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CONTENTS

Needs for more Effective Municipal Solid Waste Management Planning System of Local Authorities in Thailand

Jareerat Sakulrat and Rotchanatch Darnsawasdi

Abstract— *Despite the drastic changes on municipal solid waste (MSW) management in Thailand in the past decades, continue efforts are needed to increase collection efficiency, reduce open dumps, and increase recovery rate. This study founded that a key barrier for achieving effective MSW management is a low planning capability of local authorities who are responsible for managing MSW at present. The majority of local authorities in Thailand unsystematically design operational management system and prepare MSW management plan. The deficit will increase the chance of making the wrong decision or delaying corrective actions to the problem. Therefore, measures to improve MSW management planning unit of local authorities are essentially needed in order to enhance the performance of MSW operational management system. The objective of this study is therefore to identify the root causes – why local authorities in Thailand are now unable to systematically design the system for their MSW and prepare MSW management plan. This knowledge is important for designing effective measures in the future to enhance the capabilities of local authorities in Thailand for planning effective MSW management system for their regions.*

Keywords— **Municipal solid waste, Planning, Local authorities, Thailand.**

1. INTRODUCTION

The quantity of MSW increases each year with the continuing population growth. However, the growth rate of MSW has declined since the economic crisis in 1997 as shown in Figure 1. In 2006, total amount of MSW generated throughout Thailand was 14.63 Mton or 40,082 tons/day, 2.3% increase from last year [1]. Of that amount, 21% was generated from the capital city, Bangkok, 32% from municipal areas and 47% from outside municipal areas. The generation rate varies. It was approximately 1.5 kg/cap/day in Bangkok, with 0.7-1.0 kg/capita/day in municipal areas and about 0.4 kg/capita/day outside municipal areas [2], [3].
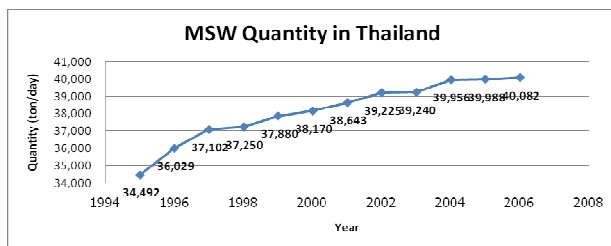
Fig. 1. MSW quantity in Thailand from 1994-2006.

With continuing improvement, the collection efficiency at present was 60% overall (compare to 30% in 1997), 100% in BKK, 70-80% in municipal areas, and 20-30% outside municipal areas [1]. The recovery rate was up from 5% to 22% via composting and recycling (Figure 2).
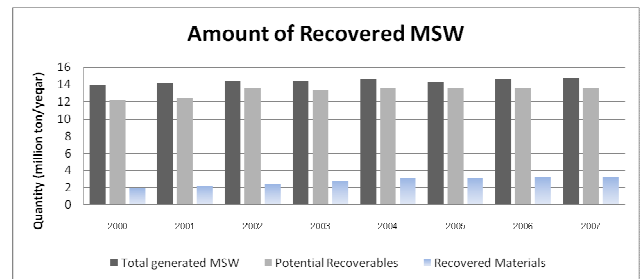
Fig. 2. MSW Recovery rate.

Open dumps are redeveloped or replaced by sanitary landfill particularly in municipal areas, provided with control systems for groundwater contamination and air pollution. As a result, sanitary disposal increases from 25% to 36% overall in 2006 [1]. All MSW collected in BKK are disposed of in sanitary landfills. Meanwhile, 33% and 4% of MSW in municipal areas were landfilled and incinerated respectively. Unfortunately, only 6% of MSW outside municipal areas were landfilled [1]. The remaining was still openly dumped.

Therefore, improvement actions need to be continuing to increase collection efficiency and to increase the recovery rate (the proportion is still low compared to the amount that has the potential for recovery) in order to reduce openly dumped and extend the lifespan of sanitary landfill. These will consequently reduce environmental harm and gain backs the public confidences and subsequently participation.

