100	145,100	28,400

Notes:

1. Areas are rounded to nearest 100 ha.
2. The total area of commercial forest differs significantly from SIFMP II 2006 report (Table 3-1). That table reports the "effective area" of commercial forest, which is the area of commercial forest adjusted for reduced yields in areas of greater than 15° slope, classified as semi-commercial and included in riparian buffers (as outlined in p4 of the SIFMP II 2006 report). Commercial forest in this report is the sum of forest areas classified as either commercial or semi-commercial in the SIFMP II commercial forest are spatial layer (this comprises polygons labelled as "C" or "S", respectively for the COMM2006 attribute). Some commercial forest polygons were not labelled for this attribute, it is assumed (as there was no metadata accompanying the spatial layer) that these were areas assessed to be non-commercial, although located in generally commercial forest areas. Adjustments for reduced yield in semi-commercial forests and higher slope areas are made in woodflow modelling.
3. 2006 primary forest logged areas differ from SIFMP II 2006 report (Table 3-1) as a result of the correction of errors in that table in the original document.
4. Division of 2006-11 harvest areas between primary and secondary and commercial and non-commercial forests was based on data from satellite images and spatial analysis and understanding of logging history of province
5. Plantation areas have been updated from SIFMP II 2006 report using data from the two plantation companies (on industrial plantations) and the SIG Ministry of Forestry smallholder (village) plantations data base.
6. The area of secondary forest logging in Makira province exceeds the pre-2006 primary forest logged area. This reflects recent logging in whole licence areas being classified as secondary logging, when some must have been in primary forests that were not logged previously.

- **Table 3 Summary of potential future commercial forest areas (ha[1]) by province and forest status, based on introduction of a 45 year harvest cycle.**

Province	Area	1° forest in 2006		2° forest in 2006			Total
		Unlogged	Logged 2006-11	Unlogged	Logged 2006-11		Commercial
Availability for harvest[2]		Current & 2055+	2050-2055	2010-35+	2050+	Plantation	Forest
Central	68,500	6,000	2,800	7,600	1,400	200	16,600
Choiseul	330,200	123,800	22,200	18,600	100	800	165,300
Guadalcanal	538,710	2,000	49,000	37,600	14,300	800	89,400
Isabel	422,760	79,400	27,100	68,800	68,200	800	176,000
Makira	329,100	6,100	36,900	9,000	13,400	400	52,300
Malaita	413,800	28,600	27,000	10,400	9,000	3,100	69,100
Western	551,520	78,900	38,200	120,700	38,800	29,500	267,300
National	2,654,590	324,700	203,100	272,700	145,100	35,600	836,100

Notes:

1. Areas are rounded to nearest 100 ha.
2. Availability for harvest is based on Table 3-2 in the SIFMP II 2006 report and assumptions of a minimum 45 year harvest cycle for logged primary and secondary forests. The current length of harvest cycles is considerably shorter. Unlogged primary forest areas figures vary significantly from those in the 2006 SIFMP II report due to the use of different figures on total commercial forest area (see note 2 in Table 2).

3.2. Future commercial forest area

The adoption of approximately 45 year harvest cycles was considered in the 2006 SIFMP II report to be the minimum requirement for the Solomon Islands forest industry to operate on a sustainable basis. With such a harvest cycle the forests would provide on-going revenue for SIG, customary landowners and logging companies, as well as support local employment. It was anticipated to be sufficient to allow the structure and productive capacity of current secondary logging areas to be restored and consequently maintain ecosystem goods and services associated with the forests.

Potential future commercial forest areas for each province have been estimated on the assumption that a 45 year harvest cycle is implemented (Table 3). The immediate resource is represented by about 324,700 ha of unlogged primary forest and any mature sections of the 272,700 ha of currently unlogged secondary forest. The almost 350,000 ha of primary and secondary forest logged between 2006 and 2011 should be rested from timber production until at least 2050.

3.3. Timber production from natural forests

The majority of wood harvested from natural forests is exported as logs. National log export volumes (Figure 2) have increased from about 6-800,000 m^3/y (pre-2006) to over 1.5 million m^3/y in 2010 and 2011[4]. Total log exports since 1995 are estimated to exceed 16.4 million m^3. Annual log exports have exceeded the estimated annual sustained yield of Solomon Islands forests[5] by a factor of at least two over that entire period.

Western and Isabel Provinces have historically been the main sources of log exports (Table 4) and have accounted for approximately 6.3 million m^3 prior to 2006. These two provinces have remained the major sources of log exports since 2006, although exports from Choiseul, Makira, Malaita and Guadalcanal have expanded rapidly. Rennell-Bellona and Temotu Provinces do not contribute significantly to log exports[6].

Productivity of Solomon Islands' forests varies widely between provinces, based on climate (particularly exposure to cyclones), soils, geology and landform. Historical data indicates an annual average commercial harvest yield of approximately 30 m^3/ha (Table 4). Analysis of the figures over the period 2006-2011 indicate the national average has fallen to about 25 m^3/ha. The reduction may reflect several factors, including that smaller trees are being logged in the secondary forests and that some logging is taking place in marginal or non-commercial forest areas (Table 2).

[4] 2011 log export volume has been estimated by extrapolating export volumes for the first half of the year through to year's end. Recent data from SI C&EB (to November 2011) estimated total annual log exports for 2011 of 1.85 million m^3.
[5] Estimated in the 2006 SIFMP report.
[6] As noted previously, for this reason, these two provinces have been excluded from the analysis in this report

- **Table 4 Estimated logging yields from natural forests.**

Province	1994-2005[1]			2006-11[2]		
	Export volume	Logged area	Average yield (m^3/ha)	Export volume	Logged area	Average yield (m^3/ha)
Central	239,000	7,600	31	55,400	4,200	13
Choiseul	773,500	18,600	42	927,000	22,300	42
Guadalcanal	367,800	37,600	10	618,300	63,200	10
Isabel	1,439,800	68,800	21	1,994,800	95,300	21
Makira	301,200	9,000	33	1,099,700	50,300	22
Malaita	286,900	10,400	28	839,600	36,000	23
Western	4,954,600	120,700	41	3,160,700	77,000	41
National	8,362,800	274,200	30	8,695,500	348,300	25

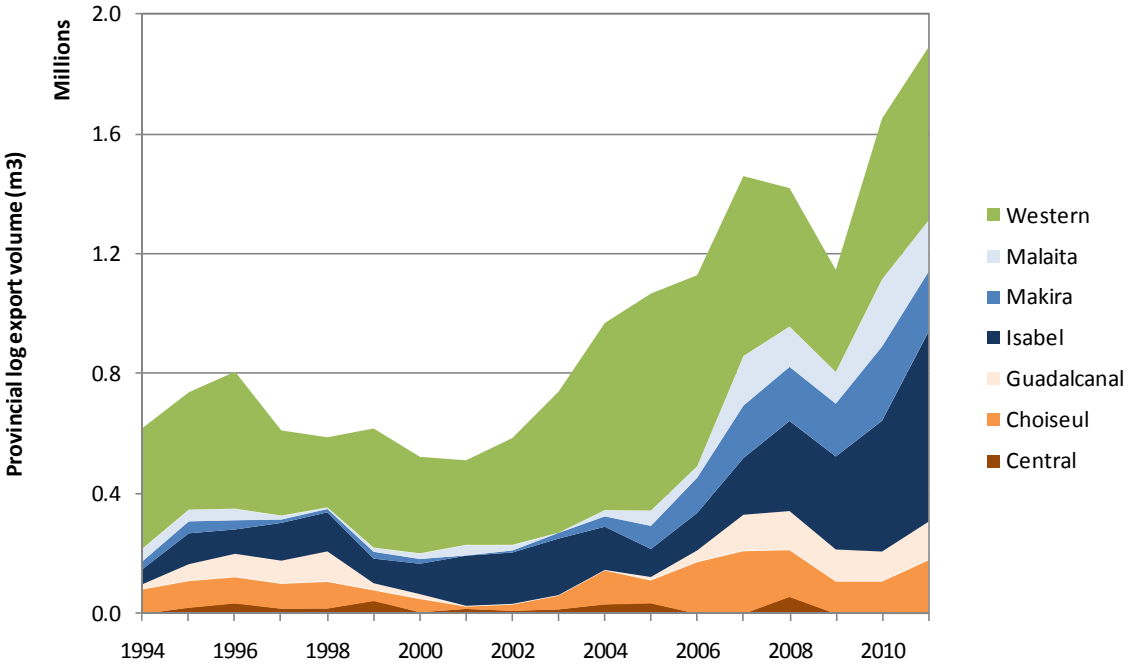
Notes:

1. Data for 1994-2005 taken from SIFMP II 2006, Table 3-3. Note that values for Central Province (and Rennell-Bellona; which is not reported here) in that report were incorrect and inconsistent with other data in the report.
2. 2006-11 logged area estimates include primary and secondary commercial forests and logged non-commercial forests and are taken from Table 1.

3.4. Woodflow assessment

The historical ‘flow’ of wood from each province’s natural forests over time ('woodflow'; Figure 4) illustrates the traditional dominance of log exports from Western province, the rapid escalation in timber production from the early 2000s and the extension of timber production to include Isabel and then the other larger provinces.

Future woodflows may be projected from schedules of future harvesting operations, data on the available harvest areas and estimated wood yield from harvest areas. Since future harvesting operations are not scheduled, it has been necessary to develop scenarios that include projections of future harvest patterns.



Source: SIFMP II 2006; MoF and C&ED data

Note: 2011 is estimated end of year total, based on projecting outputs for first six months of the year

- **Figure 4 Historical woodflows or log exports from Solomon Islands, by province.**

The scenarios (described below and summarised in Table 5) have been developed for Solomon Islands' larger provinces (i.e. not Rennell-Bellona or Temotu provinces) in ways that reflect the current and historical patterns of timber production. They allow for continued (but limited) harvesting in non-commercial forests located within licence boundaries and adjacent to commercial forests. Premature or re-entry logging of current secondary forests is included in all scenarios: this reflects current practice across most provinces.

- **Scenario A: One-off utilisation of the primary and current secondary commercial forest area:** logging continues in each province at the average rate for 2006-2011, until the entire primary commercial forest and all pre-2006 secondary commercial forests are fully logged. Some of the demand for timber is obtained from non-commercial forests areas as the current primary and secondary forest resource is being depleted. Yield in these areas is assumed to be significantly less than that from commercial forests. Following completion of this cycle of logging, there is no further re-entry logging in secondary forests for the duration of the woodflow modelling.

  This scenario broadly corresponds with the natural forest woodflow modelling undertaken for the 2006 SIFMP II report. However, the use of different commercial forest areas to the 2006 report and inclusion of logging of the pre-2006 secondary forests provides for a quite different woodflow outcome.

- **Scenario B: Market driven business as usual logging:** in this scenario logging takes place with little effective control until Solomon Islands' commercial forest resources are exhausted. Logging continues in each province at the average rate for 2006-2011, drawing on remaining primary forests, secondary forests and accessible, marginal forest areas (in the non commercial forest zone). Re-entry logging in secondary forests continues on a 10 year cycle until forest productivity diminishes to very low levels. Forest composition changes in each phase of re-entry logging, with larger trees and those from more valuable species depleted most rapidly.

  This scenario maximises the short-term yield and value of timber production, but has the greatest impact on the ecology of the forests and the value of ecosystem services it can generate. It is considered to represent an extreme and unsustainable level of forest utilisation.
- **Scenario C: Later re-entry into recovering forests:** this scenario follows Scenario B, except that after utilisation of the current primary and secondary forest resource, timber production in the subsequent secondary forests is managed on a 25 year harvest cycle. Yield in second and subsequent logging phases is diminished and smaller and lower value logs increasingly contribute to the harvest.

  This scenario extends the life of the forest resource beyond Scenario B, but the harvest cycle is considered to be too short to provide for the long-term ecological needs of the forest.
- **Scenario D: Sustainable rotation:** in this scenario timber production moves to the minimum harvest cycle considered to be necessary for sustainable rotations in tropical rainforests (45 years). Yield and log composition in secondary forests are similar to those in primary forests. There is no further logging in non-commercial forests.

  Tropical forestry literature (see Shearman *et al.*, 2012) suggests that even this harvest cycle may be too short to meet the long-term ecological requirements of the forest.

Woodflow modelling with these scenarios has adapted the process used in previous forest resource assessments. Future logging rates are based on the average for 2006-2011 for each province. Where the modelling suggests there are insufficient resources to satisfy this demand in a particular province, the excess demand remains unmet and does not increase the log export rates in other provinces. Woodflows are based on actual values to 2011 and then projected using the above scenarios to 2070. In the model, logging ceases in a province when the total estimated resource falls below 25,000 m^3 and resumes when it increases above this level. Following the SIFMP II 2006 report, available timber yield is estimated from the "effective area" of forests (i.e. that adjusted for reduced yield on high slope and in semi-commercial forest areas) rather than the actual area of commercial forest.

Other plausible scenarios could be constructed, but most would fit in the range of resource use or conservation covered by these scenarios. The rates of decline in yield in successive harvest cycles used in the scenarios is based solely on assumptions: (to our knowledge) no analysis of the change

in yield with successive premature secondary forest logging cycles has been undertaken for Solomon Islands' forests.

Table 5 Summary of Solomon Islands woodflow scenarios

Scenario	Harvest cycle for 2° forests	Yield reduction in successive harvest cycles[1]	Non-commercial forest yield[2]	% non-commercial forest logged
A. One-off utilisation	Pre-2006 secondary forests logged once and no further logging takes place	Not applicable	10%	20%
B. Business as usual logging	10 years	75%	10%	20%
C. Later re-entry logging	25 years	50%	10%	20%
D. Sustainable rotations	45 years	None	No further logging in non-commercial forests	

Notes:

1. Yield reductions in successive harvest cycle is an assumption only. We are not aware of inventory data from Solomon Islands' forests that show how potential yield changes in secondary forests.
2. Yield in non-commercial forests is an assumption only, however it has been set at a level lower than the combined adjustment for high slope and semi-commercial forests (40% and 50%, respectively) in the SIFMP II 2006 report.

