EIA follow-up

A solution for noise problem from Bangkok Suvarnabhumi Airport

Thesis submitted for degree of Master of Science in Environmental Management

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Synopsis:

This thesis is an analysis of the linkage between monitoring of actual noise data from Bangkok Suvarnabhumi Airport and the noise effect to the surrounding area. The main problems from noise due to airport operation are sleep disturbance and activities annoyance.

This thesis employed EIA follow-up method of collect and analyze data; and aviation noise to analyze the problem in this paper. Existing monitoring data will be analyzed together with the flight number using the airport, the noise level released from the different type aircraft and the prediction from EIS.

The monitoring data give the information to decision makers on how is the actual noise problem from the airport operation. This information can be used to analyze on how to deal with the noise problem which is raised from communities.

Picture for front cover is taken from:
http://www.airportsuvarnabhumi.com/gallery/
Taken by Mr. Boonlert Tangtaveevech

Preface

This report is prepared during 10th semester of the study program Environmental Management, in Department of Development and Planning at Aalborg University, in spring 2007.

In this report the literature sources are prepared in accordance to the 15th edition of Chicago manual of style. Conveniently provided are appendices A, B, C, and D.

I would like to say thanks to all the interviewees from the communities around the airport and officer at the noise and vibration control bureau, Pollution control department. Also I would like to thank Carla Smink for her well intended opinion and comments throughout the project period. Finally, this report can not be done without the support from my family and friends.

Siam Phoolcharoen

List of Abbreviation

CARTEC- Committee on Aeronautics Research and Technology for Environmental Compatibility

Db(A)- Decibel (A)

DNL- Day and Night noise level

EIA- Environmental Impact Assessment

EIS- Environmental Impact Statement

EPA- Environmental Protection Agency (USA)

FAA- Federal Aviation Associatio

HPA- hypothalamic pituitary adrenal

ICAO- International Civil Aviation Organization

INM- Integrated Noise Model

KMIT- King Mongkut Institute of Technology Ladkrabung

NEB- National Environmental Board (Thailand)

NEF- Noise Exploresure Forecast

PCD- Pollution Control Department (Thailand)

SEA- Strategic Environmental Assessment

SNS- sympathetic nervous system

UK- United Kingdom

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Chapter1 Introduction

The protest sign in the first picture was written as “The great airport but the people are in trouble”.

Retrieve from: **www.angkor.com/.../2bangkok/sbia/completed.shtml**

The second picture show the signs as “How will you feel if this were your house” and “Thank you for the aircraft that brought noise to us”.

Source: Thansetthakit newspaper on 14/05/2007 page 33

These are the pictures of the people around the airport protesting the problem from airport to resident around the area. These two pictures can easily explain that noise is the concerned problem by the people in the area.

This thesis seeks to analyze on how monitoring, which is part of Environmental Impact Assessment (EIA), will deal with noise problems from the Bangkok Suvarnabhumi Airport operation.

The concept of monitoring entails the EIA practitioner to collect the relevanct data to compare and analyze with predictions from EIS, standards from the regulator or expectations set out. These steps aim to secure the environmental performance of the project.

This introduction will describe the background information that leads to the emergence of monitoring noise affect from Bangkok Suvarnabhumi Airport. This introduction will consequently address the background information of Bangkok Suvarnabhumi Airport, the concept of EIA including the project required EIA in Thailand, and finally a short description of EIA follow-up which includes monitoring.

The protest again the Airport caused from some people who live around the airport claimed their neglect of responsible from the airport authority. This cause from at the operation period of this airport, the airport authority did not monitor the noise effect from the airport operation. This leads to mitigation with the non actual effect.

1.1 Long history of Bangkok Suvarnabhumi Airport

date	Action
year1960	the Royal Thai Government hired Litchfield Whiting Bowne and Associate Co.,Ltd, to carry out some studying with the aim to lay out a city plan for Bangkok Metropolis
year 1987	the senate proposed the new airport to be located at Nong Ngu Hao
year 1990	the airport authority hired consultant company to revise the airport master plan in order to use as a airport development in long run

7-May-91	Thai carbinet approved the construction of Bangkok second airport
20-Mar-92	The airport authority signed the empoyment contract to create a master plan in designing the pre-development project, organising and controlling the engineering plan in details as well as managing the construction works on the financial plan of THB 914 million within the duration of 7 years and 6 months. The new airport grand opening was originally aimed for year 2000.
25-Aug-92	Thai carbinet granted the budget of 80 million baht to develop ground service which is expected to start in 1993
7-May-95	the Thai Cabinet approved the construction of the 2nd Bangkok airport on the location of Bang Chalong Sub-district, Rachathewa Sub-district, Nongprue Sub-district, Samutprakan Province and assigned the Airports of Thailand Public Company Limited to take charge.
16-May-95	the Thai Cabinet approved that 'a company limited' be established in order to operate the construction of this new airport, as a result the Ministry of Finance was assigned to deal with the company establishment registration and named it as 'New Bangkok International Airport Limited' with the starting registration fund of THB 10,000 million and would stand its status as a state enterprise under the supervision of the Ministry of Transport.
31-May-95	the Ministry of Finance made an order No. 76/2538 of 31 May 1995 appointing a provisional working group in order to establish the company limited held the position as a chairman by Mrs. Maneemai Wuthithoranetikul, Deputy Director-General of the Department of Central Account. The working group participated in considering the budget and agreed that this company limited be granted the first registration fund of THB 10,000 million comprising 100 million shares and each share values of THB 100 and also be named 'NEW BANGKOK INTERNATIONAL AIRPORT LIMITED'. This decision was settled on October 9, 1995.
7-Dec-96	New Bangkok International Airport Limited was officially granted a permission to register in accordance with the Civil and Commercial Code. The Ministry of Finance and the Airport of Thailand Public Company Limited are the shareholders.
27-Feb-97	New Bangkok International Airport Limited was officially established as a state enterprise. The Ministry of Finance and the Airport of Thailand Public Company Limited were holding its shares of 51.39% and 48.61% respectively.
21-Jul-98	The Thai Cabinet granted with the investment fund of THB 120,000 million for the New Bangkok International Airport Limited to build the airport, that can hold over 30 million passengers per year, as well as agreed to invite private companies, organizations to take part in investing on businesses at the airport.
year 2000	His Majesty King Bhumibol granted a name 'Suvarnabhumi Airport' for this new airport.

29-Sep-06	Suvarnabhumi Airport was officially open for service. All the on-going commercial activities from Don Muang Airport were transferred to Suvarnbhumi Airport. The old Don Muang Airport would only be used particularly for the military purposes and other general aviation.

Table 1.1: The history of Bangkok Suvarnabhumi Airport.

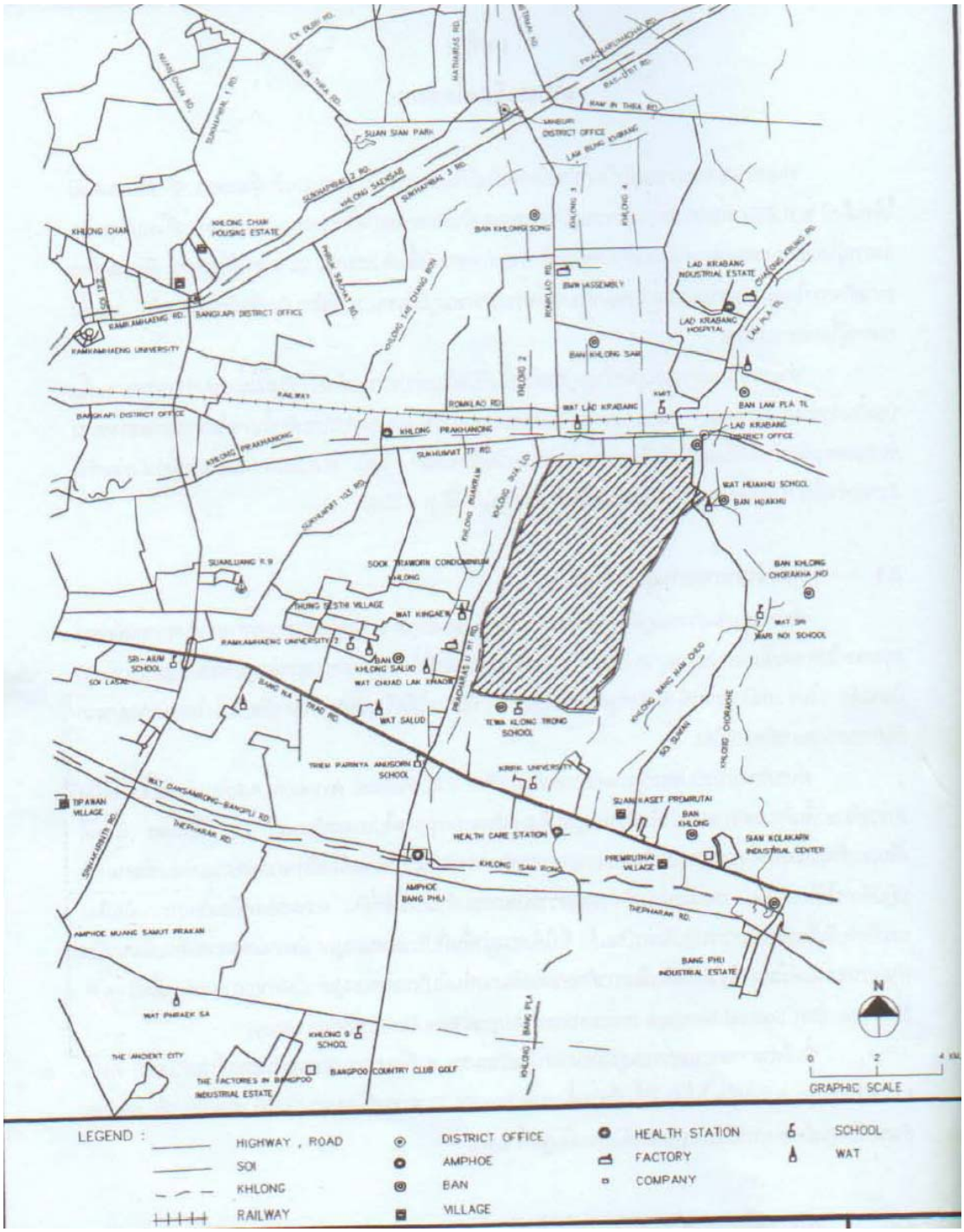
TAMS Co. Ltd. scrutinized the construction of the new commercial airport by evaluating the 7 possibly suitable locations as followed;

1. Sai Noi District, Nonthaburi Province, the area that is connected to Nakhon Pathom Province
2. Lad Lum Kaew District and Lad Bualuang District, Pathumthani Province, the area that is connected to Ayudhaya Province.
3. Don Muang Airport
4. Nong Jok District, Bangkok
5. Area of Nong Ngu Hao Sub-district
6. Bang Bor District, Samutprakan Province
7. Bangplee District, Samutprakan Province

Airport information

The Bangkok Suvaranabhumi Airport is located 25km east of Bangkok city centre in Bang Plee district, Samutprakarn Province as shown in the map below. It covers 32 square kilometers - four kilometers in width and eight kilometers in length.

This airport planed to carry 45 million passengers per year. The expected full capacity is aiming at 100 million passengers per year. It is expected that flights using the airport during peak hours for 45 million passengers is 76 flights per hour and 112 flights for 100 million passengers per year.



Map 1.1: the location of Bangkok Suvarnbhumi Airport

(Source:Bangkok Suvarnabhumi Airport Environmental Statement (2005) page 2-2)

1.2 Environmental Impacts Assessment

EIA was first introduced in the U.S. in 1969 and has since been adopted in 100 countries worldwide. (Wood, 2003) It has become one of the fastest growing

environmental management instruments. In many countries, EIA implementation has become mandatory in order to receive the necessary permit.

UNEP define EIA as *an examination, analysis and assessment of planed activities with a view to ensuring environmentally sound and sustainable development.* (Christensen et al, 2005) From this definition, EIA is a systematic process to predict and assess the likely environmental impact from the proposed projects. This also includes viewing to ensure that the project will operate in environmentally sound. EIA ensures that implications on the environment from a proposed project are taken into consideration. The most common processes in EIA are as follows(Christensen et al,2005); 1) screening, 2) scoping, 3) baseline setting, 4) identification of alternative, 5) prediction and evaluation, 6) mitigation, 7) documentation and hearing, 8) monitoring. Each step is detailed below:

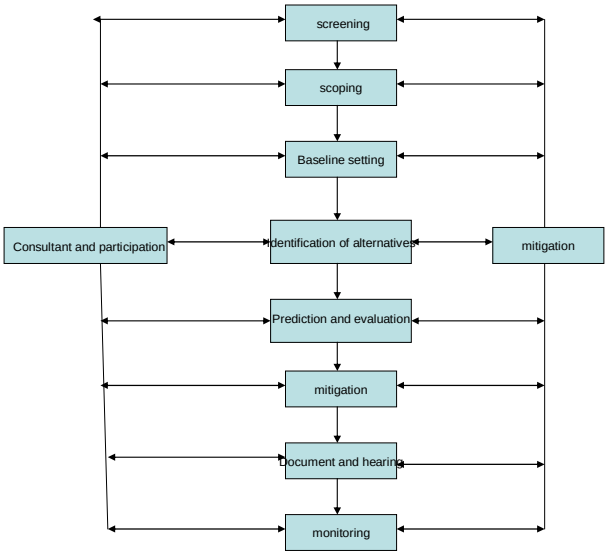


Figure 1.1 Important steps in EIA process
(Adapt from Christensen et al (2005) page 301)

Screening

Screening is the first step in EIA. Screening is used to identify whether a project is liable for an EIA or not. Screening is needed in order to identify a project that will

have significant impacts on the environment. The most common ways of identifying impact are as follows:

- Screening made on exclusion/inclusion list

In order to identify significant impact projects, most countries make a list of project types where EIA has been required. Here screening will decide whether the project is subject to EIA or not.

- Screening is made as a discretionary decision where individual projects are assessed

In this part, screening is made based on each project. The project will be assessed. The projects that have significant impact then will have to go through full EIA.

Scoping

Scoping is the step that takes place in order to identify the EIA process and determine terms of reference for the EIA. The purpose is to identify key issues to be analyzed in the environmental assessment.

Baseline setting

In order to predict the impact, it is necessary to have a clearer understanding of the environmental situation in the project area. The baseline setting provides this information for the assessor.

Identifying alternatives

This step aims to identify possibilities of developing the project in a more sustainable manner than first though. Considerations here may include needs for the need for a change in project location, size, process, equipment and the layout of the site.

Prediction and evaluation

After assessors receive the baseline information and alternatives, they then need to predict the impacts from the proposal and evaluate the significant outcomes.

Mitigation

After the likely impacts of the project on the environment have been predicted, they need to be mitigated in order to avoid, reduce, repair or compensate.

Documentation and hearing

After making the assessment, the information needs to be compiled in order to provide the general public and project stakeholders with the appropriate information. After this input has been given, the final decision on whether consent or permits should be given can be made.

Monitoring

This step takes place upon completion of the project. The aim here is to track the actual impacts from the project. This will give information on whether the actual impacts comply with predictions and regulations.

In this research will focus on EIA follow-up which is the monitoring process in EIA. The focus will concern on noise monitoring data due to the airport operation.

1.2.1 EIA requirement in Thailand

The institutionalize Environmental Assessment in Thailand began with the proclamation of the enhancement and conservation of national environmental act in 1975. The result from this act was the national environmental board (NEB). In section 17, it allowed minister to establish the categories of projects that needed to do Environmental Impact Statement (EIS). The Private sector projects need to do EIA in order to get the permit for the projects that have significant environmental impact by the categories of ONEB. (Yap, 1994)

In Thailand, the screening process is based on the exclusion/inclusion list. According to the National Environmental Quality Act 1992, the Minister of Natural Resources and Environment with the approval of the National Environmental Board (NEB) will have the power to issue the notification prescribing of categories and size of 22 projects of activities of government agency, state enterprise or private organization,

which are required to submit and Environmental Impact Assessment (EIA). These projects can be divided into 7 groups as following:

- Industry
- Residential building and service community
- Transportation
- Energy
- Water resource
- Watershed area
- Mine

The detail on each group in which projects should submit EIA will be in Appendix C. In case of Bangkok Suvarnabhumi Airport, the 22 projects, required EIA, is including all size of commercial airport. This is the reason to submit EIA for Bangkok Suvarnabhumi Airport.

Angus Morrison-Saunder and Jos Arts (2004) divide EIA into two parts which based on the consent decision. There are Pre-decision and follow-up EIA. Pre-decision involve in the process before implement of the project which are including screening, scoping, baseline setting, identify alternative, prediction and evaluation, mitigation, and documentation and hearing. EIA follow-up is implemented to the project after these processes.

1.2.2 Follow-up EIA

Plan-do-check-act is the fundamental steps of any environmental management system which is also pertain to EIA. Post project action is important in order to secure environmental performance. The core function of this process is to ensure that unexpected environmental impacts are taken into account. It also helps provide a baseline for future projects. (Christensen et al, 2005)

The main elements of EIA follow-up are as following: (Art et al, 2001)

- Monitoring
- Evaluation
- Management

- Communication

These elements will be detailed in chapter3. The actions that can possibly do with the excessive impact of unanticipated changes are: (Christensen et al, 2005, p 315)

- Stop or modify casual activity
- Impose penalties if legal standards are breached
- Add or scale up mitigation measures

1.3 Problem formulation

After the long history of planning for theBangkok Suvarnabhumi Airport, it was finally opened on September 28, 2006. It was planned to be the hub for the Southeast Asia region with a capacity of 45 million passengers per year. Suvarnabhumi Airport was caught in the public eye. It was widely believed that Suvarnabhumi was not yet ready for opening. At that time, construction work at the airport was not yet finished. After the authorized opening, complaints were made by members of the public and communities around the area. The main problems being reported are noise, flooding and waste.

Environmental Impact Assessment (EIA) is a tool in assessing environmental effects from a project. It is the process to ensure environmental implications from a project are taken into account before the project commences. EIA aims to minimize negative and maximize positive impacts. In Thailand, the building of an airport is one of the projects that are required to carry out EIA.

EIA follow- up aims to monitor the actual impacts of the project on the environment. It is a key step in EIA and the assessment can not be considered complete if the project impacts are not monitored. Monitoring can help improve the project management system and can also act as an early warning of any unforeseen problems that may arise. Pre-project predictions cannot always be accurate and follow-up helps to appraise and amend these predictions. Public perception and opinion can be considered part of a follow-up.

Noise was one of the main issues that concerned residents near Bangkok Suvarnabhumi Airport. The airport boundaries are close to the residential areas, temples, universities, schools etc. Some of these places are sensitive to noise from the airport. It is common knowledge that airports have to deal with noise from aircrafts which can often disrupt everyday tasks. During the early operation of the airport, there were many newspapers ran reports of protest at, complaints being made about and other problems from the airport. An officer in the pollution control department reported that the noise levels predicted in EIA are far below the actual noise levels since commencement of operation at the airport. This leads to the following research question:

How will EIA follow-up deal with noise problems in the case Bangkok Suvarnabhumi Airport?

This thesis seeks to provide data from noise monitoring at Bangkok Suvarnabhumi Airport. This data will be used to analyze noise pollution predictions from Environmental Impact Statement (EIS), standards and regulations of noise in Thailand and the perception of people around the airport.

Chapter2 Research methodology

This chapter contains description of the theoretical approach and methodological framework uses in this research. Firstly, it will explain the relationship between elements within the analysis. Secondly, methodology within this research is trying to correlate between noise monitoring and the problem from airport operation.

2.1 Research methodology

This research aims to study on EIA process in Bangkok Suvarnabhumi Airport which focus in the monitoring process as one part of EIA. This research will analyze on numeric scientific data and qualitative data from the examined effective people around the airport. These information will broaden understand about the adverse effect from the operation of new Bangkok International Airport.

EIS can not address all actual adverse impact. This is also the strength of monitoring process in EIA because without monitoring unexpected effects and cumulative effects will not be considered. During operation, the actual impact from the project will occur and then reflect from the effect population will come up. EIA can not stop after the operation of the project but it has to work until the use of its project.

After the operation of the Bangkok Suvarnabhumi Airport, pollution control department has measured noise level from different locations around the airport. Even though this information can give a clue to the noise problem, the numeric monitoring information can not guarantee anything that the impact is acceptable because even some people live in the acceptable noise level for the authority but due to the vulnerable area, such as temple and university, the noise level in that area also can not acceptable for these land use purpose. The people who live around that area should have right to show their perception on the project. The acceptable from the authority is might not be the acceptable for the community who are the receiver from the effects. The information from the effected people from the airport will state the explicit information from their feeling and also the noise annoyance problem for their daily activities.

The number of flights using Bangkok Suvarnabhumi Airport will be used to analyze the monitoring noise level from monitored stations in order to analyze on the noise problem. The support data also come from the noise level of specific aircraft during taking off and approaching the airport. This will give the evidence on the influence of flights on noise problem and to analyze on the mitigation measurement.

2.1.1 Unit of Analysis

The unit of analysis is noise impact because noise from Suvarnabhumi airport is the most consideration issue from the mass. This research is based on noise pollution that state in EIS and the standard of the noise pollution then compare with numeric data from authority with the qualitative data from effected group around the airport.

2.2 Methods used in this analysis

This research analysis part will be based on two methods of analysis which are EIA follow-up and Noise effect from aviation.

2.2.1 EIA follow-up

This method of analysis involves in data collection of the noise effect from airport operation based on 15 monitoring stations. EIA follow-up will compare monitoring data with the standard from government and the prediction from Environmental Impact Statement which is a part of project permission. This theory also has the extension to analyze on the collection data.

2.2.2 Noise effect from aviation

This method of analysis is used to link the monitoring data with the cause from airport operation which is the source of noise. This theory will also give the background information and acknowledge analyzing on the noise effect to surrounding area. This theory also deals with the mitigation measurement that could improve the noise quality which released to the neighborhood.

2.3 Data considerations

Data considerations in this research are scientific numeric data, predicted data from EIS and the qualitative data from receivers which are group of effective. All the data will be collected and analyzed together. The data from EIS is used as predicted information before the operation in order to clarify that how effective is the EIS. Scientific numeric data and qualitative data from receivers will be used together to analyze the actual impact from noise that occur during operation of the airport.

2.3.1 Data collections

Data collections from this research come from both primary sources and secondary sources. Both sources of information are used to identify the noise impact from the airport. The primary source will give the actual consideration from the people around the area that have on noise issue. It is important to have primary interview because this will give the chance to have the right information which is suited with this research. The secondary information is also important because some data is costly and timely to collect the primary data such as flight number and noise data from airport operation.

Primary data

The main primary data are the qualitative interview which perform with 6 people from the communities who effected by the airport and one interview with Noise and Vibration bureau officer. Qualitative interviews can explore the perception of their problem from the noise problem due to the operation of the airport. These interviews will show deep detail into their problems. These interviews perform with six different residents around the airport who have the effect and benefit from airport operation.. These interviews perform separately. These interviewees are located in the different area with the different act in the communities. The questions for this interview are located in the Appendix D. The locations of the interviewees are located in the following map. The list of the interviewees is in the following:

1. Kanwipa who has the coffee shop in the Ldkrabung Temple area
2. Pangrum who lives in Ladkrabung Temple community
3. Yatigaro who is a monk in Ladkrabung Temple

4. Patcharee who is the head of administration and lecturer at Kirk University
5. Nawasorn who lives around Kirk University area
6. Wanna who lives around Bangchalong Temple

In additional from these people, the researcher also interview Noise and Vibration Control bureau officer who can give us clear understand of what is the actual noise condition at the area around the airport.

Secondary data

Secondary data are collected from literature review, newspaper, internet, monitored data from the pollution control department, ministry of environment and also the number of flight using Bangkok Suvarnabhumi Airport during its operation. These data will use to be analyzed with the theories.

2.4 Content of the report

This part of this chapter summarizes the different chapters and the methods employed in the different chapters. It also present the linkage between the chapters in answering the research question as illustrate in figure2.1.

Chapter3 EIA follow-up

This chapter will give the overview of what is mean by follow-up EIA. It is also included the components of follow-up. The objective of follow-up is also described here in order to explain the need for this process. The stakeholders that should be part of follow-up will be on detail here. This chapter also extends through the regulatory setting for EIA follow-up.

Chapter4 Airport Noise

This chapter will explore about the Noise problem from the airport into detail. It deals with the source of noise from airport that make problem to the surrounding communities. Then go into detail that what will be the result of noise to community surrounding. Then it will also include mitigation process of noise from airport.

Chapter5 Monitoring Suvarnabhumi Airport

This chapter will link between theoretical part and empirical part. Both parts will be analyzed together. The collecting data will be used to analyze the noise effect from the airport operation in order to show how monitoring work in Bangkok Suvarnabhumi Airport noise issue.

Chapter6 Conclusion and Recommendation

This chapter will conclude all finding from this report and make the recommendation to improve the project by the finding.

The relation between each chapter will be as following figure:

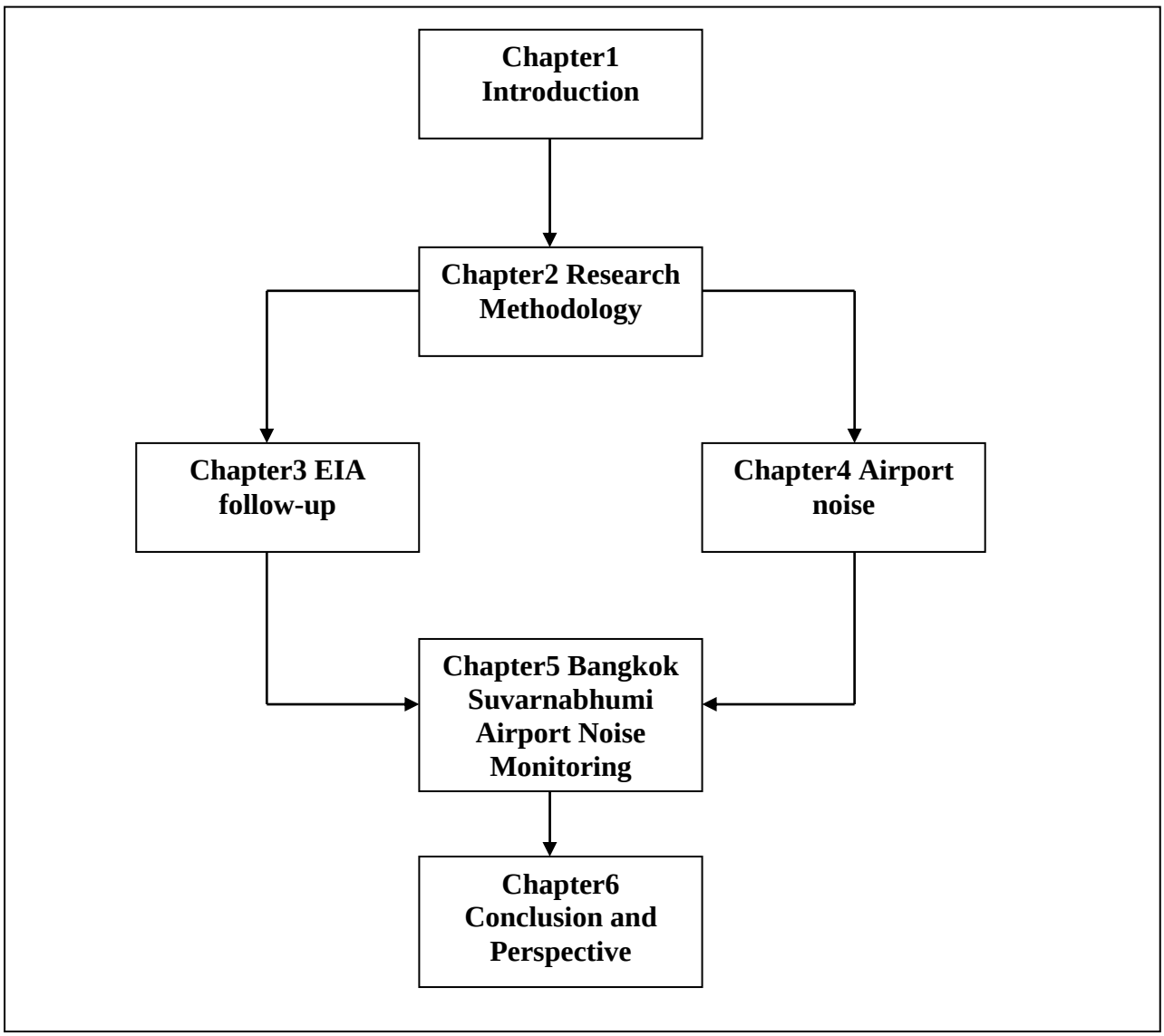


Figure2.1: The linkage between chapters**.**

Chapter 3 Environmental Impact Assessment Follow-up

This chapter will provide the foundation of the EIA follow-up which will be used to analyze in Chapter6. EIA follow-up elements will be provided in order to understand the process in EIA follow-up and consider the process used in this case. The need for EIA follow-up will provide the detail on why this case need follow-up. Then the objective of EIA follow-up will be present in order to analyze whether this case comply with EIA follow-up objectives. After that the regulation and institution arrangements will present. This will use to analyze the influence on perform EIA follow-up and the aspect of this follow-up. Finally the project types and stakeholders will be presents. The information in this chapter will provide the analytical framework that can be used in the subsequent chapters.

3.1 Introduction to EIA follow-up

Generally EIA follow-up takes place after the permission is in place. It relates to the construction of the project, how it is operated and the decommission phase. EIA follow-up is in place until the very end of the project's life cycle. It plays an important role in tracking the environmental performance of the project.

Art et al, 2001(page 176) stated that EIA follow-up comprises four elements which are as follows:

1. Monitoring:

   Monitoring compares data that has been collected in the assessment with the standards, predictions and expectations outlined prior to the project's commencement. Post project monitoring takes into consideration compliance to the guidelines set out and the effectiveness of the project. In some cases, multiple projects may be included in the monitoring process in order to compare effects and outcomes from various studies.

2. Evaluation:

   Evaluation takes into account the findings of the project in relation to standards, pre-project predictions and expectations. It often includes scientific and technical policies.

3. Management:

   Management is the act of responding to the issues which may arise from the monitoring and evaluation processes. The role of management is undertaken by the parties including the proponent and the regulator.

4. Communication:

   Communication is the act of informing project stakeholders and the general public about the results from the EIA follow-up. Again the proponent and the regulator may be involved in the communication process.

This research will focus on the monitoring process which is the most important step in order to get in formation. The further analysis will go through evaluation process with the factor that has influence on the noise effect. First the result from monitoring will be presented. After that, the result from monitoring will be used to compares with standards from the government and prediction in Environmental Impact Statement (EIS).

After the presentation of the elements of EIA follow-up, the next step is to clarify the need for EIA follow-up. This will give the idea on how the EIA follow-up may tackle the problems from the operation project. This following part will provide the idea on how the EIA follow-up will deal with the noise problem.

3.2 The need for EIA follow-up

The main function of EIA follow-up is to understand the outcomes of any EIA project. Without the follow-up the outcomes of the project's activities will be unknown. It is a way of gathering information about the impact of the proposed activities and the effectiveness of the project in achieving the goals outlined. One of

its most important functions is to create a method of feedback on the EIA activities. It also helps to evaluate the effectiveness of the EIA process and this evaluation may be used to improve EIA projects in the future. (Morrison-Saunders and Arts, 2004)

The key parts of EIA follow-up deal with future activities and any uncertain outcomes of the proposed goals. It also helps to realize pre-project predictions, proving them either wrong or right or giving more accurate readings related to these predictions. The fact that environments are dynamic and subject to change also makes the follow-up process one of great value in keeping data up to date and accurate. (Morrison-Saunders and Arts, 2004)

EIA follow-up provides a link between pre-project goals and targets and post-project achievements. It helps to bridge the gap between the uncertain pre-project predictions and the real analysis and data from project research as can be seen in figure 3.1.

This figure will give the clear understand to the case of Bangkok Suvarnabhumi Airport. The project is already finished with the construction. This research will deal with monitoring the noise effect from the airport operation whether the noise is complied with the standard and the prediction and track the noise effect from the project during the time period of the airport. The operation of the airport without EIA-follow-up, the uncertainties impact from the project will be not known.

The following section will provide the purpose of EIA follow-up which range from the technical and scientific to socio-political and management aspect. These all aspects aim to improving EIA knowledge and practice. This part below will provide the link between the practice of EIA follow-up in Bangkok Suvarnabhumi and the objective of EIA follow-up.

3.3 Objectives of EIA follow-up

Arts and Nooteboom (1999), IAIA (1999) and Arts et al (2001) identify the various objectives of EIA follow-up as follows (Morrison-Saunders and Arts, 2004, page 8)

1. **Control of projects and their environmental impacts:**

   EIA follow-up provides information, which is utilized to verify project projections and control the project's findings. It is used as a method of retrieving data and information from the project and is a form of feedback about the project's undertakings. This leads to better understanding of the project's findings of the impacts to the environment.

   EIA follow-up provides a platform for the verification of the project outcomes and control of the procedures that are to be implemented. In case of noise from Bangkok Suvarnabhumi Airport, monitoring can be used as control tool of the noise level from the airport which causes impact to the communities around the airport. This monitoring can lead to improve the noise mitigation of the airport.