According to the management structure (Figure 3), the capability of each local authority is crucial to address this issue. Local authority must be able to develop policy and a plan that meet its local needs and consistent with national or regional policies, acquires sufficient budget and appropriate technology, operates the designed system, enforces the relevant laws, and encouraged public to participate in the system in order to achieve

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effective MSW management system.

Fig. 3. Structure and conditions of MSW management.

According to its duties, local authority should efficiently perform two key functions, including planning and operating. However, operating performance relies partly on planning performance. Therefore, having an effective planning unit will also enhance the performance of MSW operational management system. The problem of inadequate budgets or low public participation could be eased by a good MSW management plan. Collection and transport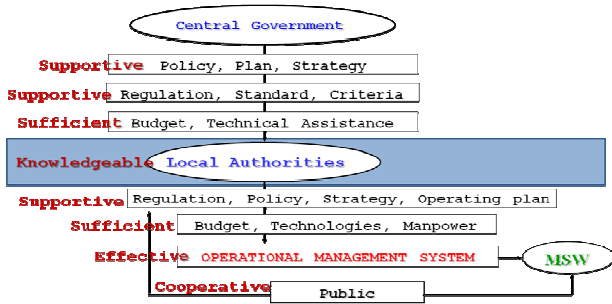ation cost, accounting for a half of the entire management cost, could be reduced while the efficiency increases if properly planed.

Evidences have clearly shown that the root cause of current inefficiencies is because local authorities are unable to prepare comprehensive management plan, which result in lacking sufficient capital and operating costs, appropriate infrastructure and equipment. Public participation is low. Therefore, improvement on MSW management planning of local authorities is crucial for improving MSW management in Thailand to achieve sustainable system.

However, this study has found that little attention has been paid to this aspect, comparing to other issues such as the improvement of management technologies, budget and public participation. The improvement of MSW management planning function of local authority is not addressed in the current national management policy. No study revealing factors that actually hinder these local authorities from preparing proper management plan has been carried out.

Therefore, the aim of this study is to identify the root causes – why local authorities in Thailand are now unable to prepare comprehensive MSW management plan. This knowledge is important for designing effective measures in the future in order to enhance the capabilities of local authorities in Thailand for planning effective MSW management system in their regions.

2. MSW MANAGEMENT PLANNING SYSTEM

In general, key steps are similar including Problem diagnosis and definition, Goal and objective setting, Strategy development, and Implementation as summarized in Figure 4.

The planning output is MSW management plans, which should contain all necessary information for implementation to effectively regulate the operational management system. MSW management plan should be prepared in three format including Strategy,

Project/Program plan, and Day-to-day operating plan or long-, medium-, and short-term plans respectively. These MSW management plans should be systematically related to each other to ensure the success of MSW operational management system.
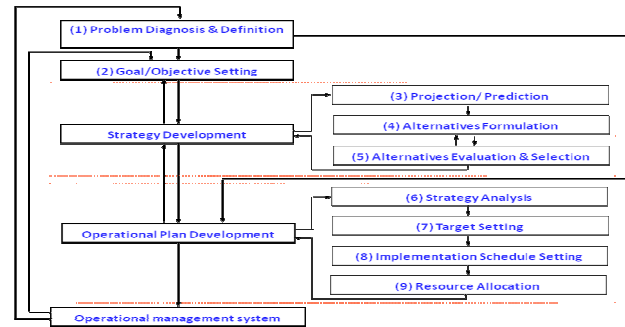
Fig. 4. MSW planning procedure.

Based experiences of various countries, each local authority needs the following components in their organization in order to carry out palnning procedure and produce proper planning output effectively. These are

(1) information management system

(2) decision support system

(3) planning management system

(4) planning staff

(5) planning facilities and

(6) organisation administrative structure

The relationship of these components to the performance of MSW planning is presented in Figure 5.
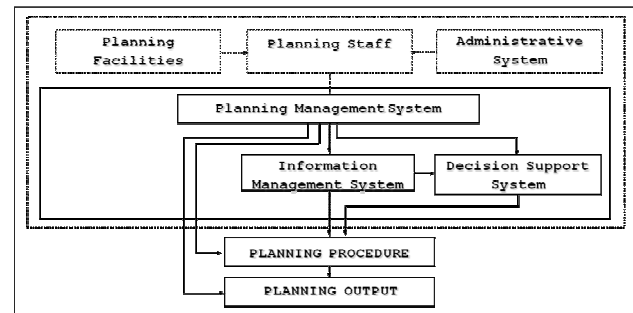
Fig. 5. The Structure of an effective MSW management planning system.