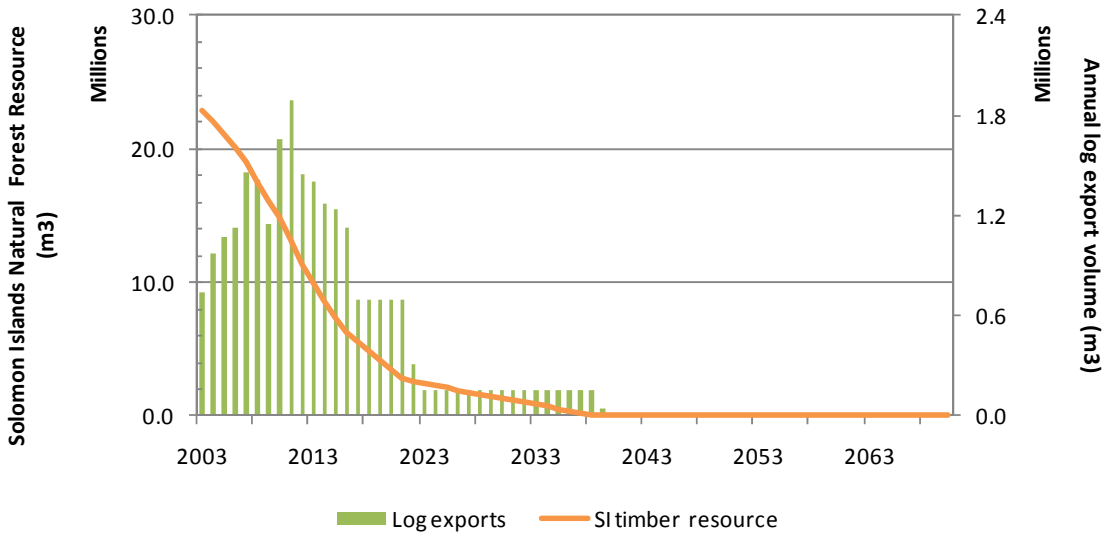
3.4.1. Scenario A: One-off utilisation of primary and current secondary forest area

Scenario A (Figure 5) has been included to represent one-off utilisation of the current primary and secondary forest estate. It is similar to woodflow modelling undertaken for the 2006 SIFMP II report, except that it includes logging of secondary forests and has corrected data on the extent of the commercial forest estate.

Approximately 24.2 million m^3 of logs would be exported from Solomon Islands under Scenario A between 2003 and the projected exhaustion of the resource in 2039. The recent average rate of log export is projected to be sustained by the available resource only for the next two to three years (Figure 5). From 2014, the commercial forest resource of each province is progressively utilised to the point where by 2022 only Choiseul Province is projected to be capable of sustaining commercial timber production (with exports of approximately 155,000 m^3/y through to the late 2030s).

The durability of the Choiseul forest resource under this scenario reflects the relatively low rate of recent log export (11% of total exports) in relation to the extent of the resource and the assumption that logging capacity or export demand would not be transferred from other provinces as those resources are utilised. It seems more likely that if demand for wood from China was sustained,

logging capacity would be progressively transferred, giving a much more rapid rate of resource depletion than depicted in Figure 5.



- **Figure 5 Woodflow modelling for Scenario A: One-off utilisation of the primary and current secondary commercial forest area. The figure shows projected log exports under the assumptions summarised in Table 5 and with future log export demand based on the provincial averages for 2006-2011.**

With the inclusion of pre-2006 secondary forests and allowing for continued logging in non-commercial forests, the life of Solomon Islands' forest resources is projected to extend for more than a decade longer than was estimated in the 2006 SIFMP II report. Even if logging continued at its current rate (approximately 1.9 million m^3/y), the Solomon Islands' primary and pre-2006 secondary forests are projected to sustain logging until the early 2020s, with only Choiseul forests available after that time.

3.4.2. Scenario B: Market-driven business as usual logging

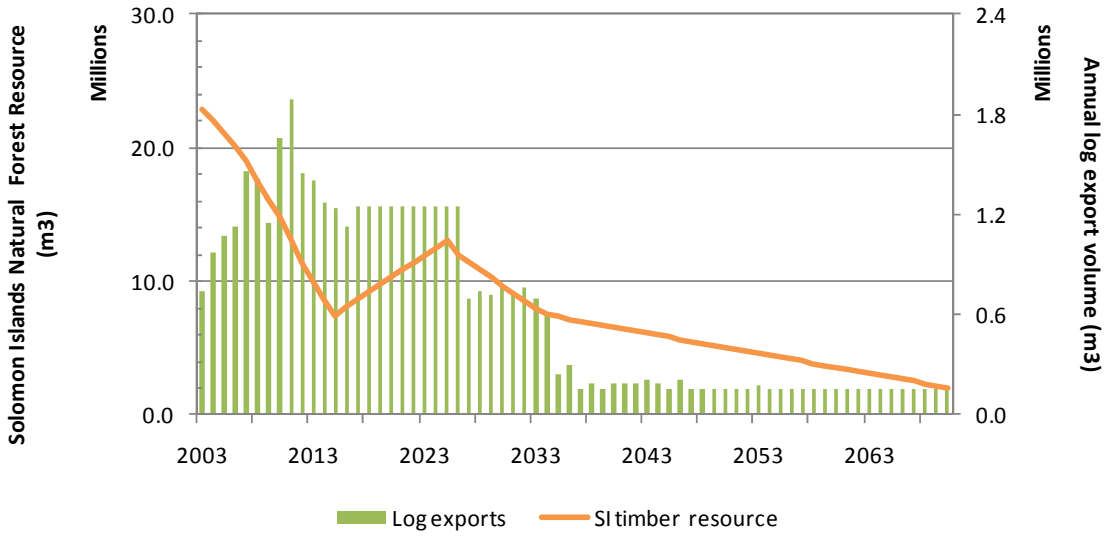
Scenario B (Figure 6) reflects a continuation of the current exploitative pattern of timber production in Solomon Islands. It anticipates that re-entry to secondary forests will occur on a roughly 10 year cycle and that there will be continued logging of marginal forests. The scenario anticipates that the yield declines by 75% in successive harvest cycles and that after several secondary forest harvest cycles only small logs of lower value species are produced (see section 3.5).

This scenario represents a situation in which the forest estate in all but Choiseul Province is logged to the point where its productive capacity is virtually eliminated. While this would be the long-term outcome of Scenario B, log exports are projected to be sustained at over 600,000 m^3/y until 2034,

after which they would fall rapidly to 150,000-200,000 m^3/y. Over the period to 2070 over 42.2 million m^3 of logs are projected to be exported from Solomon Islands forests.

Under this scenario, log exports beyond 2050 would be almost entirely dependent on production from Choiseul Province. If, as noted above, logging capacity was shifted to Choiseul following the exhaustion of resources in other provinces, the Solomon Islands' commercial forest resource could be entirely depleted.

This scenario also projected a rapid change in the composition and structure of the forests, with larger trees and those of higher value, darker coloured species, almost entirely removed by the second, secondary rotation.



- **Figure 6 Woodflow modelling for Scenario B: Market-driven business as usual logging. The figure shows projected log exports under the assumptions summarised in Table 5 and with future log export demand based on the provincial averages for 2006-2011.**

Although this scenario is projected to maximise the short-medium term log export capacity of Solomon Islands' forests, it is anticipated to have the greatest impact on the provision of ecosystem services (e.g. clean water, flash flood mitigation, biodiversity protection, bush food provision). It is unclear whether after the multiple cycles of premature re-entry logging anticipated by this scenario the forests could recover to provide timber and other forest products and services, even if protected from harvesting for many decades.

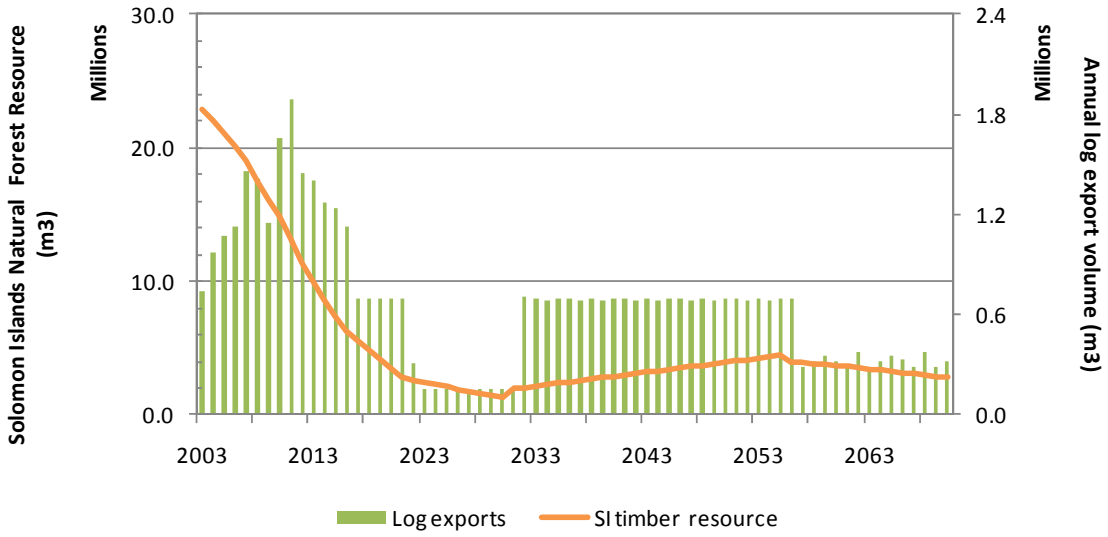
3.4.3. Scenario C: Later re-entry logging into recovering forests

Scenario C (Figure 7) is based on a management regime that allows re-entry logging to occur after a 25 year break, following the utilisation of the current primary and secondary forest estate. This is

premature and means that yields do not fully recover to the level of the original primary forest (assumed to be 50% loss in yield with successive harvest cycles).

Scenario C is projected to provide sustained opportunities for timber production from natural Solomon Islands' forests. Total projected yield to 2070 is almost 45.0 million m^3, which is almost 7% more (in total) than for Scenario B.

The scenario projects that log export from four provinces (Guadalcanal, Isabel, Makira and Malaita) would cease between 2013 and 2016. While it would be premature, logging is projected to recommence in these provinces in the early 2030s. Logging in Choiseul Province (only) is projected to continue throughout that period.



- **Figure 7 Woodflow modelling for Scenario C: Later re-entry logging into recovering forests. The figure shows projected log exports under the assumptions summarised in Table 5 and with future log export demand based on the provincial averages for 2006-2011.**

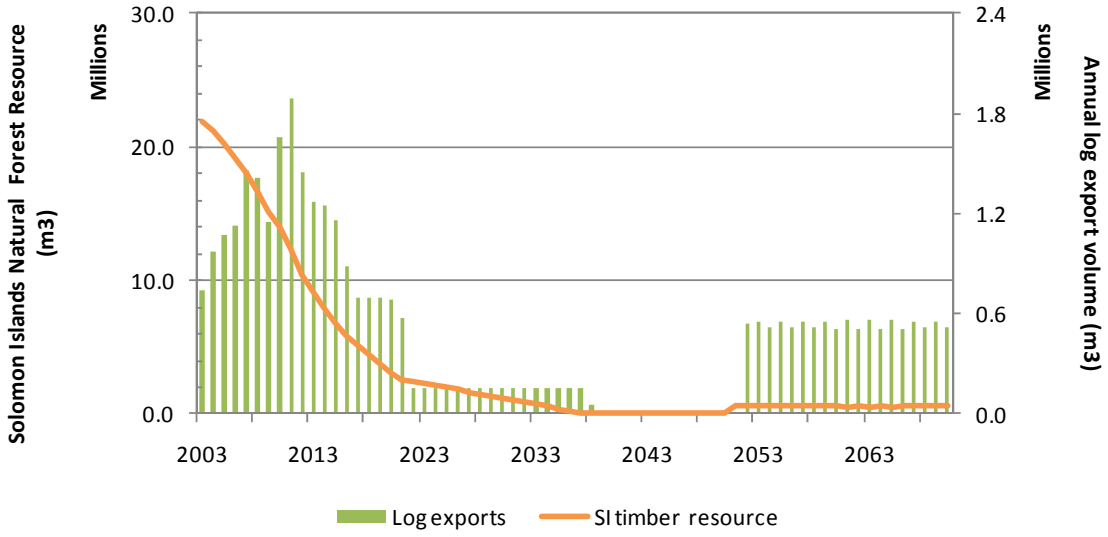
3.4.4. Scenario D: Sustainable rotations

Scenario D (Figure 8) is the projected outcome of moving the Solomon Islands natural forest industry to a mode of operation in which natural forests are managed in a way that sustains (in the long-term) timber yields and the provision of forest ecosystem services. Under this scenario, logging in non-commercial or marginal forests would cease and all future harvest cycles would be extended to 45 years (which is at the lower end of estimates of the time needed for forests to recover their structure and composition following logging; Shearman *et al.*, 2012).

Total log exports to 2070 under this scenario are approximately 33.5 million m^3. Log exports are projected to halt following the depletion of primary and pre-2006 secondary forests in all but

Choiseul Province by the early 2020s. Log exports could be maintained from Choiseul (with logging at about the 2006-2011 rate) until the late 2030s. Log exports are projected to return to over 500,000 m^3/y from the early 2050s.

Scenario D is anticipated to allow recovery of the species composition of the original natural forests and enable the growth of larger logs. It is also anticipated that this scenario would provide greater levels of ecosystem service generation than other scenarios.



- **Figure 8 Woodflow modelling for Scenario D: Sustainable rotations. The figure shows projected log exports under the assumptions summarised in Table 5 and with future log export demand based on the provincial averages for 2006-2011.**

3.5. Solomon Islands log groups and grade size trends

The market value and duty payable on Solomon Islands logs varies with size and species. Four main species groups have been defined (Table 6), based on wood properties. Species group and size determine logs' market value and hence the duty payable (for natural forest log exports) to Solomon Islands Government[7]. Legally, only logs from "regular" size grade trees (above 60 cm in diameter at breast height over bark; dbhob) logs are available for export. Smaller logs can be exported, although they should only be from the head of "regular" sized trees or from smaller trees that are unavoidably felled during road construction or other development activities.

[7] Logs that are not exported and logs grown in plantations do not attract a duty from SIG.

Group 1 species are 'shade tolerant' and relatively slow growing. Slower growth confers preferred wood properties (i.e. higher durability, greater strength, darker colours etc), and higher value. At the opposite end of the spectrum, Group 4 species are typically light demanding and possess less-preferred wood qualities (lower durability, strength etc). Nevertheless they play a critical role in recolonising disturbed forests. Such logs attract lower prices and lower duty.

- **Table 6 Species groups for Solomon Islands logs**

Group[1]	Major Species
1	*Palaquim* (Pencil Cedar), *Calophyllum*, *Pometia* (Tuan, Akwa), *Planchonella*
2	*Schizomeria* (Beabea), *Dillenia*, *Gonostylus* (Ramin), *Terminalia brassii*
3	*Terminalia* (Except *T.brassii*), *Terminalia calamansanai*, *Burkella*, *Celtis*, *Alstonia* (Milky Pine), *Dysoxyllum*, *Endospermum*, *Amoora*, *Campnosperma*
4	*Maranthes*, Mixed Species, *Parinari*

Notes:

1. Excludes the species reserved for domestic processing including *Instia bijuga* (Kwila) and *Vitex cofassus* (Vasa) which are prohibited for log export.