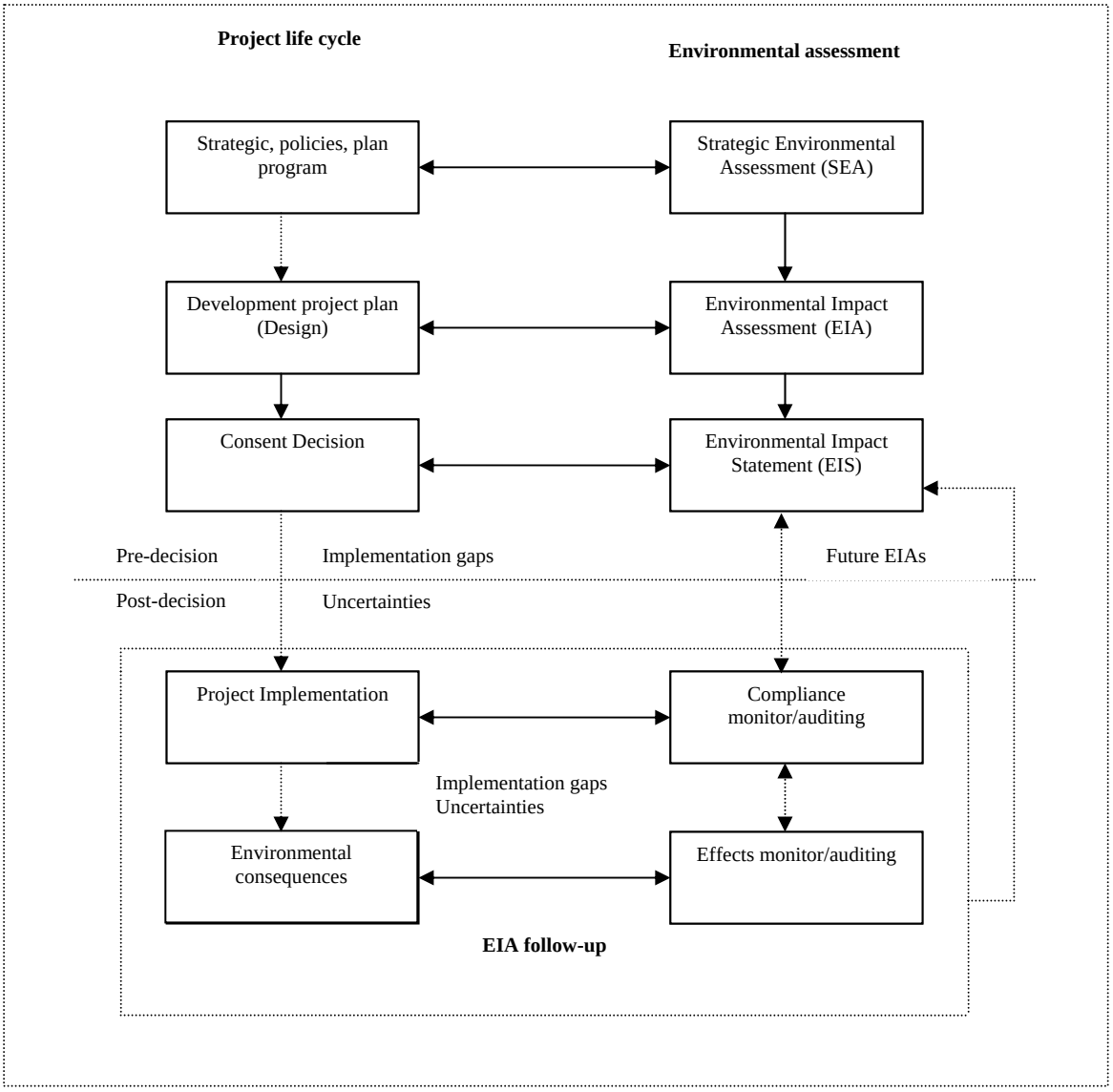


Figure 3.1: EIA follow-up as a link between EIA and Project Implementation (Source Arts et al (2001 page 177)).

2. Maintain decision-making flexibility and promote an adaptive management approach.

The information from the follow-up program can provide the project manager and the regulatory agency with the opportunity to respond to changes in the environment outlined in the project.

With the information from monitoring, project manager and regulatory agency will have chance to identify the actual impact from the project because without the monitoring, they can not know that the effect might have different from the

prediction. With the information in hand, they can make the right decision to tackle the actual impact.

In this research, the flexibility decision deal with the mitigation of noise exposure and the effected area. The capacity of the airport will increase. This monitoring will track the effect that come up with the increasing capacity.

3. Improve scientific and technical knowledge

Most EIA relate to scientific issues. In part EIA follow-up is used to evaluate the accuracy of the EIA predictions and the mitigation measures to be taken. EIA follow-up shows the impact of the project and this information can help to improve the scientific and technical knowledge for future related projects.

4 Improve public awareness and acceptance

Ongoing EIA follow-up may improve public awareness of the issues through data released to the public. This could lead to public action in the resolution of environmental issues. In case of Bangkok Suvarnabhumi Airport, the communities arranged the protest against the Airport Authority of Thailand on the issue of noise.

5 Integration with other information

Information from the EIA follow-up can be integrated with other environmental research programs such as reports and EMS projects. This may lead to better understanding of the environmental issues.

In this report, it will focus only in control of the project; remain decision making flexible and improving public awareness and acceptance. These objectives of the EIA follow-up will use to analyze the result from monitoring whether the Bangkok Suvarnabhumi Airport monitoring is comply with these all objective.

As in the objective of EIA follow-up, the objective of EIA has to deal with stakeholder of the project. Due to different regulatory setting, the form of EIA follow-up will be different. The different pressure on the EIA follow-up will influence the

form of EIA follow-up carry out. Next part will present the regulation and institution arrangement that have influence on the practice of EIA follow-up.

3.4 Regulation and institutional arrangements

These include regulatory and administrative framework for conducting EIA follow-up. According to Morrison et al (2003), they can be divided into three main sources, which are: command and control, self regulation and public pressure. The relationship between regulations and aspects of EIA can be seen on table3.1.

Regulations are some of the main factors that influence EIA practitioners to carry out follow-up. Morrison et al (2003), states that setting regulations is a key task to be undertaken in the early stages of EIA follow-up. It has been noted that these regulations can take time to work effectively and be properly implemented.

Jesus (2002) provides an example of a case in Portugal, where regulations were only put in place after two years of EIA follow-up. He found that the enforcement from the government have been useful to define mitigation, monitoring and obtain feedback. This leaded to changing in environmental behavior but however more time and more projects are needed to fully evaluate Portugal's newly instigated follow-up procedure. This example shows that only nine environmental case studies has been undertaken during the design phase for a series of highway, railway, pipeline, harbor and transmission line projects. From this we learn that despite regulations being put in place there is no guarantee that the follow-up will actually take place.

Aspect of EIA follow-up		**Regulatory setting**	
	Command and Control	**Self regulation**	**public pressure**
Nature of follow-up	Strict requirement	Flexibility	Variable
Screening	Always	Specific activities	Specific public issue(s)
Scoping	comprehensive follow-up	Major issues	Aspects of concern to community
Methods, techniques used	Variable-whatever is needed to demonstrate compliance(Often scientifically rigorous approaches)	Industry best practices, pragmatic	Variable(from expert judgment to scientific research)

Starting moment	Consent decision(in proactive regimes during EIA)	During EIA	Afterwards (construction and operation stages)
Instrument	Permits, contracts, licenses	EMPs, EMS, corporate environmental reports	Response to public issues raised
Focus	Compliance with regulations	(Environmental) management of activity	Public concern
Feedback mechanism, safeguard	Surveillance by regulator	Environmental accountancy, public account, accreditation programs	Media
Main parties involved	Regulator-proponent(bilateral)	Proponent(internal)	Public-regulator-proponent (external)

Table 3.1: Relationship of regulatory setting to approaches and techniques in EIA follow-up (Source Morrison-Saunders et al (2003 page 49))

Self regulation is another leading factor in the implementation of EIA follow-up procedures. Marshall (2001a; 2001b) and Marshall et al (2001) supports this fact with an example of an industrial-led case that has played an important role in carrying out EIA follow-up in the UK.. In this case, Environmental Management System is one of the most important tool that has be successfully drive EIA follow-up activities. It gives evidence that self-regulation may play a part in filling gaps left by government regulatory boards for EIA follow-up There are some role that often motivated for industry to participated in self regulation and other green initiatives arises from public pressure and meet community expectation.

It is apparent that regulations alone do not always ensure that EIA follow-up will take place. Self regulation and public responsibility help to make the EIA follow-up process to be carried out with more meaningfulness and not just as paper work to be filled in as a government requirement.

This part will use to analyze the monitoring process in Bangkok Suvarnabhumi Airport in order to identify the influence on the monitoring process in chapter5. The result from analyze will demonstrate whether which regulatory setting have influence on this monitoring process.

3.5 Stakeholder

There are three main stakeholders related to the EIA follow-up. These are the proponents, the regulator and the community (Morrison-Saunders and Arts, 2004 page13)

Proponent

Proponents are the private or government organizations who develop the projects. The basic roles of the proponents are to manage the project and mitigate the impact realized by the project. The proponent is expected to perform EIA follow-up in most cases. In some regulations, EIA follow-up is required to be done by the proponent (Morrison-Saunders et al, 2003). The follow-up carried out by the proponent is called *first parties follow-up*. In case of Bangkok Suvarnabhumi Airport, the proponent is the airport authority of Thailand.

Regulator

This group is the regulation agency. The function of this group is to ensure that the environment performance by the proponent comply with EIA approval conditions. It is also used to improve the EIA process in the future and a means for the government agency to keep abreast and control of the project's performance.

The regulator involve in the monitoring process in case of Bangkok Suvarnabhumi Airport is the Pollution Control Department. It is the government organization in the ministry of natural resource and environment. Its aims relevant to the case of noise from Bangkok Suvarnabhumi Airport are monitoring and enforcement of the noise impact.

Community

This group is involved with the project close to the area where the project is being operated. This group of stakeholders may have special knowledge of the local environment, independent to that of the proponent and regulator. They may also be interested in the EIA performance from both stakeholder groups and exert pressure on the proponent and stakeholders to carry out the EIA follow-up. Their involvement may vary from actual involvement in EIA follow-up to simply receiving information from the collected data. The follow-up carried out by this group is called *third parties follow up* (Morrison-Saunders et al, 2003)

In this group, community is the people who live around the airport area who have the effect from the airport. In this study, the focused groups are residents who live in the area, students and lectures from education institutions in the area, and monks from the temples in the area.

There are also other organizations that can be part of EIA follow-up such as non government organizations, consultancy agents etc. These groups of people may have special knowledge related to the project, which could help the EIA follow-up to be more effective. But in this research will focus only three stakeholders as state above.

3.6 Chapter summary

In EIA follow-up, it composed with monitoring, evaluation, management and communication. These report main focuses are on monitoring data and go further in evaluation of the monitoring data.

EIA follow-up is the linkage between pre-decision and post-decision. This linkage will give the feedback from the operation of the project. This information will be used to inform decision makers in order to undertake the right action with the right scale to straggle the actual environmental impacts. EIA follow-up can be performed by different groups of people. The main consideration on this is proponent, regulator and community. These groups of people are also the main important people which will be focused on this thesis.

Chapter4 Noise pollution from aviation

Chapter 4 will give details of how noise affects people around the airport areas. It will also give information on noise measurement standards that are commonly used. Finally there will be a review of noise abatement from various airports.

4.1 Introduction

As worldwide travel increases, the aviation business is also growing (Upham, 2003). Technological advances are making the world smaller while contact and research are becoming far easier. Compared to 20 years ago when air travel was slow and too expensive for most common people, today it is possible to travel across continents in a matter of hours. Today travel is far more affordable, opening doors to worldwide travel to a much broader range of people. Air travel is the preferred choice for long distances due to its fast and efficient service.

The increase in aviation businesses across the world means that there is a constant, growing frequency in airport use and airplane activity and thus an ever-increasing level of pollution being caused by this activity. Noise pollution is a major problem during aircraft landing; take off, taxiing and engine testing, while fuel and engine emissions are largely unnoticeable but very evident upon environmental testing. (CARTEC, 2002).

According to the CARTEC report of 2002 noise pollution is a major official concern around the busiest airports in the US. This may be due to the fact that noise pollution is the most confronting aspect of aircraft activity especially in areas close to airports. Noise is an overbearing factor for residents around airports and there is little that can be done to decrease volume levels in this respect.

Noise is defined as ‘unwanted sound’. Certain levels of noise pollution can cause hearing loss, disturbances of regular human activity and can affect human health and well being. Noise pollution can also be directly linked to psychological discontent.

This chapter will focus mainly on noise pollution in areas close to airports. As stated above, one of the main concerns for public interest in airport neighborhoods is

exposure to noise and so following, airport noise pollution, mitigation measures and human perspectives will be detailed.

4.2 Airport Noise

4.2.1 Sources

Among the main sources of noise pollution in airport areas, aircraft movement, transport to and around the airport and airport construction are the top contributors. Aircraft take-off, landing, taxiing and engine testing are further and perhaps more constant and overbearing contributors.

Concerns regarding noise pollution are often obstacles in airport expansion. Many airports find that they are unable to perform to their full capacity due to implications of noise pollution on surrounding neighborhoods. Often runway expansions, required to increase flight services are prohibited due to the level of noise that would be involved both in the construction of the new runway and the running of flights on the new runway.

4.2.2 Stakeholders

The construction and running of an airport is considered a life long investment, not only of time but money. In any airport project there will be a large team of experts and employees involved in the setting up and running of the company. There are many groups of people involve in the noise affect from the airport.

According to chapter2, this part will focus on three major stakeholders who are the proponent of the project, the regulator and the effected people. So this research project will focus primarily on government organizations, Airport Company and communities affected by the operations of an airport. This report considers that these are the three main sectors related to airport noise pollution management

Government branches are one of the main actors in the operations of an airport. They have authorization and power in decision making in regards to almost all aspects of airport activity starting with construction and a large role in monitoring the success of

the project. In Thailand for example the Pollution Control Department is the main body employed in monitoring the effect of noise from airports in the surrounding areas.

Airport Authority of Thailand is the proponent of the Bangkok Suvarnabhumi Airport. They seem to be noise source for the surrounding area. The mitigation measurement should be made in order to reduce the noise effect that cause by the operation of the airport. With the good responsibilities from the proponent, the noise problem will not be any significant problem.

Surrounding communities are the main groups affected by airport noise. They have the right to propose legal actions against the problems of noise pollution with support from the local community. It is important that local communities are consulted and involved in the airport operations to ensure the satisfaction of people affected by these operations.

Noise measurement

EPA has adopted five systems of "sound descriptors" in order to summarize how people hear sound and how noise affects people's health and well being. They are as follows:

A-weighted sound

One's ability to hear sound is depended on the frequency of the sound. In general people hear sound at a frequency of between 1000 to 6000 Hertz. To measure sound on the scale that approximate that way it is heard by the people, weight number have to apply in order to adjudge the level into the scale that human can hear. (NPC, nd)

There are many methods used to weigh the frequency spectrum to mimic the human ears. This research has taken considerable time to find out the weight methods. A weighted method is recommended by EPA due to its convenient system and accurate readings. (NPC, nd)

The A-weighting system is also used to describe the following three descriptors. A-weighted decibels can be used to find the value of sound at the instant level.

Equivalent sound level

A-weight is not suitable to measure varying sounds that change over time. To measure this kind of sound, equivalent sound level measurement is used. It is A-weighted sound level that is equivalent to an actual vary sound level, in the sense that it has the same total energy for the duration of the sound.

For example, the L_{eq}, 24h of 60 dB(A) means the sound energy that is produced over a 24 hour period by the sound sources, is equivalent to the constant sound energy of 60 dB(A).

Day-Night Sound level

Although Equivalent sound level is suitable to measure varying sound overtime, it does not give the priority to night time sounds levels which, for humans are more sensitive than day time. People naturally expect night time sound to be substantially quieter as it is a time of rest and sleep. Therefore night time noise can have a much greater effect on humans than that of day time.

Day-Night sound level is established to overcome this problem. This is an A-weighted equivalent sound level but with special consideration and emphasis for night time. It is an A-weighted system which adds 10 decibels for night sound (10pm-7am).

NEF

NEF is a method established by US Federal Aviation Agency (FAA) to measure the level of annoyance to communities from aircraft noise around the airports. This NEF number is used to categorize the residential areas. Residential areas should have an NEF of 30 or less.

Noise Contour

NEF is used to be based number to draw Noise Contour of the airport noise. It is the same as geography contour. Noise Contour is the line that connects the same level of NEF number to show the area that has the same noise exposure from the airports.

Noise contour will be used to assessment the impact of noise from the airport. The benefit of using noise contours is to manage the land used of the area around the airports. This contour will give the information to the decision maker to allocate the land around the area with the appropriate purposed.

The relation between sound descriptor

This section will be very important in order to link between each sound descriptor. The major sound descriptors that will be used in this analysis are L_{eq}, DNL and NEF. These relations are based on the Environmental Impact Statement of Bangkok Suvarnabhumi Airport. L_{eq} is equal to DNL-5 and NEF+30 in db(A). So DNL is equal to NEF+35.

4.3 Effect of noise on people

Noise is a major factor in the consideration of the effects of airport activity on people in surrounding areas. Problems which arise vary from public annoyance to serious psychological effects and hearing loss. This section will underline the effects of noise release from aircrafts on people.

4.3.1 Annoyance

It may seem that noise control would be a simple problem to resolve from an urban development point of view. However, considering that noise is constantly released from many sources the problem is not so easy to fix. Noise pollution leads to interference in regular communication and activities; it causes breaks in concentration levels; it can prevent people from partaking in outdoor activities. Some groups are more prone to 'annoyance' from noise than others, particularly older people, children and those with problems sleeping. Factors outlined by the United Kingdom parliament of science and technology in 2003 are as follows:

- Occurrence of exposure
- Fear of accident
- Fear of the future
- Lack of control

Occurrence of exposure

Frequency of exposure to noise is a dominating factor in annoyance levels. Even lower noise volumes can become more annoying according to how often the noises are released.

Fear of accident.

Those with a fear of flying may find that constant exposure to noise omitted by aircrafts has a generally unnerving effect on the individual.

Fear of the future

As more airports are being built and more aircraft activity being engaged human fears too gain momentum.

Lack of control

A lack of control on noise level in noise exposed areas increases annoyance factors and causes more discontentments.

Varying levels of noise effect individuals differently. Certain people may find certain noise levels far more troublesome than that which many others barely notice. The following table outlines the effects of different noise levels on the average person.

DNL (dB)	Qualitative Description of potential for hearing loss	Percent of population highly annoyed	Average community reaction	General community attitude
75 and above	Hearing loss may begin to occur	>37	very severe	Noise is likely to be the most important of all adverse aspects of the community
70	Hearing loss not likely	22	severe	Noise is one of the most important adverse aspects of the community environment
65	Hearing loss will not occur	12	significant	Noise is one of the most important adverse aspects of the community environment
60	Hearing loss will not occur	7	moderate to slight	Noise maybe considered an adverse aspect of the community environment
55 and below	Hearing loss will not occur	3	moderate to slight	Noise considered no more important than various other environmental factors

Table 4.1: Effect of noise on people.

(Source TEAM, 2005)

4.3.2: Sleep disturbance

It is human nature to need sleep in order to recharge their bodies and minds to prepare for a new day. Overbearing noise levels can cause people to lack this sleep that helps them to function effectively in everyday life. A United Kingdom office of science and technology report revealed that sleep deprivation is a major complaint made by people living in areas near airports. Inadequate sleep can lead to weakness, stress and disorientation in every day life.

Hume and Watson, 2003 page 61-62 outlines from the study of Morrell et al (1997) that high level of noise from aircraft often lead to problems such as:

- Delay sleep onset
- Increased awaken from sleep
- Sleep loss
- Premature awakening at the end of sleep
- Reduced quality of sleep
- Extended periods of inadequate sleep are proven to lead eventually to weakness and ill health.

4.3.3 Stress

With the regular disturbances in daily activities and communication due to noise pollution, human habits naturally and inconveniently change. Over time this leads to stress brought on by the inability to perform their usual activities effectively. Although not a direct effect of exposure to noise, it can have major disadvantages for human unable to overcome the annoyance.

Stress, however can be a direct effect of noise pollution. The following excerpt from Hume and Watson 2003 (p.64) supports this fact:

"Noise, particularly loud and unexpected, is known to have an undesirable physiological effect on the recipient. How much this and the slower responses lead to a generalized stress response via the hypothalamic pituitary adrenal (HPA) axis, sympathetic nervous system (SNS) and cardiovascular reactivity is controversial. The HPA axis and SNS have central roles in the ongoing homeostatic regulatory processes of the body in the face of the changing environmental stimuli that an individual encounters. This provides the body with the physiological survival mechanism commonly termed 'fight or flight', which can be activated in situations where the individual is unable to cope adequately with an extreme and potentially threatening set of stimuli."

Babishch's (1998,2000) study and Ising et al (1999) both provide information to support the observation that increased levels of noise lead to increased levels of stress hormones in the blood. Thus it can be said that noise can have both direct and indirect implications on people's stress levels.

4.3.4 Hearing loss

Hearing loss is one of the most severe results of exposure to noise pollution. Over exposure to very loud noises can destroy the hearing system and causes hearing loss in individuals. The Federal Interagency Committee on urban noise has concluded that noise above 75 decibels can and commonly does lead to hearing loss.

4.4 Noise abatement

Although it is impossible to eradicate noise from aircrafts, with professional planning and technological advancements, aircraft noise may be reduced. This section will outline the propose plan from International Civil Aviation Organization (ICAO) plans to tackle noise pollution. It is important to take lessons from airports that have already commenced work on noise abatement and achieved results in the process. The following list outlines some of the procedures which have been undertaken in order to reduce noise levels:

- Reducing aircraft noise at source
- Land use planning and management
- Change of operation procedures
- Restriction on aircraft noise
- Noise charge

4.4.1 Reducing aircraft noise at source

International Civil Aviation Organization (ICAO) aims to reduce the noise at source from aircrafts for the last 30 years. Aircrafts are required to meet standard established by ICAO council. These are contained in Annex 16- Environmental Protection, Volume I (Aircraft Noise to the Convention on International Civil Aviation). (ICAO, nd)

The first generation of jet powered airplanes was not cover by Annex 16. The standard for the aircraft that designed before 1977 was included in chapter2 of Annex 16. The aircrafts that included in this chapter are such as Boeing 727 and Douglas DC-9. The newer aircrafts are required to meet stricter standard contain in Chapter3 of Annex 16. The examples of aircraft are Boeing 737-300/400, Airbus A319 and Boeing 767. After the fifth meeting of committee on environmental protection, council adopted the new chapter4. Chapter4 is more stringent than chapter3. This will apply to new certified aircrafts and aircrafts to re-certify to chapter4. (ICAO, nd)

With the aim to reduce noise, the newer aircraft will operate quieter. In contradiction, the increasing of flight is the major cause for noise problem. The target of noise

reduction has to be dealt with others mitigation procedures which will explain as following.

4.4.2 Land use planning and management

Land use planning and management is the effective action to ensure that the purpose of land use around the airport is compatible with the aviation. (ICAO,nd) Noise from the aircrafts can not be totally eliminated. The area, which is close to the airport, could be affected from the aircrafts noise. This is the reason why land use planning and management should take place to minimize this problem.

This method of reduce noise problem include buy out and reduce noise at recipient. In some area, the noise level can be over acceptable for the standard. This area can not be managed for any purpose. The solution for this might be to buy out the land by the airport authority. But some cases the owner of the land do not want to move out from their place due to any reason. Organizations, institutions and private homes with long settlements in airport areas are often less than willing to accept buy-out offers but instead seek compensation for disruption, which can be used to invest in infrastructure to reduce noise pollution. Such infrastructure includes that installation of sound proof insulation.

4.4.3 Change of operation procedures

ICAO (nd) suggested that these procedures could lead to noise reduction at comparatively low cost. This can lead to 3-12 db(A) noise reduction and 8%-36%reduction in noise contours area on approach and 2 -9 db(A) noise reduction and 23% -42% reduction in noise contours area on take off. Noise abatement operational procedures in use today can be broked down into three categories as following: (ICAO, 2007)

Noise abatement flight procedures

· Continuous Descent Arrival (CDA)

· Noise Abatement Departure Procedures (NADP)

· Modified approach angles, staggered, or displaced landing thresholds

· Low power/low drag approach profiles

· Minimum use of reverse thrust after landing

Spatial management

· Noise preferred arrival and departure routes

· Flight track dispersion or concentration

· Noise preferred runways

Ground management

· Hush houses and engine run up management (location/aircraft orientation, time of day, maximum thrust level)

· APU management

· Taxi and queue management

· Towing

· Taxi power control (Taxi with less than all engines operating)

The uses of these methods are based on the lay out of the airport and its surrounding. But the important consideration is the safety. ICAO's noise abatement procedures are contained in Annex 16, Volume I, Part V and *Procedures for Air Navigation Services — Aircraft Operations*

4.4.4 Restriction on aircraft noise

Due to the noise concern, many developed countries have adopted the restriction on noisy aircrafts. In 1980s, this restriction focused on Non Noise Certified aircrafts. Later in 1990s, the restriction moved to aircraft complying in chapter2 of Annex 16. Today it moves to chapter3. (ICAO,nd)

The restrictions on aircraft noise could lead to reduce in aircraft noise from the airport. It also causes economic implication for the airline concern. ICAO (nd) suggested that the restriction should be adopted by the noise sensitive airports.

4.4.5 Noise charge

ICAO’s noise charge was first established in 1981. It is contained in *ICAO's Policies on Charges for Airports and Air Navigation Services*. Even though reduce noise at source could lead to noise reduction but many airport need to be apply noise abatement program. The ICAO (nd) recognizes that the noise abatement program may be costly. The cost from this program need to be attributed from the airport authorities and suppose to be recovered by the users of the airport. From the point of ICAO (nd), this program should be applied at the airport where there have the problem and the charge should not excess the cost of their noise abatement program.

4.5 Chapter summary

This chapter presents the problem from aircraft noise which is varying from annoyance to hearing loss. The effects on people are also varying from people to people. Even the area where receive the same noise level, the effect on that is different.

Even the aircraft noise is the main problem from airport operation; there are still processes to mitigate these problems. ICAO introduces the noise mitigation measurements which are varying from taking action at the source, at the operation of aircraft and taking action at the receiver. The different place has to take different action due to the different location, stakeholder and funding. There is no best solution for this. The most important is to compromise the need between proponent and the effected people.

Chapter5 Bangkok Suvarnabhumi Airport Monitoring

Chapter 5 will provide the monitoring data from Pollution Control Department (PCD). This data will be used to analyze with Noise effect to people, prediction from Environmental Impact Statement from Airport Authority of Thailand and the standard from National Board of Environment. This detail in this chapter will provide for further conclusion on the research for the next chapter.

5.1 Noise standard

In order to facilitate the creation of suitable living environments, National Environmental Board (NEB) has developed a standard for noise criteria**.** NEB's noise policy clearly requires noise attenuation measures are provided when proposed projects are to be located**.**

NEB regulation set forth the follow noise standards for the maximum acceptance:

L_{max} is not over 115 db (A)

L_{eq} 24 h is not over 70 db (A)

L_{eq} 24 h should not over 62 db (A) for living area which mean by the area is resided by the people

And the maximum noise level for vulnerable areas is 55 db (A). Vulnerable areas define by the area which has sensitivity to noise. In this study, the research focuses on temple and educational institutions.

Even though there are some limited for the noise level in Thailand. It does not mean that the lower noise level than this limited is not caused any problem. From table 3.1, it presents the effect of noise on people. The noise level between 70-55 db (A) can be recognized as adverse environmental effect. Even if the effect from these noise level can not cause hearing loss, but it can annoy people in the area. With the noise level of 65 db (A) and more, noise can be significant impact on the community.

By mean of PCD, they state the quality of noise level. The equivalent noise level over 70 db (A) is unhealthful. If it is between 55 and 70, the noise quality is in moderate

level. At the noise level below 55db (A), it is the good noise quality which mean by acceptable for all activities of land use.

Due to the forecasting of noise effect from the airport, it use the computer program and it use Noise Exposure Forecast System that has been designed to predicted to predict annoyance from aircraft noise. The NEF model is supported by a document that contains guidance which is design to achieve compatible land use around the airport.

The NEF standard on land use, given by the ICAO, state that the NEF less than 30 is suitable for all activities but in case of vulnerable areas such as educational institutions, hospitals and temples which should install sound proof insulation in order to release the noise effect. The NEF between 30-40 for living areas could cause the complain from the living communities in the area while for the vulnerable area such as educational institutions, hospitals and temple, this area in this NEF should install the sound proof insulation. For the NEF more than 40, it is not suitable for living area and vulnerable area as state before.

The policy on land use around Bangkok Suvarnabhumi Airport concerns on land in noise contours of NEF30 and more as affected area. To buy out, the NEF levels have to be more than 40 while the NEF between 30 and 40, the airport authority will install the noise insulation for the household.

5.2 Environmental Impact Prediction from EIS

5.2.1 Method use in this noise prediction

The method, used in this assessment, is based on the computer modeling. This computer modeling estimated exposed noise based on collection of noise released from each type of aircraft. This collection forecasts the noise impact by using each noise from landing and taking off from each aircraft type.

The noise model from the airport is depend on index of the airport such as type of aircraft using airport, the number of flight using airport, the activities of the airport

during day and night, the planning of using runway and route of flight to and from airport.

In this impact statement, the noise expected to release from Bangkok Suvarnabhumi Airport is forecasted by Integrated Noise Model (INM) computer modeling of Federal Aviation Association (FAA) Version 6.0. This assessment forecast only the noise released from aircrafts, not the accumulate source such as electricity producer, the transport around the airport area and etc.

5.2.2 Limitation of this INM computer model

This model using for assessment the noise impact for Bangkok Suvarnabhumi Airport considered only the source of noise from aircrafts. This assessment did not include the source of noise from other sources such as traffic and ground operation. In contradiction, the actual noise, is released from airport, includes not only aircraft noise but also the activities around the airport which may include the noise from industrial estate, noise from traffic using highways and etc.

The noise contour from this computer modeling is depended on managing thrust and flying route for aircraft. These variables are not instant. These variables can not be accurately expected. This noise contour can be used as only for reference because the real practice is not always the same as the information used in the model.

The result from this model also depends on other conditions that have the influence on the noise release from the aircrafts. These conditions are wind direction, temperature, geographic of the airport and the structure of the surrounding area. These conditions also influence on the released noise to the surrounding area. In INM modeling, it is difficult to feed accurately data for this information.

The other variable that influence on the accurately of this prediction is the operating data of the airport. These variables are the distribution of flight operation, number and type of aircrafts using airport, the number of flight during day and night time and the operation of the airport in the future. These information are complicate to use the

accurately data because all these information are not instant. It is always changing overtime.

5.2.3 Data for INM model

This noise impact prediction is based on three scenarios. These three situations are as following:

Scenario1

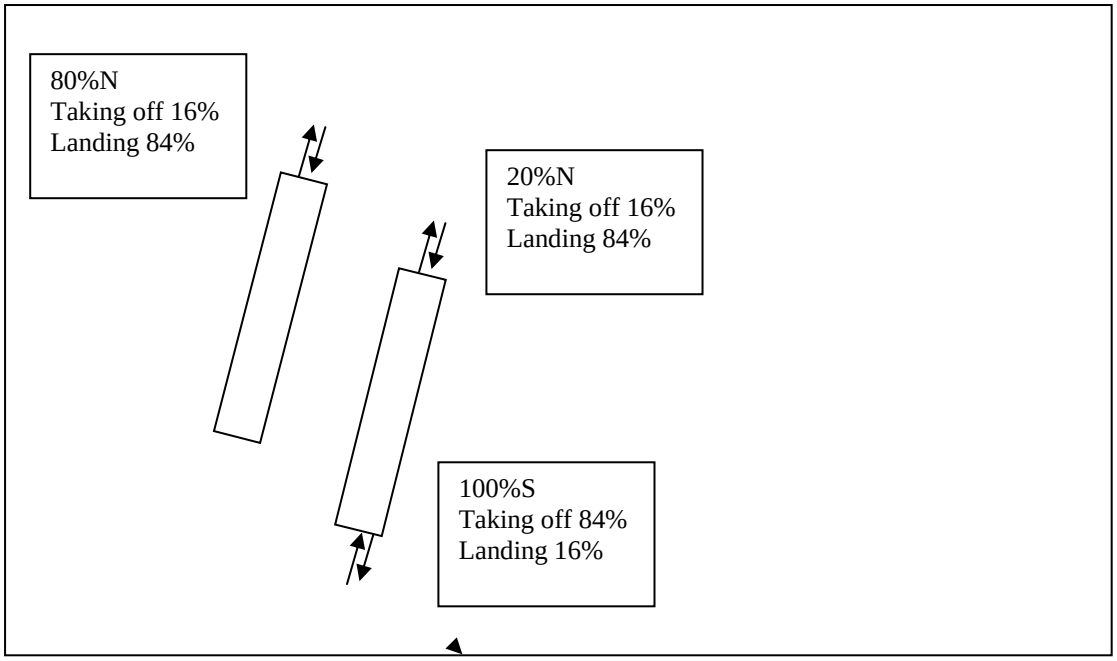


Figure 5.1: Airport operations due to scenario 1.
(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement).

Scenario 2

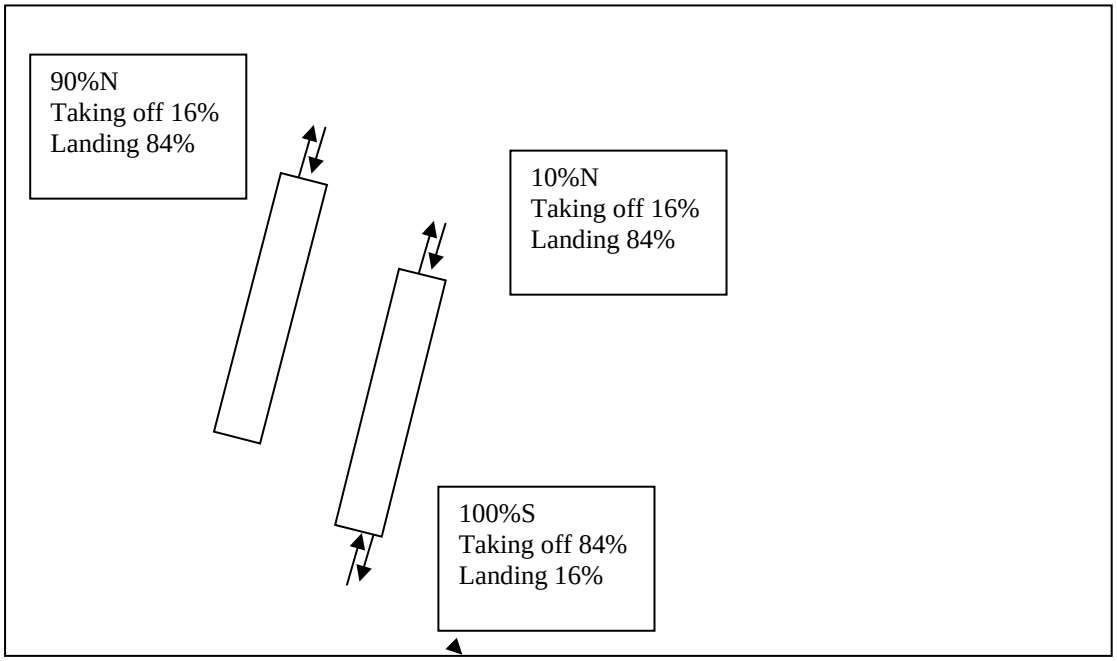


Figure 5.2: Airport operations due to scenario 2.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement.)