An information management system (IMS) is needed to ensure that all required information is collected on a regular basis, reliable, and properly handled and organised [4], [5]. Once information is obtained, the information management system manages and processes this information in a fashion that can be easily understood by all relevant personnel. Computer then becomes necessary when a large amount of data is collected.

The decision support system (DSS) is essential to help planning staff making all decisions based on scientific evidence, not perceptions. Intensive analysis needs to be carried out to cover all aspects of each alternative against

key criteria, including efficiency, economic, environmental impact, and social impact. Thus, the decision support system ensures that information on the performance of existing and proposed MSW operational management systems against each criterion is available before decison is made. The decision support system can include the use of computer-based analytical tools, which can handle large amounts of data and carry out complex calculations [6], [7].

The planning management system is needed to ensure the readiness of planning staff before initiating the process. In other words, the planning process must itself be planned and properly managed. The role of the planning management system includes identifying and inviting participants, scheduling meetings and establishing deadlines, and ensuring that necessary follow-up steps are taken [8].

This component ensures that all necessary activities are carried out in an orderly manner to achieve a comprehensive planning outcome. Preparation of the planning work plan is one of the means to control the planning process. The processes that will be performed over the planning period to develop the MSW management plan are documented and described in sufficient detail so that it is well understood by the planning staff and line personnel can cooperate with it readily.

Human resources are always the prime suspects of any problem in the MSW management planning system. Appropriately trained and experienced people are essential requirements, as MSW management planning process is complex [9], [10], [11]. These staff must be well capable of performing the given task. Despite the individual academic background, there is a need of system to ensure that planning staff is given clear instructions on the nature of their jobs and responsibilities to maximize their performance [9].

Planning supporting facilities should then be provided to planning staff particularly computer facility to store and analyse intensive information and to enhance their capability to handle the complexity. At present, various analytical tools have been developed to assist the local authority in evaluating the performance of alternative MSW operational management systems regarding financial and environmental aspects or selecting an optimal choice.

Another factor that affects the performance of planning staff is the administrative structure of the organisation. It reflects the working conditions required to maintain a stable and competent work force [12]. The administrative structure relates to the distribution of units, responsibilities and authority; management and organisational structures; interactions between departments; institutional capacities; and personnel administration [13].

3. STUDY METHODOLOGY

At present, local authorities in Thailand are mainly classified into four forms, based on the development of their responsible areas. In municipal areas, local authorities can be classed as Nakhon Municipality (NM)

– most developed area, Muang Municipality (MM), and Tambon Municipality (TM) while local authorities outside municipal areas are classed as Tambon Administrative Organisation (TAO).

Accordingly, management capability of each form is different. Local authorities in urban area or major cities tend to be higher capability than the ones on rural areas. Therefore, each form of local authorities should have different problem and then require different improvement methods for their planning function.

It is essential to know the root causes or problem characteristic of MSW planning function of each form. Proposed improvement can then provide ultimate impact. In doing so, the following steps are conducted in this case study.

1. develop an evaluation framework - Questionnaire is a method used to obtain answers
2. select local authorities to be studied
3. develop a questionnaire
4. send and collect the questionnaires
5. conduct a deep interview with selected local authorities based on the returned questionnaires
6. identify the root causes – why local authorities in Thailand are now unable to prepare MSW management plan

3.1. Studied Local Authorities

At present, there are 36 local authorities in the form of Nakhon Municipalities, 137 in the form of Muang Municipalities, 1,042 in the form of Tambon Municipalities, and 6,505 in the form of TAOs (DOLA 2003). However, of these 7,720 local authorities, this study focuses on local authorities in which MSW is a crucial problem for their areas are firstly targeted due to limited study timeframe. As the national goal is aiming at a generation rate of less than 1 kg/cap/day, any local authorities, which have a MSW generation rate higher than 1 kg/cap/day, are then considered to be in the critical stage and are the target of this study.