Sustainable woodflow is predicated on allowing full recovery of the composition and structure of previously logged forests. This restores productive capacity (in terms of potential yield per hectare) and ensures that larger and more valuable logs are available for harvest. Analysis of C&ED data for 2011 confirms the trend identified in the SIFMP II 2006 report of declining size of exported logs (Table 7). Small and super small logs have increased as a proportion of all logs exported (from 13 to 20% and 6 to 12%, respectively; Figure 9) and there has been a corresponding reduction in regular logs. At present, there has been no detectable trend in the mix of species groups in export logs.

- **Table 7 Distribution of log exports by species groups and grades: 2005 and 2011**

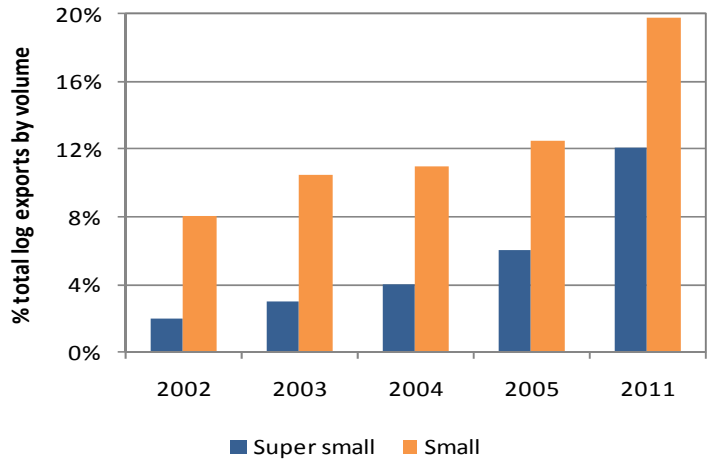
	Regular		Small		Super small		Low	
Group	**2005**	**2011**	**2005**	**2011**	**2005**	**2011**	**2005**	**2011**
1	24%	22%	5%	7%	2%	4%	7%	6%
2	18%	20%	2%	3%	1%	2%	7%	3%
3	14%	9%	4%	6%	2%	4%	3%	2%
4	5%	5%	2%	4%	1%	3%	4%	2%
Total	61%	55%	13%	20%	6%	12%	21%	13%

Source: SIFMP II 2006, C&ED data

The increasing proportion of smaller logs being exported suggests growing technical contravention of felling licence conditions, which stipulate that only trees over 60 cm dbhob are to be felled. It

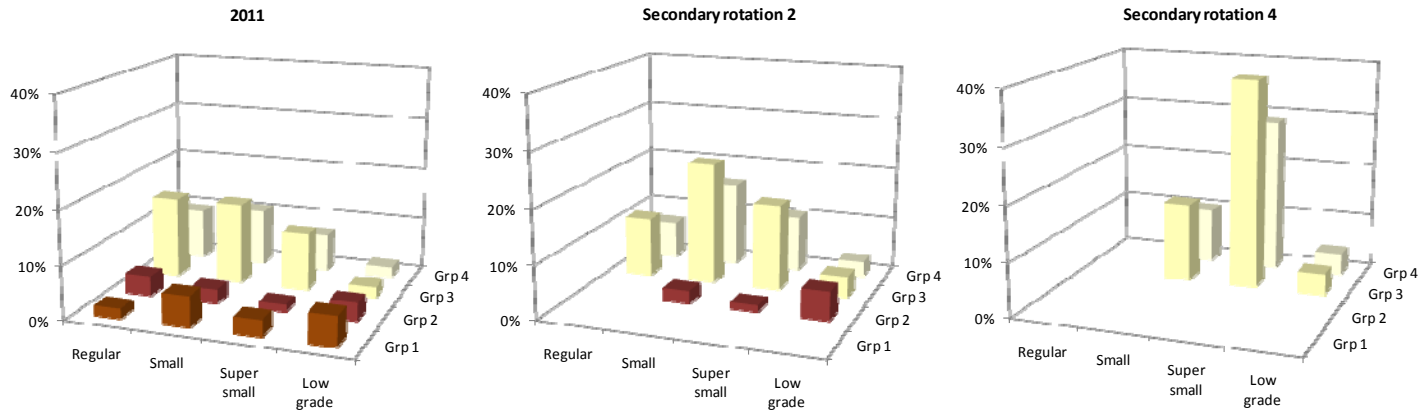
also confirms that re-entry logging is widespread and that the harvest cycle has been too short to allow the forests to recover their original structure and size composition.

The implications of repeated harvest cycles on the size and species composition of log exports were explored in scenarios paralleling those developed for woodflow modelling (section 3.4). The scenarios extrapolated the observed changes in size and species mix, based on the expectation that repeated, premature harvest cycles would increase the proportion of smaller logs and those of lower value species, with paler and less durable timber (Figure 10).



Source: SIFMP II 2006 report; SIG C&ED data

- **Figure 9 Change in the proportion of small and super small logs between 2002 and 2011.**



Source: SIG C&ED data for 2011. Secondary rotation 2 and 4 based on assumptions of change in log size and species group. First and third secondary rotation scenarios not shown.

- **Figure 10 Scenarios illustrating anticipated change in species mix and size of exported logs from repeated, premature harvest cycles in natural forests. Graphs show the percent of total log exports included in each log size and species group combination. Darker colours reflect more intense colour and greater durability of wood from group 1 and 4 species.**

Repeated cycles of premature re-entry logging is anticipated to almost eliminate the more shade tolerant and slower growing group 1 and group 2 species. In these hypothetical scenarios, this would be achieved by the third premature secondary harvest cycle. The short harvest cycle would also mean that the forest is largely composed of small diameter trees that would produce small or super small logs.

The increase in smaller and lower value log classes would also be accompanied by a reduction in the value of log exports and duty payable to SIG. Average duty under the three scenarios depicted in Figure 10 would decline from \$216 SBD/m^3 currently to \$181 SBD/m^3 in secondary rotation 2 to \$174 SBD/m^3 in secondary rotation 4[8].

3.6. Non-declining woodflow potential

It should be possible to manage the current remaining resource on a non-declining yield basis if the annual harvest volumes are maintained. This yield level was estimated by SIFMP II (2006) to be approximately 250,000 m^3/y. This estimate has not been formally updated as the concept has not been incorporated into the management of Solomon Islands forest resources. If a 45 year harvest cycle is capable of maintaining natural forests' structure and composition, Scenario D (Figure 8) suggests that log exports of around 500,000 m^3/y may be maintained.

3.7. Environmental implications of future forest management

Tropical forestry literature is replete with warnings of the ecological dangers of unregulated and damaging logging operations and premature re-logging of secondary forests (e.g. Schindele 1989; Woods 1989; Uhl and Viera, 1989; Johns, 1992; d'Oliveira and Braz, 1995; Gerwing *et al*, 1996). Neil (1984), in his study on Kolombangara Island, warned of forest structure collapse and smothered tree regeneration due to climber and weed invasion due to altered forest canopy openings caused by increased or repeated logging operations.

A polycyclic logging intensity of 5-8 trees/ha/cycle is considered to be sustainable for most tropical forests (Boerboom and Wiersum 1983). Logging intensities exceeding 8 trees/ha/cycle could jeopardise regeneration, regardless of how well an operation was planned and executed (Sist *et al*. 1998).

No recent post-logging residual stand stocking information or stand damage measurements are available in Solomon Islands to assist in forecasting forest recovery from primary or secondary logging. However, studies of rainforest regeneration following unplanned logging in Vanuatu (which has similar forest types) found that an average 43 m^3/ha of logs were removed by harvesting

[8] Average duty estimates based on November 2011 export duty rate schedule and US dollar-SBD exchange rates.

and a further 22 m³/ha of trees were destroyed by poor felling and skidding practices (Applegate 1992). This level of exploitation and damage created large gaps in the canopy, providing ideal growing conditions for weed species such as *Merremia* vine, which can form closed communities and suppress tree regeneration.

Evidence of creeper invasion is apparent on sections of North New Georgia which were subjected to repeated, short rotation logging cycles. KFPL's plantations were established in this area because the natural forests lost their productive capacity as a result of repeated logging and weed infestation.

Despite their apparent potential to sustain employment and SIG revenues over the next decade or more, the potential environmental consequences of the current exploitive logging practices should be considered carefully. They are most likely already contributing to changes in essential ecological functions and the provision of ecosystem services such as provision of clean water; flood mitigation; protection from erosion; food provision; carbon storage; and maintenance of cultural heritage. In the longer term, they may lead to irreversible loss of productive capacity timber and other ecosystem goods and services.

3.8. Revenue from log exports

The natural forest sector is a major revenue source for SIG and landowners alike. As previously indicated, SIG derives revenue from export tariff duties based on declared FOB (free on board) values which are generally in line with the prescribed 'Export Duty Rate Schedule' (EDRS). The EDRS is a SIG instrument administered by Ministry of Finance and Treasury (MoFT) and gazetted by ministerial order to determine payable duty rates based on a determined FOB prices (in US$/m³) for all Solomon Islands logs (by species and by grades; Table 8).

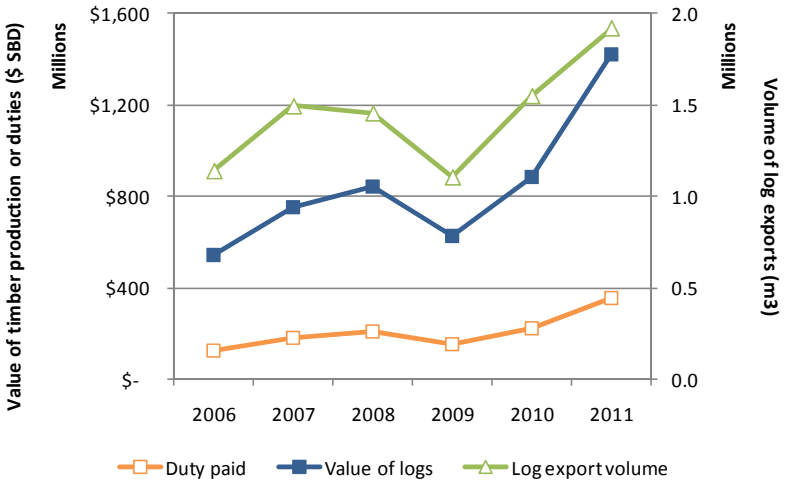
- **Table 8 Export duty rate schedule (October-December 2011)**

Species	Regular Grade (US$/m^3)	Small Grade (US$/m^3)	Super Small Grade (US$/m^3)	Low Grade (US$/m^3)
Palaquim (Pencil Cedar)	32.66	29.66	28.66	23.66
Calophyllum	33.66	30.66	29.66	23.66
Pometia (Tuan, Akwa)	33.66	30.66	29.66	23.66
Planchonella	32.66	29.66	28.66	23.66
Schizomeria (Beabea)	29.66	26.66	25.66	22.66
Dillenia	26.66	24.66	23.66	21.66
Gonostylus (Ramin)	28.66	26.66	24.66	21.66
Terminalia brassii	27.66	25.66	23.66	20.66
Terminalia (except T. brassii)	24.66	22.66	21.66	19.66

Species	Regular Grade (US$/m^3)	Small Grade (US$/m^3)	Super Small Grade (US$/m^3)	Low Grade (US$/m^3)
Terminalia calamansanai	24.66	22.66	21.66	19.66
Canarium (Gnali)	25.66	23.66	22.66	21.66
Burkella	25.66	23.66	22.66	21.66
Celtis	24.66	22.66	21.66	19.66
Alstonia (Milky pine)	24.66	22.66	21.66	19.66
Dysoxyllum	24.66	22.66	21.66	19.66
Eugenia (Water gum)	25.66	23.66	22.66	21.66
Endospermum	24.66	22.66	21.66	19.66
Amoora	24.66	22.66	21.66	19.66
Campnosperma	25.66	23.66	22.66	21.66
Maranthes	22.66	21.66	19.66	16.66
Mixed Species	22.66	21.66	19.66	16.66
Parinari	22.66	21.66	19.66	16.66

Source: SIG C&ED data.

The total value of logs exported from Solomon Islands between 2006 and 2011 exceeded $5.2 billion SBD. Exports attracted a total duty of over $1.2 billion SBD (Figure 11). The value of log exports and the duty they have attracted increased more than threefold between 2005 and 2011, which is much more than the increase in log export volumes. Income earned by landholders and log exporters is not reported.



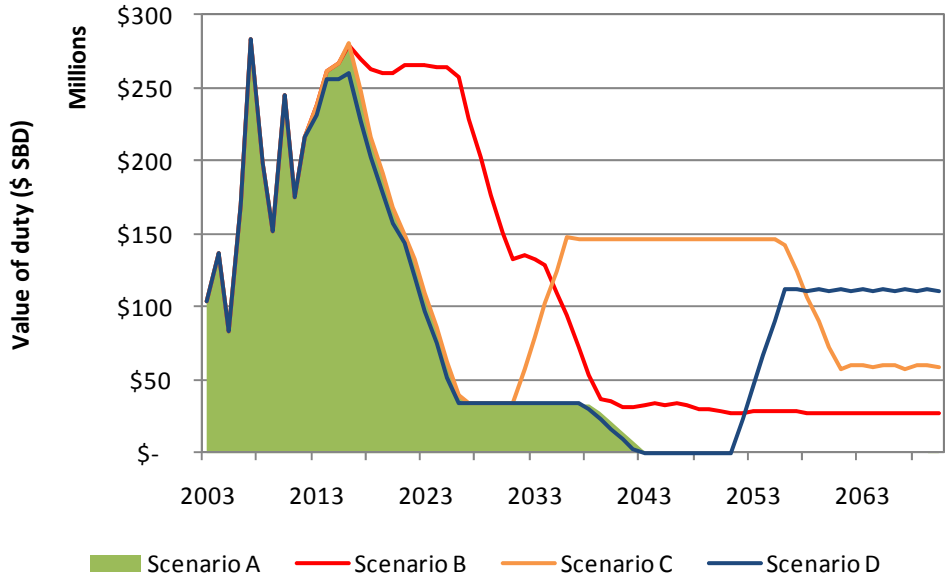
Source: C&ED data

Note: 2011 data estimated based on average for 9 months to September

- **Figure 11 Solomon Islands log exports 2006-2011: volume exported, value of logs and duty paid to SIG.**

3.9. Revenue projections

The woodflow and log size scenarios described in section 3.4 and Figure 10 (respectively) were used to project revenues (from tariff duties) which may accrue to SIG from future log exports (Figure 12). Scenario A shows average SIG revenue from log export duties as the current primary and secondary forests are utilised. Average annual duty[9] would fall from almost $280 million/y in 2016 to nothing by 2044. Total SIG revenue to 2070 is projected to be $4.3 billion SBD.