Scenario 3

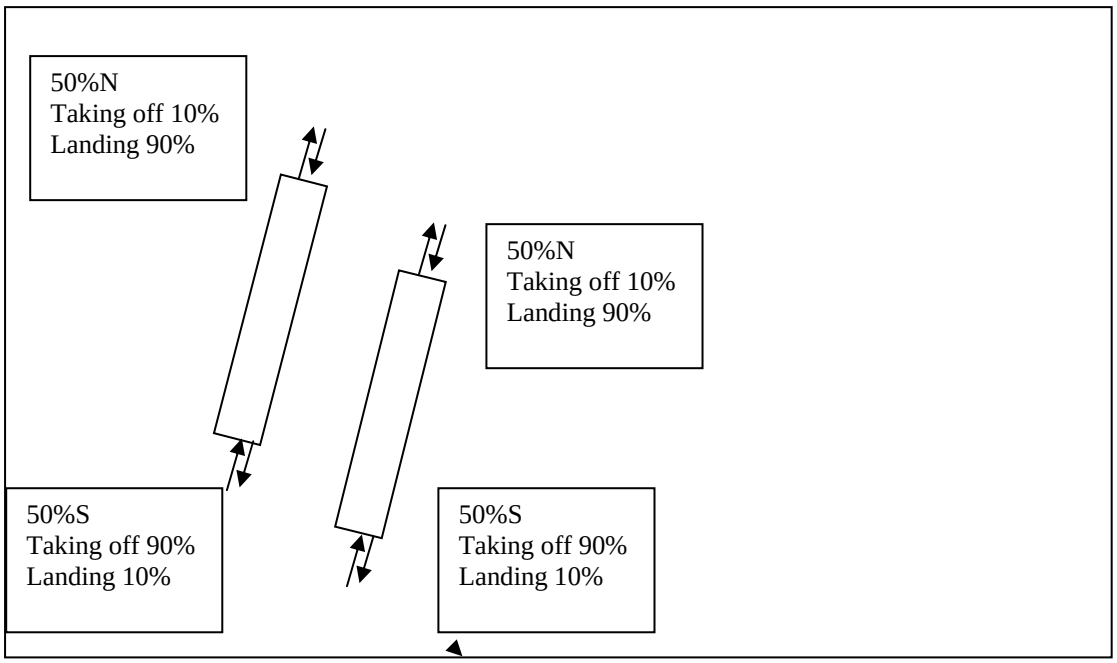


Figure 5.3: Airport operations due to scenario 3.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)

Out of these situation, there are also some other information that needed to be consider in this model. This model is based on 45 million passengers per year. The ratio of flights use Bangkok Suvarnabhumi Airport is also important for this calculation. The calculation is based on the following ratio for type of flight using airport in table 5.1-5.3.

International flight	Domestic flight	Cargo flight	Total
145067	79024	10029	234120

Table 5.1: The flight number is expected to use Bangkok Suvarnabhumi Airport for 45 million passengers.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)

Types of aircraft using Bangkok Suvarnabhumi Airport are expected to be as following table5.2 and 5.3:

The proportion of flight using airport during day and night uses as following:

Day flight (07.00-22.00) 80.9%

Night flight (22.00-07.00) 19.1%

There are still some other conditions that need to be used in this model. All the other information is based on the expectation from the assessor.

The flight route of this assessment is based on three situations which stated before.

Type	International(percents)	Domestic(percents)
Boeing 747-400	70	50
Boeing 767-300	4	0
Boeing 757-200	10	0
Boeing 737-500	10	17.5
Airbus 310-200	6	20
BAE 146-300	0	7.5
BAE HS-748	0	5
Total	100	100

Table5.2: The flight ratio of commercial aircraft.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement.)

Type	Percentage
MD 11F	12.7
A 300 F	7.2
B 747 F	49.4
AN 6	8.4
ANT	8.4
B 707 F	12
B767 F	0.6
B757 F	1.2

Table5.3: The ratio of cargo aircraft.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)

To analyze the noise from the aircraft, this research will need to show the noise level from different major aircrafts that used in this ILM model. Due to the ratio of flight, the international flights have the most influence on the number of flights, then domestic flights and cargo flight. The international flights are approximately 14.5 times more than cargo and domestic flights are approximately 7.9 times more than cargo flights. The following table will show the noise level standard from the major aircraft used in the ILM modeling from the Federal Aviation Administration (FAA) certify under 14 CFR part 36. This table is based on the loudest engine in the model.

aircraft type	take off (dbA)	approach (dbA)
Boeing 747-400	90.8	93
Boeing 767-300	81.6	92.3
Boeing 737-500	78.4	89.8
Boeing 757-200	75.9	87.9
BAE 146-300A	75.8	87.6
Airbus 310-203	77.2	87.5
Boeing 747-400F	90.4	93.1

Table 5.4: Noise level from FAA standard certify.

(Source: Advisory Circular, Estimated airplane noise levels in A-weighted decibels, FAA.)

From table 5.2 and 5.3, the most frequency flights using Bangkok Suvarnabhumi Airport are Boeing 747 type aircraft which from the aircraft noise level table shows that it produces highest noise from entire aircraft using in the prediction of noise impact from this airport. From three tables above, they show that the predicted noise level from Suvarnabhumi Airport is based on the use of Boeing 747-400 aircraft which is the loudest among the aircraft used in this prediction. 60 percents of all the flights expected to use Bangkok Suvarnabhumi Airport are Boeing 747-400. The result from this prediction is depended on the noise from Boeing 747-400 fleets.

The result from table above shows that approach procedure making more noise than take off procedure. Subsequently, the plan to operate aircrafts for taking off and approaching has influence on the noise to the surrounding area, especially the area in the runways' pathways which will have more influence from the aircrafts noise than the sideline area.

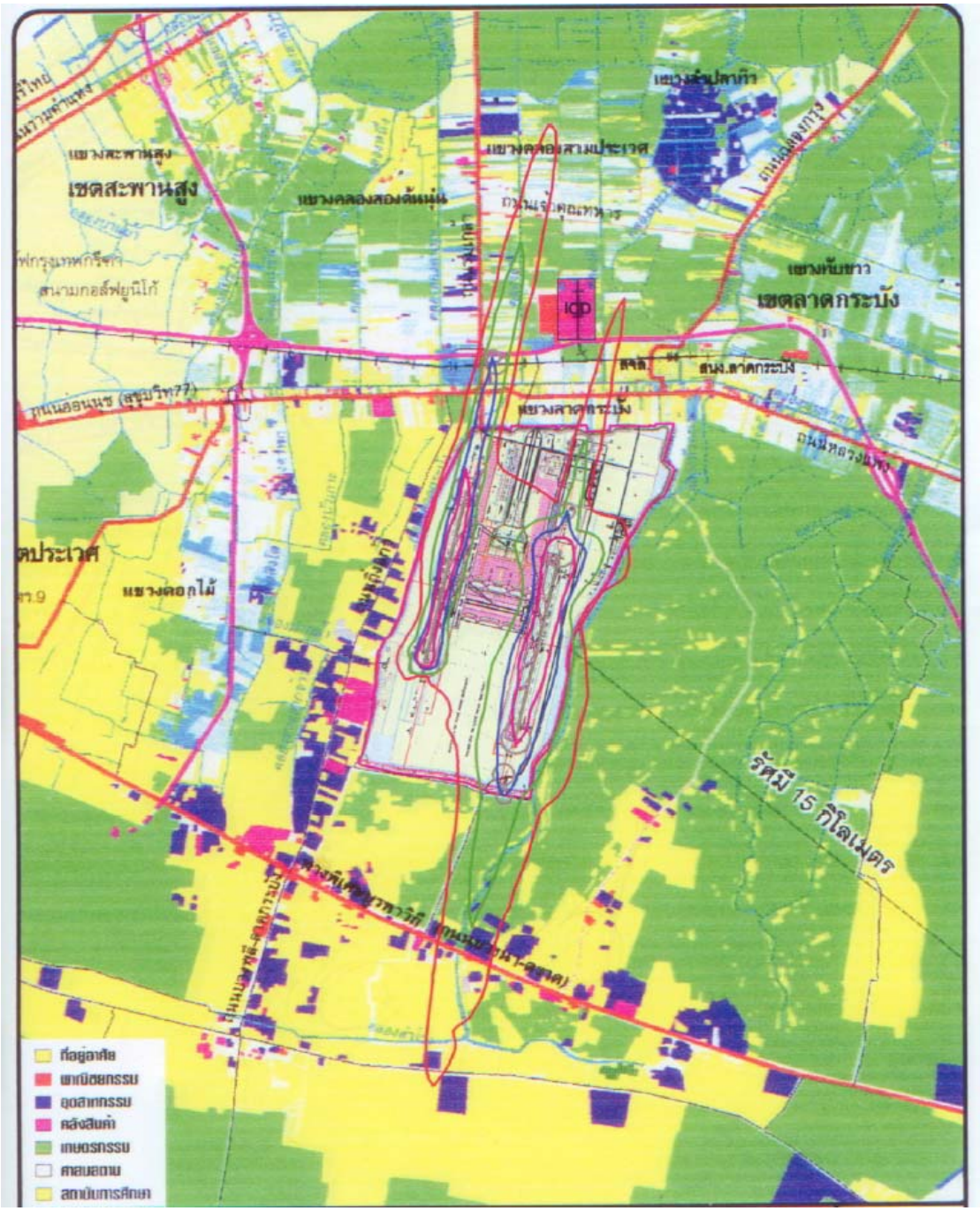
5.2.4 The result from this modeling

The results from the computer model show the different NEF from the three different situations of aircrafts using two runways. The effected areas show in the following table5.5 and in the map 5.1-5.3 based on three scenarios that state before.

NEF	situation1			situation2			situation3		
	Effect area outside the airport	**Effect area in the airport**	**total effect area**	**effect area outside the airport**	**effect area in the airport**	**total effect area**	**effect area outside the airport**	**effect area in the airport**	**total effect area**
30-35	12.944	23.362	36.306	13.404	25.568	38.972	12.292	29.417	41.709
35-40	3.035	13.176	16.211	4.802	13.111	17.913	2.13	16.245	18.375
40-45	0.322	7.077	7.399	0.534	7.654	8.188	0.162	8.012	8.174
>40	-	3.23	3.23	-	3.751	3.751	-	3.845	3.845
Total	16.301	46.845	63.145	18.74	50.084	68.824	14.584	57.519	72.103

Table 5.5: The expected effect area.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)



Map 5.1: The effected area from scenario1.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)

Yellow means living areas and educational institutions

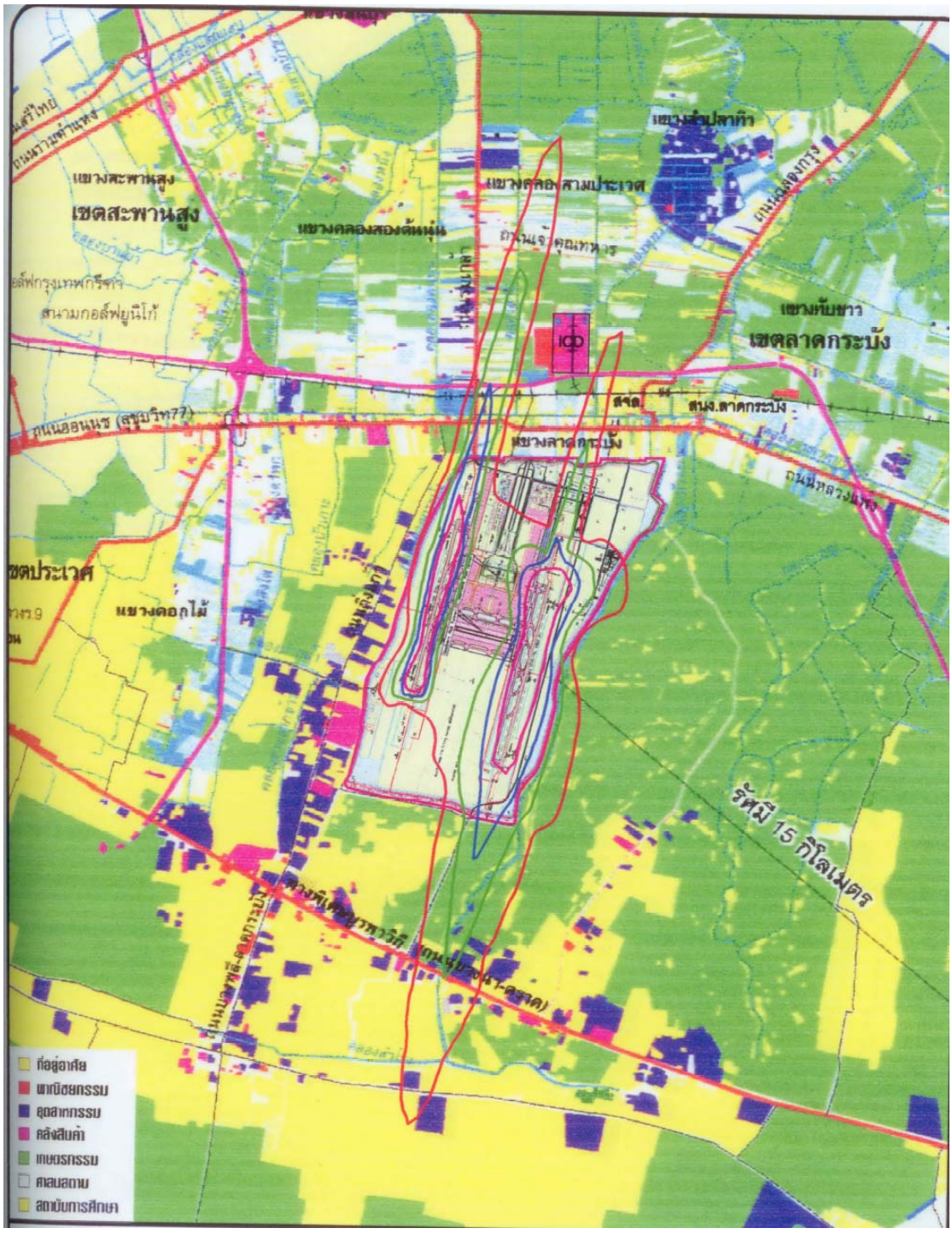
Red means business areas

Purple means industrial areas

Pink means warehouses

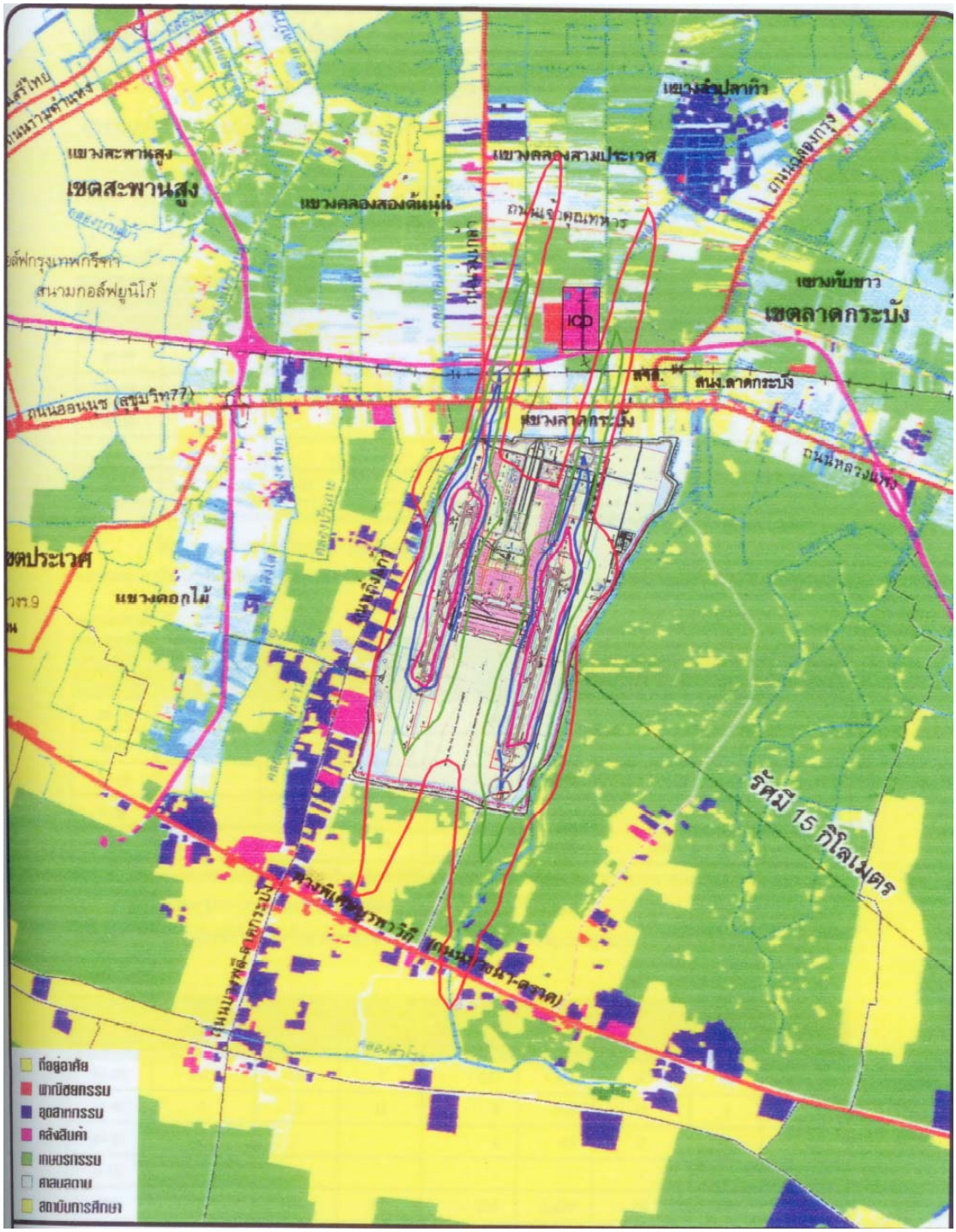
Green means agriculture areas

White means religion places



Map 5.2: The effected area from scenario2

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)



Map 5.3: The effected area from scenario3.

(Source: Bangkok Suvarnbhumi Airport Environmental Impact Statement)

5.3 Institution setting for EIA follow-up for noise impact from Bangkok Suvarnabhumi Airport

Due to the EIS from Bangkok Suvarnabhumi Airport, Airport Authority stated that noise monitoring will be held by the third party. This monitoring stations are set in 13

location in the north and south of both runways. The noise monitoring data will be delivered to the Office of Natural Resources and Environmental Policy and Planning (ONEP) every 6 months. The monitoring will collect monthly noise data.

After the opening of the airport, Airport Authority did not perform monitoring process as state in EIS. The operation of the airport releases the noise problem to the surrounding area. Some people claimed the neglected responsible from the airport authority due to noise problem. ONEP requested Pollution Control Department (PCD) to monitor the noise effect from the airport. The purposes of this monitoring are to control the noise effect as a regulator and responsible for the issue raised from the public.

5.4 Monitoring

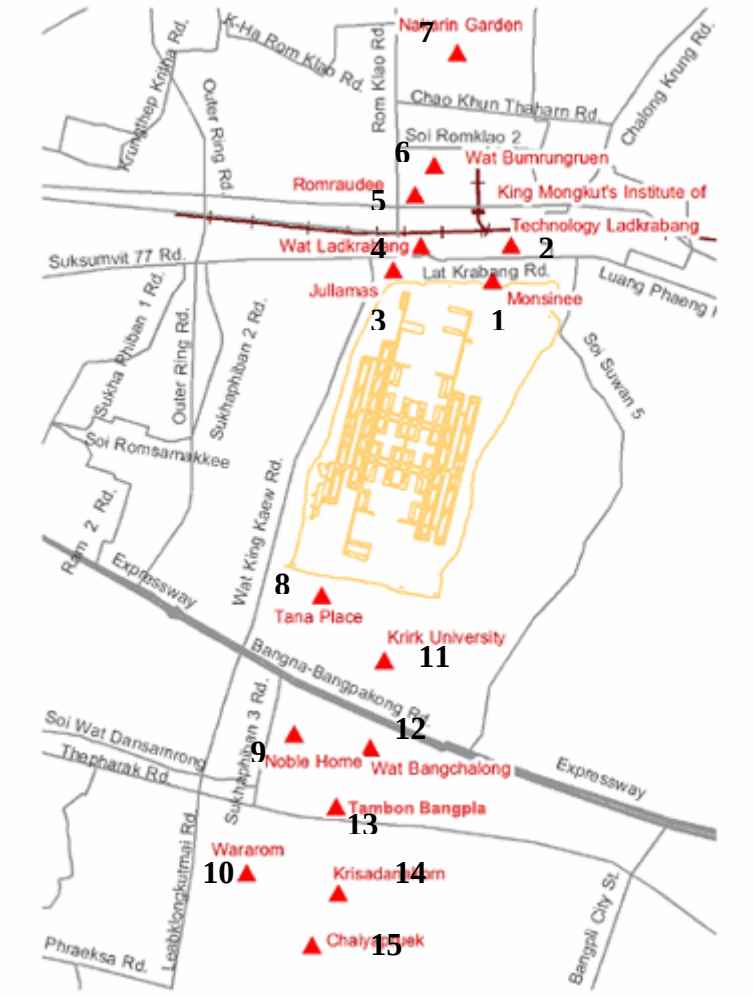
The monitoring data in this report is coming from monitoring process that performed by Pollution Control Department in order to control the noise release to the communities around the airport. The monitoring station is set in pathway from the airport runway as shown in the map5.4.

Form all the monitoring station, there are ten residential areas, two educational institutions and three temples. The residential areas are Jullamas, Romraudee village, Nakarin garden, monsinee, Tana place, Noble Home, Wararom, Tambon Bangpla, Krisadamahanakhon, and Chaiyapruek. Two educational institutions are Kirk University and KMIT. Three temples are Ladkrabung Temple, Bumrungruen temple and Bangchalong temple.

5.4.1 The need for monitoring for Bangkok Suvarnabhumi Airport

From figure 3.1, EIA follow-up can be used at project implementation stage and to monitoring the environmental consequences from the operating stage. In case of Bangkok Suvarnabhumi Airport, this research focuses on operating stage of the airport. The purposes of this monitoring are to comply with the government standard and demand from public pressure.

From the interview with officer in noise and vibration control bureau, pollution control department, ministry of natural resources and environment, he explain that the predicted noise contours from EIS is much different from the data collected from monitoring. The actual noise impact from the operation covers more area than the prediction.



Map 5.4: The monitoring station location.

(Source: Pollution control department retrieve from http://gendb.pcd.go.th/SWPNOISE/en_noiselevel.asp)

5.4.2 Monitoring Data

As shown in the map above, all the noise monitoring stations are on the landing and taking off pathway of the airport as seen in the map. The take off and approach routes will have the maximum effect from noise compare to the sideline area. There are 15 monitoring stations. The monitoring stations were set as two parallel lines from the

east and west runways as show in the map above. There are seven in the north and eight in the south. The monitoring data has not continued over time but in some period after the opening of the airport until June 2007. The collection of this monitoring data is collected in equivalent noise level for 24 hours. This monitoring data is in appendix A.

Most of the monitoring data from the Pollution Control Department was not over the standard from the PCD which set through L_{eq} 24 hours = 70 db(A). In some particularly day, the level of noise was higher than standard. This might cause from the other conditions such as the operation of flight during take off and landing, runway used and weather condition as such wind direction. There are many conditions that have influence on the noise exposure to the areas. From the average monitored equivalent noise level, it shows that the station that closer to the airport will have the higher level of equivalent noise exposure that because the aircraft is lower when it is closer to the runway. From the information from FAA, Approaching Aircraft releases higher noise level than taking off aircraft. This is also the condition to make noise level different between taking off runway and approaching runway.

The following tables show the average equivalent noise level (L_{eq}), the maximum equivalent noise level and the maximum noise level at the 15 monitoring stations. These all number can illustrate the noise receiving level at different place away from the airport site.

Station	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07
Northern								
Jullamas	65.25	68.65	69.12	66.88		67.65		67.54
ladkrabung temple	65.17	67.87	68.33	66.71		69.06		65.77
Romraudee village	61.03	67.15	68.05	67.60		65.81		67.13
Bamroongruen temple	69.42	67.62	67.78	67.81		67.00		64.94
nakarin garden	66.47	66.25	65.31	65.91		63.93		63.30
Monsinee	64.34	61.86	61.20	64.07		64.01		62.33
Kmit		59.45	58.88	59.41				60.37
South								
tana place	62.92	64.07	65.88	64.62		64.16		69.46
noble home	58.02	59.27	59.19	58.94		59.26		63.61
Wararom		55.05	58.38	56.57		56.47		57.93
kirk university	68.05	65.79	65.28	66.43		66.14		64.00
bangchalong temple		68.40	67.40					
tambon bangpla			63.81	64.76		62.97		61.27
Krisada mahanakhon		66.40	62.39	61.32		61.05		61.01
Chaiyapruek		62.14	60.71	59.61		60.05		56.44

Table 5.6: The monthly monitoring average equivalent noise level 24 hours.

Station	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07
Northern								
Jullamas	66.6	71.1	71	70.4			73.8	68.9
ladkrabung temple	69.1	70.2	72.1	70.2			71.6	67.5
Romraudee village	69.4	68.6	69	69.1			67	68.3
bamroongruen temple	78.3	72.4	70.5	69			67.7	65.8
nakarin garden	69.9	73.1	68.5	73			65	64.4
Monsinee	66.8	67.9	66.4	67.6			65.4	64.1
Kmit		71.2	62.9	62.8				63.3
South								
tana place	65.3	78.8	70.7	68			65.8	72.6
noble home	58.9	71.7	68.4	60.9			60.3	66
Wararom		57.4	75.6	58.1			58.1	60.8
kirk university	69.5	81.3	70.7	68.8			67.2	66.4
bangchalong temple		69.1	70.9					
Tambon bangpla			64.6	72.3		63.4		67.8
krisada mahanakhon		72.9	66.9	65.6			62.5	59.8
chaiyapruek	66.6	71.1	71	70.4			73.8	68.9

Table 5.7: The maximum equivalent noise level 24 hours.

Station	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07
Northern								
Jullamas	98.5	100.7	101.7	99.1			100.7	97.8
ladkrabung temple	99.8	97.7	99.1	98.1			98.2	97.3
Romraudee village	98.8	98.8	101.5	96.9			96.5	98.5
bamroongruen temple	100.6	99.4	98.4	95.1			97.9	97.4
nakarin garden	100.8	105.4	96	102.5			101.5	96.1
Monsinee	106.3	97.2	100.3	100.4			100	88.8
Kmit		105.8	98.6	91.3				96.1
South								
tana place	100.1	105.6	105.2	102.7			100.6	106.4
noble home	89.4	112	105.2	94.1			97	105.6
Wararom		88.4	105.3	87			96.6	100.2
kirk university	96.5	105.7	105.3	95.4			103.2	96.9
bangchalong temple		95.3	105.3					
tambon bangpla			94.6	90.8		101.9		101.4
krisada mahanakhon		105.3	105.1	91.8			106.9	99
chaiyapruek		105.4	105.4	104.2			94.4	100.3

Table 5.8: The maximum noise level.

From Table 5.6 (average L_{eq}), this table presents the average value of L_{eq} 24 hours. This table aims to present the overview of the mainstream value of L_{eq} 24 hours at each station. The numbers in the table show that all the average value of L_{eq} 24 hours are lower than 70 db(A) which mean the mainstream value of L_{eq} 24 hours at all stations are complied with the regulation.

Table 5.7 shows the maximum number of L_{eq} 24 hours. Due to table 5.7, even though all the average values of L_{eq} 24 hours are less than 70db (A), these values are the average so there might have some higher and lower also. This table gives the picture of how high is the noise in the noisiest day at the airport during the monitoring period. The highest Leq 24 hours may be not complied with the standard of 70db(A) due to

different conditions as such the route for take off and approach, types of aircraft, weather conditions and the operation procedure of the aircraft.
Table5.8 show the maximum number of noise level. This is the highest noise level that released at the specific time. All maximum noise level is complied with the 115 db (A) standard by NEB.

These three tables will be used together to analyze on the noise level of these monitoring data related to the number of flight from Bangkok Suvarnabhumi Airport. The number of flight will relate to the average L_{eq} because from the assumption that higher number of flight will produce higher noise level. The relation between three tables is to consider whether the maximum noise level and maximum L_{eq} from each month will have influence on the average L_{eq}.

To analyze on noise measurement, it is important to consider on the flight using Bangkok Suvarnabhumi Airport. The data on flight number using Bangkok Suvarnabhumi Airport is shown on Appendix Z. The number average of flights per day using Bangkok Suvarnabhumi Airport is as following:

month	**average flights per day**
October	760
November	747
December	792
January	810
February	832
March	787
April	689
May	655
June	654

Table 5.9: The average flight numbers using Bangkok Suvarnabhumi Airport.

Most of the highest level of average $L_{eq,}$ L_{eq} max and Lmax are in the period of November to January. These months are in the winter which is the high season for tourist to come to Thailand. This can related to the average flight per day during December to February from table5.9. As evidence from this, flight number have

influenced on noise monitoring level. The international flights usually use larger fleets. This also influence on the highest level of noise from table 5.8.
From the hypothesis, the closer station to the airport in the same pathway and direction of the runway should have higher level of noise because the closer to the airport, it mean the lower the aircraft and as the consequence from this, the monitoring station is closer to the noise source.

As contradiction from table 5.7, considering the northwestern stations of these monitoring stations which are Jullamas, Ladkrabung Temple, Romraudee, Bamrungruen Temple and Nakarin garden during February 2007, some monitoring station that located closer to the airport than other but the noise level was lower in the L_{eq} average. This mean the noise level at some farther station from the airport runway had the overall noise level higher than the closer one. This is not cause from unusual incidence but it might cause from the usual flight operation during that month which the flights take off and approach above the farther station but just exactly over the farther monitoring stations than the closer monitoring stations. Another cause might come from the weather condition as such wind direction during that month.

The other influence on these numbers might come from some domestic flights switch to use Donmuang Airport since 25 March 2007 due to the runway maintenance. This may decrease about 100 domestic flights per day. Even though there are 100 flights less than before, the aircrafts use for domestic is smaller if compare with international flight. From table 5.4, it shows that larger size aircraft will produce more noise than the small one. Most of the international flight use larger number of Boeing 747. This issue on switch some domestic flights to Donmuang Airport might not ensure on the noise reduction because in some monitored stations, the L_{eq} from table 5.6 is still higher than other period before switching to Donmuang Airport.

Due to the new airport operation, the monitoring data is not collected over one year round. From these data, it is impossible to compare the collected data between the same periods in different year due to newly open airport. In the future, after one year operate; the information from this will help to give some more information on the noise level during each period of the year. This information will help the airport authority to consider on the specific mitigation measurement in order to reduce the

noise effect. Since the starting period of the airport, the function operation at the airport is not stable due to the improvement of the operation and increasing number of flight using the airport.

Out of this monitoring data, Pollution Control Department also survey the effected building by the noise from Bangkok Suvarnabhumi Airport. After the airport opened, with the number of 800 flights per day, the effected area in NEF more than 40 are 5.36 km^2 and after switch some domestic flights to Donmuang Airport, average flight are 700 flights per day, then the effected area in NEF more than 40 become 2.6 km^2. To this consideration, this research will not go through deep detail on the area but this will give a cue on how the monitoring data could help on consideration of effected area in order to consider further mitigation measurement.

5.4.3 Monitoring station and the EIS

To evaluate the effectiveness of EIS, this research will analyze based on the monitoring stations from PCD. In this section, the research will present the monitoring stations, which monitored by PCD, in the NEF noise contours which based on three scenarios used in prediction.

Scenario1

NEF	**living area**	**Temple**	**Educational Instiurion**
NEF 30-35	monsinee, romraudee, nakarin garden, Jullamas	Ladkrabung temple, Bamrungruen temple	KMIT, Kirk University
NEF35-40	Jullamas, Romraudee	Ladkrabung temple, Bamrungruen temple	
NEF 40-45			
NEF >40			

Table 5.10: The monitoring station where located in noise contours prediction from Scenario1.

Scenario 2

NEF	living area	Temple	Educational Instiurion
NEF 30-35	monsinee, romraudee, nakarin garden, Jullamas	Ladkrabung temple	KMIT, Kirk University
NEF35-40	Jullamas, Romraudee, monsinee	Ladkrabung temple, Bamrungruen temple	- - -
NEF 40-45	- - -	- - -	- - -
NEF >40	- - -	- - -	- - -

Table 5.11: The monitoring station where located in noise contours prediction from Scenario2

Scenario 3

NEF	living area	Temple	Educational Instiurion
NEF 30-35	monsinee, romraudee, Jullamas, Tana place	Ladkrabung temple, Bamrungruen temple	KMIT, Kirk University
NEF35-40	Romraudee, monsinee	Ladkrabung temple, Bamrungruen temple	KMIT
NEF 40-45	- - -	- - -	- - -
NEF >40	- - -	- - -	- - -

Table 5.12**:** The monitoring station where located in noise contours prediction from Scenario3

5.4.4 Compare standard-monitoring

Due to the monitoring performing in the expected affected area, the noise level from most of the stations does not comply with the standard from government. Most of the stations have the noise level over 70 db(A) in some particular day. The noise level around 70 db(A) does not mean that these noise level can not be acceptable for living area but it depends on the purpose of land use in the area. In other hand, the noise level at the vulnerable stations may be acceptable for residential area but not for the vulnerable purpose like educational institutions and Temple.

From all the vulnerable points in this monitoring, the L_{eq} level is above the maximum noise level for vulnerable area. These place need to be compensated in order to mitigate the noise problem that have the influence on their activities.

Most of the residential areas noise level reach 62 db(A) which is the noise level for living area. Due to the government policy, if the area in the NEF40 and more (L_{eq}=75db(A)), the airport authority needs to buy out these area. If the noise level is not over NEF40, airport authority will compensate to mitigate the noise problem.

From these monitoring, some area is suitable for some purpose but might be not for other purpose. The noise protection in the building is needed for the building that could not be moved out from the effected area. The land use planning is needed to be placed the right activities for the right place for the future.