3.2. Evaluation Framework

According to the key for effective MSW planning presented in the last section, root causes of ineffective MSW planning are then assumed to relate to the weaknesses of these components. The questions used to obtain information on the performances of these components are summarized in Table 1.

Questionnaire is a method used to answer these questions. The first part collects the background information of the studied local authorities. The second part collects data on the performance of their MSW operational management system. The third part then asks for information on the performance of those key components.

Table 1. Assessment questions for the planning system

Component	Question
Information Management System	• What data/ information are available for planning activities? • Is the available data/ information conveniently retrieved and accessed by relevant staff? • Is the available information in the format that is ready to be used by relevant staff?
Decision Support Subsystem	• Is the detail of the performance of existing operational management system and the possible alternatives available? • What criteria are used to evaluate the possible alternatives? • What computer-based analytical tool is used in the process? • Is there any formal meeting in the division before making the decision? • Is there any public hearing before the final decision on strategy?
Planning Management System	• Is the detail of planning procedure, information management manner, decision making manner, and plan management manner documented? • Is the work plan addressing planning activities with corresponding staff available? • Is the available work plan conveniently retrieved and accessed?
Planning Staff	• How many staff are involved in the planning activities? • What are their professional backgrounds (e.g. engineering, science)? • Is there any training program for improving knowledge of corresponding staff? • Are they given a clear instruction for performing their task?
Planning Facilities	• Is there any budget available for running the planning activities, training corresponding staff, and acquiring planning facilities? • What facilities/materials are available for assisting corresponding staff using less time and improving their knowledge?
Administrative System	• What are other tasks they need to do besides regulating the operational management system? • Does the system allow carrying on the process until the completion?

4. RESULT

For the first phase, the questionnaire was sent to 337 local authorities, in which 137 of them returned the questionnaire, giving about 40% response rate. These include 11 Nakhon Municipalities (73%), 12 Muang Municipalities (37%), 79 Tambon Municipalities (45%), and 35 Tambon Administrative Organisations (32%).

4.1. Performance of Local Authorities

Planning output of all local authorities that returned the questionnaire are summarised in Table 2. Of these local authorities, 19 local authorities do not have any types of MSW management plans. That means 85% of studied local authorities have at least one type of MSW management plan although only 16% of them have all three types or only 4% have all types of management plans containing all necessary information for managing their MSW.

Table 2. Planning output of each form of local authorities

Planning Output	Form of Local Authority				
	Total (137)	NM (11)	MM (12)	TM (79)	TAO (35)
Group 1: None	19	0	0	11	8
Group 2: Only Day to day operating plan	36	1	3	21	11
Group 3: Only Project/program	28	2	1	19	6
Group 4: Only Strategy	6	1	1	3	1
Group 5: Day to day operating plan and Project/program,	23	3	2	14	4
Group 6: Project/program and Strategy	1	1	0	0	0
Group 7: Day to day operating plan and Strategy	3	0	1	2	0
Group 8: Day to day operating plan, Project/program, and Strategy	21	3	4	9	5
Group 9: Day to day operating plan, Project/program, and Strategy with all necessary information	5	0	2	2	1

The performance of each form of local authorities is further evaluated.

4.1.1. Tambon Administrative Organisation (TAO)

Planning output of studied TAOs is given in Figure 6.

Fig. 6 shows that MSW strategy or long term plan is not prepared in the majority of them (Group 1, 2, 3, 5,6,7). Moreover, about 25% does not any MSW management plan while the remaining have only operating plan or only program plan.
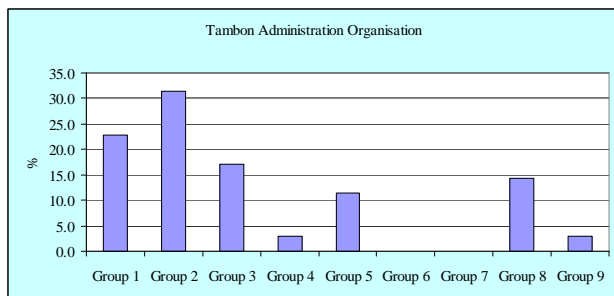
Fig. 6. Planning performance of Tambon Administration Organisations.