Note: Revenues based on constant 2011 SBD prices ($157/m^3) and do not account for the expected price reduction as log sizes decline because of short harvest cycles in secondary forests.
Value of duty for scenarios B and C are identical until 2016.
Values plotted for the scenario period (2012-2070) are the five year running average of projected duty revenues: which have been calculated to smooth some year-to-year variation in SIG revenue.

- **Figure 12 Projected SIG revenue flows associated with woodflow scenarios.**

Under scenario B, SIG revenues are projected to be sustained at relatively high levels (above $200 million SBD/y) until the mid 2020s and would remain above $100 million SBD/y until the mid 2030s. Future revenues under this scenario would be sustained by relatively low rates of logging in Choiseul Province: which would only occur if logging capacity was not shifted from other areas once commercial timber resources were exhausted in other provinces. Total export duty revenue for SIG over the period 2003-2070 is projected to be $2.3 billion SBD.

Scenarios C and D follow a similar path until about 2030, when secondary logging recommences in scenario C. Revenues are projected to increase to almost $150 million SBD until the mid 2050s.

[9] Running average over five years to the year for which data were plotted.

Reduced yields in the third secondary forest cycle would sustain SIG duty revenues at about $50 million SBD/y (Figure 12). Total SIG duty revenue under this scenario is $8.5 billion SBD.

The return of secondary logging in scenario D in the 2050s would see SIG duty revenue from log exports increasing to over $100 million SBD/y. Revenues are projected to be sustained at this level indefinitely. Total revenue under scenario D is $6.2 billion SBD.

Net present values (NPV; at discount rates of 4 and 8%[10]) of SIG revenue flows have been calculated for the four scenarios (Table 9). Despite scenario B having lower overall duty revenue than scenario C, it provides the greatest NPV, reflecting that most of the revenue occurs early in the scenario period.

- **Table 9 Net present value (NPV) at 4% and 8% real discount rates and total projected revenue for woodflow scenarios, 2003-2070. Calculations are based on constant 2011 prices.**

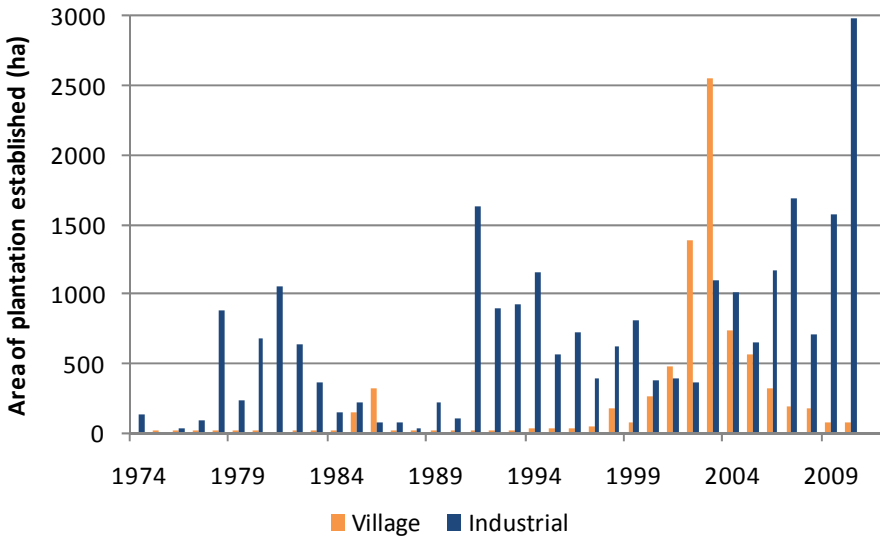
Scenario	NPV @ 4% discount rate	NPV @ 8% discount rate	Total undiscounted revenue
Scenario A	$2.72 billion SBD	$1.87 billion SBD	$4.30 billion SBD
Scenario B - 10 year harvest cycle	$3.86 billion SBD	$2.34 billion SBD	$7.64 billion SBD
Scenario C – 25 year harvest cycle	$3.46 billion SBD	$2.03 billion SBD	$8.52 billion SBD
Scenario D – 45 year harvest cycle	$2.84 billion SBD	$1.86 billion SBD	$6.22 billion SBD

Note: Calculations are based on constant 2011 real values for revenues from timber for each group and size of log.

[10] 4% and 8% real discount rates used for illustrative purposes only and are examples of discount rates commonly used in analyses of NPV of public investments in Australia. NPV of scenario C exceeds that of scenario B at approximately 1.4% real discount rate.

4. Plantations

The plantation sector represents an opportunity for employment and income-generation within the rural sector. Industrial-scale plantations are managed by two major commercial operators, Eagon Pacific Plantations Limited (EPPL) and Kolombangara Forest Products Limited (KFPL), both of whom operate in Western Province. Customary landholders spread throughout Solomon Islands have established and manage a large number of "smallholder" or "village" plantations. The first commercial (or industrial) and village plantations were established in the 1970s. Rates of both village and industrial plantation establishment have been highly variable between years (Figure 13), with over 2,000 ha of either form established in some years. The total plantation estate is estimated to be 35,600 ha, of which almost 80% is industrial plantation (Table 1).



Source: EPPL and KFPL data; SIG MoF small holder data base

- **Figure 13 Annual rate of plantation establishment for industrial and village plantations**

4.1. Current commercial plantations

EPPL and KFPL operate industrial plantations on SIG-land in Western Province under long term lease arrangements. Unlike operators in the natural forest sector, both companies hold Forest Stewardship Council (FSC) accreditation for sustainable forest management.

Since 2006, KFPL has undergone several major changes including the transfer of ownership from the original investors (SIG and the UK-government investment entity Commonwealth Investment Corporation) to a US-based private equity group. During the intervening period, KFPL received considerable financial support to replant large areas of under-performing plantation (approximately

4,700 ha). More recently, KFPL has been sold to a private Taiwanese company involved in the production of high-value niche products for windows and blinds.

Under-developed estates on Isabel Island (ex-Allardyce Tract, now Isabel Provincial Government responsibility) and MoF estates in Temotu and Western Province, represent an additional 7,000 ha of potentially commercial forestry plantation. The Allardyce Tract plantations were logged in the early part of the decade and have not been replanted. This land provides an attractive opportunity for investment in the plantation sector due to relative secure land tenure arrangements. Older MoF estates in Temotu and Shortlands have not been actively managed over the past decade and their current suitability for commercial production is unknown.

The dominant industrial plantation species are *Eucalyptus deglupta* and *Gmelina arborea*, which are used for plywood and other relatively low value industrial applications. There are also small areas of Teak (*Tectona grandis*) and Mahogany (*Swietenia macrophylla*) plantations, which are suitable for higher-value uses.

4.2. Village plantations

An active program of forest extension resulted in the establishment of large numbers of smallholder "village" plantations during the 2000s (Figure 13). After peaking at over 2,500 ha in 2003, expansion of village plantations has almost stalled. This is attributed to grower confusion over an anticipated 'government funded scheme' which curtailed individual planting efforts encouraged under the MoF-SIFMP II extension program.

The main species established have been the potentially high value species, Teak and Mahogany. Smaller areas of *E.deglupta* and *G.arborea* have been established. MoF have continued to advise existing smallholders and encourage maintenance programs for existing plantations, which is vital to ensure production potential and revenue expectations are realised.

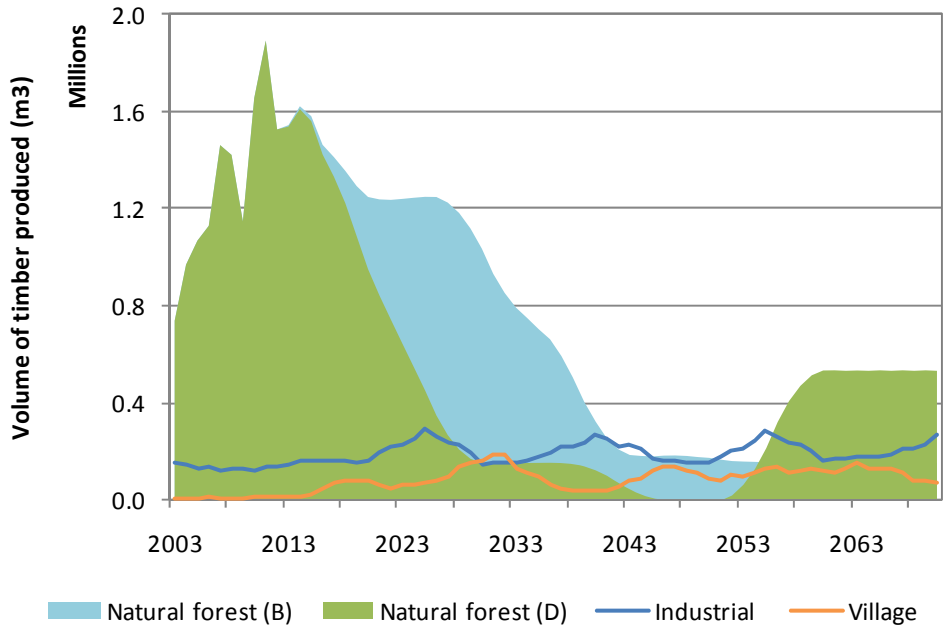
4.3. Plantation woodflow projections

Plantation woodflow projections have been updated from the 2006 SIFMP II report. Woodflows from the village and industrial sectors were included, based on these assumptions:

- **Industrial plantations:** no further expansion in the industrial sector, resulting from limits in availability of new land with appropriate tenure security. All current plantations are re-established using the same species at the end of each rotation.
- **Village plantations:** plantations expand at the average rate for each species for 2006-2011, with plantations all replaced when they reach maturity.
- **Rotation length and harvest volume:** thinning and harvest volumes and rotation lengths given in Table 4-3 in the SIFMP II 2006 report were used without modification.

While it should be possible to maintain a program achieving approximately 140 ha/y of new village plantations, it seems unlikely that all existing village plantations will be replaced at maturity, without significant intervention by SIG. While industrial plantations may expand somewhat (as discussed in section 4.1), expansion is likely to remain limited by access to land with secure tenure arrangements.

Projected yields from industrial plantations (Figure 14) range between about 150,000 m^3/y and almost 300,000 m^3/y. There is significant variation in projected annual yield which results from the life cycles of various phases of plantation expansion. Yield from village plantations is projected to increase from very low levels currently to a peak of over 185,000 m^3/y. Yields are projected to stabilise at about 80-100,000 m^3/y from the 2050s.



Timber production volumes post 2011 are the five year running average. This figure was used to smooth out the highly volatile annual plantation rate and its impact on annual timber yields in first and subsequent rotations.

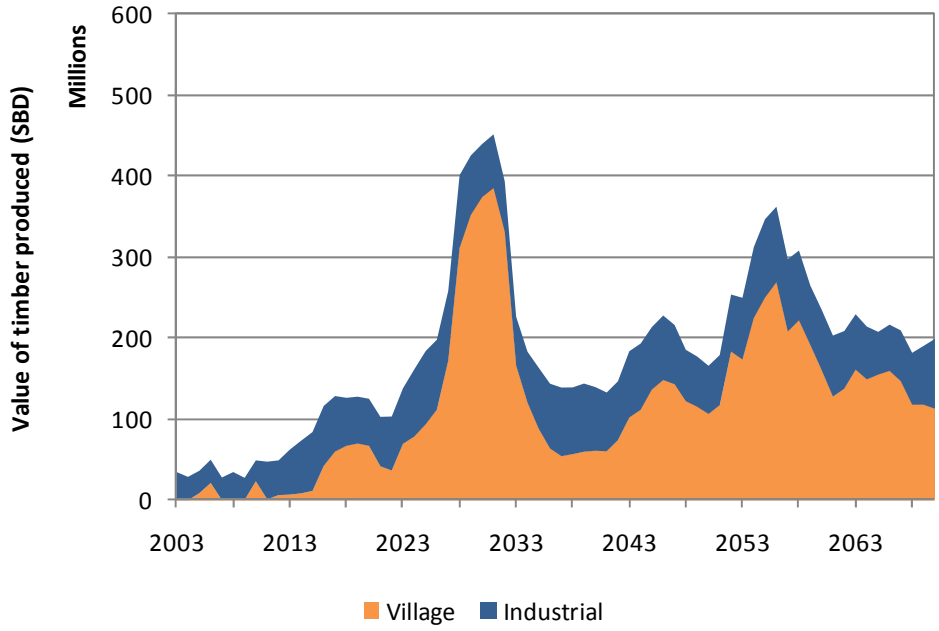
- **Figure 14 Projected woodflows from industrial and village plantations, with natural forest scenarios B and D included for reference.**

While plantations represent a relatively small resource relative to natural forests, they have potential to play a significant role in Solomon Islands' future timber industry if they are well-managed. They have potential to be a source of forestry-related income (to landholders rather than SIG) and employment during periods when timber supplies from natural forests are either not available for harvest (scenario D) or have been exhausted (scenario B; Figure 14).

4.4. Plantation income projections

No direct SIG revenues are raised from plantation activities due to their duty exemptions. However, these plantations provide revenues for commercial and village operators and represent employment opportunities.

Income potentially generated under the woodflow scenarios depicted in Figure 14 were determined using the revenue after cost data presented in the 2006 SIFMP II report (Table 4-4). Based on woodflow modelling and these revenue figures, income from wood produced by plantations is projected to increase to be consistently over $200 million SBD by the 2050s. Income generated by industrial plantations is projected to be relatively stable at about $60-70 million SBD. Income from village plantations is projected to be more volatile and reach a peak of almost $400 million when the 2003 plantations are harvested (Figure 15).



Source: SIFMP II 2006 report and Figure 15.

No SIG revenues are generated from either the commercial or village plantation sector. Income for industrial plantations is depicted as adding to income from village plantations

- **Figure 15 Projected income generated from industrial and village plantations.**

As SIG duties generated from natural forests are not directly comparable with revenues generated for plantation owners, the two sets of data are not plotted together. However, it is clear from Figure 14 that plantations could play an important role in sustaining a timber industry in Solomon Islands. However, they are unable to address any loss of SIG duty revenues resulting from either exhaustion or protection of the forest resource.