5.4.5 Compare EIS-monitoring

In this part, this research will analyze monitoring data with the prediction from EIS. The noise impact predictions that come from EIS were done in three scenarios. The analysis will be based on comparing three scenarios with monitoring data based on monitoring stations. The aim of this part is to prove the accuracy of the prediction from EIS and analyze on the inaccuracy in order to improve the future prediction. To analyze on this issue, this research will make the analysis based on table 5.6 and 5.7 for the monitoring data because table 5.6 shows the average value for L_{eq} which use as a medium value for all the monitoring data and table 5.7 shows the maximum L_{eq} which will give the maximum noise level at the monitoring station.

Scenario1 and Scenario 2

The noise contours from scenario1 and scenario 2 are similar. The different are the northern part of western runway and eastern runway because the scenarios used to predict this noise contours are similar. The different between these two scenarios are the uses of both runways in the northern part of the airport runways as can be seen in figure 5.1 and 5.2. From these figure, the different between runway uses are only ten percents which will not make a lot of different in the noise contours. In the southern part of both runways, there will not be any different between both scenarios because both scenarios use same operation in the southern part of both runways. The noise contours in scenario 2 cover more area above western runway while in scenario 1 cover more area in the eastern runway as can be seen in map 5.1 and 5.2. The noise monitoring stations are in the same noise contour in both scenarios except for Monsinee(1) which in scenario2, it is located in NEF35-40 while in scenario1, it is located in NEF 30-35.

In scenario 1 and 2, most of the monitoring stations in northern area of the airport are complied with the EIS prediction except Nakarin garden(7). Nakarin garden station is the most northern station of the western runway. This might cause from the operation procedure of the flight pass through this station. The high level of aircrafts pass through the monitoring station also influence on the level of noise at the monitoring station. Another variable that has influence on the noise level is also the physical condition of the area around monitoring station.

In the southern part of both runways, most of the monitored data is not complied with the prediction except Wararom(10). These might come from operation procedure of the airport. The operation procedure on the southern part of both runways might operate more flight than expectation. The more flight operates than the expectation might cause the higher noise level for the monitored stations.

Due to the L_{eq} max from monitored stations in table5.7, this data is not complied with the prediction. The higher level of noise might come from the vary condition of weather, operation procedure and some specific aircraft. The different condition of weather has influence on the noise condition of the area as such wind direction and

also this could influence on the operation procedure of the airport. Another condition is the use of different aircraft. From table 5.4, the different aircraft releases different noise level and even taking off and approaching also make the different noise level.

Scenario 3

The noise contours in scenario3 use the entire runways and both in the northern part and southern part. In scenario3, runways are planned to use with the same percent for northern, southern of the west and east runways as seen in figure 5.3 so the noise contours are similar in the northern part of both runways and southern part of east runway but cover less area if compare to scenario1 and 2 in the northern of west runway and southern of east runway as seen in map 5.1-5.3 and cover more area in the northern east runway and southern west runway.

Most of the noise monitored stations in the northern part of the airport are complied with the prediction except two stations which are Nakarin garden(7) and Jullamas(3). The reason for this might come from the different operation procedure which might deal with the flight number using the runway. The southern part of the airport is not complied with the prediction. This might come from the same reason as in the first two scenarios.

From all these three scenarios above, most of the stations in the northern part of the airport are complied with the prediction. Only in some particular day that they were some vary conditions which influence on the noise being monitored. This might cause from weather conditions, operation procedure and type of aircraft using airport in some particular day.

In the south, the prediction was not complied with the monitor. This might cause from operation procedure that used in prediction is not the same as in three scenarios. The number of aircrafts using south runway might be not the same as in prediction.

Due to the number of flights used in prediction, the expected flight is 234120 flights per year. The average per day is about 641 flights. This number should be the expected number at time of doing EIS. In reality, the number of flight using this airport is over 800 flights per day before switch some domestic flight to Donmuang

Airport. This might be the main cause for incorrect prediction of the EIS. Even after switch some part to Donmuang Airport, the number of flight using Bangkok Suvarnabhumi Airport is still more than prediction. In the future, the flight number should increase year by year which will produce more noise impact for the surrounding area.

5.5 Effected communities

This issue is based on interviews of six people who living surrounding the airport and have the effect from the airport operation. This issue will be related with the activities that have been disturbed, time of disturbance, how it is disturbed and other perspective from communities to the airport. These interviews were based on three different areas which are Ladkrabung temple (max L_{eq} average = 65.17 and min L_{eq} average = 69.06), Kirk University (max L_{eq} average = 68.05 and min L_{eq} average = 64) and Bangchalong temple (max L_{eq} average = 68.40 and min L_{eq} average = 67.40).

Noise from the airport is unwanted sound. It is the same in case of Bangkok Suvarnabhumi Airport; noise causes people against the airport operation. Since the authority opening the airport in September 29, 2006, there have been many groups of communities try to negotiate with the authority in order to solve noise problem.

5.5.1 Sleeping Disturbance

The main issue of noise problem is that noise is annoying daily activities. All the interviewees agreed with the issue of noise disturbance during sleeping time after the operating of the new Bangkok airport. The resolution of this problem so far for them was to close the windows and turn on air conditioning but not all the buildings have air conditioning.

Wanna, who live close to Bangchalong Temple (station12 in map 5.4), do not have air conditioning. Her house is made from wood so during night it is the problem for her family to sleep during the aircrafts pass through her house. Her baby always cries at the early time but right now he is used to the noise. Her husband have to work hard at

the factory all day and he can not have a continue sleep during night. This cause stress for her husband and some time the noise made him angry.

Same as Pangrum, she lives close to Ladkrabang temple (station4 in map 5.4). During the early period of opening the airport, she could not sleep. The only way she can do was taken the sleeping pill. Living in this area also, Yattigaro (station4 in map 5.4), a monk at Ladkrabung temple, is the represent from Ladkrabung temple. He agreed that noise from the aircraft during night time disturb their sleeping. They have been awakening all night by the aircraft noise.

Luckily Kanwipa, she also lives around Ladkrabang temple (station4 in map 5.4). She has the coffee shop in the townhouse building. Air conditioning was installed in her house so during night time, noise is not such a problem for her family. Some day during summer, air conditioning was out of order so that night her family could not have good night sleep because of the noise.

Same problem at Kirk University (station11 in map 5.4), there is a dormitory in the university area. During the night time, students and lecture at the institution could not sleep because of the noise from aircrafts.

5.5.2 Daytime annoyance

Not only night time disturbance, but also some activities during daytime also need quiet atmosphere. Most of the interviewees did not have much problem with the daytime disturbance. In some specific case, people have to concentrate on their work so noise can lead to problem.

Yatigaro explained about the noise disturb when monk at Ladkrabang (station4 in map 5.4) did meditation and Buddhism worship. In his opinion, only one time disturbance, the activities have to stop during the approaching of aircrafts. This cause discontinue in the activities. Most of the activities at Ladkrabung temple are in the open air building. This might be the cause of more effect than the activities in air conditioning building.

It is the same problem at Kirk University (station11 in map5.4). Patcharee, lecturer and head of administration department, agreed with Yatigaro on the issue of noise disturb the concentration on the activity of students at the university. Even though all the lecture rooms are equip with air conditioning but students were disturbed by approaching aircraft. Lectures had to stop during the aircraft moving close to university building. To solve this problem at the moment, the lecturers need to use speaker in order to make it louder. This could not help much.

Wanna also had the issue on TV signal which was disturbed during the aircraft pass over her house. Every time aircrafts fly close to her house then they could not watch TV. This caused bad mood.

5.5.3 Benefit to some group of people

Like Kanwipa, she has her own coffee shop. She thought noise disturbs her but due to the operation of the airport, she also has more customers. Her customer comes from the people who work at the airport. This point is also the trade off between noise disturbance and the business grown. The head of the noise pollution bureau also agreed on this issue. The land use on the effected area should manage in the matching way between purpose of land use and the noise effect. The business areas or the business that related to airport can be around the airport which will be convenience for them to transport.

Even though the airport operation could lead to complain from the people in the effected area, there are some groups that benefit from the operation of the airport. This perception can be used to manage the land use around the airport. The effected area with the noise level is not complied with its purposes can be switch with the purpose which match with other purpose.

5.5.4 After switch some flights to Donmuang Airport

After some domestic flights switched to Donmuang Airport, most of the interviewees still have problem with noise disturbance during sleeping time. They said all the large fleets still take off and land and as consequence of these, they still have problem with sleeping.

Yatigaro, from Ladkrabung Temple, told us that even there were less flight operate at the airport but every time when they perform some Buddhism activities and the flight take off or land, they still had to stop. One flight land and take off, they had to stop anyway. It does not matter with number but instead it depends on each aircraft noise. During the night time, it still disturbs their sleep.

Some people from this interview do not know that the airport authority of Thailand had switched some domestic flights to Donmuang Airport. They did not recognize the different between before and after the switching.

From the interview, the research found out that even these interviewee in the noise area which is less than 70 db(A) but they face the noise disturbance problem. Before making these interview, researcher only assume that noise level that have influenced on people activities should be in the area that noise level is over 70 db(A). This also explores the research that the airport authority of Thailand needs to mitigate the problem for these groups of people also.

After switched some flight to Donmuang Airport, the assumption out of this issue is that noise should be less problematic for people. In fact, the problem is almost the same for the interviewees. If consider from flight number, it is less than before switching. If consider on the flights that still operate at Bangkok Suvarnabhumi Airport, the international flights are still the same number. The international flights are usually operated with larger aircraft if compare with domestic flights. The international flight operate during the late night time at Bangkok Suvarnabhumi Airport but domestic flights have several flight operate during night if compare to international. This might be the result of why interviewees are still facing with noise problem.

5.6 Chapter summary

The monitoring process in this case performed by PCD which is a regulator in order to control the noise impact from the airport under the pressure from effected people. Form of this monitoring is to control the significant noise impact.

From the monitoring, the prediction is seem to be felt when compare with actual noise level especially in the southern area of both runways. The monitoring could lead to mitigation the actual noise impact. The expected flight number seem to be the mistake that feed into the calculation in noise contours which are used as a reference to take buy out and compensate mitigation.

Even in some area, the noises level is complied with the standard given by the government, there are still conflict because some vulnerable purpose of land use is not complied with the noise level. This hypothesis can be supported by the interview from the communities.

Chapter6 Conclusion and Recommendation

This chapter will conclude on the theories and analytical part from the previous chapters to answer the research question. The limitation on this research will be stated here. Finally this chapter will present future perspective of this EIA follow-up in Bangkok Suvarnabhumi Airport case.

6.1 Conclusion

(The result of the EIA follow-up on mitigation of the noise pollution caused by the Bangkok's Suvarnabhumi Airport is the principal purpose from this study.) Since one of the well documented airport's major consequences is the noise's health impact to the people who lived around its area. The health hazardous effect of the airport's noise may range from minimal impact for its annoyance to a complicated societal affect on psychological stress or the worth impaired effect of hearing loss. Thus, the airport EIA of the noise control after the airport on work has been reviewed and analyzed.

EIA follow-up has been designed to monitor and evaluate the sustainability of the EIA proposed counter-measures to cope the consequences of the airport's noise pollution. As well it has included the accomplishment review of public communication applied to the community in the area of the airport base. The hypothetical premise is that the EIA might underestimate the cumulative effects of the noise pollution that affect the community. The study of the EIA follow-up would be a feed back mechanism to reflect the pitfall of the methodology to both the policy makers and EIA technocrats so that the future procedures of assessment will be improved.

Environmental Impact Statement of Bangkok Suvarnabhumi Airport imposed the Airport Authority to monthly monitor noise level on vulnerable areas. However, the Airport Authority had not complied to this recommendation. As a consequence, those intolerable affected people of the neglected response, then, protested against the airport authority. This need further study to reconcile such a societal conflict.

So ONEP requested Pollution Control Department (PCD) to monitor the noise affect from the airport. The key purpose of this monitoring is to alleviate the noise pollution as a responsible agency

As in case of Bangkok Suvarnabhumi Airport, the evidence from noise monitoring stations turned to be a follow up instrument to confirm the scenarios profiled of the EIA's prediction. The noise contours is basic reference for buy out for people who has reside in Noise Exposure Forecast(NEF) area more than 40 while compensate mitigation for the people who has resided in Noise Exposure Forecast (NEF) between 30 to more than 40. The monitoring data demonstrated the extension of the affected area down to the south and west of the runways. Without these monitoring designs, the mitigation measure and compensation from the airport authority would not be accommodated timely.

The royal Thai Government through the Pollution Control Department has applied a standard level to regulate the noise pollution in the airport base's surrounding. This would be actual noise from airport operation that can feed back to the airport authority to mitigate the impact.

The monitoring data can confirm the effectiveness of the EIA's prediction. In order to appropriately manage the noise problem, assessment needs to be followed by generation of monitoring data and detection of incompatibility of the actual effect to the prediction. This process can compensate the pitfalls of the prediction. In this case, the major mistake caused by the under-estimated number of flights using the airport. The new noise contours can be made in order to use as a reference to the buy out and compensate mitigations. The new noise contours which made from the actual number of flight using the airport can give more accurate in the effected area.

This monitoring in this case is critical tool to reconcile the conflict between airport authority and the communities surrounding the airport on the noise issue raised. Without the monitoring process, airport authority will not have information to confirm whether the EIA is correct or not. The airport authorities will use this information as a reference to adjudge the noise contours. These noise contours will use in land use management process in order to buy out the land (NEF more than 40) from the most

effected communities and compensate to the land owner that live in the noise level between (NEF30-40). The result from this research will give the right information to the decision makers in order to mitigate the noise problem from airport operation. Not everyone will satisfaction with the mitigation but the purpose of mitigation is to maximize the satisfaction with lowest the cost.

6.2 Recommendation for Bangkok Suvanabhumi Airport

The current demand for Bangkok Suvarnabhumi Airport is to mitigate the noise impact from the aircraft. The solutions taken into accounts should be the recommendation by ICAO which are reducing noise at source, land use management and planning, change of operation procedure, restriction on aircraft noise and noise charge. Change in operation procedure is the only mitigation measurement that is flexible and feasible in this case. It can adjust from time to time to moderate an appropriate operation procedure. The changes include the angle of aircrafts approaching and taking off, the routes for aircrafts after taking off and before landing, and also ground management.

The main mitigation measurements that should be optional at the moment are buy out the effected area from L_{eq} more than 70 db(A) and compensation for the residential area and vulnerable area as such educational institutions and temples that have effect from noise because the noise level under 70 db(A) is complied with the regulation but it is not complied with the vulnerable purpose of land use. As a consequence from monitoring, the actual information can be used to feed the INM model in order to update proper noise contours map as a reference for further management of noise pollution. Even the airport authority has undertaken some changes in operation procedure but there is still noise effect to the area close to the airport. It is impossible that airport will absolutely diminish the noise impact to surrounding populations. The change in operation together with additional measures can help airport authority in saving the cost for buy out and compensate on effected households.

Change in operation procedure is also important mitigation measurement because it is most flexible mitigation that can be change over the time . The recommend change is

the angle use during taking off and approaching because the increasing of angle use during taking off and landing will reduce the effected area along the runway path. This procedure need to be concern on the safety also. This mitigation has important linkage with monitoring because without monitoring data, it is impossible to know that the mitigation take place is effective or not. This is the important reason that Bangkok Suvarnabhumi Airport need to keep tracking on noise data to compromise mitigation measurement with the noise level. This is the way to improve their mitigation.

6.3 Limitation of the research

The time constraint is the main limitation of this study. The monitoring data from Bangkok Suvarnabhumi Airport is only for short time which is an obstacle for searching interview people and searching for the data. If this research can be extended, this research can give more information for decision makers to reduce the noise problem.

The interviews which perform in this research are limited by the time, the period of interview and the number of interviews. The interview took place during April 2007 which this period of the year is the long vacation for people. Most of the people from outside of Bangkok area will go back home. All the education institutions are closing. Some schools around the airport might have more problems with noise because the building of public school in Thailand made of wood and non air conditioned building. Unfortunately, it was during a summer period so no one came to school.

Noise problem from airport operation is the main consider for public in Thailand at the moment. It is difficult to get some information including some interviews with the government department regarding noise issue from Bangkok Suvarnabhumi Airport because the negotiation between the effected communities and airport authority is not ended yet. Most of the information needs to get through Airport Authority of Thailand which sometime it is very difficult to get through information due to the negotiation period between Airport Authority of Thailand and effected communities.

6.4 Future perspective

It is important to keep tracking noise level from Bangkok Suvarnabhumi Airport. In the future, the flight using the airport will grow up due to growing number of passenger traffic in Asia-Pacific in 12 months until June 2006 which was 6.5% compared to Europe's 5.4% and North America's 1.1% (Asia Pacific Bulletin, 2006). To keep tracking noise monitoring data will give the cue on the change of noise level due to the mitigation process taking place keeping. The solution for noise problem can not only come from buy out and compensate because it will lead to larger amount of budget. It is necessary to find out the compromise operating procedure. To support this, it is important to keep tracking noise level due to different operating procedure in order to find the best solution.

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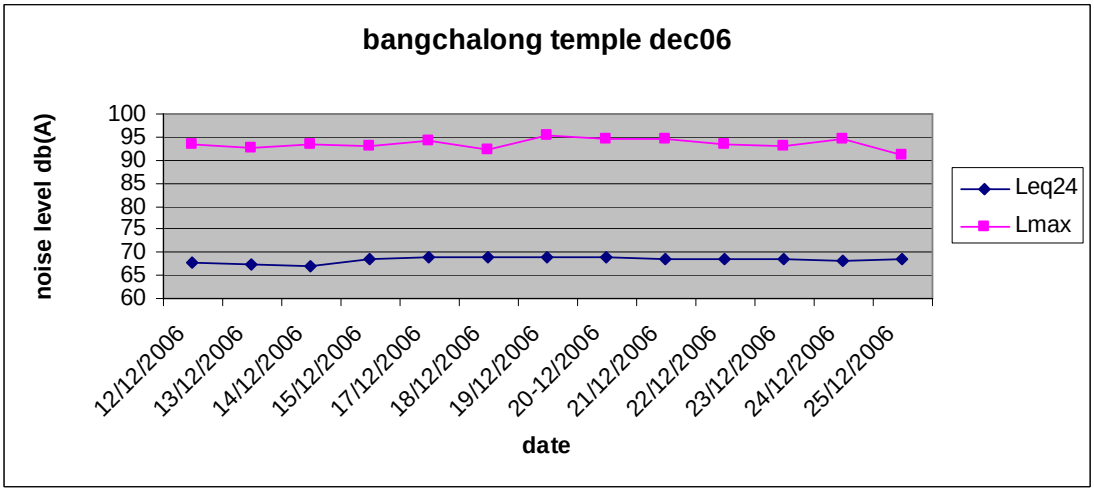
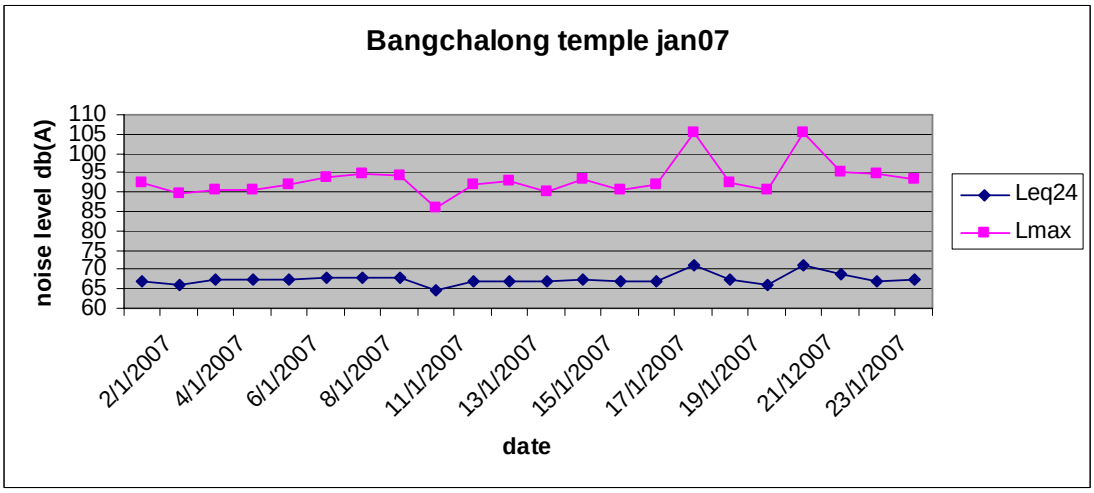
Appendix A Noise level from monitoring stations

Bangchalong Temple





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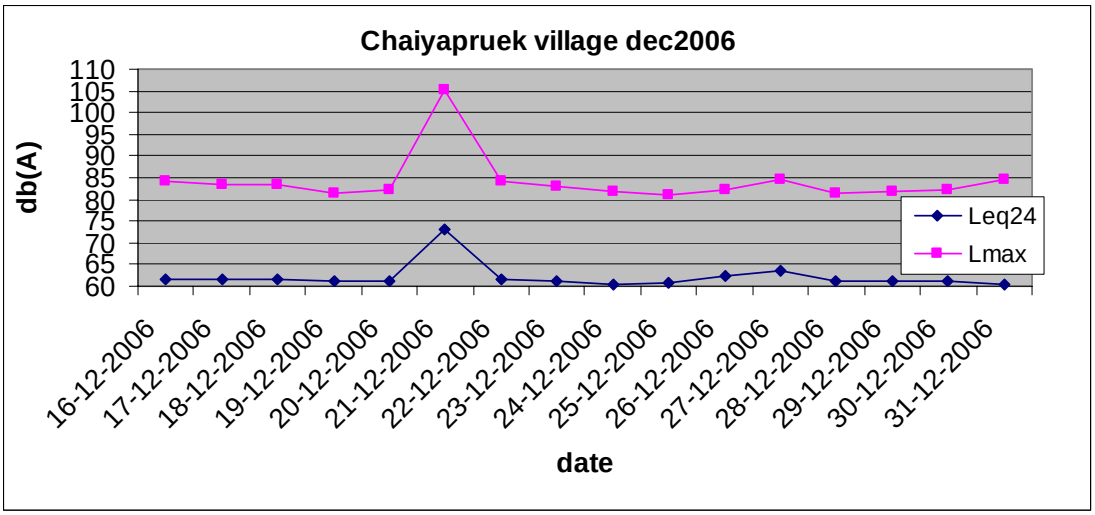
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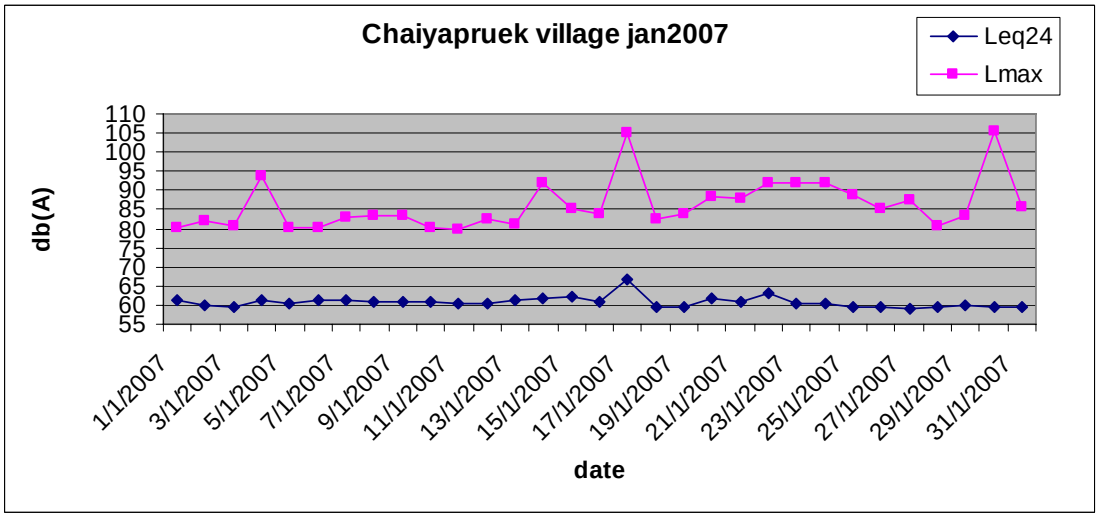
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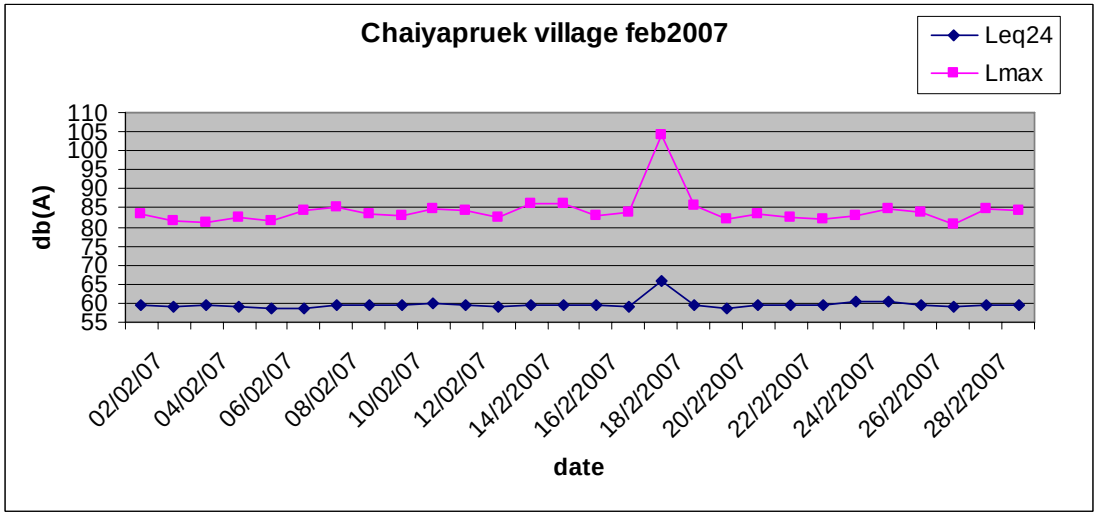
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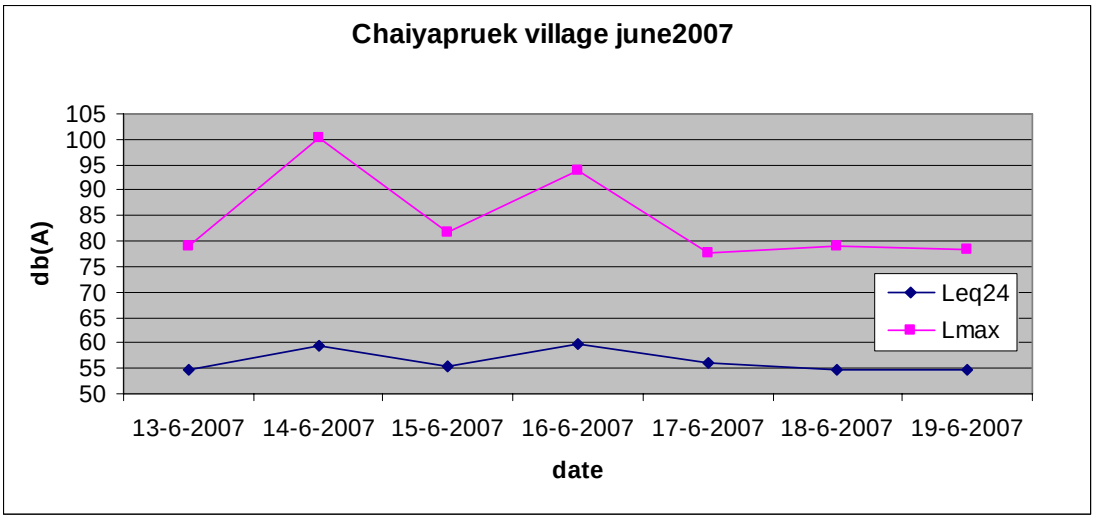

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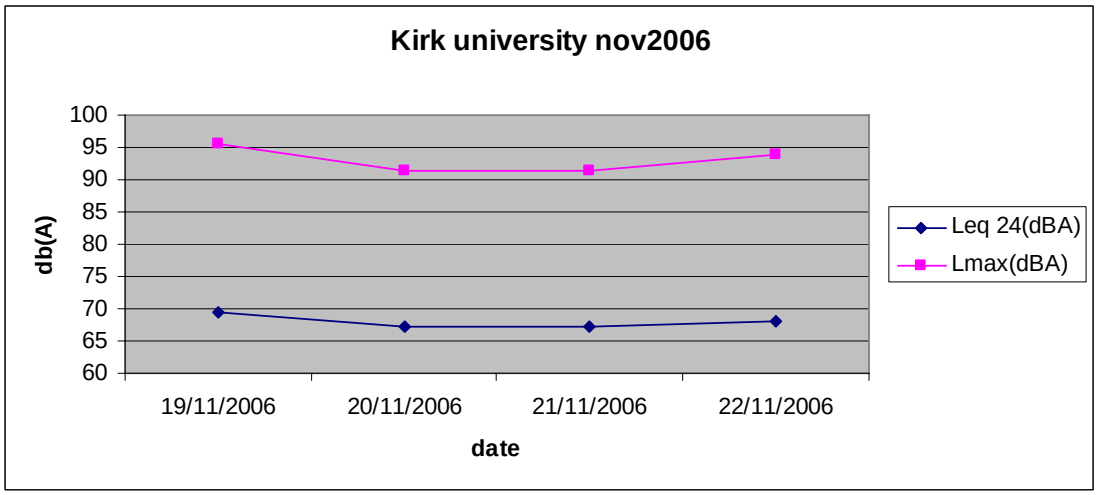