4.1.2. Tambon Municipality (TM)

Planning outputs of studied TMs is summarised in Figure 7. As can be seen, despite the similar distribution with TAOs, TMs has a slightly better performance. More has MSW management plans although these are only operating plan or only program plan.
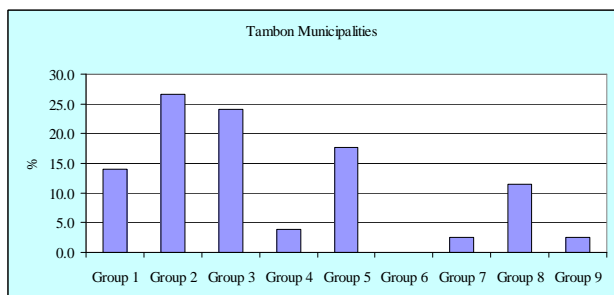

Fig. 7. Planning performance of Tambon Municipalities.

4.1.3. Muang Municipality (MM)

Planning output of studied MMs are given in Figure 8. It shows the different distribution of planning output from those TAOs and TMs. All MMs has at least one type of MSW management plan and more have two types. Half of them has prepared long term plan.
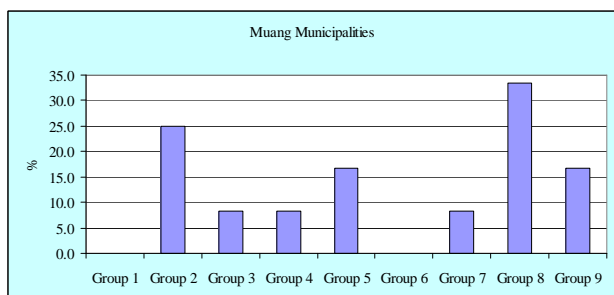
Fig. 8. Planning performance of Muang Municipalities.

4.1.4. Nakhon Municipality (NM)

Planning output of studied MMs are given in Figure 9. It illustrates that NMs have similar performance with MMs. All NMs has at least one type of MSW management plan and 50% has strategy. However, it is interesting that none of NMs have all three types of MSW management plans with all necessary information

(Group 9) when about 15% of MMs is in this group.
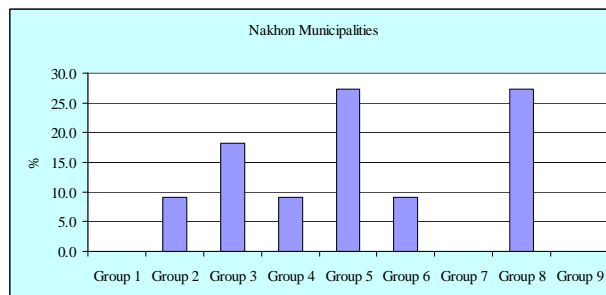
Fig. 9. Planning performance of Nakhon Municipalities.

In summary (Figure 10), Nakhon municipalities and Muang municipalities have a better performance than Tambon municipalities and Tambon Administration Organisations. As can be seen, none of studied NMs and MMs are in Group 1 or it means all NMs and MMs have at least one type of MSW management plan. Accordingly, more NMs and MMs have all three types of MSW management plans (Group 8).
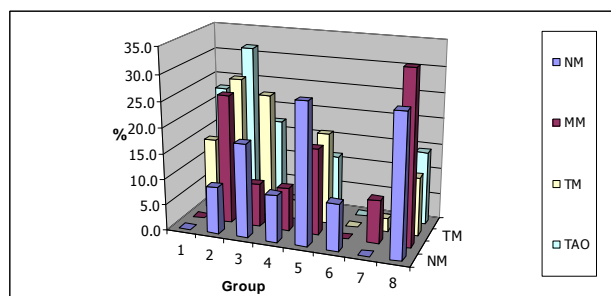
Fig. 10. Proportions of studied local authorites in each group of MSW management planning output.

However, regarding their status, local authorities in forms of Nakhon and Muang municipalities should have a better performance than at present. All should have strategy for managing their large amount of waste and handling complex problem.