5. Key findings

The consultation and analysis undertaken for this project has highlighted several important issues for Solomon Islands' forestry and log export sectors, as follows:

- **The immediate future of logging industry:** despite the acceleration in logging activity since publication of the 2006 Solomon Islands Forest Resource Assessment, it appears highly unlikely that the industry is about to crash as was suggested. Widespread (and premature) re-entry into secondary forests is projected to sustain significant levels of logging activity for at least another decade and at lower levels for several more decades.
- **Current logging industry practices are unsustainable:** widespread, premature re-entry logging that is currently practiced jeopardises future timber resources and the capacity of natural forests to provide critical ecosystem services, such as protection of water quality, flood mitigation, maintenance of biodiversity, provision of traditional medicines and food production. Repeated, short cycle logging of secondary forests will almost certainly change species composition and structure in ways that run down their productive capacity and ecological functions. The speed at which this expected transformation is not known, in part due to the lack of inventory data for logged areas.
- **Long-term natural forest woodflow and revenue projections are highly uncertain:** sustained demand from forest products manufacturers in Asia is expected to sustain the current historically high woodflows and revenues over the next several years. However, beyond about five years, uncertainty about the extent and impact of logging and the resilience of forests means that longer term woodflow and revenue projections are highly uncertain.
- **Agencies overseeing Solomon Islands' timber industry are under-resourced:** key agencies responsible for compliance and monitoring of logging operations and log exports do not have sufficient personnel or logistical resources to undertake their roles effectively. This creates considerable potential for wasteful and damaging logging operations and revenue leakage for SIG. It also means that there is insufficient information and operational control to sustainably manage Solomon Islands' natural forest resources.
- **Improved data management is required:** several SIG agencies are involved in gathering, processing and reporting information on log exports and associated SIG revenues. Data held by agencies is often inconsistent and difficult to compare and analyse. Data are vulnerable to loss or corruption due to the lack of integrated information systems.
- **The long-term future of the logging industry:** while it may be possible to maintain logging industry operations at their current level, structure and impact for at least another decade, the industry cannot do so indefinitely. Business as usual is anticipated to lead to irreversible loss of productive capacity in natural forests, essential ecosystem services and SIG revenues.

Moving the industry to operate on a more sustainable basis will inevitably lead to significant reductions in employment and revenue from the sector, possibly lasting decades.

- **The role of plantations:** the industrial plantations sector appears to operate sustainably. The potential of the village plantation sector will not be realised unless plantations are re-established at the end of their harvest cycles. It is not clear that this will happen.
- **The need for institutional strengthening in the forestry and related sectors:** stronger SIG policy, more effective implementation and improved interaction between key agencies are required if Solomon Islands' forests are to be managed sustainably and generate fair returns to landowners, the broader Solomon Islands and Government.
- **Many Solomon Islands forest ecosystems will remain largely intact:** over half of Solomon Islands is covered by forests, which by reason of topography, access, low productivity and regulation appear unlikely to be subject to commercial logging operations. Even if the country's commercial forest resources are irreversibly exhausted, significant forest areas will remain and will continue provide important ecosystem services.

6. Conclusions and recommendations

6.1. Conclusions

Wood production from Solomon Islands' natural forests has accelerated rapidly since 2006 despite the warnings of the previous Forest Resource Assessments that logging rates were already unsustainable. The country's primary commercial forests are anticipated to be fully logged in most provinces within the next decade.

Licences have been allocated to areas that have previously been logged, despite there being insufficient time for forest stand structure and log size distributions to be restored. Logging in these areas is projected to help sustain the industry for the next decade and possibly longer, but only at a long term and very significant cost to the natural commercial forest resource and the ecosystem goods and services those forests provide to the Solomon Islands community.

Alternatives exist to the currently highly exploitative operations of the logging industry. Longer harvest cycles in secondary forests may slow or even avoid irreversible damage to commercial forest ecosystems. However, extending harvest cycles to more sustainable levels will inevitably lead to significant and prolonged reductions in SIG revenue and employment. Opportunities to move to more sustainable harvesting cycles will not remain open indefinitely.

Both industrial and village plantations offer opportunities to offset some of the impacts of future management of commercial native forests on employment and economic activity, although not on SIG revenues. Further investment in strengthening the village plantation sector would be required for it to play a significant, on-going role in the country's timber industry.

6.2. Recommendations

The consultation and analysis undertaken in the course of this update of Solomon Islands' national forest resource assessment has raised a range of issues for which recommendations are made for consideration by RAMSI and SIG.

Issue addressed	Recommendations
Institutional support for sustainable forest industry	
Key agencies responsible for compliance and monitoring of logging operations and log exports are insufficiently resourced. Potential consequences include wasteful and damaging logging operations and revenue leakage for SIG.	1. Allocation of resources should be increased to ensure adequate surveillance of log shipments. In the short term (up to 1 year), this should be allocated to relevant SIG units in MoF and C&ED. In the longer-term (beyond 1 year) resources should be allocated to establishing a fully independent log monitoring service such as is operated by SGS for PNG Forests Authority. 2. MoF in-forest monitoring activities should be strengthened to ensure compliance with licence

Issue addressed	Recommendations
	conditions. 3. Donors should re-engage with MoF to support efforts for more sustainable management of Solomon Islands forests and achieve fair returns from their use.
Key agencies responsible for compliance and monitoring of logging operations and log exports do not have sufficient personnel or logistical resources to undertake their roles effectively. Potential consequences include wasteful and damaging logging operations and revenue leakage for SIG.	4. Allocation of resources should be increased to ensure adequate surveillance of log shipments. In the short term (up to 1 year), this should be allocated to relevant SIG units in MoF and C&ED. In the longer-term (beyond 1 year) resources should be allocated to establishing a fully independent log monitoring service such as is operated by SGS for PNG Forests Authority. 5. MoF in-forest monitoring activities should be strengthened to ensure compliance with licence conditions.
Logging operations are currently being conducted in unlicensed areas and in non-commercial forest. Licences are being granted for areas of non-commercial forest, including steep or high elevation land for which timber production is proscribed under SIG's Code of Logging Practice.	6. Logging licences should only be issued for commercial forest areas, as defined by Code of Logging Practice. 7. Logging licences should not be issued for environmentally sensitive areas within commercial forest estate in accordance with environmental laws.
Information for effective forest management	
Inventory information is lacking from secondary forests. As a result, the impact on future forest productivity and ecosystem service provision of premature logging in secondary forests is unknown. The capacity for informed management is diminished as a result and future woodflow and revenue projections are highly speculative and uncertain.	8. Systematic inventories of secondary forests should be undertaken to assess future growing stock, productive capacity and environmental impact. 9. Information should be used to inform SIG policy on secondary logging and future updates of the Solomon Islands Forest Resource Assessment.
Logging continues at historically high rate and is being conducted in non-commercial forest and non-licence areas. Regular monitoring of logging activity is required to enable effective management of forest resources.	10. Satellite imagery should be acquired for the largely Solomon Islands provinces and an analysis of logging areas conducted at a maximum of two yearly intervals. 11. A forest data management team and information system should be established in association with the national GIS centre.
Key SIG agencies' log export data sets are inconsistent and incompatible. Revenue compliance, monitoring and reporting may be inaccurate as a result.	12. The SIG log export committee should be reinstituted and meet monthly to share data. 13. Data protocols for log shipment reporting should be developed to enable tracking between records held by various agencies and to enable analysis by exporting province, log size and species.
Current exploitative logging practices are expected significantly diminish the provision of ecosystem goods and services by commercial forests. The nature and value of these services is currently not well understood and consequently they are not considered in forest planning or policy.	14. Studies should be conducted to determine the nature and economic value of ecosystem services generated by natural forests and how these might change with repeated, short-cycle logging.

Issue addressed	Recommendations
Plantation sector development	
Industrial and village plantations represent a small, but potentially important timber resource. They have potential to provide employment and income (for plantation owners) when timber resources from natural forests are not available in future. Insecure land tenure on customary land limits expansion of the industrial plantations sector.	15. A legislative framework should be developed to provide long-term security of tenure for sustainably-managed industrial plantations. 16. Suitable land for industrial plantations should be identified and negotiations with potential plantations developers initiated. 17. On-going funds should be provided to MoF's smallholder extension activities to ensure the village plantation sector can continue to expand and that plantations provide financial and other benefits to landowners.
Agricultural development	
Agricultural development licences are reportedly being used to clear forests in ways that circumvent forestry licensing and other regulations.	18. Relevant SIG agencies should develop clear and integrated legal guidelines for customary land conversion applications and activities and monitor and enforce compliance.

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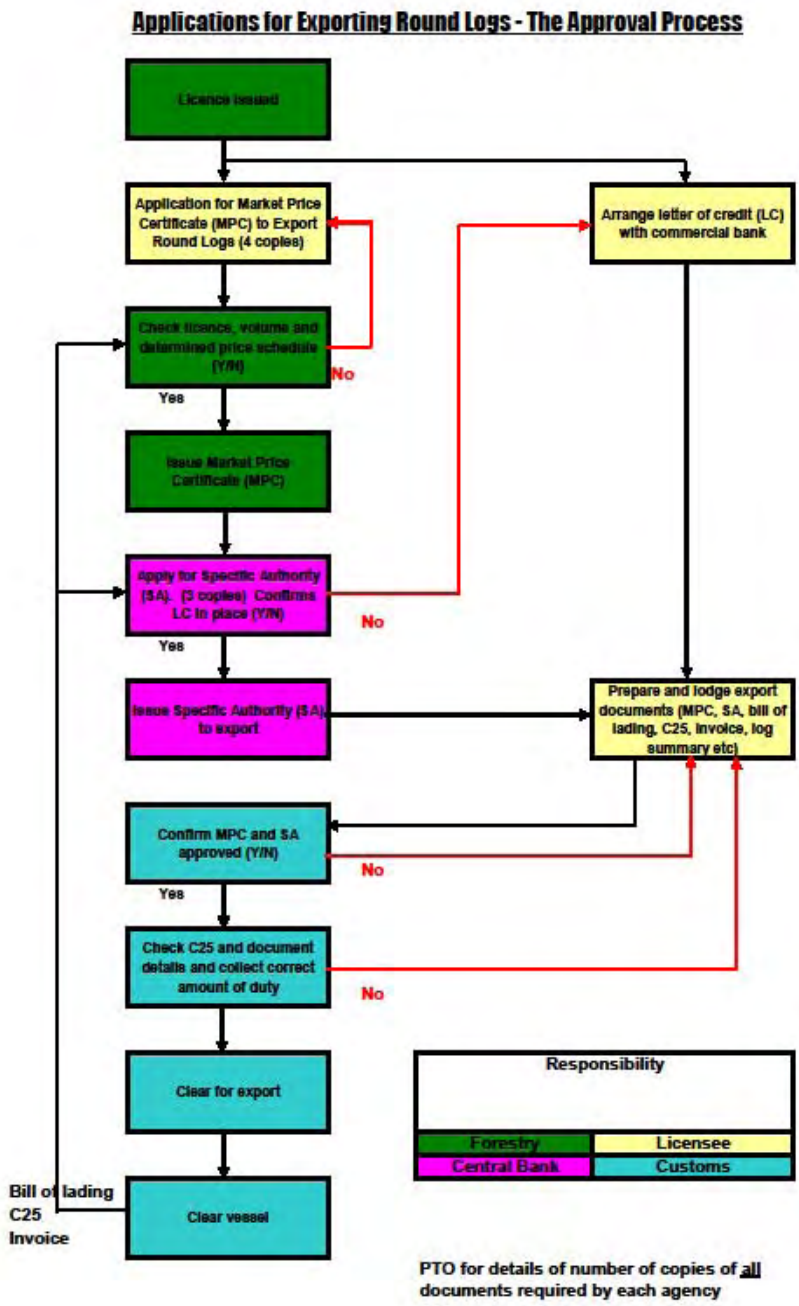
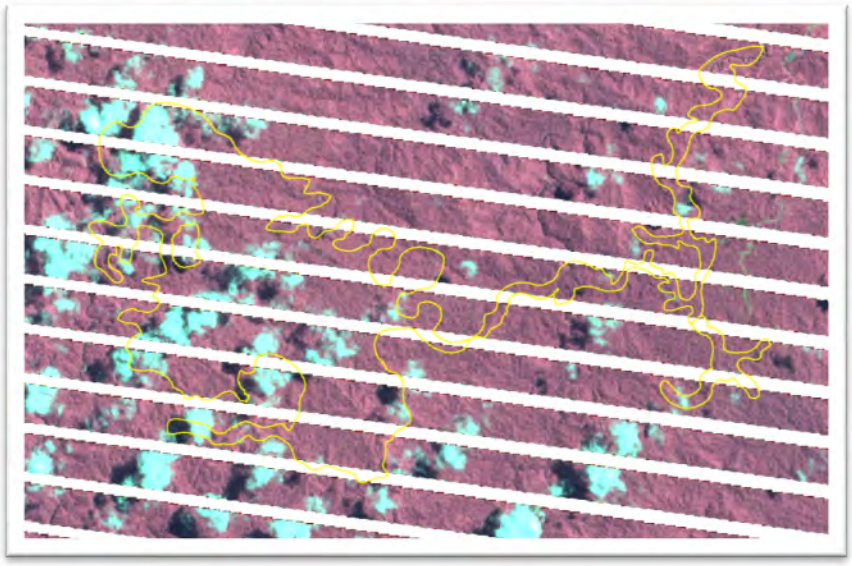
Appendix A Log Export Flow Chart Process



Appendix B Image analysis case study

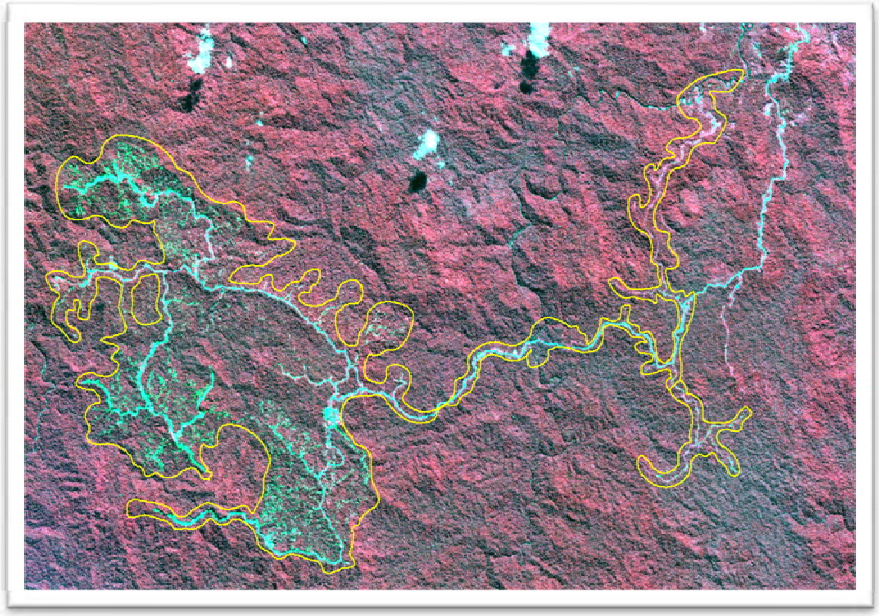
This appendix discussed examples of the mapping approaches used in capturing the logging areas from multiple satellite images.