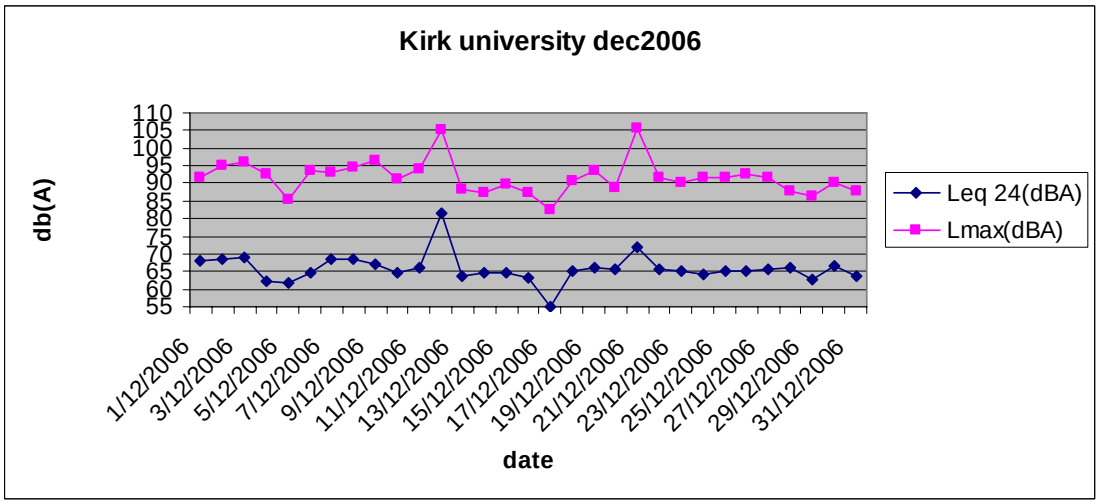

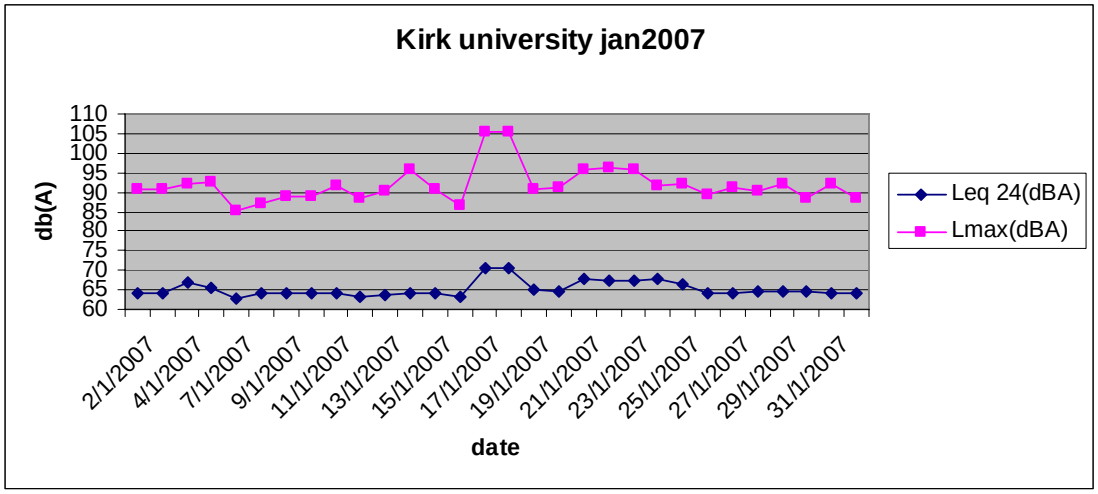
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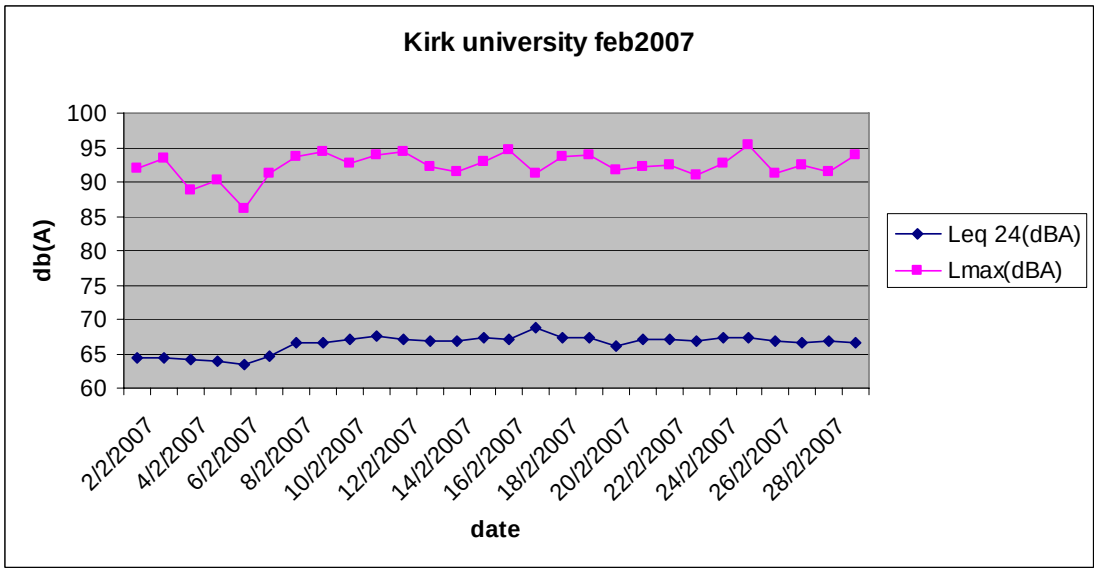
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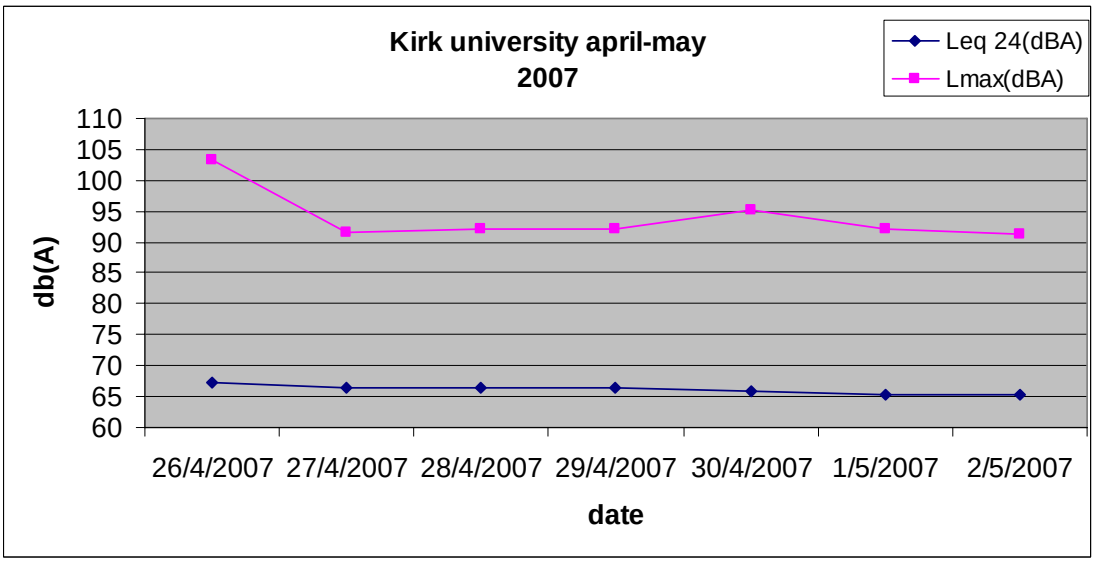
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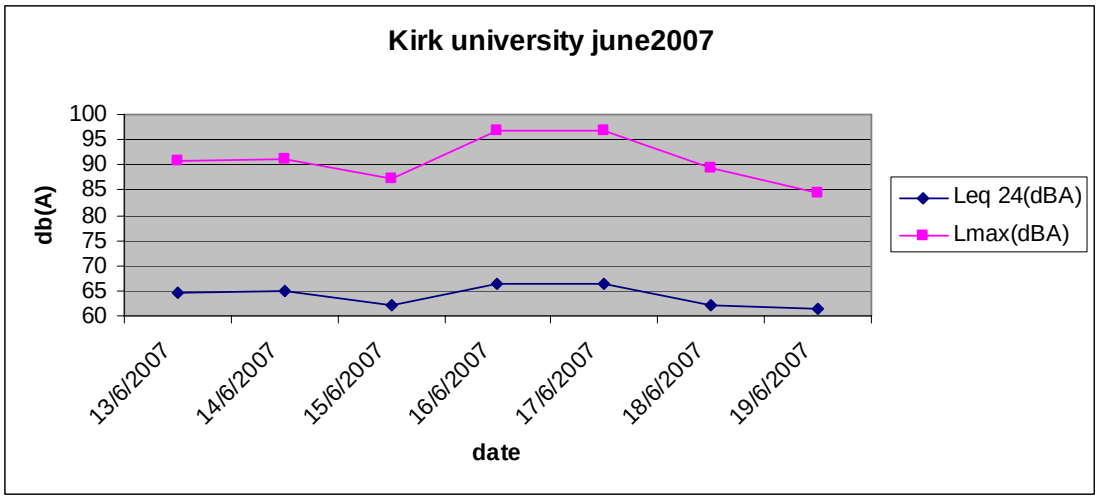
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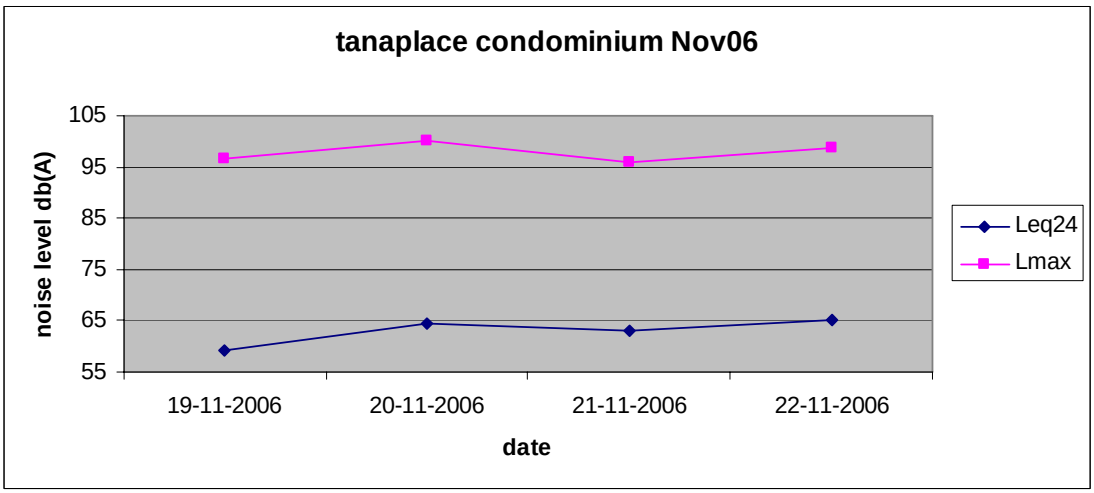
Tana place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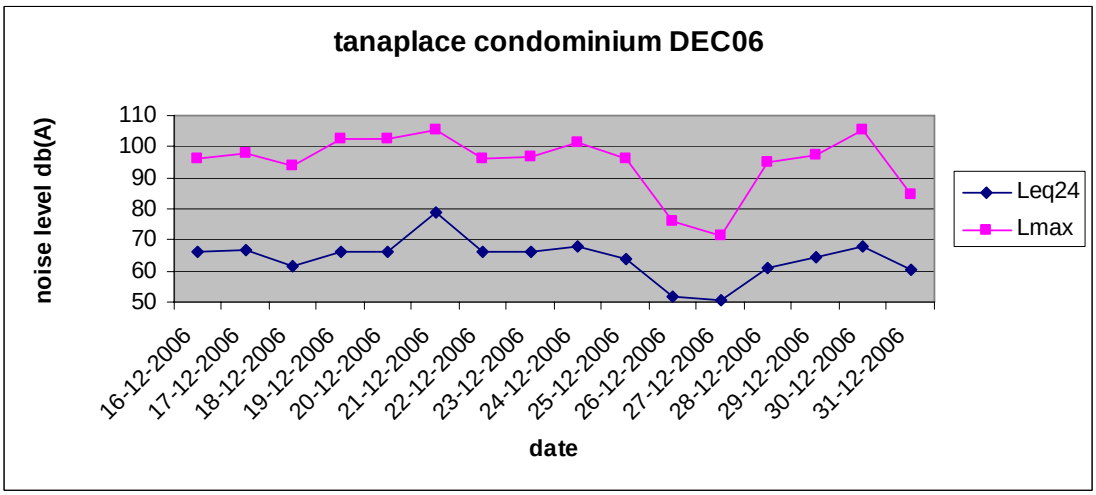
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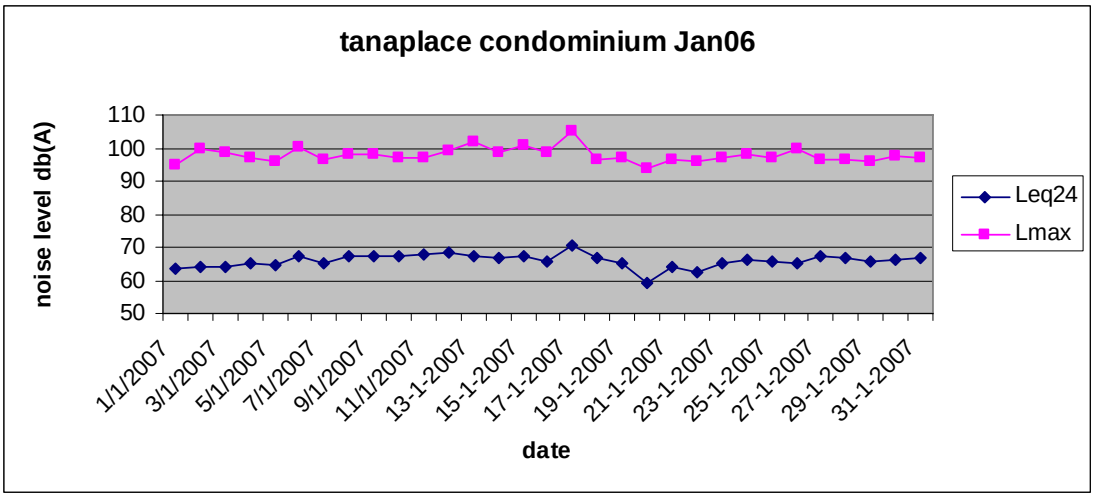
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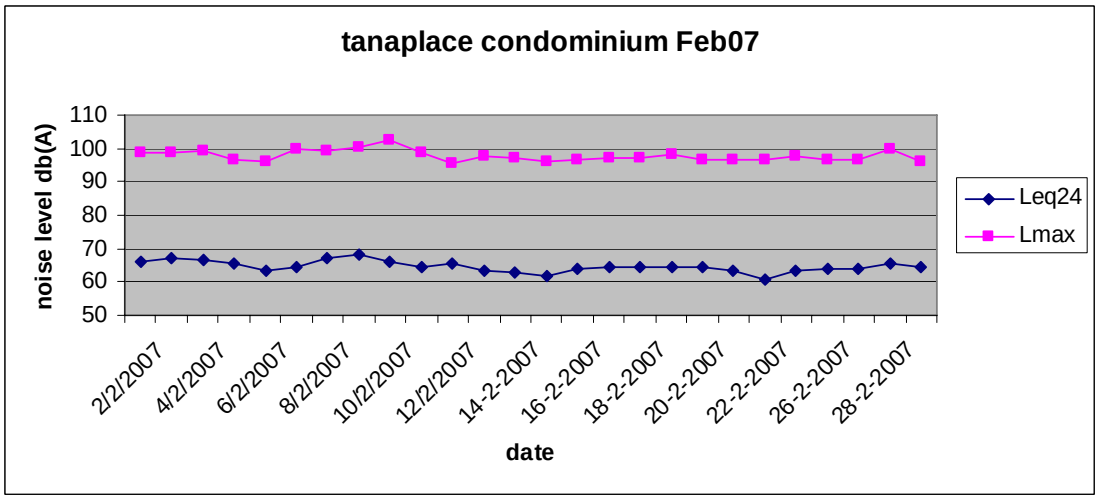
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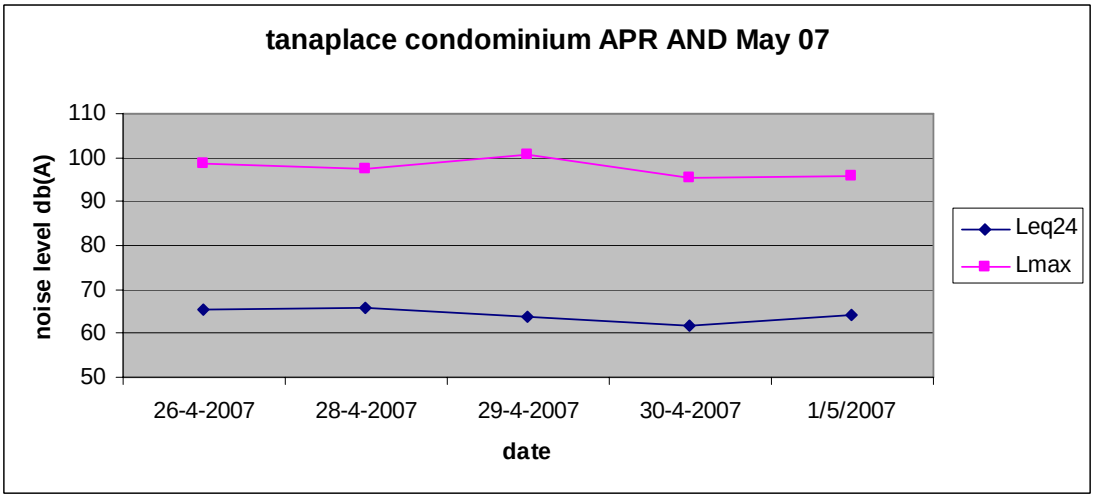
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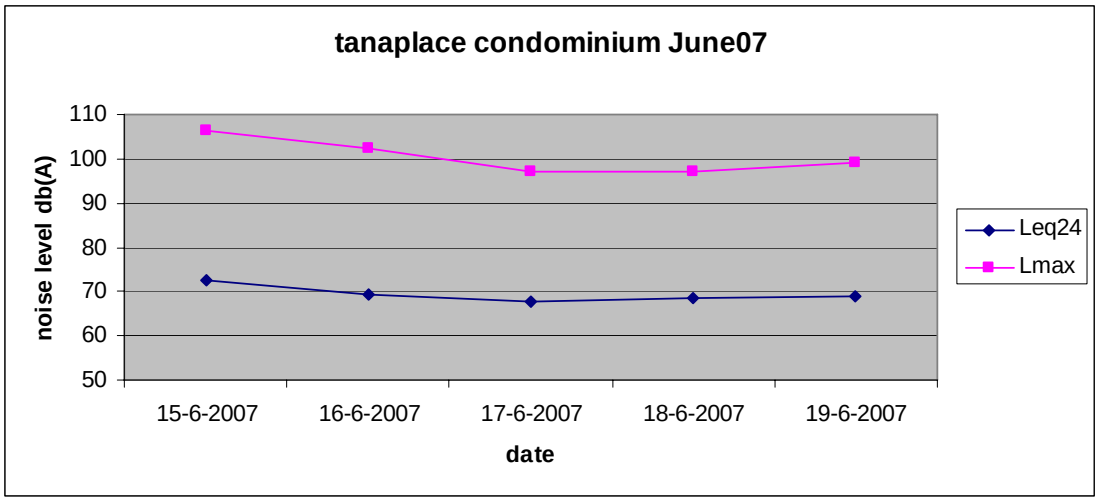
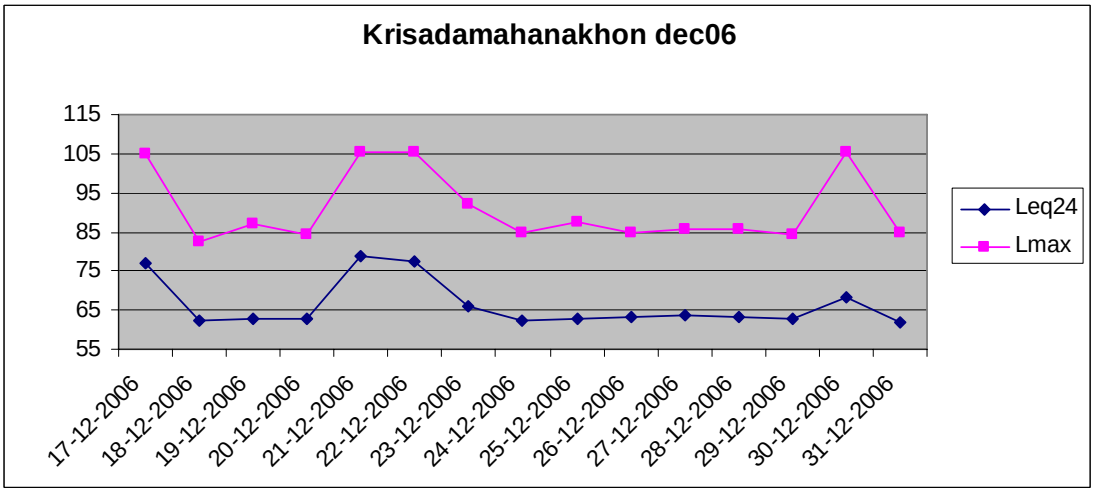
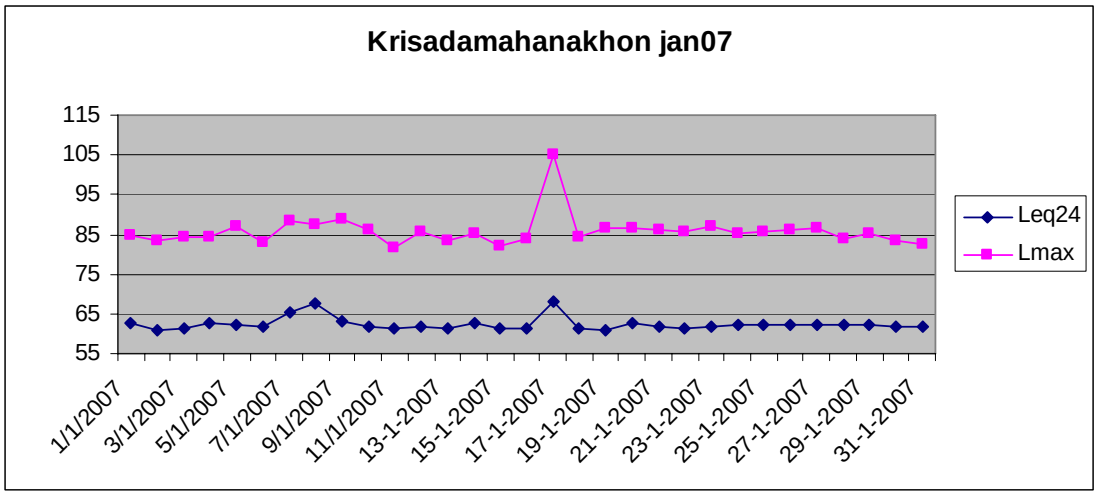


Krisadamahanakhon Village

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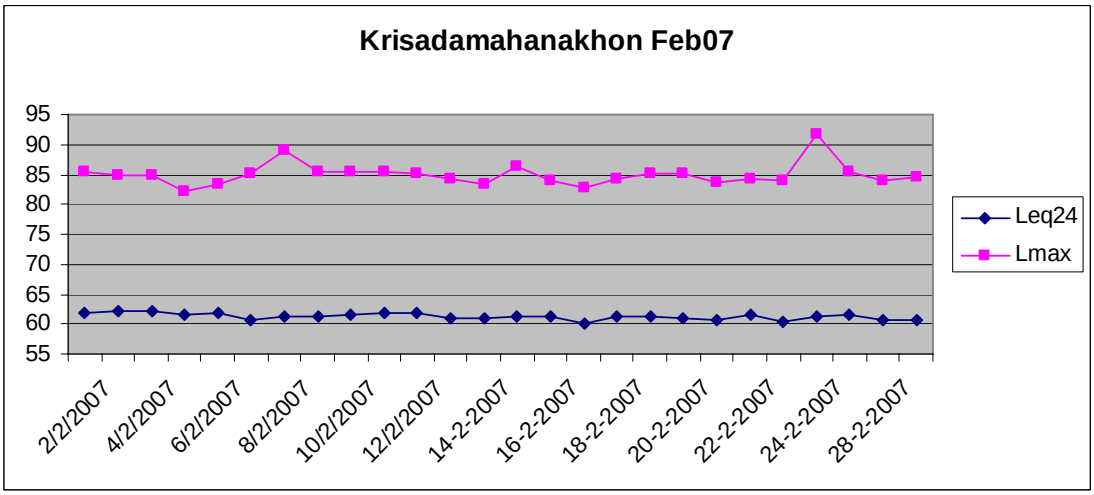
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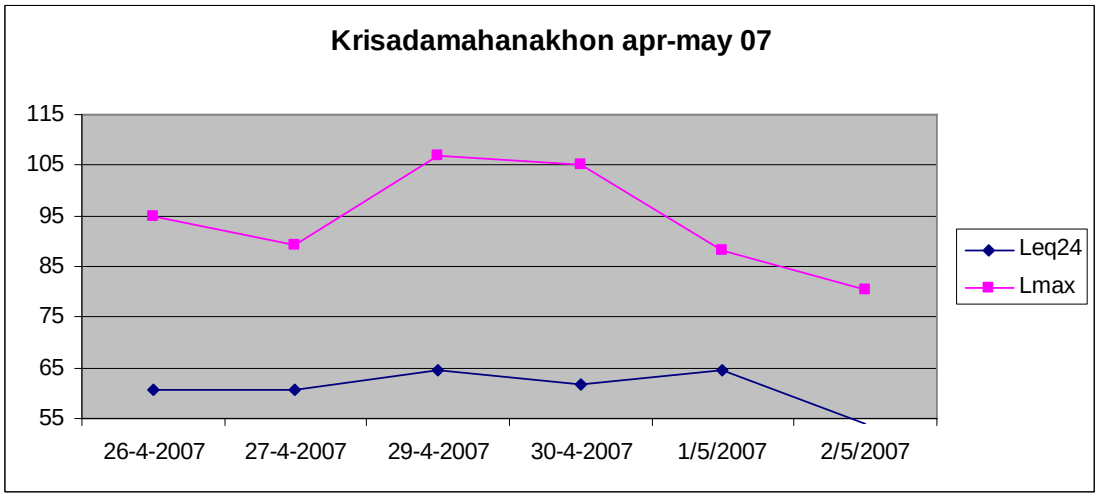
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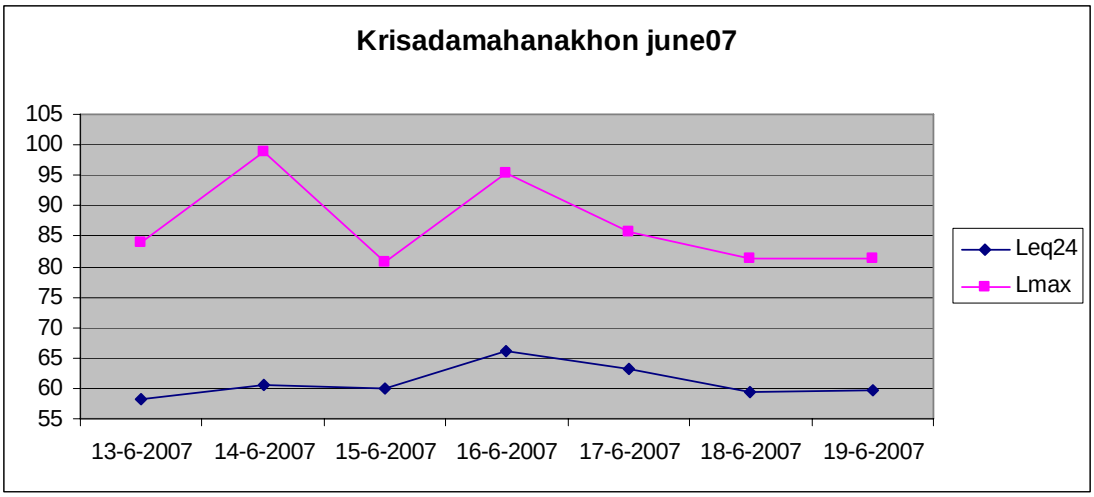
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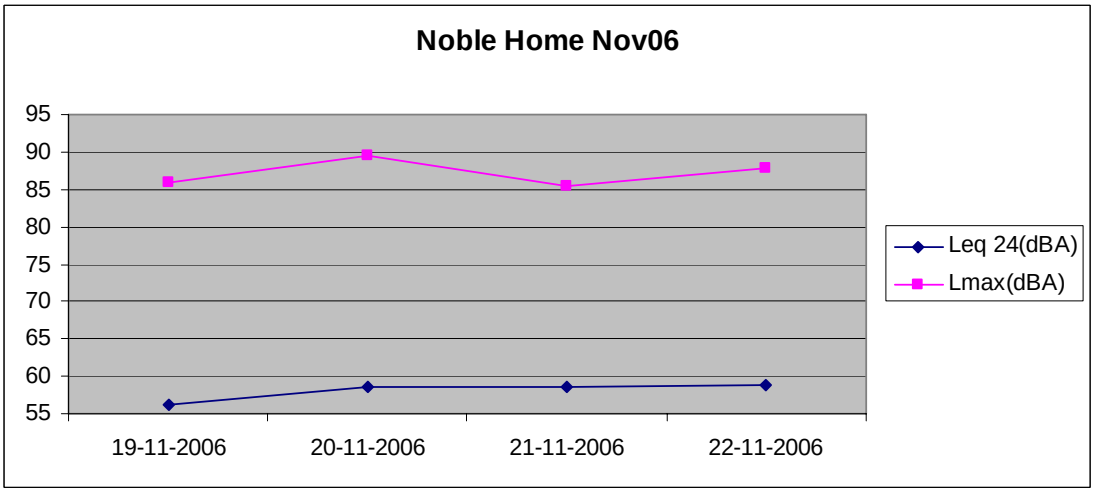
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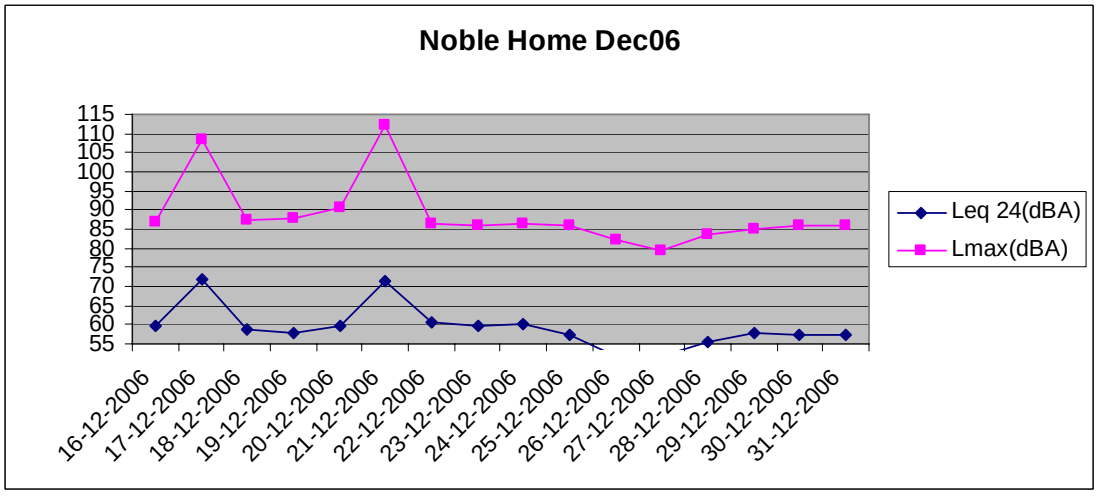
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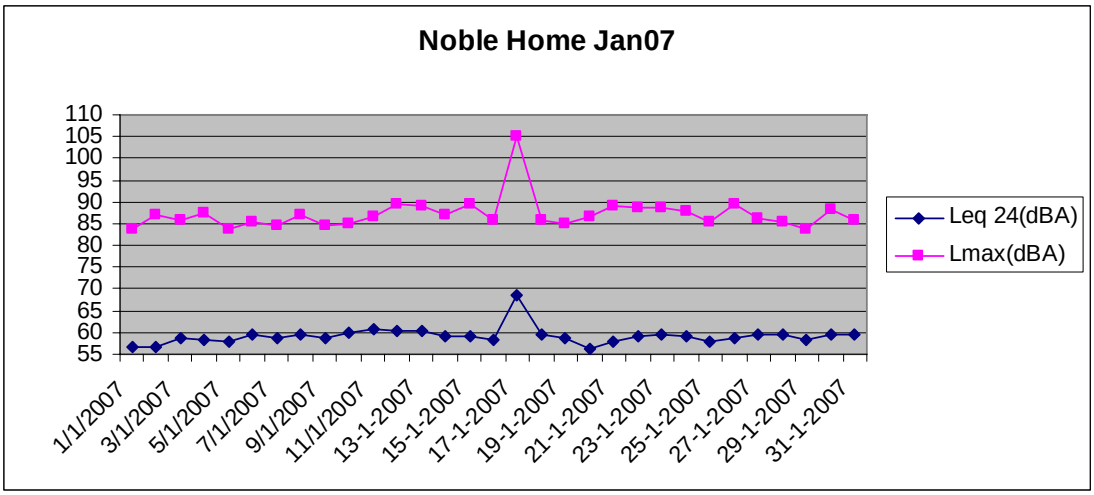
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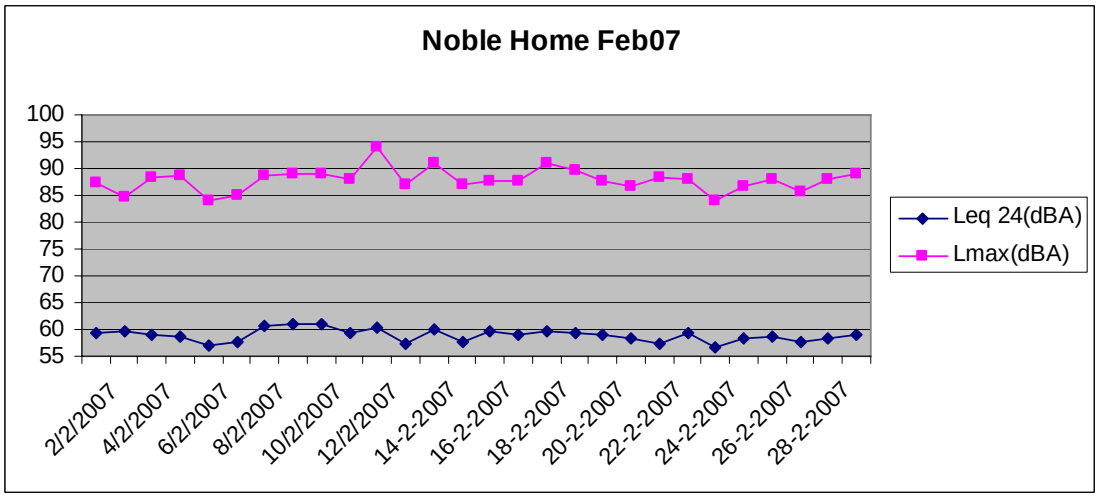
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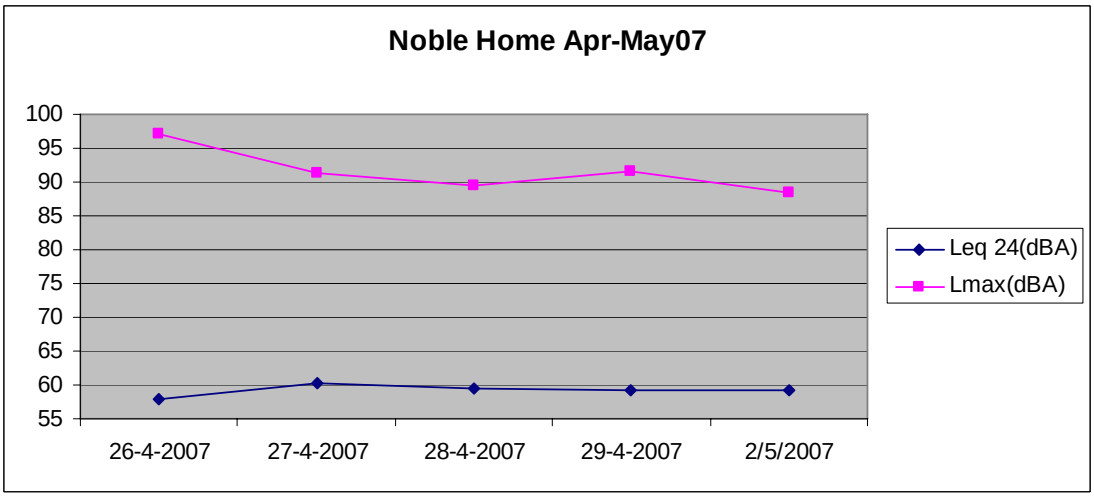
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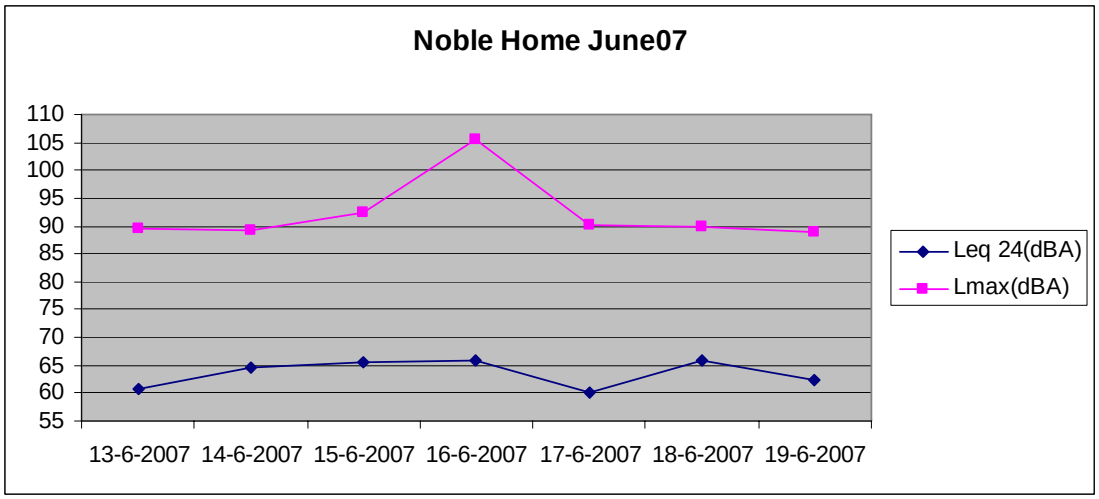
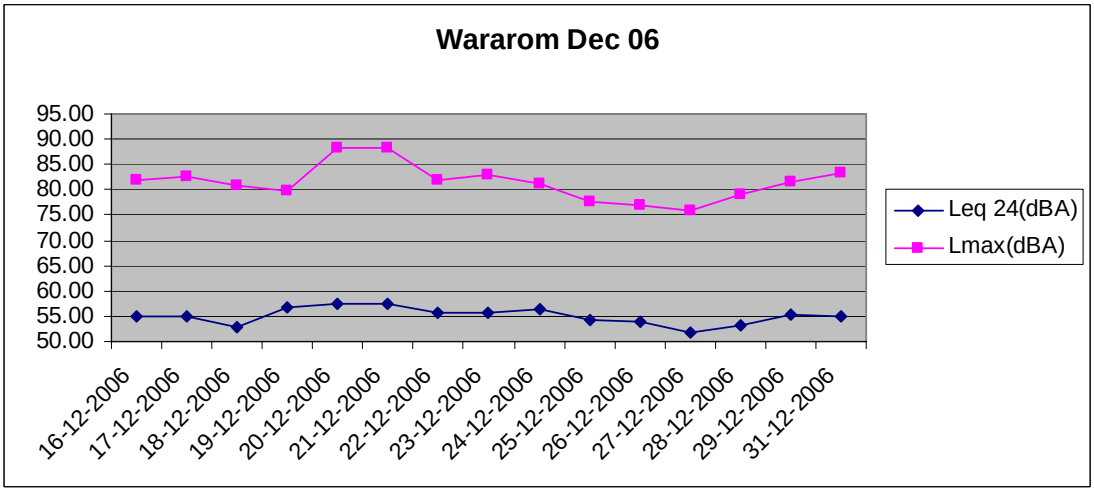
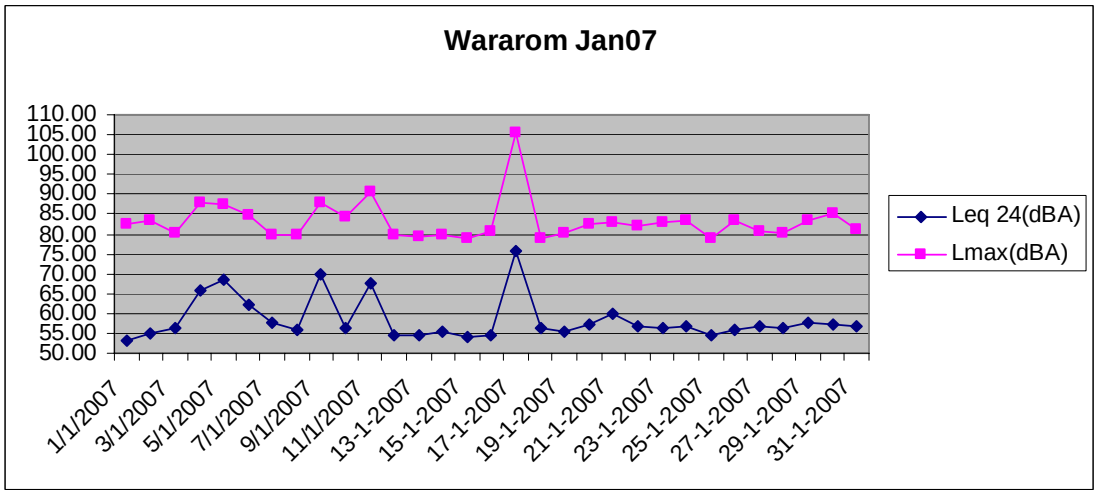
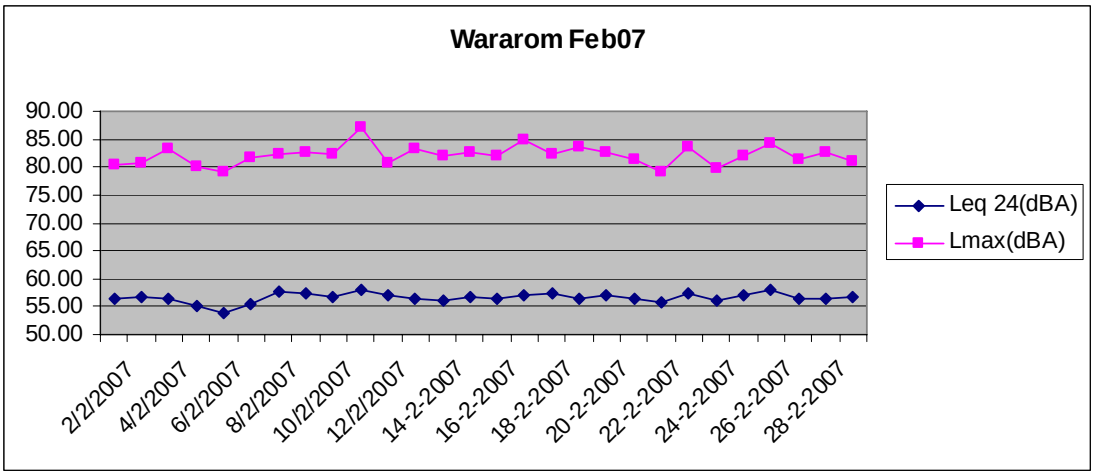
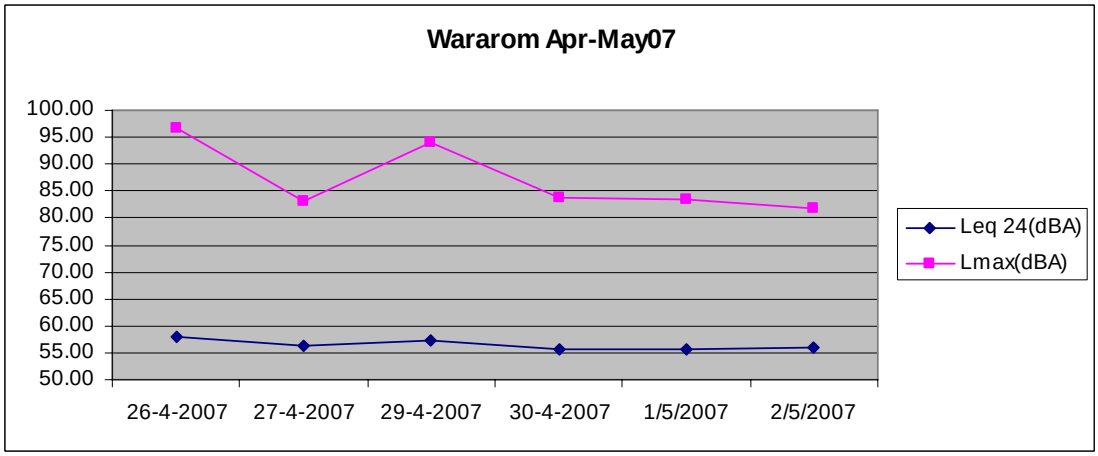