4.2. Root Causes Analysis

This section aims to identify the causes of the drawbacks of MSW management planning systems of studied local authorities. Based on the objective of MSW management planning to prepare MSW management plan, the problem pattern can be divided into eight groups as follows.

- Group 1: none of the MSW management plans are prepared
- Group 2: only the day-to-day operating plan is prepared
- Group 3: only a project/program is prepared
- Group 4: only a strategy is prepared
- Group 5: only the day-to-day operating and a project/program plan are prepared
- Group 6: only a project/program plan and strategy are prepared

- Group 7: only Day to day operating plan and strategy are prepared, and

- Group 8: Day-to-day operating plan, project/program plan, and strategy are prepared but do not contain all the necessary information.

Planning systems in each group are analysed to identify its common characteristics. Reasons for different planning output are thus revealed. In doing so, six key components (Table 1) of each planning system are evaluated to define the performance level subject to the criteria given in Table 3, including Good (G), Fair (F), and Poor (P) performance. These criteria are developed according to the preferred conditions of each component presented in section 2.

Table 3. Criteria for performance level of each planning system components

Component	Performance Level		
	Good (G)	**Fair (F)**	**Poor (P)**
Information Management System	Necessary data are available, and properly stored	Some necessary data are available or available data are not properly stored	Few necessary data are available or available data are not properly stored
Decision Support System	Decision-making data is available, all criteria are used, and brainstorming and public hearings take place.	Either decision-making data is available or all criteria are used or brainstorming and public hearings take place.	Decision-making data is not available, all criteria are not used and brainstorming and public hearings do not take place.
Planning Management System	Workplan with all information for planning process are available and conveniently accessed	Workplan with some information for planning process are available or not conveniently accessed	Workplan with few information for planning process are available or not conveniently accessed
Planning Staff	More than one person are available	Only one person is available	Planning staff is not available
Planning Facilities	Planning budget, facilities, and training programs are available	Either planning budgets or facilities or training program are available	Planning budget, facilities, and training program are not available
Administrative system	Administrative system is considered supportive		Administrative system is considered unsupportive

4.2.1 MSW management planning systems that cannot produce any MSW management plans (Group 1)

There are 19 local authorities in this group. Only local authorities in the form of Tambon Municipalities and Tambon Administration Organisations, the lower level, are in this group. The collected data illustrates that planning staff are not available in these local authorities as well as planning facilities or planning workplan.

4.2.2. MSW management planning systems that produce one type of MSW management plan (Group 2, 3, 4)

Majority of studied local authorities is in this group (70 of 137 or 51%). These local authorities have planning staff and either planning facilities or planning management system in fair or good performance. However, other 2 or 3 components are still in poor performance.

4.2.3. MSW management planning systems that produce two types of MSW management plans (Group 5, 6, 7)

There are 27 local authorities in this group. Basically, the performance of planning staff, planning facilities, and planning management system is similar to those in Group 2,3,4 but their information management system and decision support system are slightly better.

4.2.4. MSW management planning systems that produce all types of MSW management plans (Group 8)

There are 21 local authorities in this group. Most components of their planning systems are in fair or good performance. Planning staff is available with planning facilities and workplan. Administrative structure supports planning process. However, for those that have strategy with all necessary information, consultant company is hired to develop such plan otherwise all supportive components are in good performance.

4.3. Summary

The collected data has shown that a lack of planning staff is a first barrier for local authorities in Thailand to prepare at least one type of MSW management plan. Lacking planning facilities and guidelines are then a key barrier to enhance planning capabilities of these planning staff. To achieve good planning output, ineffective information management system and decision support system are main hurdles.

However, the results shows that the majority of studied local authorities have planning staff but not having planning supportive components particularly planning facilities and planning guidelines or workplans. This is slightly different from the assumption before starting this study in which lacking planning staff is a main problem.

Therefore, the attention should be firstly given to the provision of planning facilities such as computer or planning manual. Planning software or computer program should be developed for them to enhance their planning capabilities. Consequently, the development of proper information management system and decision support system is needed to ensure good planning output.