The screen image below shows the process of capturing logging areas using Landsat images dated from 2010 to 2011 and SPOT images dated from 2008 to 2011. SPOT images have been used as the main reference in capturing logging activities, however Landsat images have been used for the analysis where SPOT images were not available (e.g. due gaps in acquired data or excessive cloud cover). Landsat images captured in 2005 and 2006 were used as the base data to determine pre-2006 logging areas. SPOT images dated from 2008 to 2011 were used to capture new logging areas.

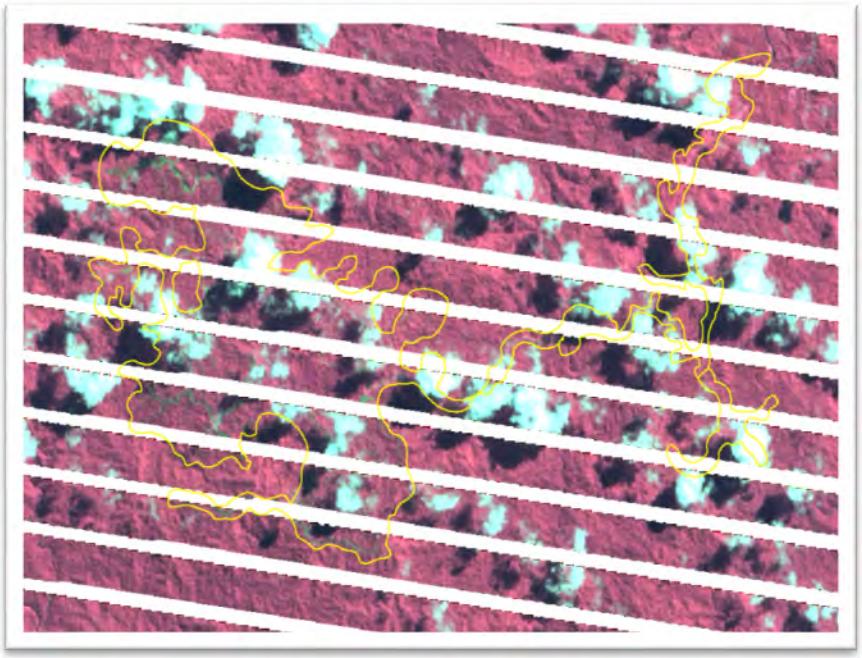


Note: White strips (Gaps in the images) are due to damage in the Landsat sensor. This problem occurred in 2003, however the satellite has been working since and USGS is planning to replace the satellite in the near future.

- **Figure 16 Landsat image captured in April 2005 (False colour, Band 4,3,2). Yellow markings highlight interpreted logging area. There is no logging activity in this area.**

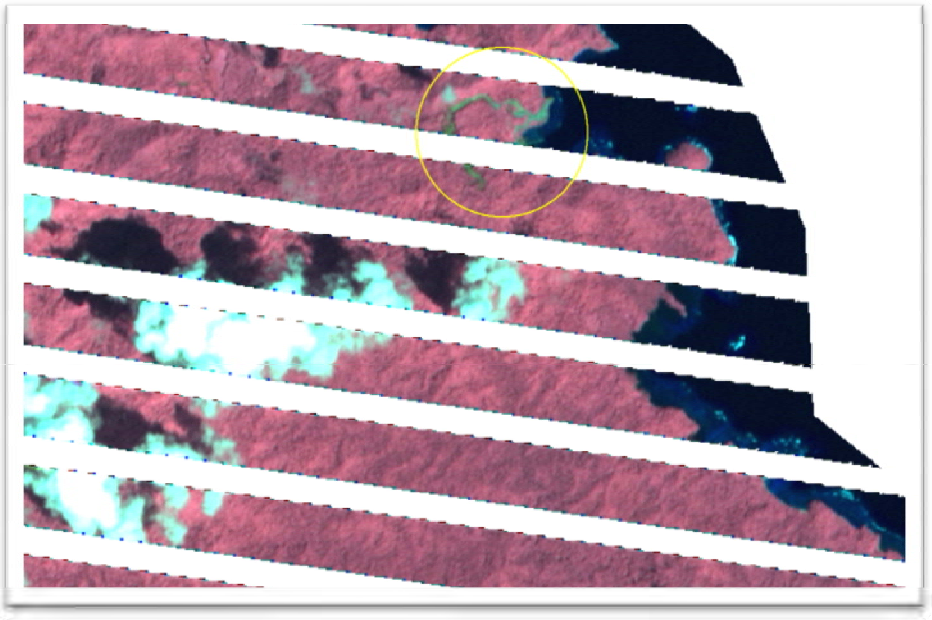


- **Figure 17 SPOT image captured in June 2011 (False colour, Band 1,2,3). Same area as Figure 16, this area has been logged and the evidence of logging (Tracks and bare ground) are clearly visible on the 2011 SPOT image.**

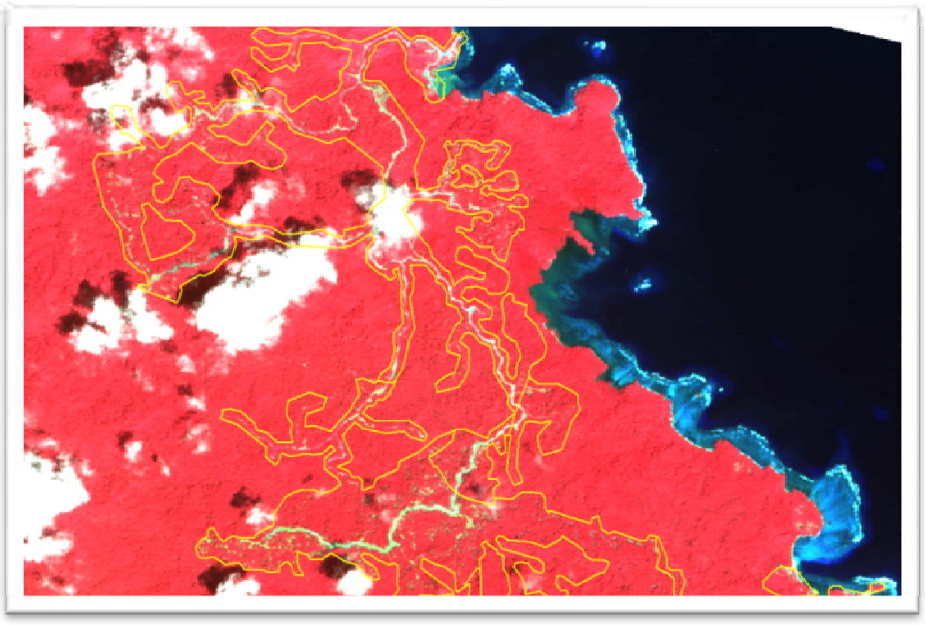


- **Figure 18 Landsat image captured on May 2011 (Band 4,3,2). This landsat image shows the logging area in May 2011 and it is clearly obvious that the logging was in progress in May but not as extensive as was visible in the SPOT June image shown in Figure 17.**

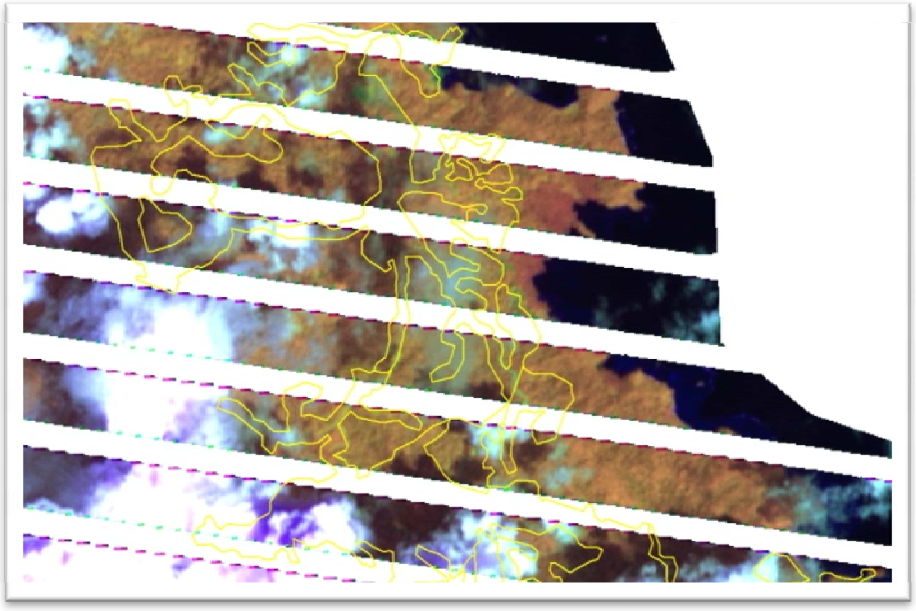
The following figures illustrate the logging activities and mapping capture over one of the logging areas in the Choiseul province.



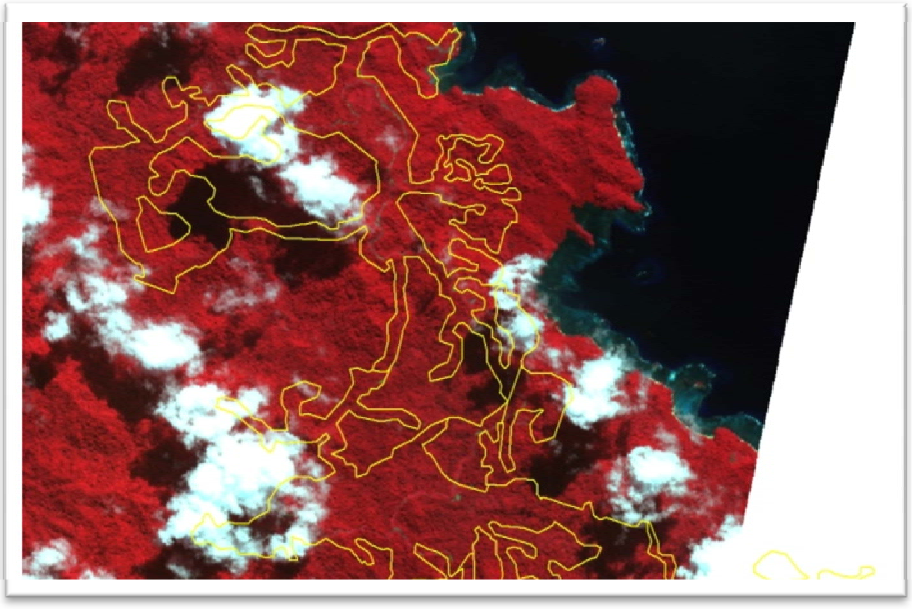
- **Figure 19 Landsat image captured on Dec 2005 over Choiseul. Only small part of this area was logged in 2005.**



- **Figure 20, SPOT image captured in Jan 2010 shows the logging activity in this area.**



- **Figure 21 More logging extend shows in landsat captured on Dec 2010.**

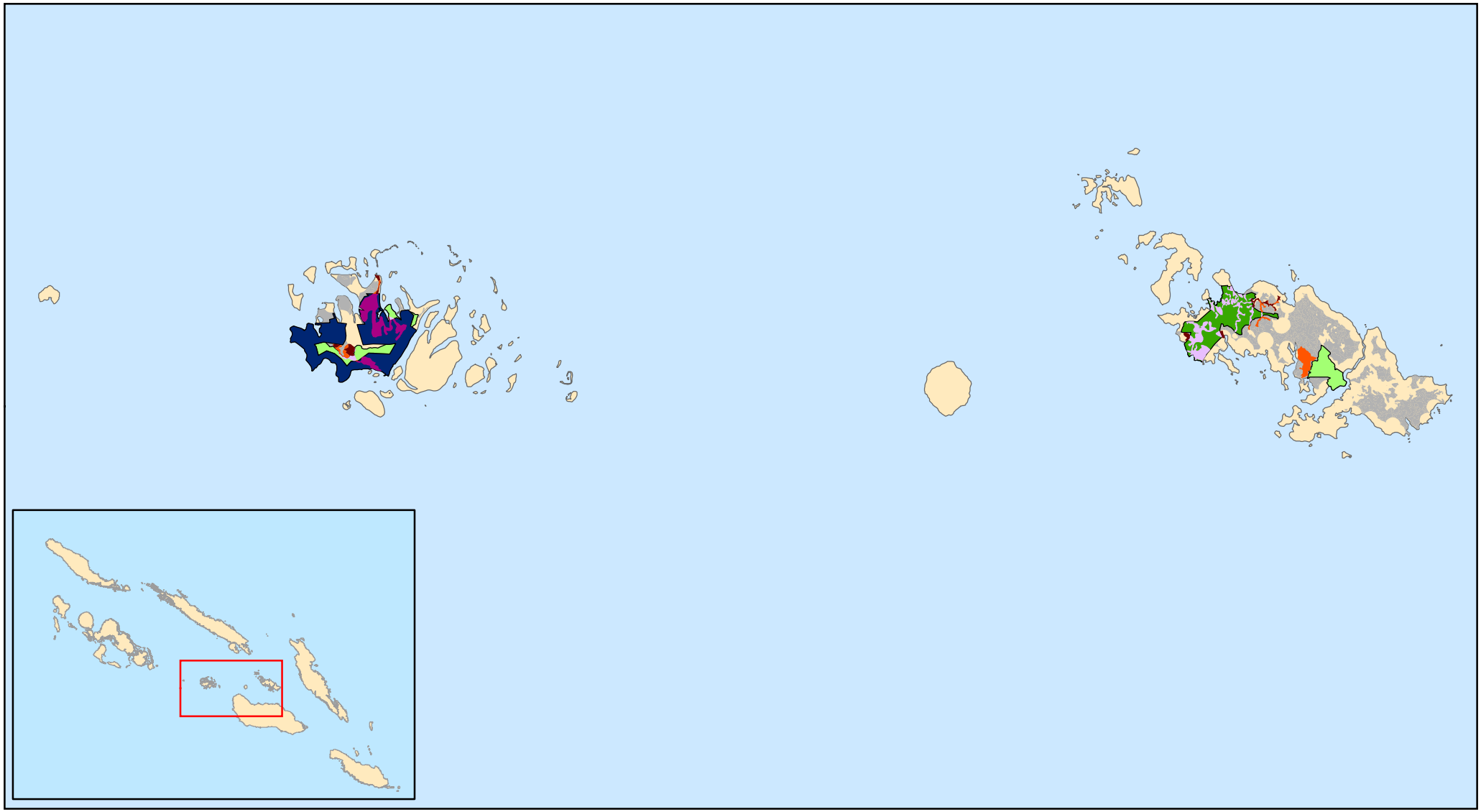


- **Figure 22 Spot imagery captured June 2011. Image shows no new logging activities since late Dec 2010 (Figure 21 and 20).**

Appendix C Maps of the logged areas for each province.