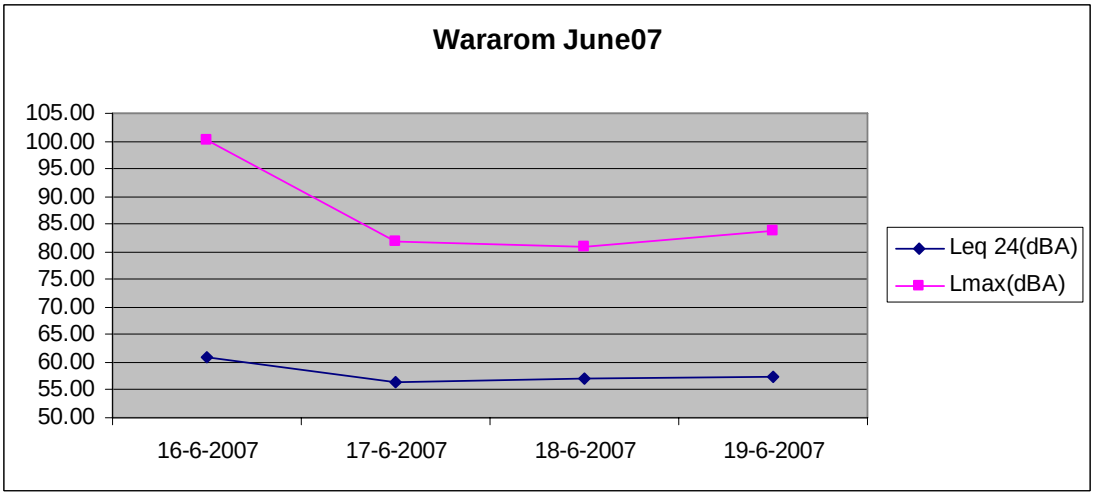
Wararom Village











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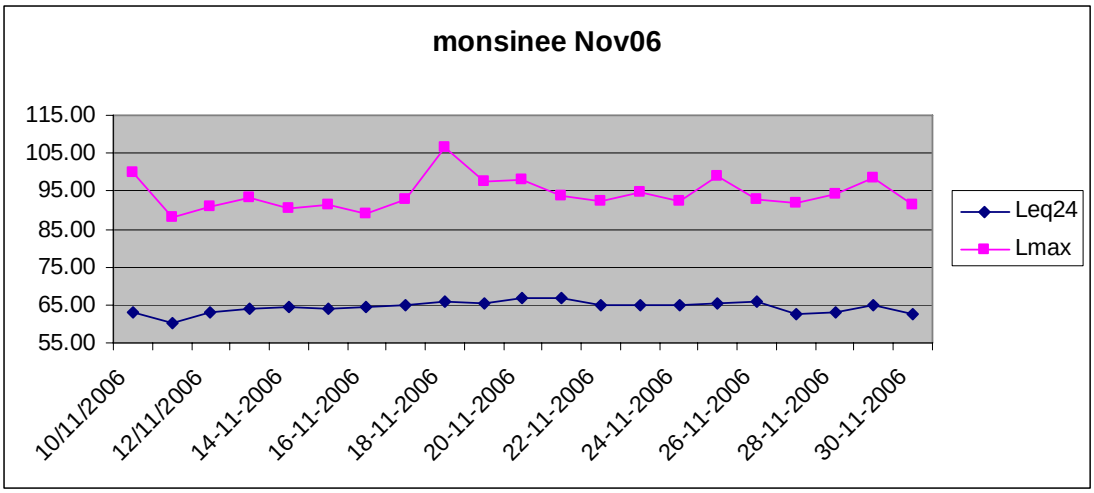
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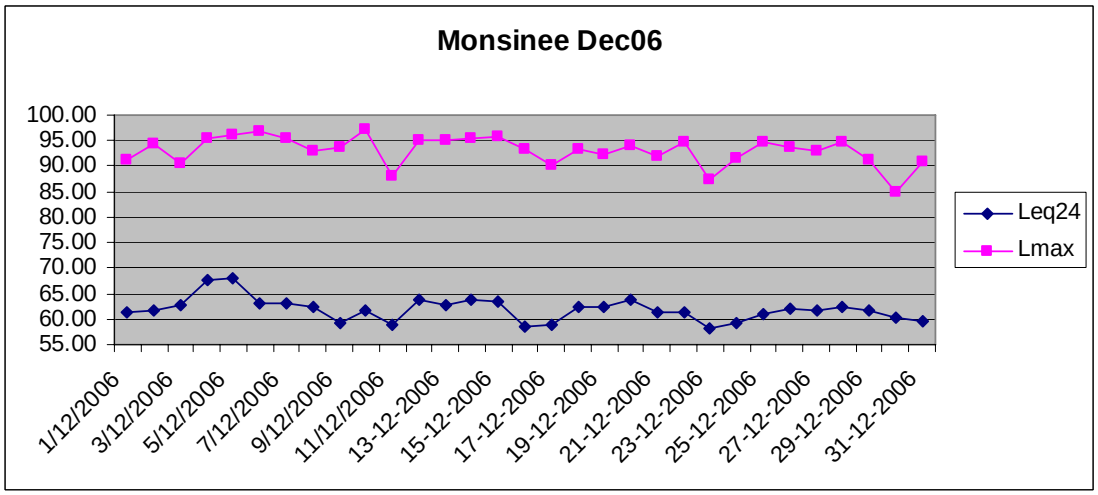
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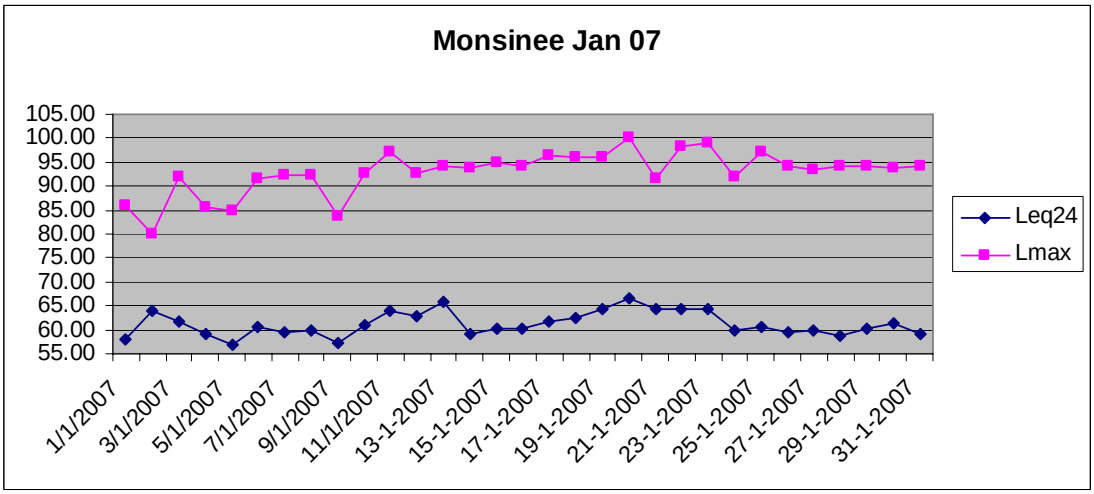
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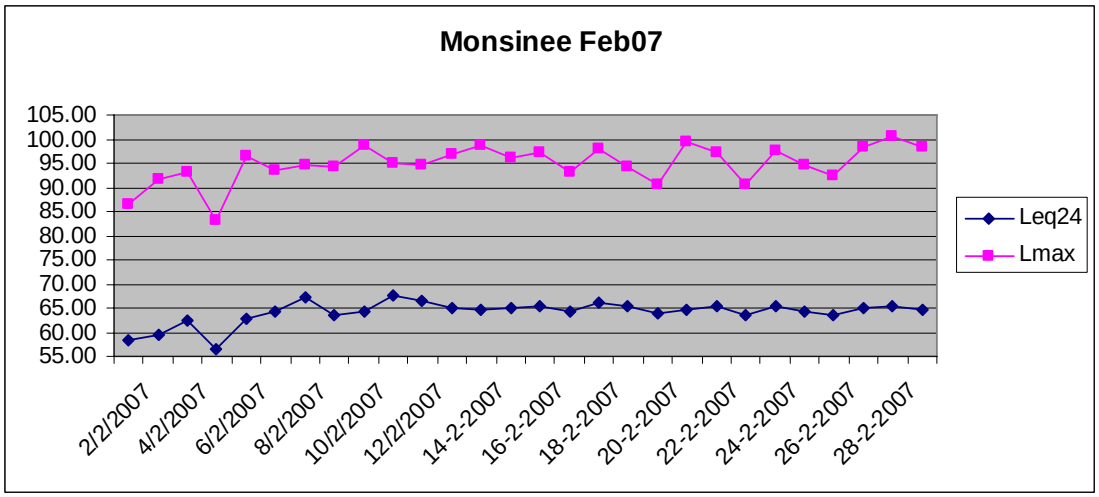

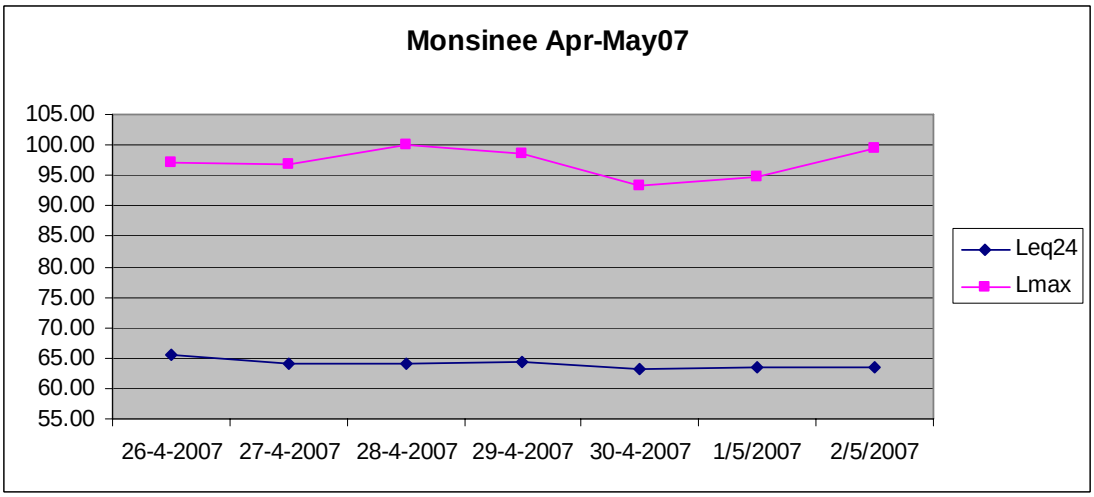

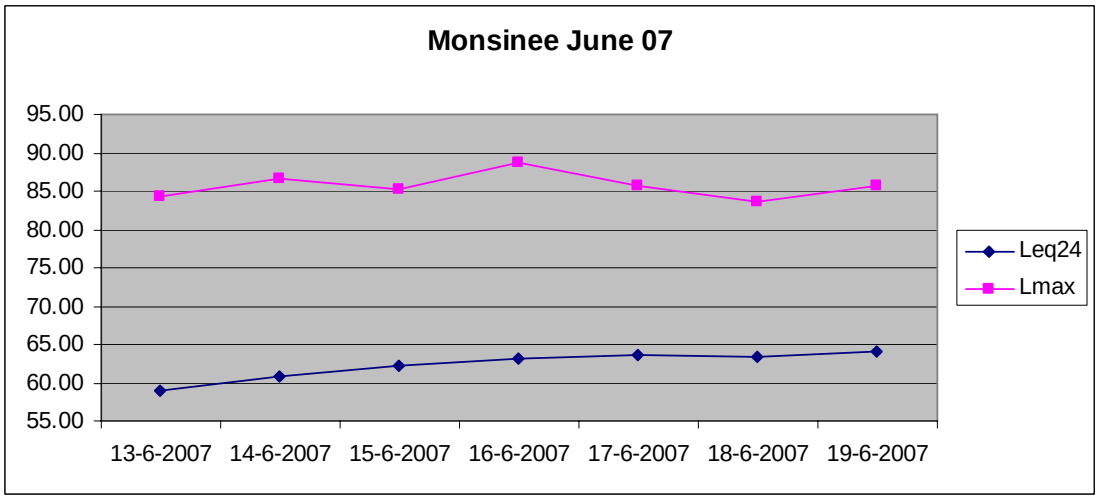

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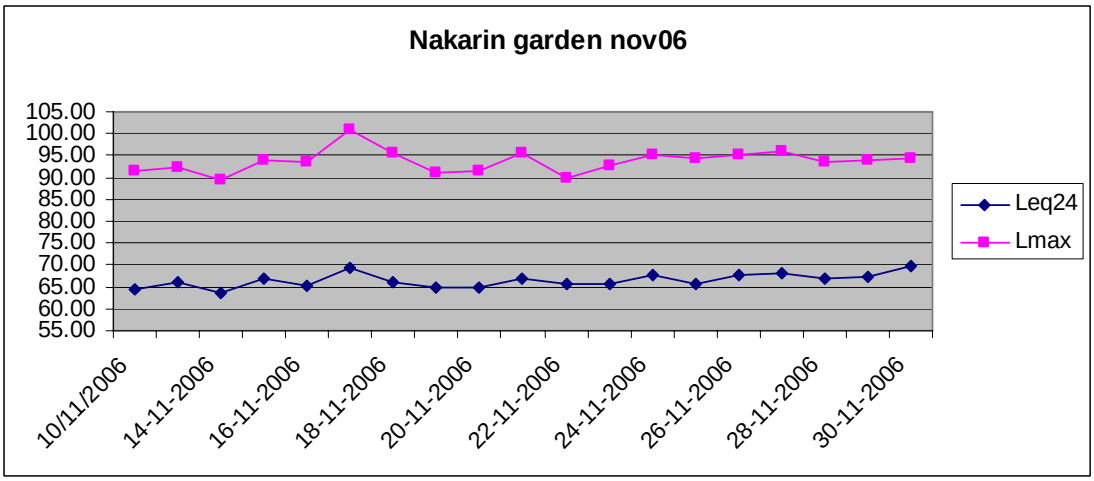
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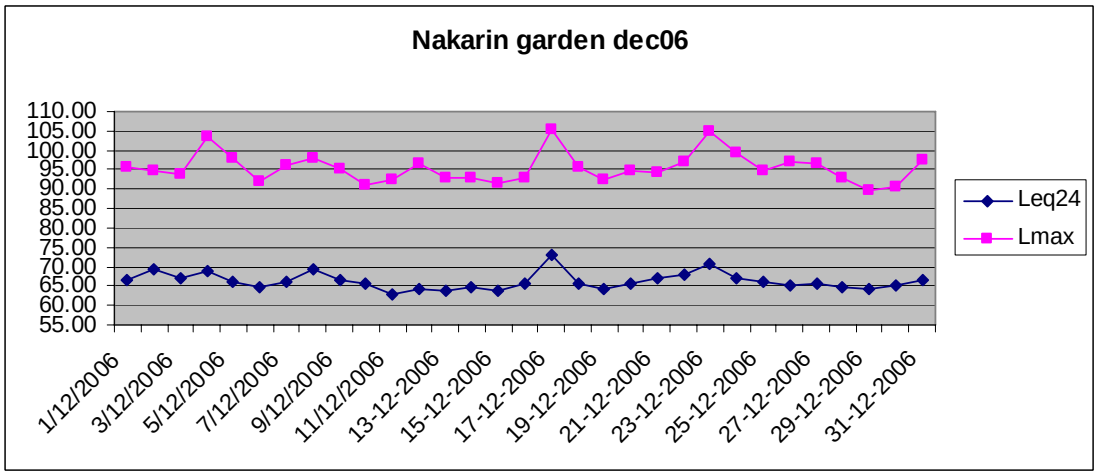
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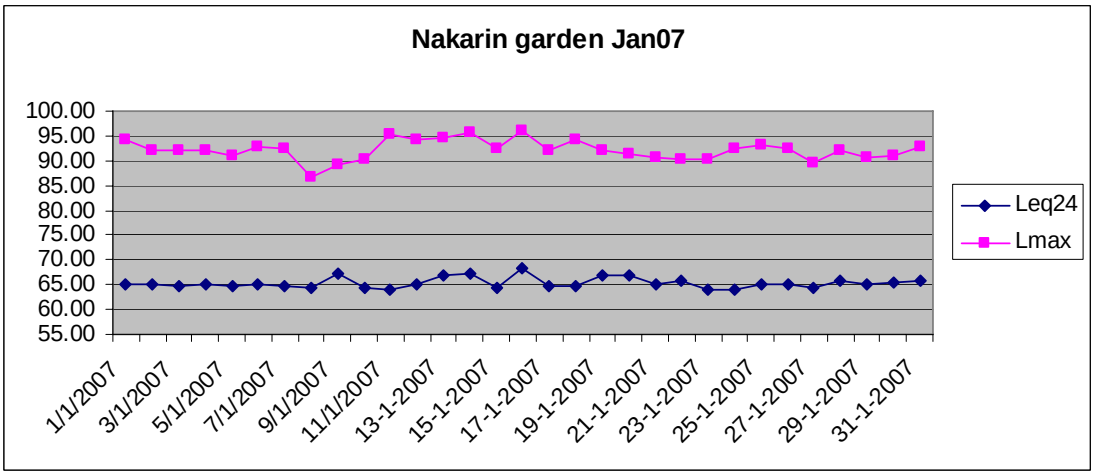
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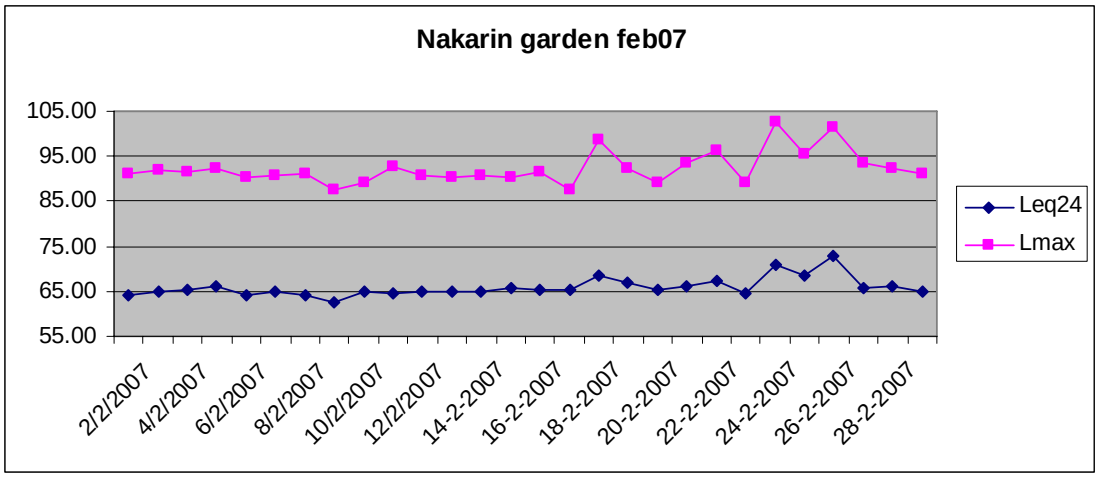