The results also illustrates that many local authorities have potentials to achieve better MSW management

planning systems. None of the studied local authorities have all components in poor performance. A better planning output can be achieved if the existing resources are improvised. Thus, it is worth improving their existing MSW management planning system. However, the improvement should be designed for each case in its own right, as none of studied MSW management planning systems has the same problem characteristics.

5. PROPOSED SOLUTION

The survey clearly shows that large number of local authorities is unable to carry out comprehensive planning process. However, giving planning supporting tool could enhance their planning capability. At present, various MSW management supporting tools are available that could be used for the case of Thailand. However, most of these supporting tools are developed in developed countries. It may not be automatically transferable to developing countries [3], [14].

Differences in waste characteristics, problem priority, locally available resources and socioeconomic structure may need different analysis. Some issues are vital in developing countries but unimportant or less important in developed countries. For instance, scavengers are not widely considered as a solution of developed countries. However, scavenger should be part of the solution in developing countries as they play a significant role in the recycling business. Planning supporting tool specifically for local authorities in Thailand should be developed.

Regarding the current planning manner at local level, MSW operational management system proposed to implement often imitates the city which is reasonably successful. Comprehensive analysis to check whether the proposed system would work in their area is rarely conducted. In doing so, various cases have failed.

The application of proposed supporting tool for future study will be addressing this current nature. The proposed tool aims to quantify an overall performance of any single MSW operational management system proposed to implement in their responsible areas. No tool having such a application is available at present.

The tool will provide a number illustrating the level of long term suitability or sustainability – showing whether MSW management system intended to implement is suitable for its community. Efficiency, economic, environmental and social performances of proposed option is evaluated. Social aspect has considered the impacts on all stakeholders related to MSW management activities including public, scavengers, manufacturer, NGOs, and academics.

6. CONCLUSION

Low planning capability of local authorities is a key barrier for achieving effective MSW management in Thailand. Although various factors affecting the performance of planning activities, the attention should be given to the development of planning tool such as computer software to assist local staff in more systematically planning and designing their MSW management system.

Majority of studied local authorities have planning staff. However, the number is limit. As 60% of studied local authorities have computer, there is a high possibility of using planning supporting tool in these local authorities to improve their planning performance.

Regarding the current designing manner at local level in Thailand, where MSW operational management system proposed to implement often imitates the city which is reasonably successful, the application of supporting tool should be able to illustrating the level of suitability or sustainability of intended operational MSW management system to its community.

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Co-Composting Rubber Factory Waste with other Wastes for Reuse

T. Kaosol and S. Wandee

Abstract— *The objective of this study is to present the characteristics of the co-compost produced from rubber factory waste and the high nitrogen-containing materials for soil fertilizers. The experiments were performed as batch tests using an aerobic composting for detention time of 60 days [1]. Rubber factory waste constitutes valuable sources of organic matter with high C/N ratio, low moisture content (30-58%) and neutral pH (7.0-8.0). The most important parameter in composting for soil fertilizer is the C/N ratio. Many researchers reported that the optimum C/N ratio for general composting should be 25-35:1 [2]. Due to the high C/N ratio, the evaluated rubber factory waste compost alone was not appropriated to be used as a soil conditioner or fertilizer. In this study, other wastes and materials with high nitrogen content and high moisture content are composted with the rubber factory waste to improve the final product nutrient. The C/N – decomposition of organic matter is brought about by microbial that use the carbon as a source of energy and nitrogen for building cell structure. Microbial that uses the carbon as a source of energy and nitrogen for building cell structure are added in some reactors to study its impact on the decomposition process. Another factor affecting the successful application of compost for agriculture purpose is its degree of stability and maturity [3]. This results show that the co-composted material formed in all the reactors with brown to brownish black color and soil-like texture after the maturation period (60 days). The co-compost from the aerobic reactor provides good humus to build up a poor physical soil and some basic plant nutrients. This co-composted material has the N, P, K and Ca content as nutrient elements which is enough to permit it to be designated a fertilizer in the legal sense. The co-composting in this research proved to be an efficient, environmental – friendly alternative to solve the disposal problems of rubber factory waste and sewage sludge. Finally, the final co-compost can be promoted for fertilizer obtaining by mixing rubber factory waste with sewage sludge from municipal wastewater treatment plan, and water hyacinth.*