Central Province

Status of the Forest Resources



LEGEND

Central License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Central License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 18
Kilometres

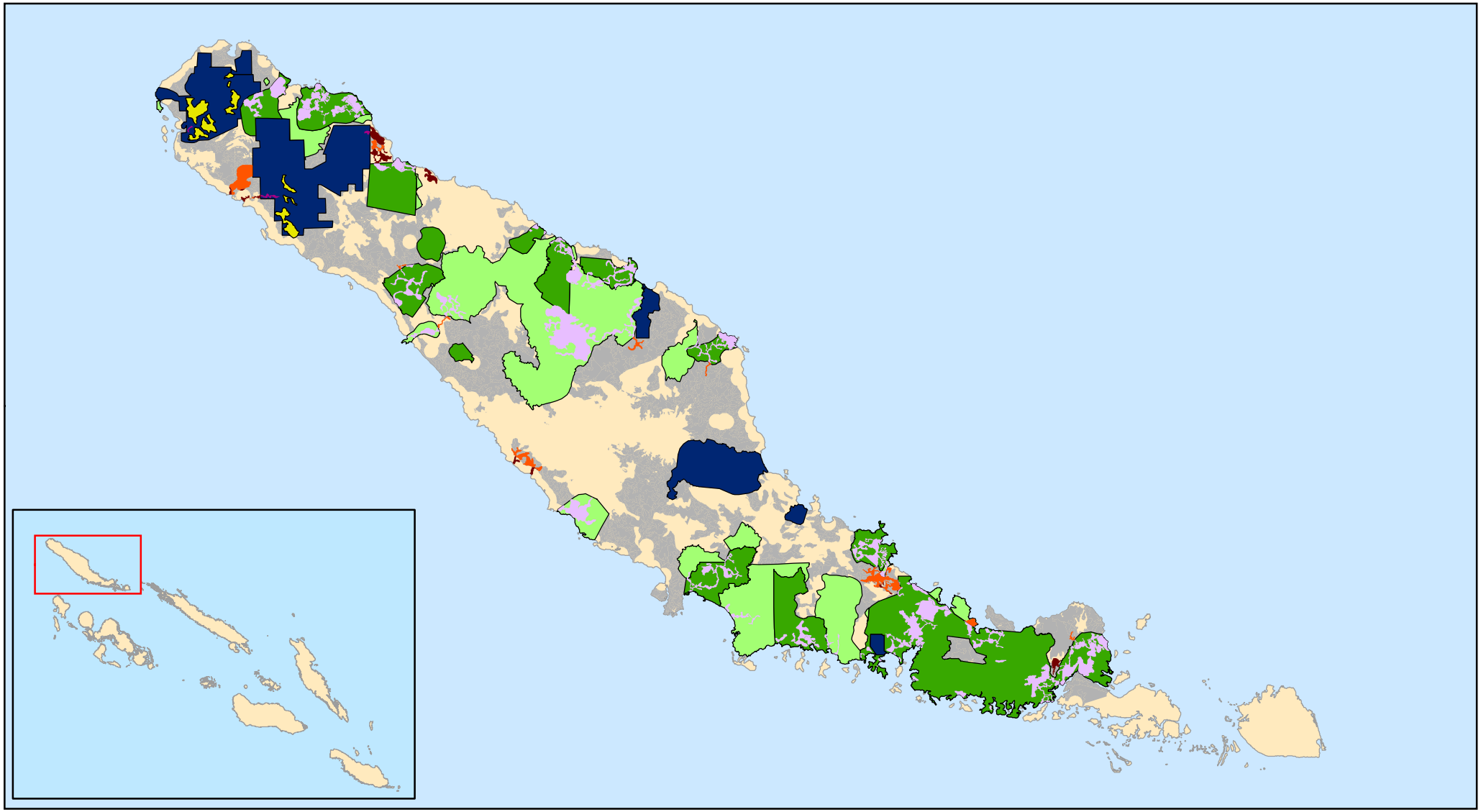
[WGS1984 UTM Zone57S]

DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

Choiseul Province

Status of the Forest Resources



LEGEND

Choiseul License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Choiseul License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 18
Kilometres

[WGS1984 UTM Zone57S]

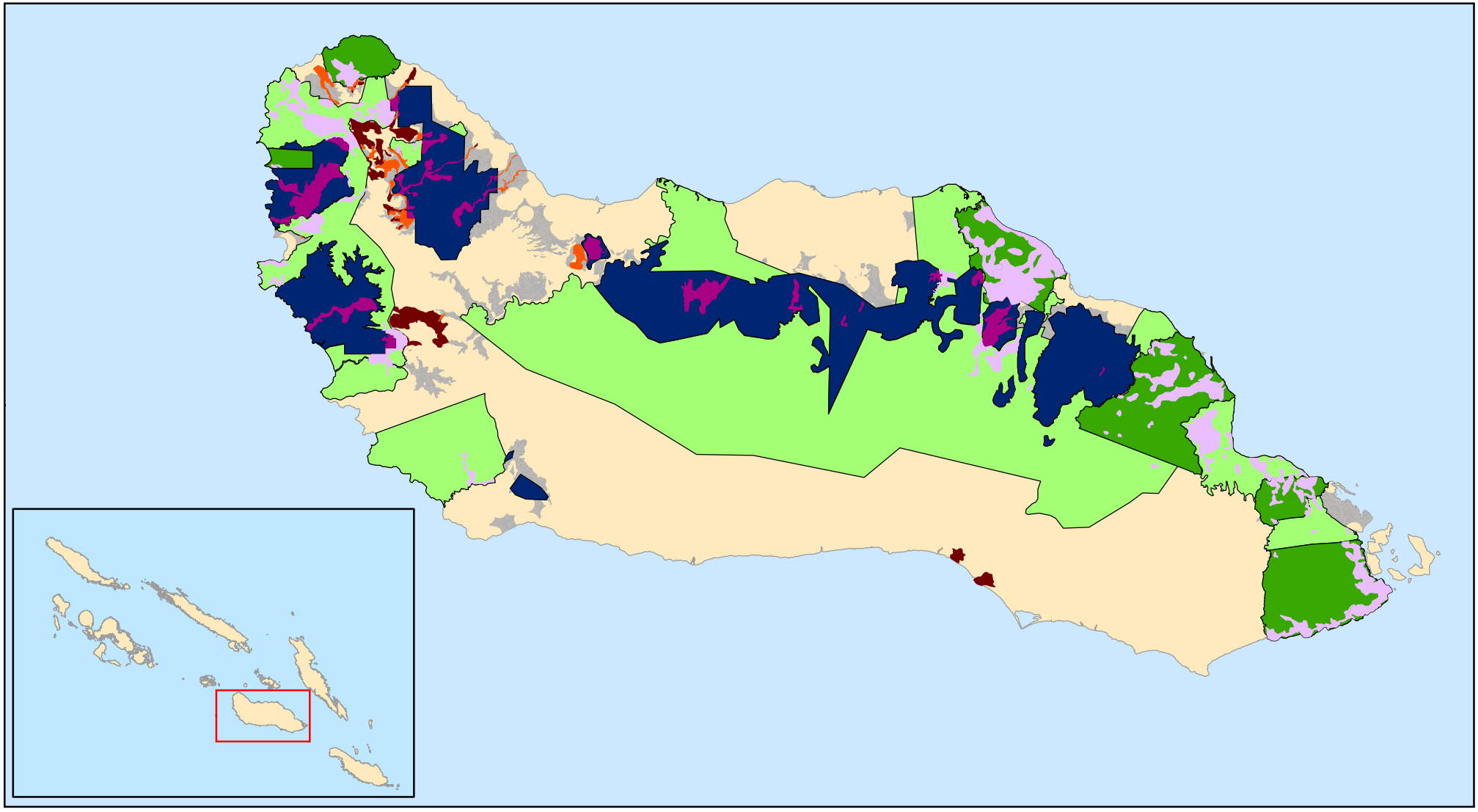
DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

February 17, 2012 | E:\Solomon Islands_project\Solomon Islands\Working\Editing_datasets\Mapping\Final_Maps_and_Data

Gaudalcanal Province

Status of the Forest Resources



LEGEND

Gaudalcanal License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Gaudalcanal License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 16
Kilometres

[WGS1984 UTM Zone57S]

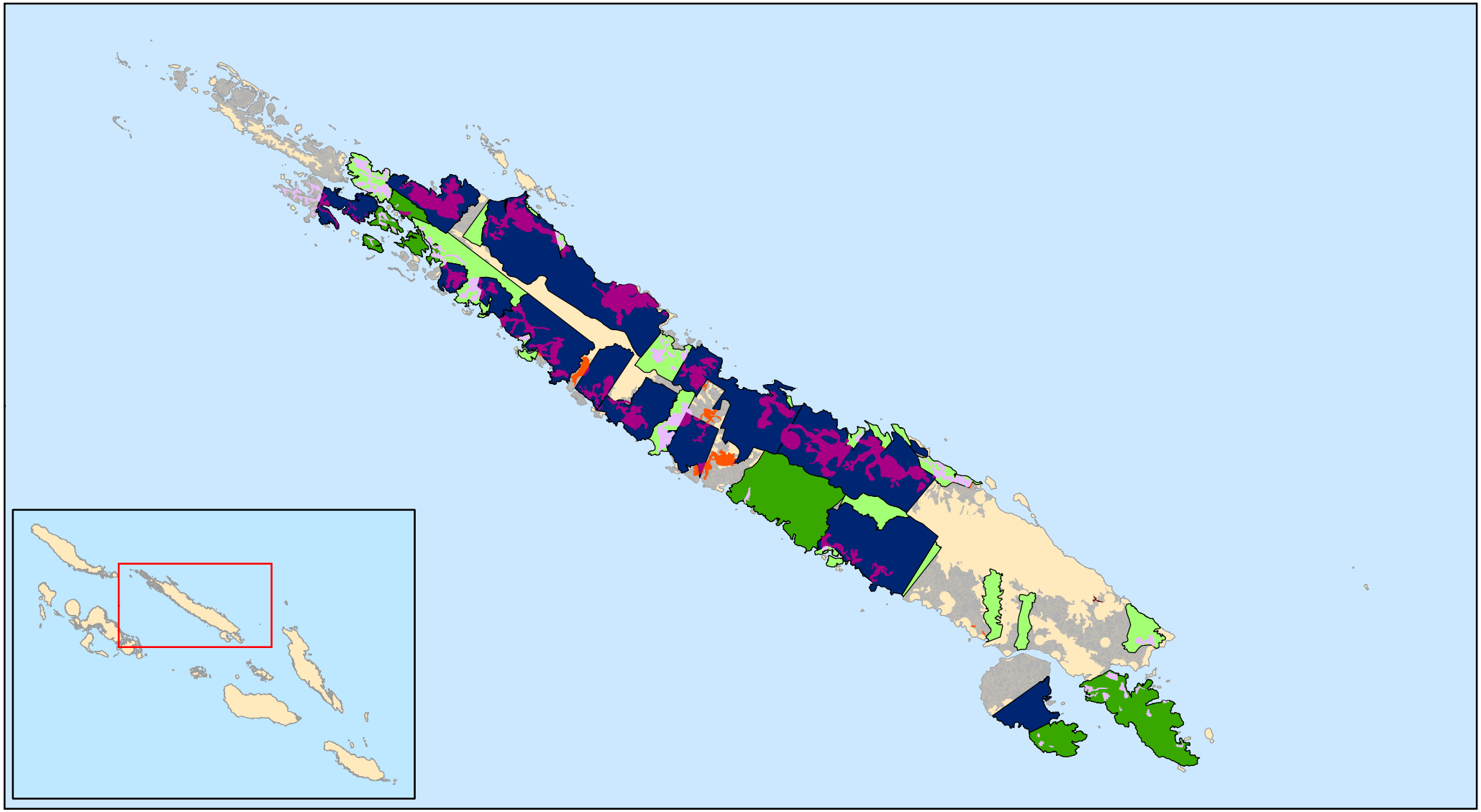
DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

February 17, 2012 | E:\Solomon Islands_project\Solomon Islands\Working\Editing_datasets\Mapping\Final_Maps_and_Data

Isabel Province

Status of the Forest Resources



LEGEND

Isabel License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Isabel License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 20
Kilometres