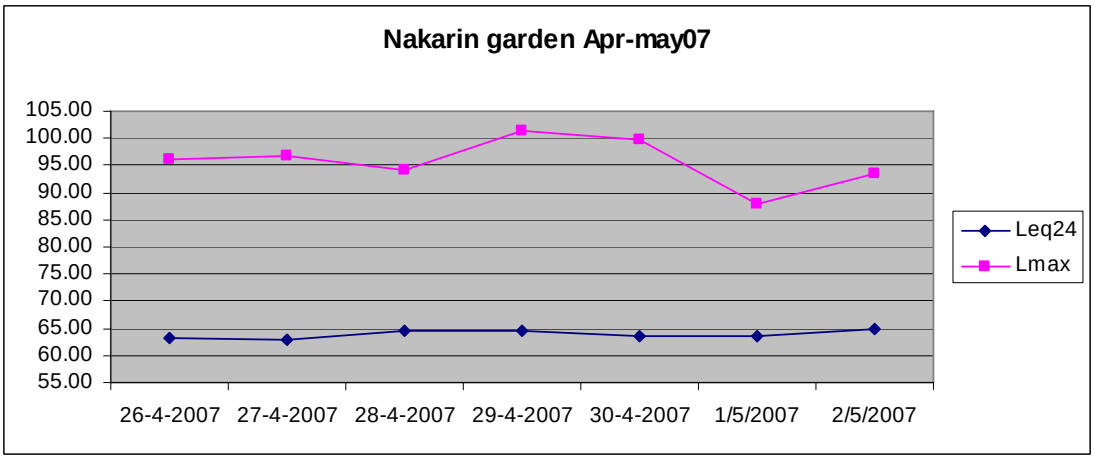

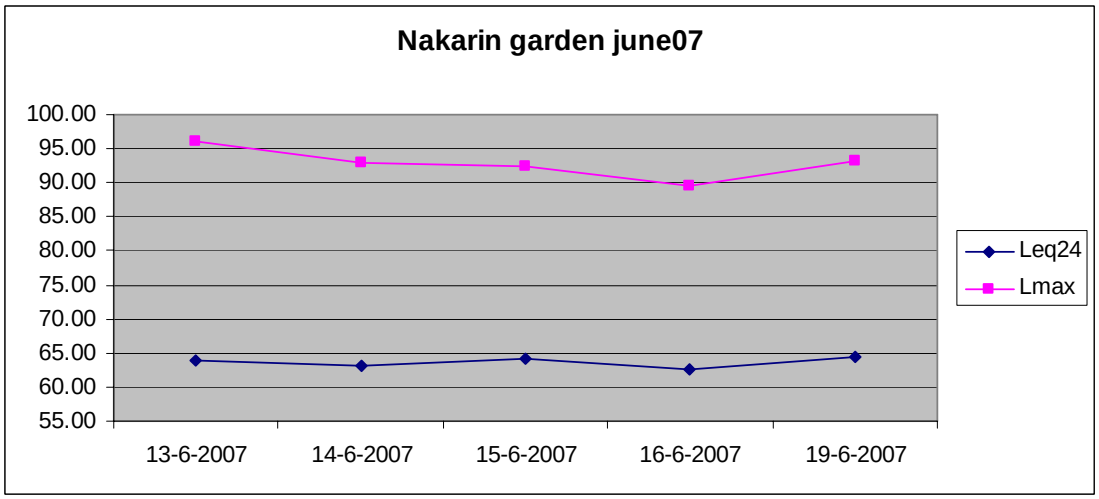

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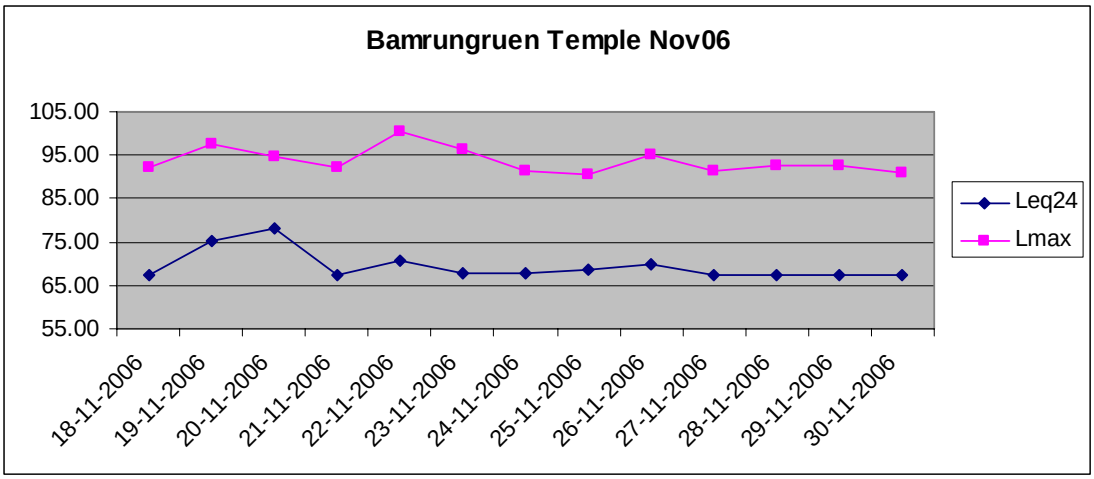
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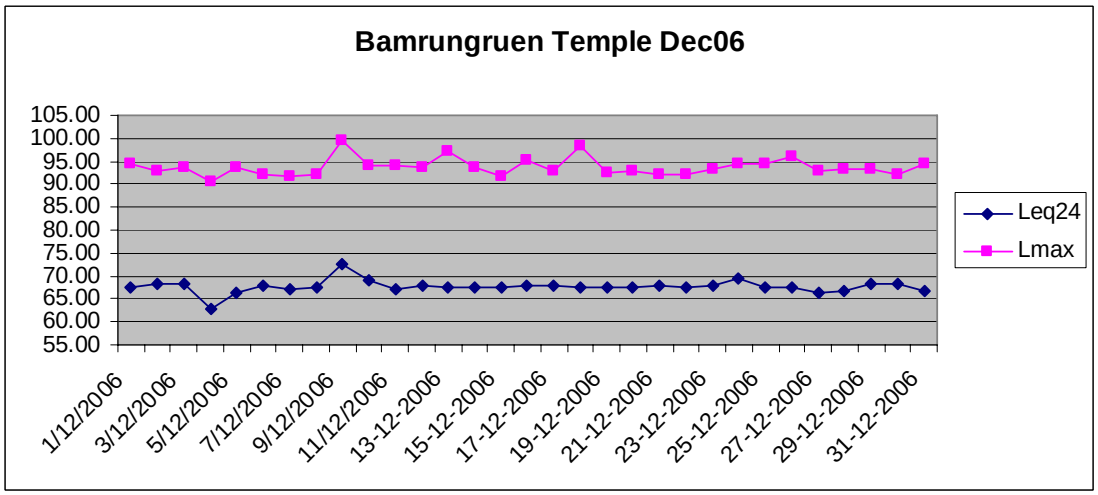
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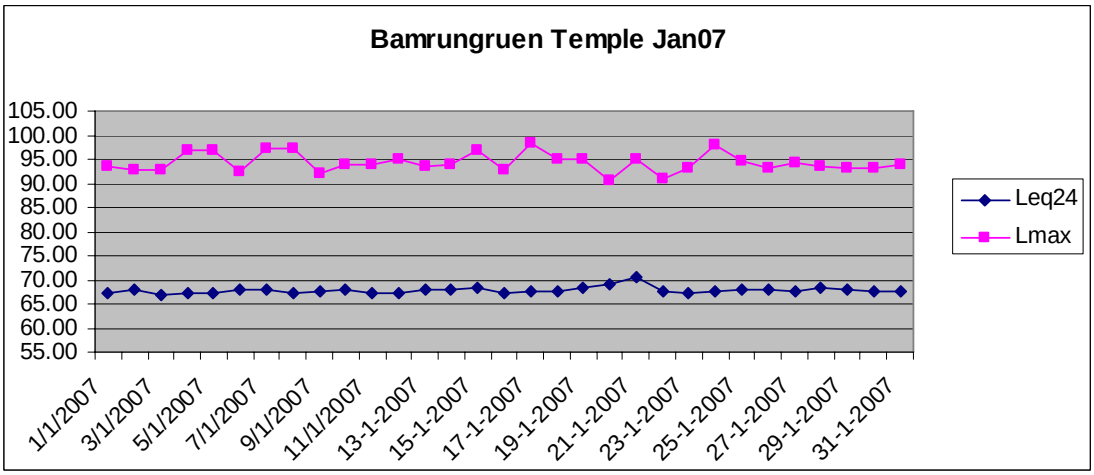
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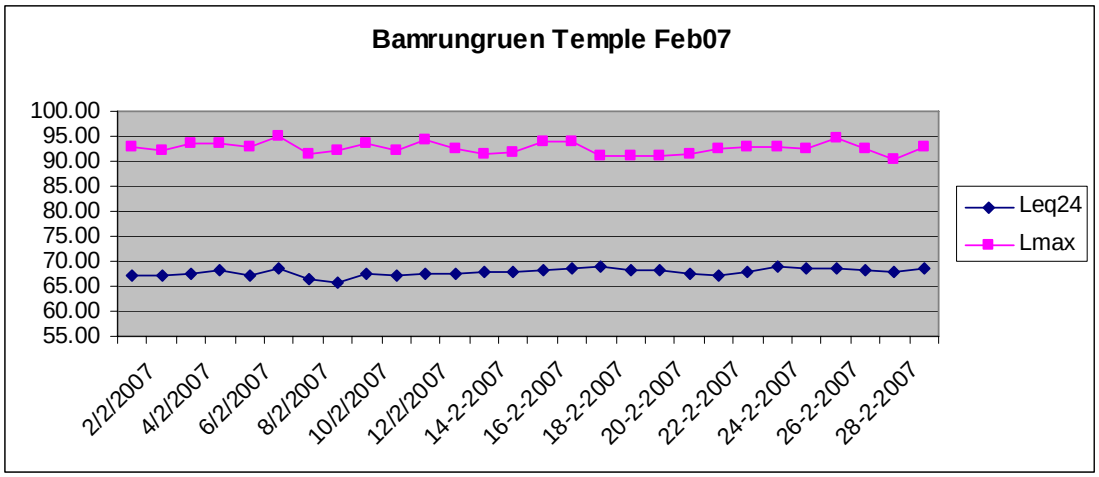
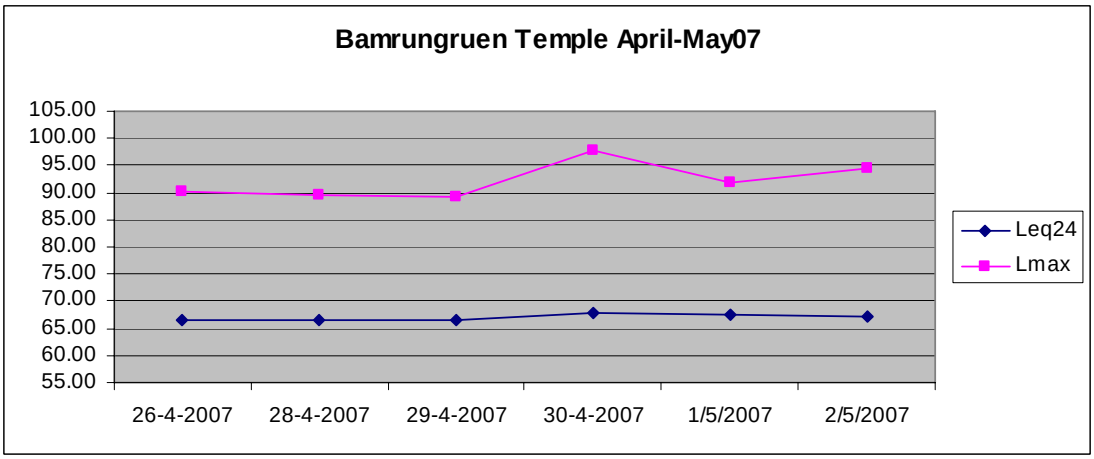
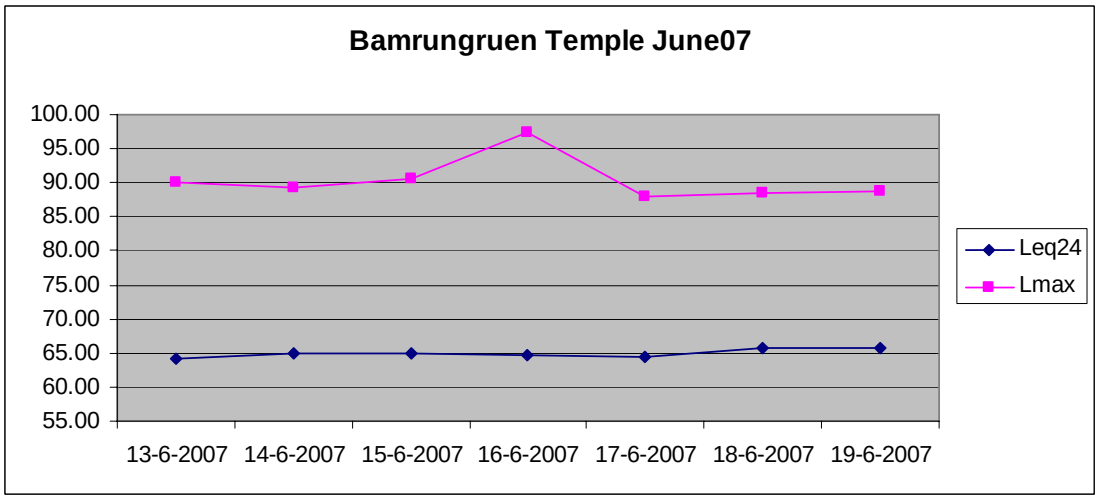
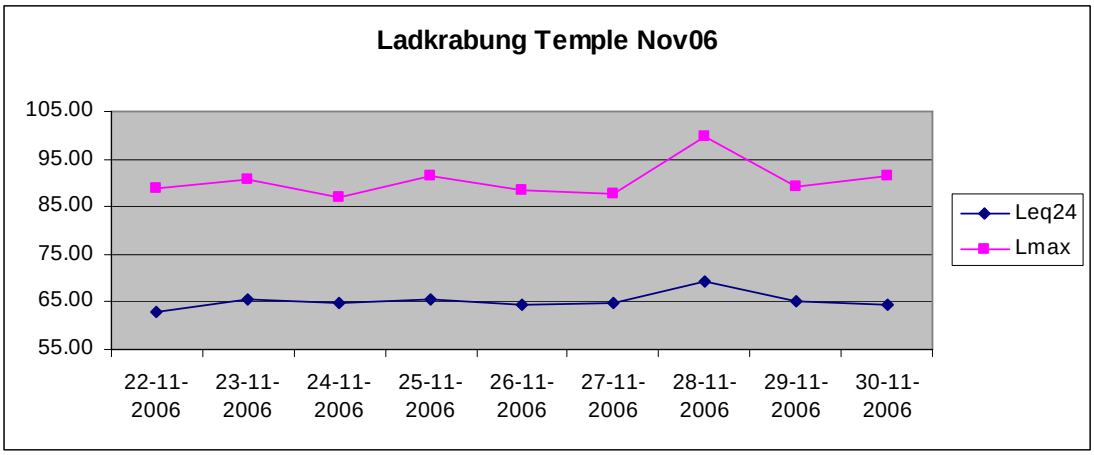






Ladkrabung Temple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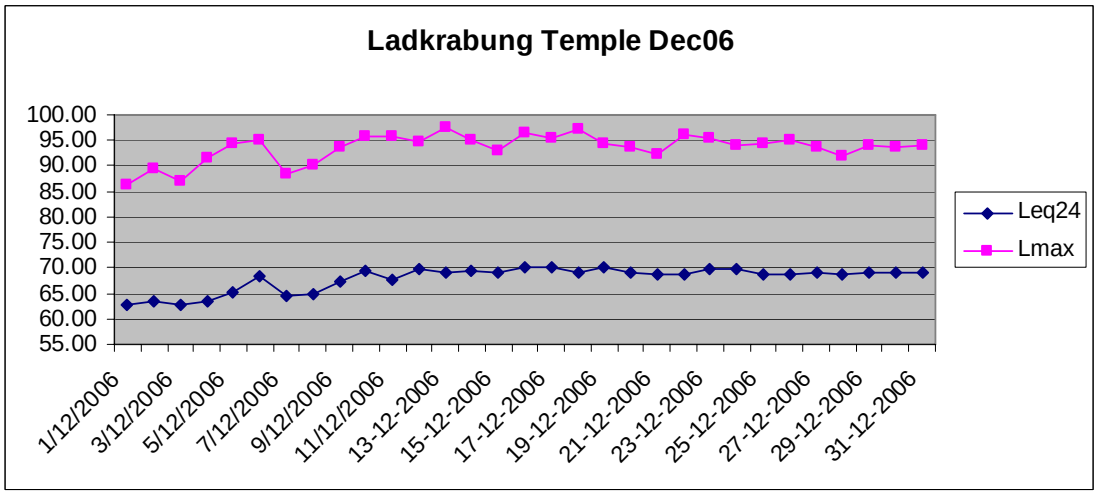
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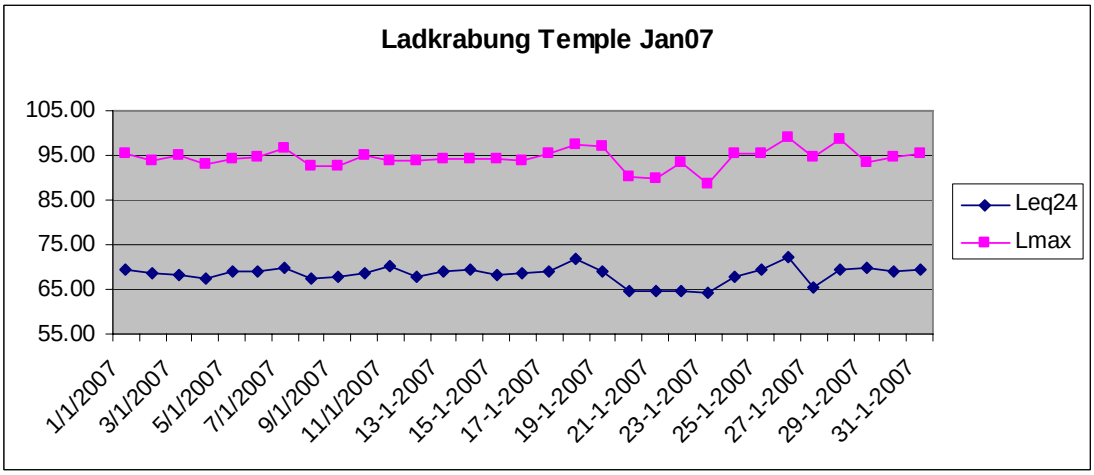
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3/1/2007
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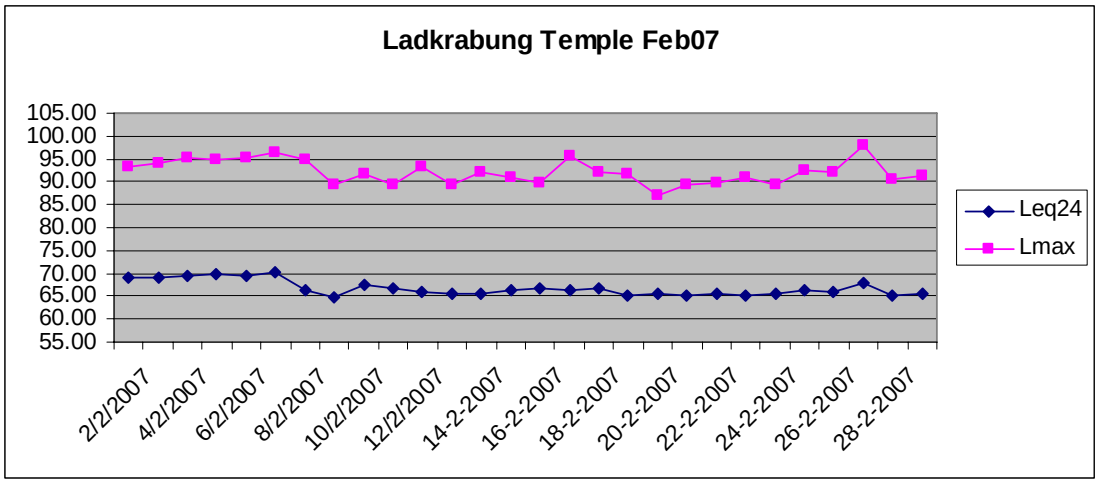

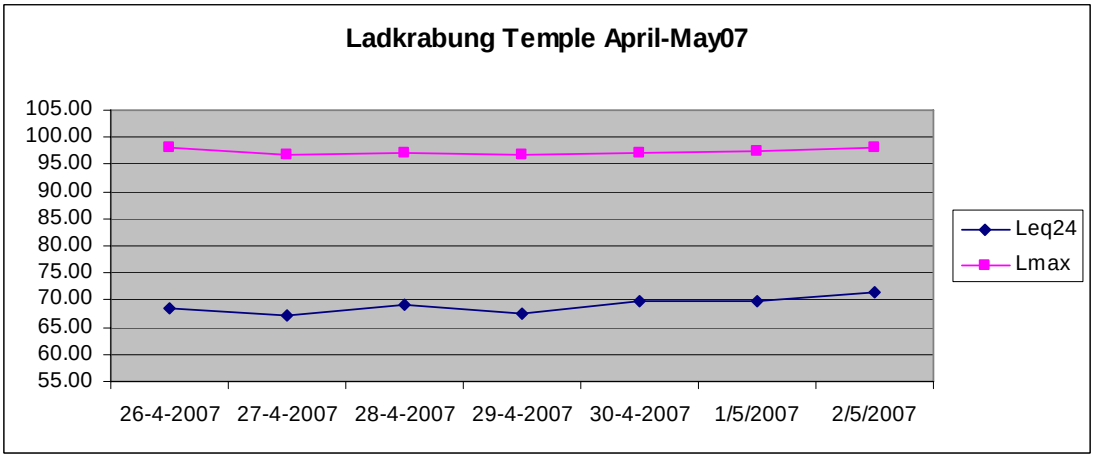

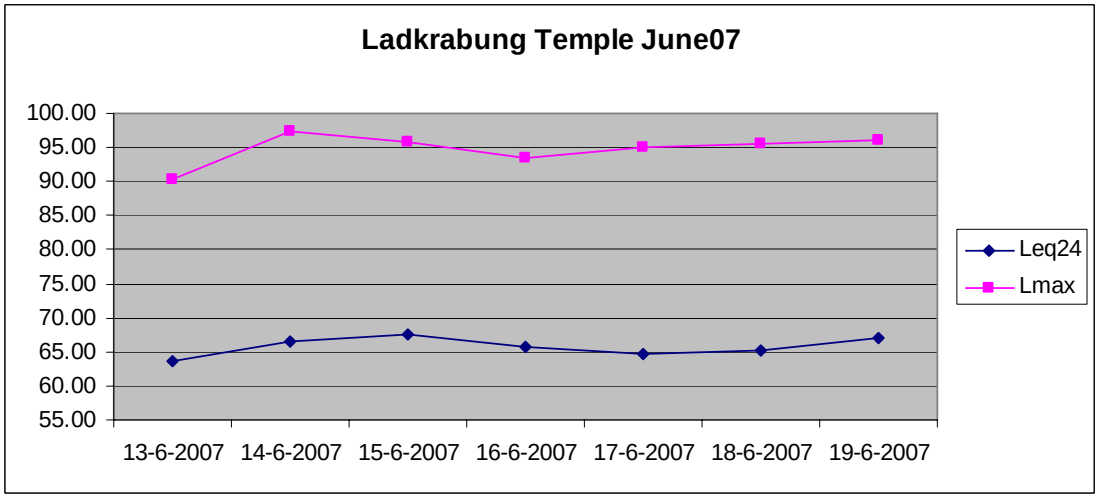

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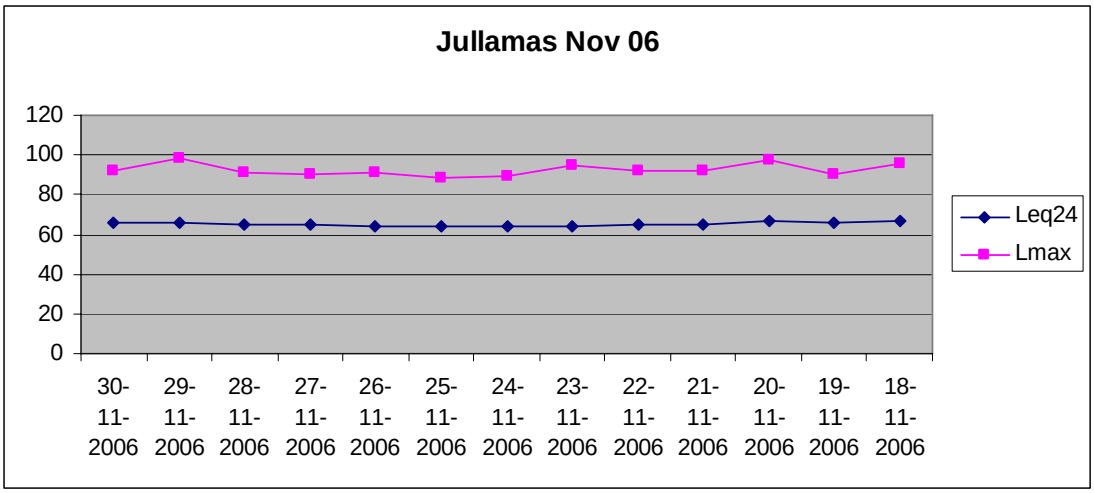
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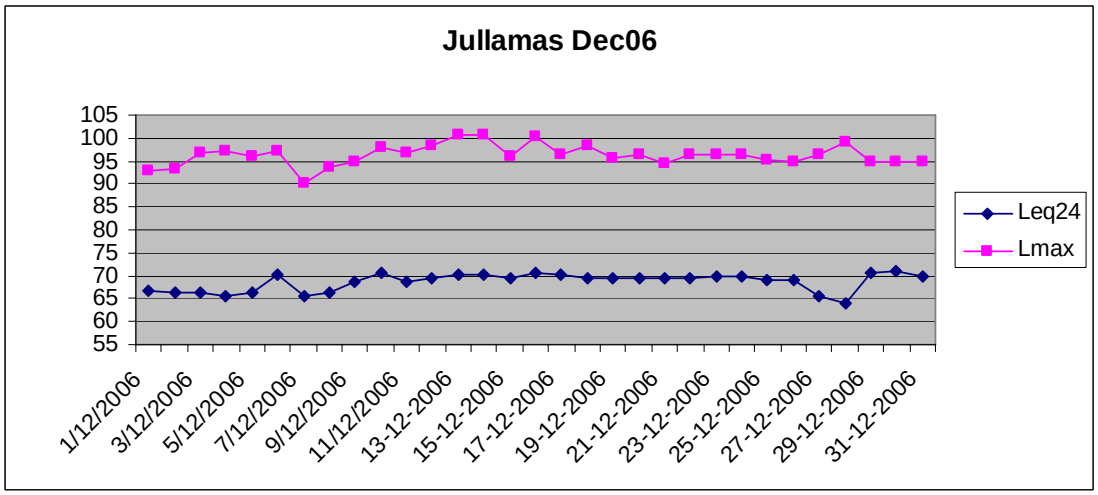
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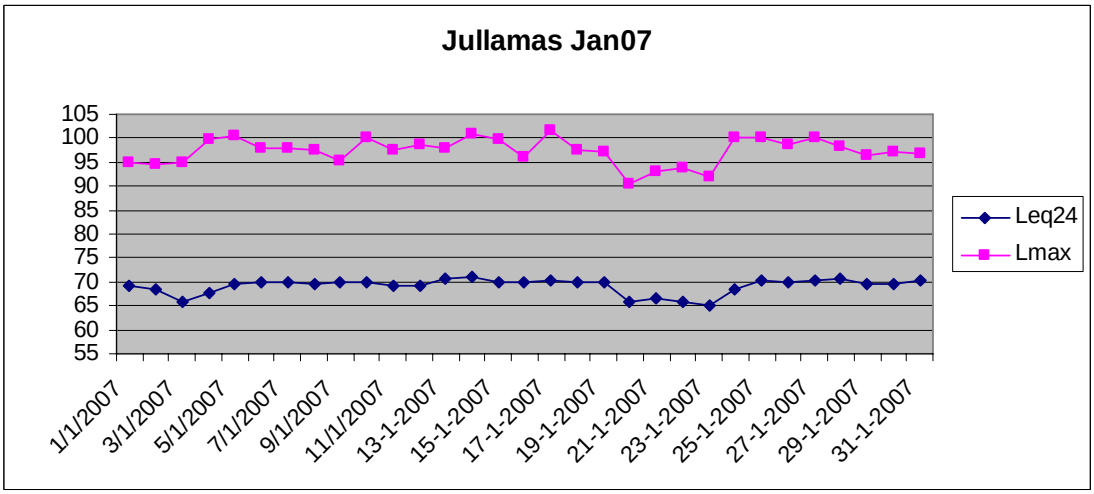
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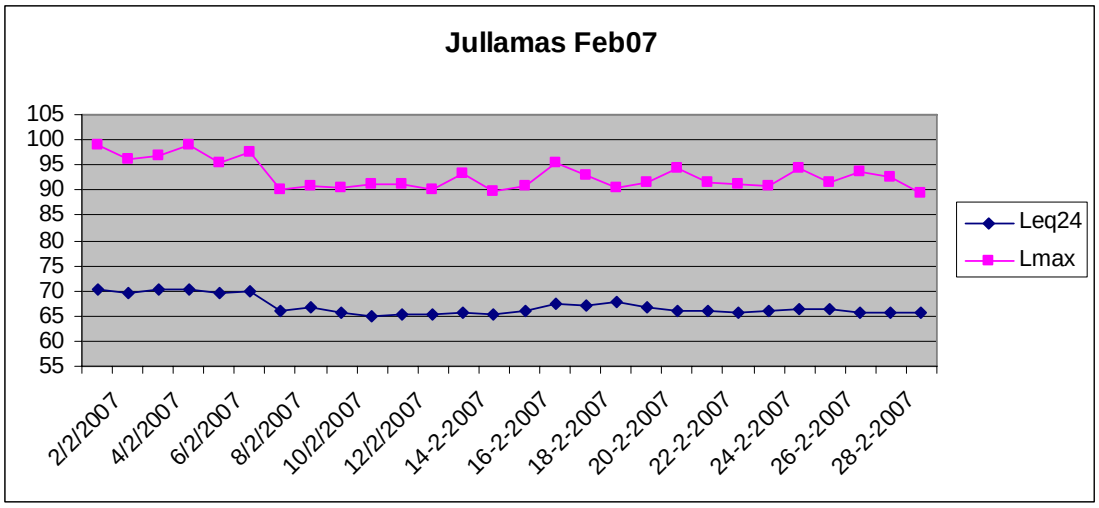
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70
65
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55
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4/2/2007
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8/2/2007
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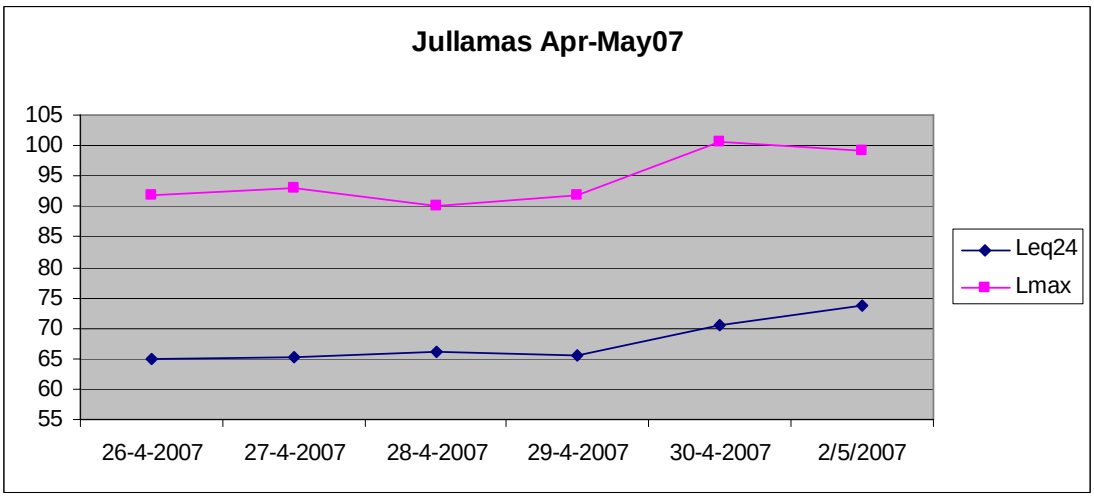
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30-4-2007
2/5/2007
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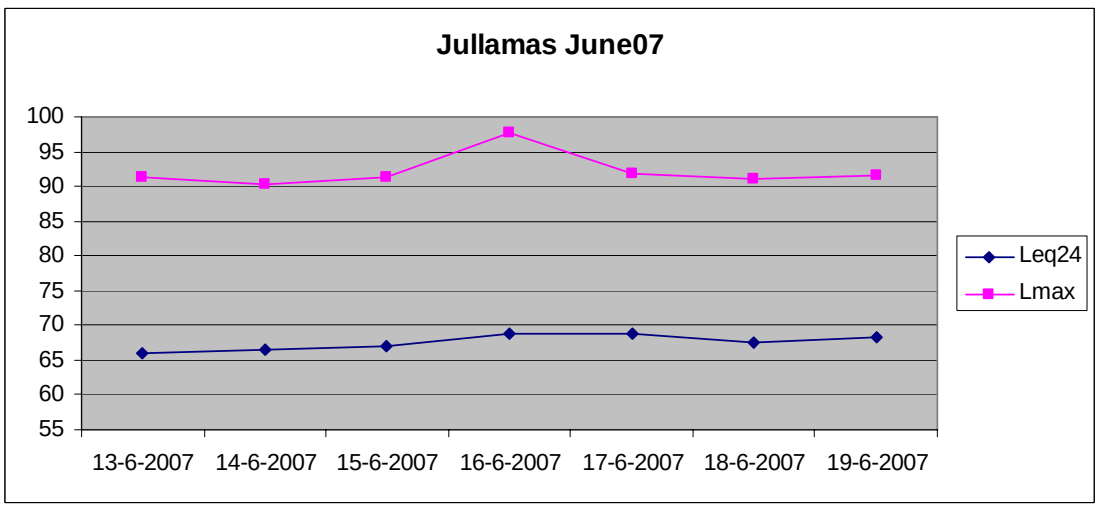
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13-6-2007
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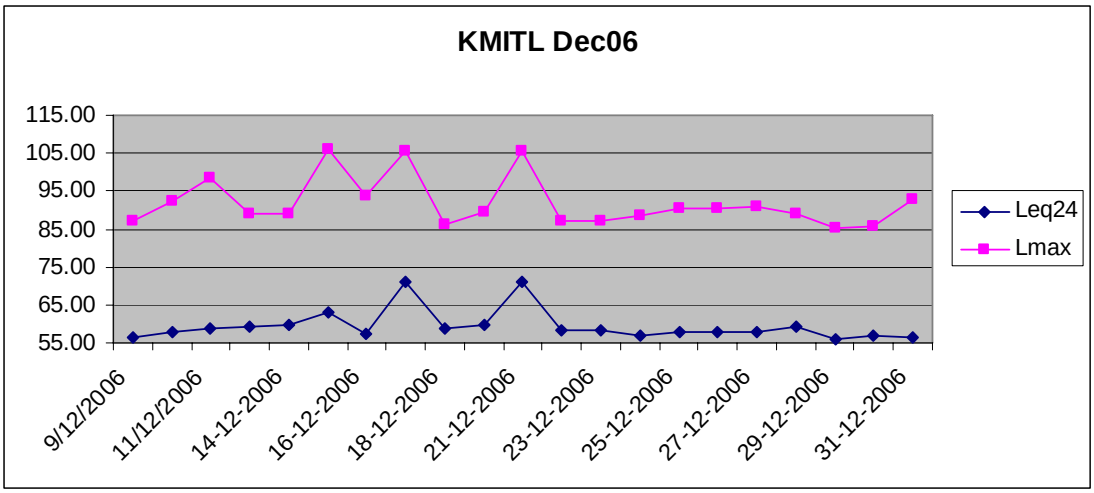
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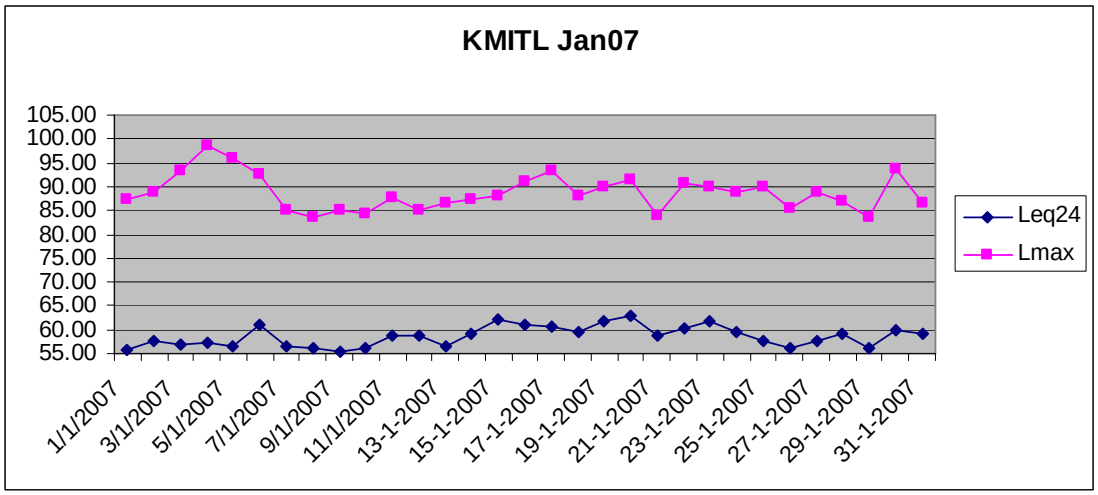
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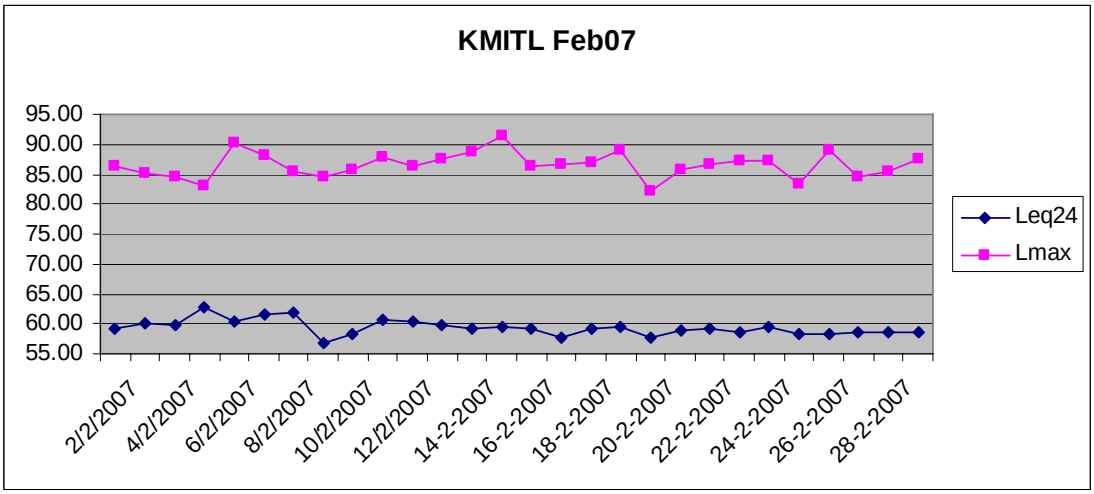
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85.00
80.00
75.00
70.00
65.00
60.00
55.00
2/2/2007
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28-2-2007
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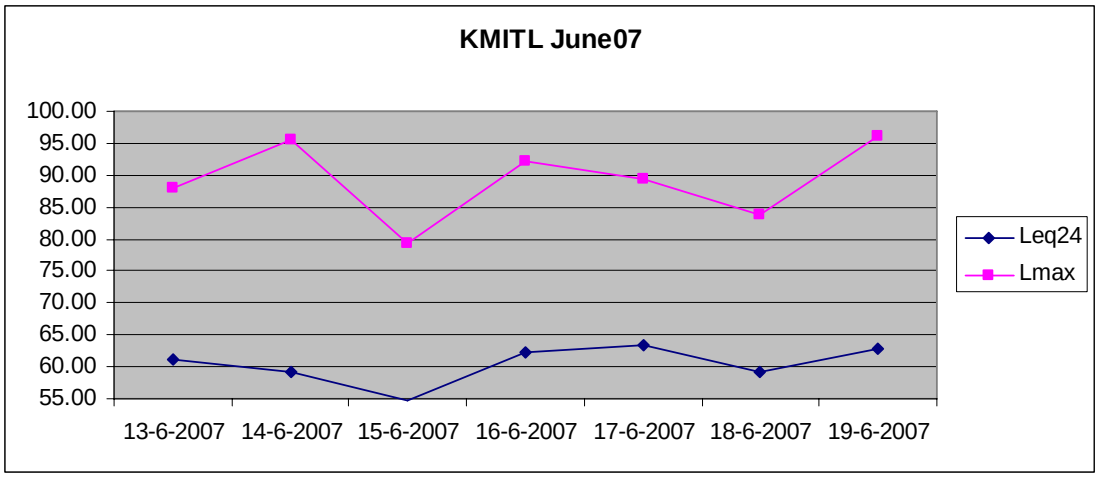
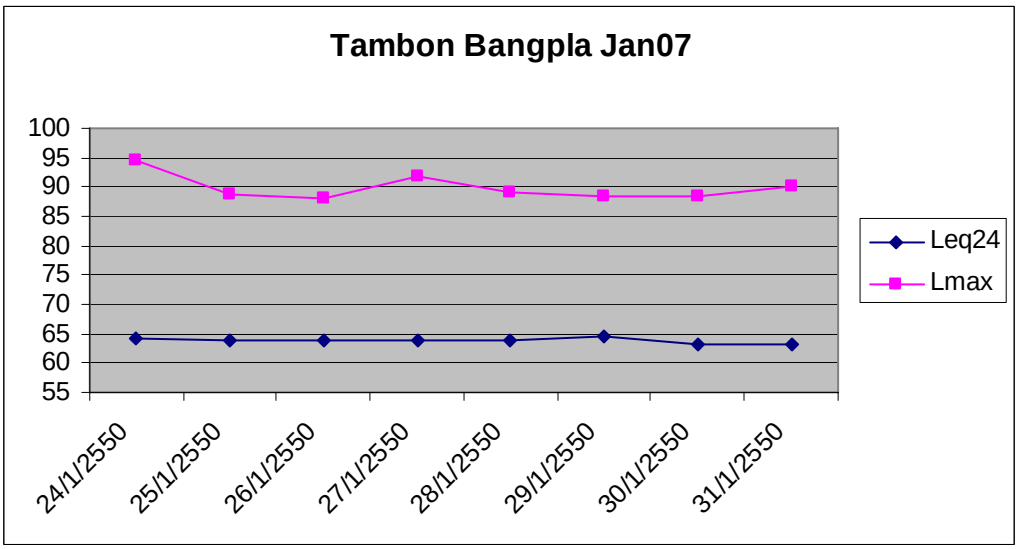
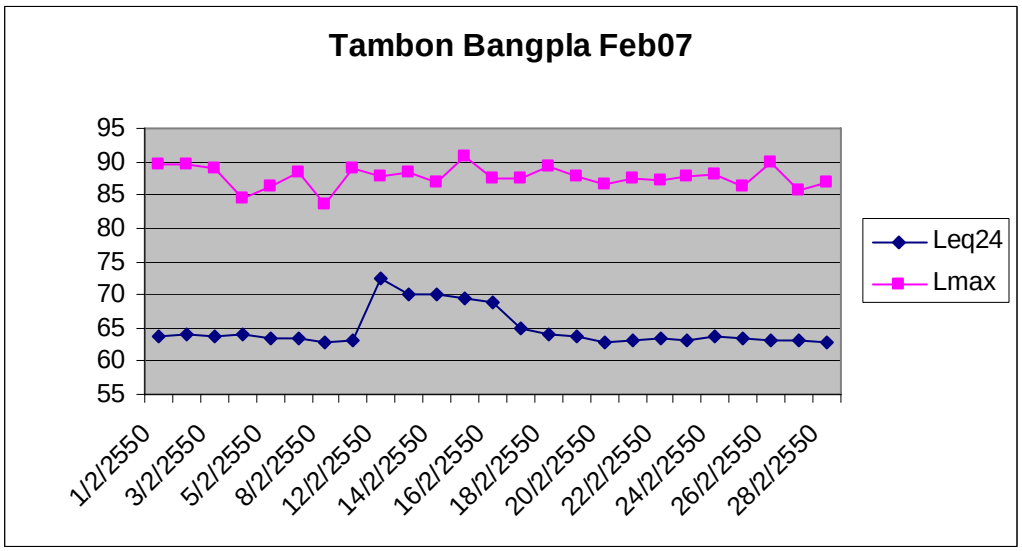
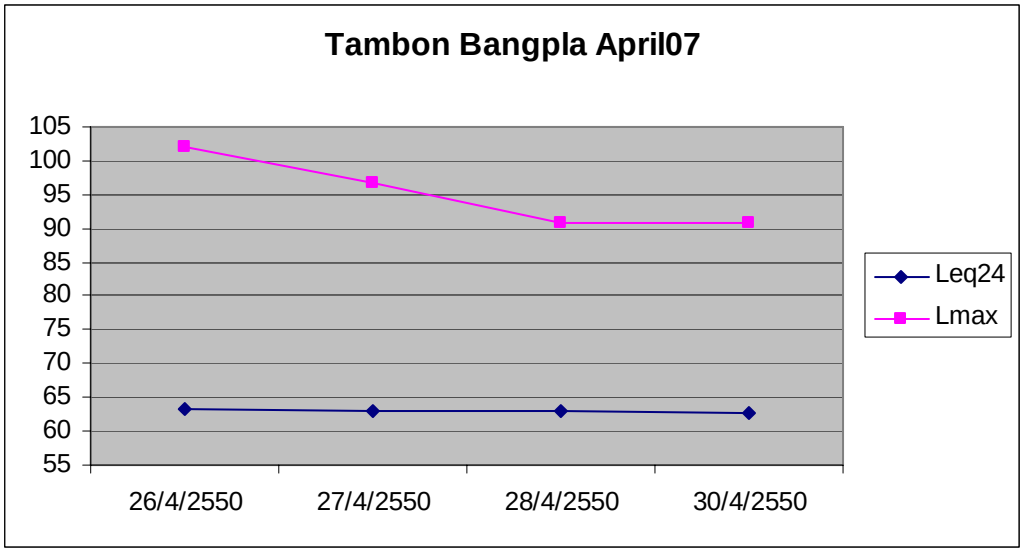
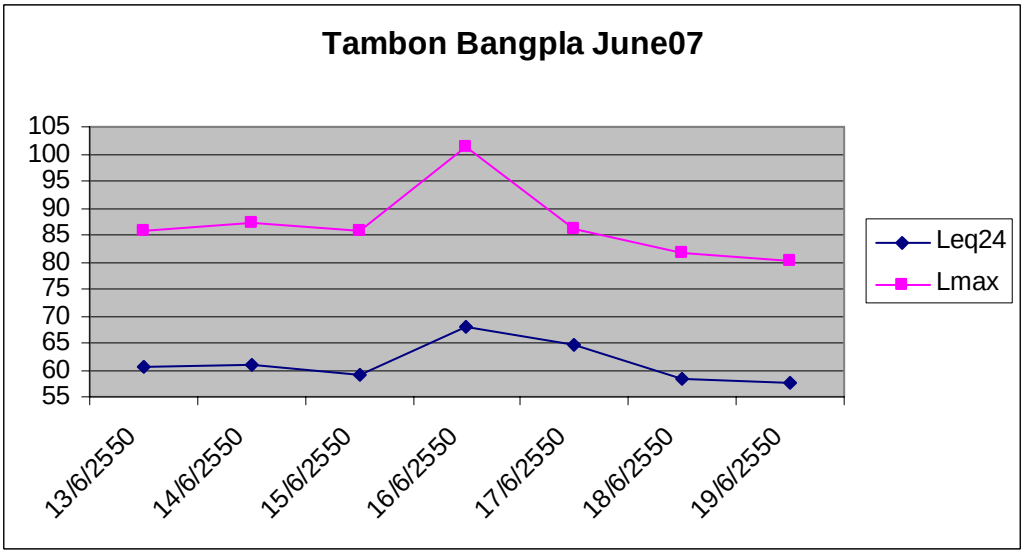


Tambon Bangpla

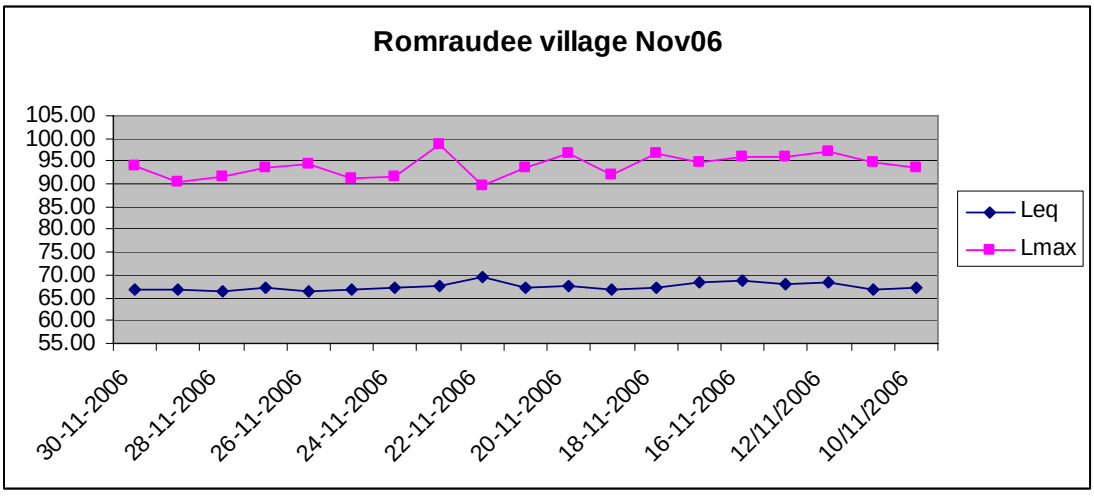


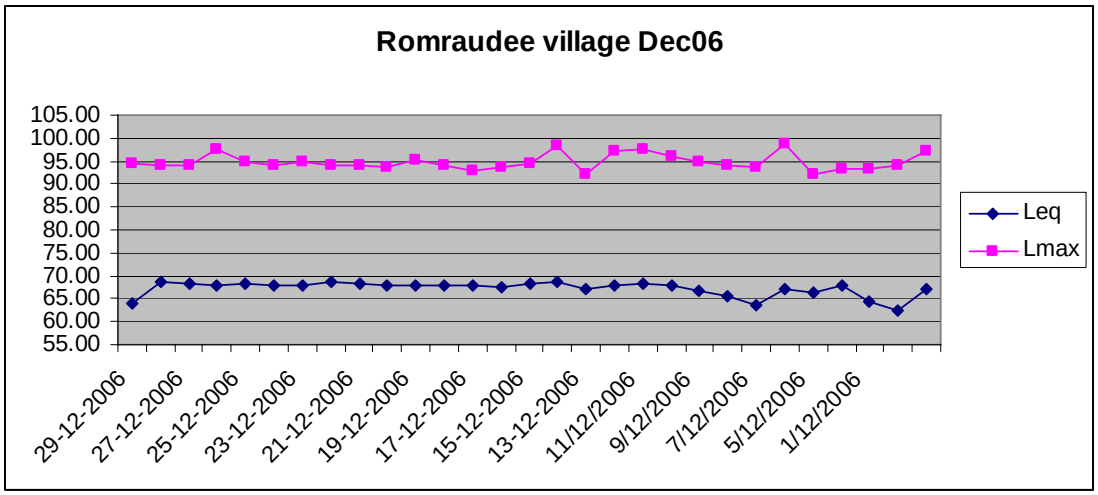






Romraudee Village

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65.00
60.00
55.00
29-12-2006
27-12-2006
25-12-2006
23-12-2006
21-12-2006
19-12-2006
17-12-2006
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13-12-2006
11/12/2006
9/12/2006
7/12/2006
5/12/2006
1/12/2006
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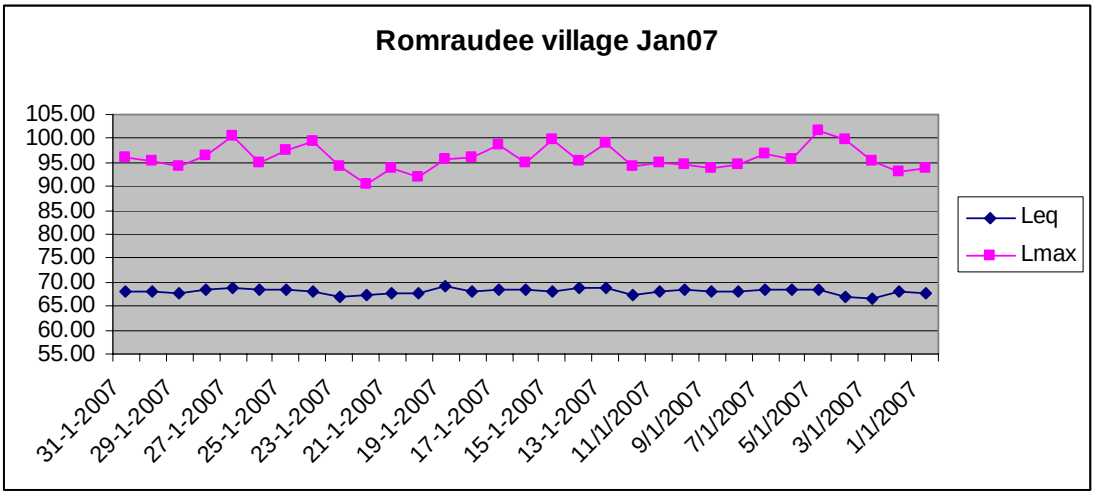
Lmax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60.00
55.00
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3/1/2007
1/1/2007
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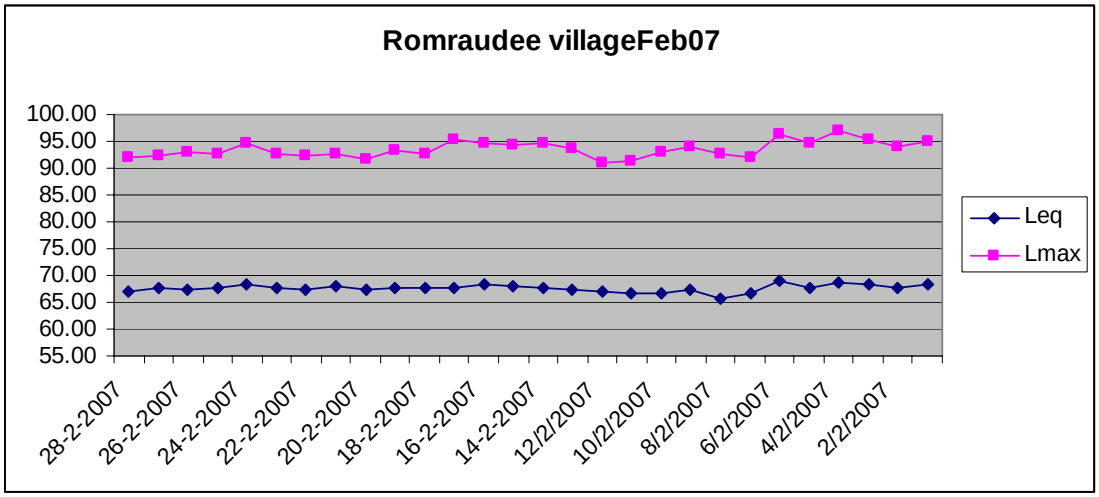
Lmax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4/2/2007
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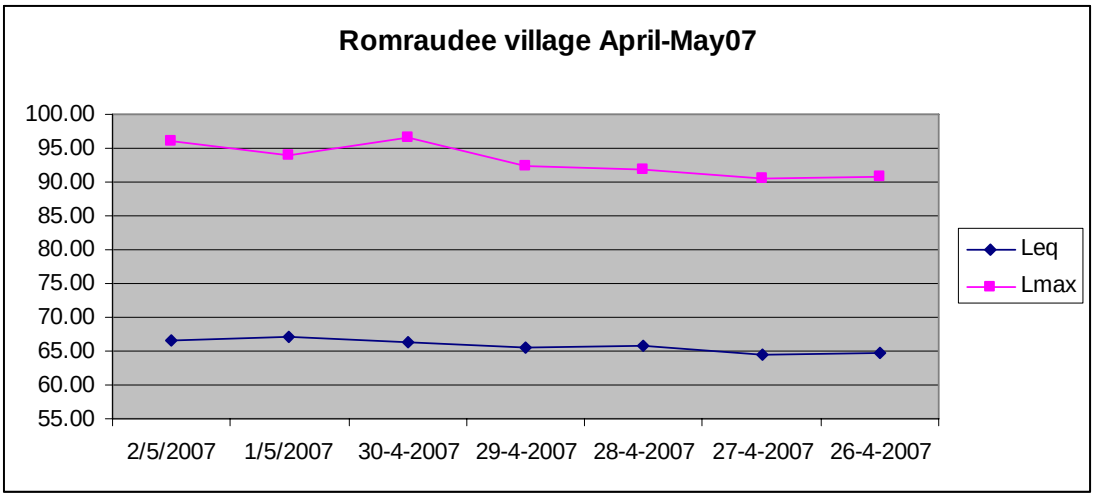

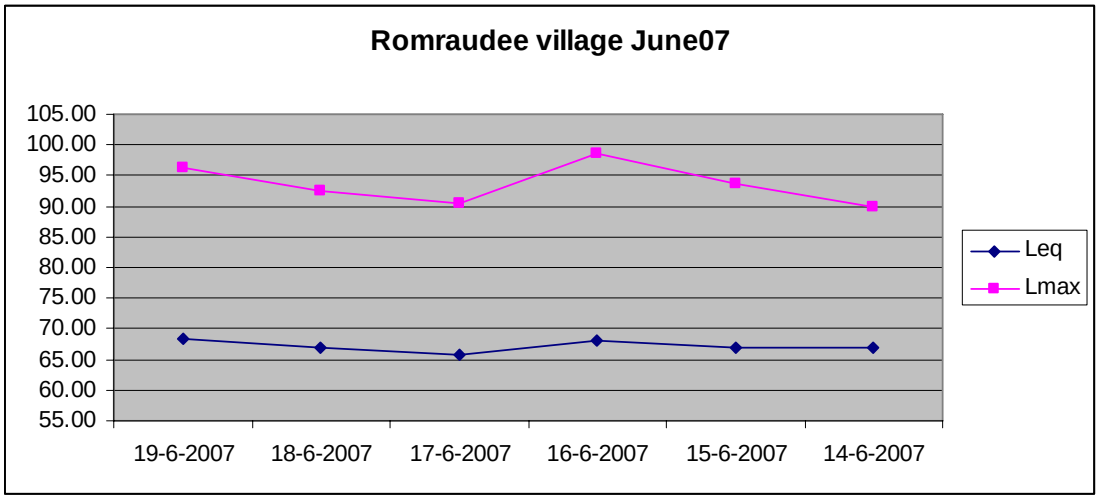

Appendix B Flight number using Bangkok Suvarnabhumi Airport

(Source: Aeronautical Radio of Thailand Limited (AEROTHAI))

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Oct-06	244	130	232	127	**733**
2-Oct-06	235	129	249	132	**745**
3-Oct-06	237	127	226	131	**721**
4-Oct-06	243	127	243	126	**739**
5-Oct-06	251	134	245	134	**764**
6-Oct-06	241	141	233	144	**759**
7-Oct-06	255	131	251	130	**767**
8-Oct-06	266	137	256	135	**794**
9-Oct-06	222	129	247	133	**731**
10-Oct-06	232	125	226	124	**707**
11-Oct-06	247	129	246	131	**753**
12-Oct-06	256	130	242	130	**758**
13-Oct-06	246	133	240	133	**752**
14-Oct-06	251	135	254	134	**774**
15-Oct-06	244	136	242	138	**760**
16-Oct-06	244	132	246	134	**756**
17-Oct-06	238	126	227	131	**722**
18-Oct-06	249	126	255	128	**758**
19-Oct-06	260	132	250	133	**775**
20-Oct-06	253	140	248	138	**779**
21-Oct-06	258	137	254	138	**787**
22-Oct-06	257	134	245	133	**769**
23-Oct-06	240	139	249	139	**767**
24-Oct-06	237	129	232	129	**727**
25-Oct-06	251	125	251	124	**751**
26-Oct-06	256	137	249	136	**778**
27-Oct-06	244	138	247	137	**766**
28-Oct-06	263	135	257	137	**792**
29-Oct-06	261	137	257	132	**787**
30-Oct-06	258	140	258	151	**807**
31-Oct-06	257	132	248	134	**771**
GRAND TOTAL	7696	4112	7605	4136	**23549**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Nov-06	243	127	233	127	**730**
2-Nov-06	244	133	240	136	**753**
3-Nov-06	253	130	253	132	**768**
4-Nov-06	252	130	245	128	**755**
5-Nov-06	243	133	244	130	**750**
6-Nov-06	240	125	238	125	**728**
7-Nov-06	239	129	240	127	**735**
8-Nov-06	249	125	251	128	**753**
9-Nov-06	241	132	237	134	**744**
10-Nov-06	254	126	247	130	**757**
11-Nov-06	243	128	252	130	**753**
12-Nov-06	245	135	242	132	**754**
13-Nov-06	244	124	244	122	**734**
14-Nov-06	239	134	245	133	**751**
15-Nov-06	256	123	247	127	**753**
16-Nov-06	248	135	235	125	**743**
17-Nov-06	255	138	255	136	**784**
18-Nov-06	236	123	221	134	**714**
19-Nov-06	240	132	248	128	**748**
20-Nov-06	245	128	239	130	**742**
21-Nov-06	242	128	213	127	**710**
22-Nov-06	258	122	243	125	**748**
23-Nov-06	247	136	248	135	**766**
24-Nov-06	266	136	251	137	**790**
25-Nov-06	248	130	249	133	**760**
26-Nov-06	247	145	234	134	**760**
27-Nov-06	243	136	245	132	**756**
28-Nov-06	242	136	245	135	**758**
29-Nov-06	260	125	252	129	**766**
30-Nov-06	213	115	199	118	**645**
Total	**7375**	**3899**	**7235**	**3899**	**22408**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Dec-06	246	123	237	122	**728**
2-Dec-06	261	138	249	133	**781**
3-Dec-06	247	133	246	140	**766**
4-Dec-06	249	140	250	133	**772**
5-Dec-06	254	142	245	140	**781**
6-Dec-06	253	137	237	130	**757**
7-Dec-06	258	144	251	146	**799**
8-Dec-06	259	147	258	151	**815**
9-Dec-06	252	133	252	140	**777**
10-Dec-06	250	135	253	132	**770**
11-Dec-06	245	138	253	137	**773**
12-Dec-06	249	135	251	138	**773**
13-Dec-06	261	133	251	130	**775**
14-Dec-06	249	134	248	135	**766**
15-Dec-06	254	146	257	142	**799**
16-Dec-06	266	151	255	140	**812**
17-Dec-06	253	142	286	135	**816**
18-Dec-06	250	132	254	135	**771**
19-Dec-06	249	136	245	141	**771**
20-Dec-06	271	138	244	135	**788**
21-Dec-06	251	142	250	144	**787**
22-Dec-06	264	147	253	144	**808**
23-Dec-06	261	142	265	142	**810**
24-Dec-06	263	154	262	148	**827**
25-Dec-06	253	145	254	142	**794**
26-Dec-06	256	146	256	150	**808**
27-Dec-06	263	148	255	145	**811**
28-Dec-06	259	157	262	152	**830**
29-Dec-06	276	159	259	156	**850**
30-Dec-06	263	160	260	156	**839**
31-Dec-06	246	154	250	154	**804**
GRAND TOTAL	**7931**	**4411**	**7848**	**4368**	**24558**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Jan-07	246	150	247	157	**800**
2-Jan-07	255	163	254	170	**842**
3-Jan-07	272	151	260	157	**840**
4-Jan-07	248	153	246	157	**804**
5-Jan-07	267	148	256	156	**827**
6-Jan-07	259	148	255	151	**813**
7-Jan-07	259	151	261	158	**829**
8-Jan-07	260	139	261	146	**806**
9-Jan-07	254	140	258	148	**800**
10-Jan-07	270	137	253	142	**802**
11-Jan-07	257	139	252	145	**793**
12-Jan-07	265	143	256	152	**816**
13-Jan-07	261	141	259	147	**808**
14-Jan-07	266	147	265	153	**831**
15-Jan-07	258	139	253	146	**796**
16-Jan-07	256	134	256	141	**787**
17-Jan-07	268	136	251	145	**800**
18-Jan-07	249	144	250	148	**791**
19-Jan-07	268	149	256	154	**827**
20-Jan-07	258	132	263	142	**795**
21-Jan-07	265	144	261	150	**820**
22-Jan-07	254	138	253	144	**789**
23-Jan-07	263	134	256	141	**794**
24-Jan-07	270	134	250	146	**800**
25-Jan-07	260	139	254	151	**804**
26-Jan-07	266	150	265	153	**834**
27-Jan-07	266	141	266	143	**816**
28-Jan-07	267	152	265	152	**836**
29-Jan-07	255	140	258	143	**796**
30-Jan-07	262	145	259	140	**806**
31-Jan-07	264	141	257	144	**806**
GRAND TOTAL	**8088**	**4442**	**7956**	**4622**	**25108**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Feb-07	259	152	276	152	**839**
2-Feb-07	278	156	269	150	**853**
3-Feb-07	274	143	272	145	**834**
4-Feb-07	268	147	272	145	**832**
5-Feb-07	260	139	264	139	**802**
6-Feb-07	267	141	267	140	**815**
7-Feb-07	275	135	258	134	**802**
8-Feb-07	259	148	261	150	**818**
9-Feb-07	267	145	264	146	**822**
10-Feb-07	271	146	275	145	**837**
11-Feb-07	269	147	272	148	**836**
12-Feb-07	259	151	263	149	**822**
13-Feb-07	259	150	262	146	**817**
14-Feb-07	275	139	263	142	**819**
15-Feb-07	259	151	263	153	**826**
16-Feb-07	284	152	274	154	**864**
17-Feb-07	272	148	270	152	**842**
18-Feb-07	296	153	286	157	**892**
19-Feb-07	257	145	265	147	**814**
20-Feb-07	260	147	256	151	**814**
21-Feb-07	269	140	259	139	**807**
22-Feb-07	264	159	268	158	**849**
23-Feb-07	286	163	284	157	**890**
24-Feb-07	277	150	274	152	**853**
25-Feb-07	270	155	275	153	**853**
26-Feb-07	258	151	261	148	**818**
27-Feb-07	260	147	263	146	**816**
28-Feb-07	270	139	262	142	**813**
GRAND TOTAL	**7522**	**4139**	**7498**	**4140**	**23299**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Mar-07	257	145	261	148	**811**
2-Mar-07	275	150	266	153	**844**
3-Mar-07	262	146	265	145	**818**
4-Mar-07	272	142	263	144	**821**
5-Mar-07	255	155	265	151	**826**
6-Mar-07	262	150	263	150	**825**
7-Mar-07	270	141	257	146	**814**
8-Mar-07	259	153	262	151	**825**
9-Mar-07	274	144	269	149	**836**
10-Mar-07	259	143	263	143	**808**
11-Mar-07	268	140	263	142	**813**
12-Mar-07	258	138	264	138	**798**
13-Mar-07	264	144	265	142	**815**
14-Mar-07	269	135	264	136	**804**
15-Mar-07	258	153	252	156	**819**
16-Mar-07	275	149	271	150	**845**
17-Mar-07	258	147	265	146	**816**
18-Mar-07	266	143	259	146	**814**
19-Mar-07	260	142	266	143	**811**
20-Mar-07	264	142	266	142	**814**
21-Mar-07	284	142	252	135	**813**
22-Mar-07	253	147	258	149	**807**
23-Mar-07	269	143	267	143	**822**
24-Mar-07	272	135	256	129	**792**
25-Mar-07	269	80	261	80	**690**
26-Mar-07	255	81	264	82	**682**
27-Mar-07	253	81	256	80	**670**
28-Mar-07	268	74	256	78	**676**
29-Mar-07	254	82	261	81	**678**
30-Mar-07	274	77	264	81	**696**
31-Mar-07	259	84	264	88	**695**
GRAND TOTAL	**8195**	**4028**	**8128**	**4047**	**24398**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Apr-07	264	85	262	81	**692**
2-Apr-07	250	81	259	82	**672**
3-Apr-07	255	80	255	78	**668**
4-Apr-07	268	80	252	80	**680**
5-Apr-07	260	82	268	86	**696**
6-Apr-07	272	80	269	81	**702**
7-Apr-07	257	73	261	78	**669**
8-Apr-07	269	90	265	87	**711**
9-Apr-07	249	74	257	78	**658**
10-Apr-07	262	78	264	77	**681**
11-Apr-07	305	76	292	79	**752**
12-Apr-07	288	86	290	83	**747**
13-Apr-07	277	81	275	85	**718**
14-Apr-07	259	83	262	84	**688**
15-Apr-07	272	90	266	89	**717**
16-Apr-07	286	81	292	85	**744**
17-Apr-07	281	87	291	85	**744**
18-Apr-07	263	77	249	79	**668**
19-Apr-07	253	81	257	81	**672**
20-Apr-07	266	78	266	80	**690**
21-Apr-07	256	72	254	76	**658**
22-Apr-07	262	77	260	77	**676**
23-Apr-07	246	75	249	74	**644**
24-Apr-07	251	76	257	74	**658**
25-Apr-07	268	73	255	74	**670**
26-Apr-07	254	80	255	83	**672**
27-Apr-07	273	81	267	81	**702**
28-Apr-07	258	74	259	78	**669**
29-Apr-07	265	85	264	82	**696**
30-Apr-07	251	73	253	81	**658**
GRAND TOTAL	**7940**	**2389**	**7925**	**2418**	**20672**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-May-07	253	80	250	74	**657**
2-May-07	274	78	249	76	**677**
3-May-07	245	72	249	76	**642**
4-May-07	269	80	259	83	**691**
5-May-07	250	71	254	74	**649**
6-May-07	256	82	256	77	**671**
7-May-07	252	74	256	76	**658**
8-May-07	247	78	246	74	**645**
9-May-07	255	73	249	76	**653**
10-May-07	243	77	250	78	**648**
11-May-07	273	71	267	72	**683**
12-May-07	254	67	257	70	**648**
13-May-07	260	75	260	74	**669**
14-May-07	248	72	254	71	**645**
15-May-07	254	72	252	74	**652**
16-May-07	261	68	252	69	**650**
17-May-07	251	73	258	73	**655**
18-May-07	270	72	261	74	**677**
19-May-07	250	70	252	71	**643**
20-May-07	259	75	256	74	**664**
21-May-07	244	70	248	71	**633**
22-May-07	246	70	251	69	**636**
23-May-07	262	69	254	71	**656**
24-May-07	250	74	251	75	**650**
25-May-07	260	70	260	73	**663**
26-May-07	250	71	257	74	**652**
27-May-07	260	77	255	76	**668**
28-May-07	250	71	252	73	**646**
29-May-07	253	70	254	68	**645**
30-May-07	255	71	250	72	**648**
31-May-07	253	75	252	73	**653**
GRAND TOTAL	**7907**	**2268**	**7871**	**2281**	**20327**

Date	Departure		Arrival		Total
	International Flights	Domestic Flights	International Flights	Domestic Flights	
1-Jun-07	267	72	261	77	**677**
2-Jun-07	249	68	252	70	**639**
3-Jun-07	260	79	261	78	**678**
4-Jun-07	246	70	247	70	**633**
5-Jun-07	252	68	254	67	**641**
6-Jun-07	258	67	249	68	**642**
7-Jun-07	244	72	253	76	**645**
8-Jun-07	271	75	258	75	**679**
9-Jun-07	250	70	255	72	**647**
10-Jun-07	264	80	265	78	**687**
11-Jun-07	247	73	246	75	**641**
12-Jun-07	250	69	249	69	**637**
13-Jun-07	260	69	255	69	**653**
14-Jun-07	246	76	246	78	**646**
15-Jun-07	265	73	261	77	**676**
16-Jun-07	248	72	252	73	**645**
17-Jun-07	255	80	255	77	**667**
18-Jun-07	241	72	245	75	**633**
19-Jun-07	251	74	252	71	**648**
20-Jun-07	258	67	249	70	**644**
21-Jun-07	254	75	250	86	**665**
22-Jun-07	264	73	261	75	**673**
23-Jun-07	253	72	255	70	**650**
24-Jun-07	260	79	260	74	**673**
25-Jun-07	251	71	249	73	**644**
26-Jun-07	248	71	255	67	**641**
27-Jun-07	251	69	259	68	**647**
28-Jun-07	251	73	250	73	**647**
29-Jun-07	270	76	263	81	**690**
30-Jun-07	249	68	254	74	**645**
GRAND TOTAL	**7633**	**2173**	**7621**	**2206**	**19633**

Appendix C Project types required EIA in Thailand

Industrial Projects

Types Projects or Activities	Size
Industrial Estate as defined by the Industrial Estate Authority of Thailand Act or projects with similar feature	All sizes
Industries	
Petrochemical Industry	Using raw materials which are produced from oil refining and or natural gas separation, with production capacity of 100 tons/day or more
Oil Refinery	All sizes
Natural Gas separation or Processing	All sizes
Chlor-alkaline Industry requiring sodium chloride (NaCl) as raw material for production of sodium carbonate (Na_2Co_3), sodium hydroxide (NaOH), hydro chloric Acid (HCl), chlorine (Cl_2), sodium hipo-chloride (NaOCl) and bleaching powder	Production capacity of each or combined products of 100 tons/day or more
Iron and/or steel industry	Production capacity of 100 tons/day or more (production capacity shall be calculated by using ton/hour furnaces capacity multiply by 24 hours)
Cement industry	All sizes
Smelting industry other than iron and steel	Production capacity 50 tons/day or more
Pulp industry	Production capacity 50 tons/day or more
Sugar industry	
Producing raw sugar, white sugar, refined sugar	All size
Producing glucose, dextrose, fructose or the like	Production capacity of 20 tons/day or more
Pesticide Industry producing active Ingredient by chemical process	All sizes
Chemical Fertilizes industry using chemical process	All sizes
Central waste treatment plant as defined by the Industry Act	All sizes

Residential Building and Service Community Projects

Types of Projects or Activities	Size
Building in areas adjacent to river, coastal area, lake or beach or in the vicinity of National Parks or Historical Park which may effect the area environmental quality	Height of 23 meters or more
	Total floor area or individual floor area in the building is 10,000 square meters or more
Residential Building as defined by the Building Control Act	80 Rooms or more
Land allocation of residential or commercial purpose	500 land plots or more
	Total developed area exceed 100 rails (16 hectares)
Hotel or Resort facility	80 rooms or more
Hospital which located	
(a)in area adjacent to river, coastal area, lake or beach	with 30 in - patient's beds or more
(b)in area other than (a)	with 60 in - patient's beds or more

Transport Projects

Types of Projects or Activities	Size
Commercial Airport	All sizes
Commercial Port	With capacity for vessels of 500 gross tons or more
Mass Transit System under the Mass Transit System and Expressway Act or project as the same characteristic or Mass Transit which use rail	All sizes
High way or road as defined by the Highway Act, passing through following areas	
Wildlife Sanctuaries and Wildlife Non-Hunting Areas as defined by the Wildlife Conservation and Projection Act	All projects with equivalents to or above the minimum standard of rural highway, including road expansion on existing route
National park as defined by the National park Act	
Watershed area classified as class 2 by the Cabinet Resolution	
Mangrove Forests Designated as the National Forest Reserve	
Coastal Area within 50 meters of high tide level	
Coastal reclamation	All sizes

Energy Projects

Types Projects or Activities	Size
Thermal Power Plant	Capacity 10 MW or more
Petroleum development	
Geophysical drilling, exploration and/or production	All size
Oil and gas pipeline system	All size

Water resource Projects

Types Projects or Activities	Size
Dam or Reservoir	with storage volume of 100,000,000 cubic meters or more, or storage surface area 15 square kilometers or more
Irrigation	Irrigated area of 80,000 rails (12,800 hectares or more)

Watershed area Projects

Types Projects or Activities	Size
All types of projects located in the areas approved by the Cabinet as class 1 B watershed area	All sizes

Mine Projects

Types Projects or Activities	Size
Mining as defined by the Mineral Act	All sizes

Appendix D Interview question

What is your name?

Are you living in this area?

How long have you been living here?

Are there any problems in your consideration before the airport operation?

What is the major problem from the airport operation?

What are the main problems from noise?

What time during the day that you think noise is the most problematic issue?

Out of sleep disturbance, are there any problems from noise disturbance?

What are they?

Still have the same problem right now?

After switched domestic flights to Donmuang Airport, have you felt the different?

If yes, what is the different?

What is your way to response this problem?

What is your house look like?

Do the airport authority come for reduce these problem?

Do you have any recommend to solve this problem?