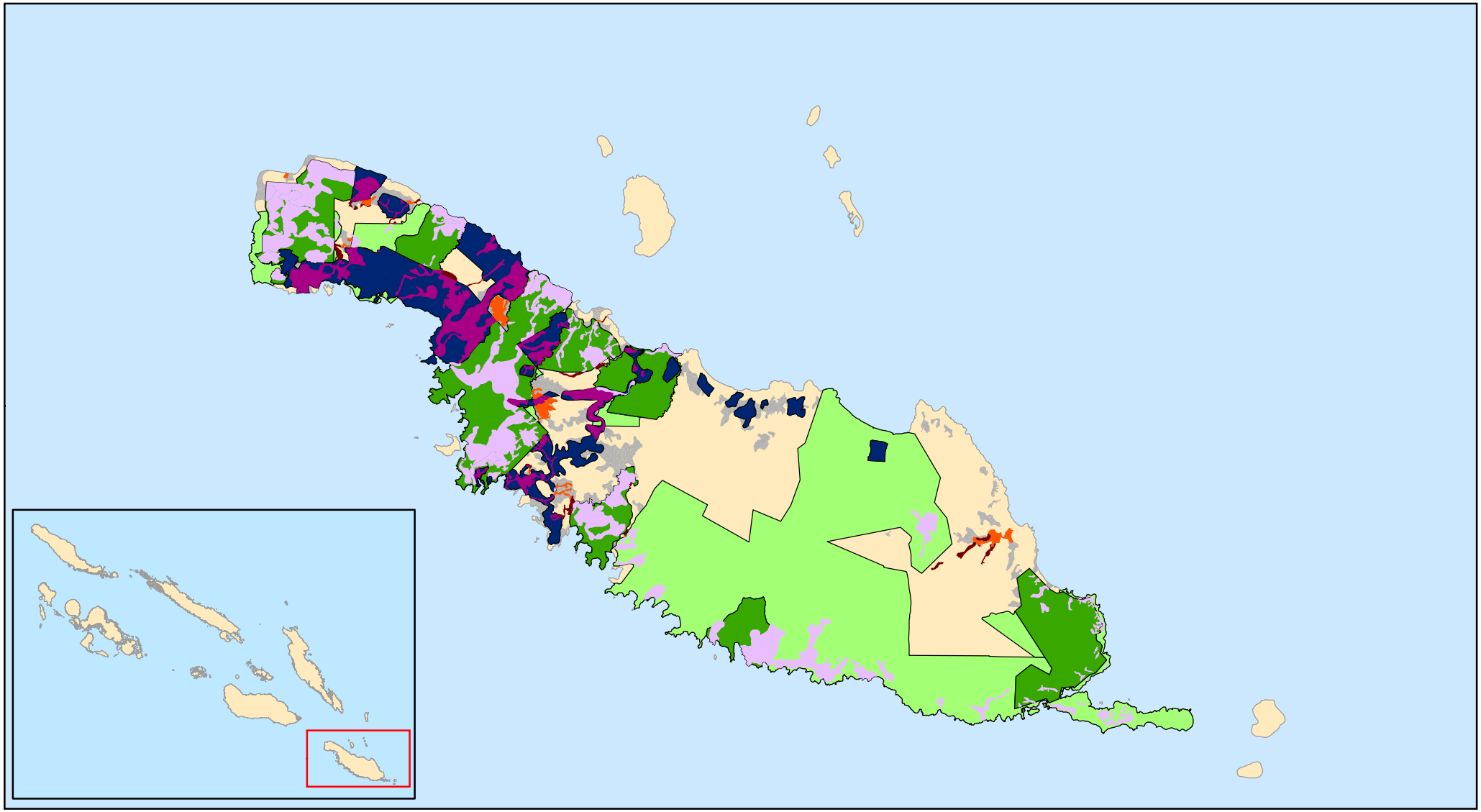
[WGS1984 UTM Zone57S]

DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

Makira Province

Status of the Forest Resources



LEGEND

Makira License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Makira License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 12
Kilometres

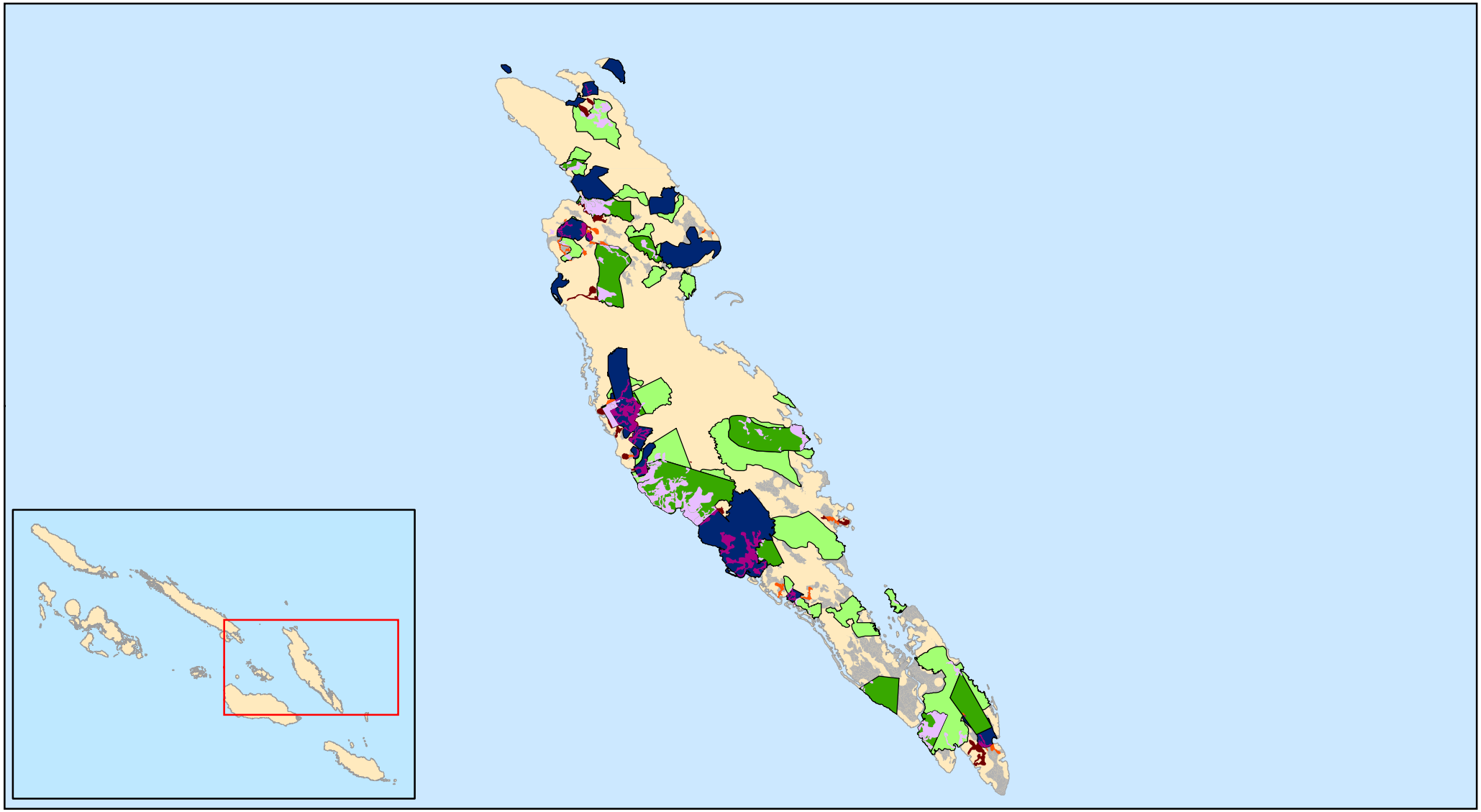
[WGS1984 UTM Zone57S]

DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

Malaita Province

Status of the Forest Resources



LEGEND

Malaita License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Malaita License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 15
Kilometres

[WGS1984 UTM Zone57S]

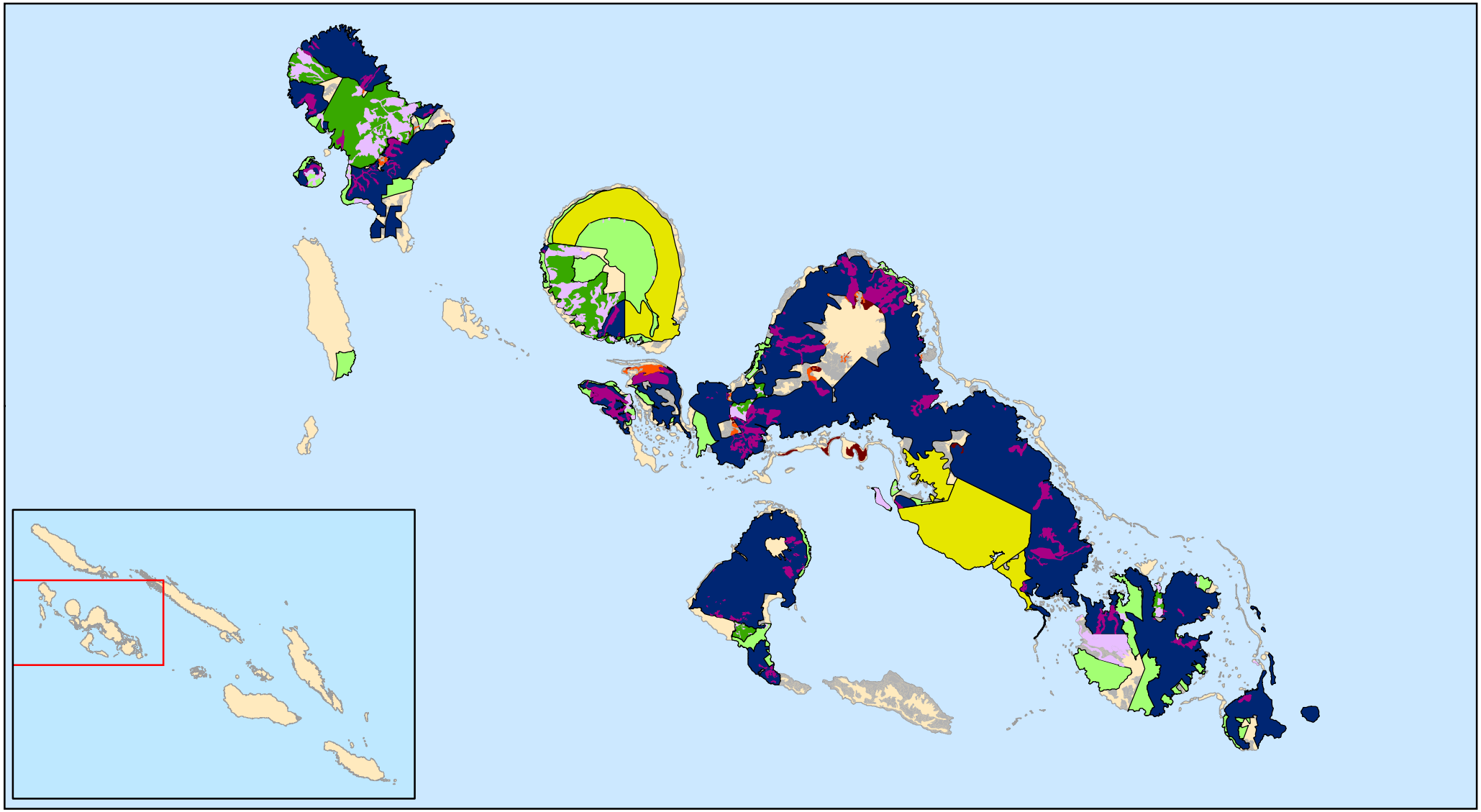
DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

November 22, 2011 | E:\Solomon Islands_project\Solomon Islands\Working\Editing_datasets\Mapping\Draft_Report\Malaita_Report_Map.mxd

Western Province

Status of the Forest Resources



LEGEND

Western License 2006

- Logging Complete
- Industrial
- Logging current or not yet started
- Unlicensed commercial forest areas

Western License 2011

- Logging current or not yet started

Captured Logged Areas

- Primary - Logging
- Secondary - Relogging
- Unlicensed Commercial Forest
- Marginal Forest

0 20
Kilometres

[WGS1984 UTM Zone57S]

DATA SOURCES
Landsat, Spot

[Solomon Islands | VW06494]

November 22, 2011 | E:\Solomon Islands_project\Solomon Islands\Working\Editing_datasets\Mapping\Draft_Report\Western_Report_Map.mxd

Appendix D Consultation List

The following table provides a list of people consulted during the project during the initial data gathering phase (October 2011) and subsequent stakeholder briefings (November 2011) and their contact details.

Person consulted	Organisation/Agency	Position	Division / Section	Contact details
Mr Mark Wiggins	Ministry of Finance and Treasury	Undersecretary		mwiggins@mof.gov.sb
Mr. David Cavanough	Ministry of Finance and Treasury	Advisor	Economic Reform Unit	dcavanough@mof.gov.sb
Ms Ruth Moore	Ministry of Finance and Treasury	Advisor	Economic Reform Unit	rmoore@mof.gov.sb
Ms Katherine Tuck	Ministry of Finance and Treasury	Advisor	Economic Reform Unit	ktuck@mof.gov.sb
Mr Dennis Meone	Ministry of Finance and Treasury	DVS Manager	Economic Reform Unit	dmeaone@mof.gov.sb
Mr Selwyn Takara	Ministry of Finance and Treasury	Director	Economic Reform Unit	stakana@mof.gov.sb
Mr Rictor Luaboe	Ministry of Finance and Treasury	ERU Staff	Economic Reform Unit	rluaboe@mof.gov.sb
Mr Andrew Minto	Ministry of Finance and Treasury	Director	Inland Revenue Division	aminto@mof.gov.sb
Mr Nathan Kama	Ministry of Finance and Treasury	Comptroller of Customs	Customs and Excise Division	nkama@customs.gov.sb
Mr Richard Brennan	Ministry of Finance and Treasury	Deputy Comptroller	Customs and Excise Division	rbrennan@customs.gov.sb
Mr John Dafisini	Ministry of Finance and Treasury	Deputy Comptroller of Customs	Customs and Excise Division	jdafisini@customs.gov.sb
Mr Max Urinimae	Ministry of Finance and Treasury	Customs Officer	Customs and Excise Division	murinimae@customs.gov.sb
Ms Nancy Kaukui	Ministry of Finance and Treasury	Customs Export Officer	Customs and Excise Division	nkaukui@customs.gov.sb
Mr Gordon Konairamo	Ministry of Forests	Undersecretary, Technical		konagordon@hotmail.com
Mr Reeves Movani	Ministry of Forests	Commissioner of Forests		rmovani@gmail.com
Ms Margaret Salini	Ministry of Forests	Deputy Commissioner, Operations	Operations Division	maggie_salini@yahoo.com.au
Mr Terrence Titilu	Ministry of Forests	Deputy Commissioner, Planning	Planning Division	ttitiulu@yahoo.com.au
Mr Richardson Raomae	Ministry of Forests	Deputy Commissioner, Forest Development	Forest Development Division	raomaerichy@yahoo.com.au
Mr Fred Pitisopa	Ministry of Forests	Deputy Commissioner, Forest Research	Forest Development Division	n/a
Mr Jim Konai	Ministry of Forests	Section Head, Licensing	Planning Division	n/a
Mr Maeli Rini	Ministry of Forests	Operations Officer	Operations Division	n/a
Mr Jim Irokete	Ministry of Forests	GIS Manager	Planning Division	jwirokete@yahoo.com
Mr Donaldson Saepioh	Central Bank of Solomon Islands	Foreign Exchange Supervisor	Foreign Exchange Department	fed@cbsi.com.sb
Mr Austin Holmes	Solomon Forest Association	President		Holmes_al@yahoo.com

Person consulted	Organisation/Agency	Position	Division / Section	Contact details
Mr Frank Mailo	URS Australia	Director	International Division	Frank_maiolo@urscorp.com
Mr Paul Tippett	SIG RAMSI Support Facility	Team Leader		Paul_Tippett@srsf.com.sb
Ms Radha Etheridge	SIG RAMSI Support Facility	Economic Governance Program Coordinator	Economic Governance	Radha_Etheridge@srsf.com.sb
Mr Jim Downey	RAMSI	Economic Governance Advisor	Economic Governance Pillar	Jim.Downey@ausaid.gov.au