Keywords— **Co-composting, rubber waste, reuse, sewage waste, C/N ratio.**

1. INTRODUCTION

A typical rubber factory waste from Standard Thai Rubber (STR20) industry consists of leaves, branch of tree, soil, and stone which came from the rubber tapping process. Thus, it contained a high level of impurities. However, these rubber wastes cannot be discharged freely due to the legal waste management policy in Thailand. Usually, these rubber wastes were used for landfilling in the factory area. However, the amount of rubber factory waste continues to grow. This situation has urged the need to develop and study alternative sustainable waste management technologies such as composting. Composting is an acceptable alternative because it not only reduces the volume of rubber factory waste but also reuses waste for soil fertilizer and produces a residue that can be used for soil conditioning.

Composting is the biological degradation of organic materials under aerobic conditions, leading to the production of final products sufficiently stable for storage and land application without adverse environmental effects [3]. It is the simple and cost-effective technology and also an environmental-friendly technology to treat and recycle organic wastes. During composting, microorganisms break down organic matter in composting material into carbon dioxide, water, heat, and the final compost product. To ensure optimal conditions for microbial growth, carbon and nitrogen must be present in the proper balance in the mixture being composted. The ideal environment for composting consists of (1) the C:N ratio of the composting material between 25:1 and 35:1 [2], (2) the moisture content between 50% and 70%, (3) small particle sizes, (4) adequate oxygen supply, and (5) sufficient void space for air to flow through [4]. The most important parameter for composting is the C/N ratio. A lower C/N ratio can result in ammonia odor. A higher C/N ratio will not form optimal conditions for microbial growth causing degradation to occur at a slower rate and temperature to remain below levels required for pathogen destruction. Phosphorus, calcium and trace quantities of several other elements are all play a part in cell metabolism. The co-composting is required for getting better quality of compost.

The most important factors affecting the compost application for agricultural purposes are its degree of stability and maturity [3]. Since rubber factory waste is a primary source of carbon, it must be mixed with a higher nitrogen-containing material such as sewage sludge, cattle manure, green vegetable, urine, food waste, feces or municipal solids waste. Thus co-composting of rubber factory waste with the higher nitrogen-containing materials seems to be an attractive and viable treatment technology in which the resources in the wastes can be reused and the safe disposal is ensured. Although, many composting experiments were conducted to describe the effects and/or optimal environmental factors including

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temperature, aeration rates, moisture and nutrient contents [5,6]. The influence of the above parameters varies with the composting materials. Moreover, no study has been emphasized on the utilization of rubber factory waste for composting. The implementation of composting of rubber factory waste at the full-scale level has been limited because of the relatively high cost and some technical problems. Thus, this study is a pilot study to experience the idea. The experiments were set up in a batch reactor under aerobic composting condition. The aerobic composting is characterized by a rapid decomposition rate and release of a great deal of energy in the form of heat from the oxidation of organic carbon to carbon dioxide [2]. Additional, it creates no odor problem and the resulting high temperature should be quite effective in reducing the pathogenic potential of the waste material.

The present investigation is focusing to promoting the land application of compost obtained from rubber factory waste and high-containing organic wastes. In order to achieve the goal, the optimum ratio and moisture content of rubber factory waste and other waste are evaluated. Experiments were carried out in a batch reactor.

2. MATERIALS AND METHODS

2.1 Experimental raw materials

Five different materials are used in this study, including ruber factory waste, water hyacinth, dewatered sludge from municipal wastewater treatment plant, dewatered sludge from wastewater treatment plant of seafood factory, and cattle manure. The rubber factory waste was collected from a STR20 industry located at Patthalung city (Southern of Thailand). The dewatered sludges were obtained from Phuket municipal wastewater treatment plant (WWTP) at Phuket city (Southern of Thailand) and a seafood industry at Songkhla city (Southern of Thailand). Table 1 summarizes the physicochemical properties of the rubber factory wastes and other wastes. Note that the rubber factory waste has low moisture content (30-58%), high organic carbon (135 g/kg) and high C/N ratio (around 270:1). Water Hyacinth could be used to adjust the moisture content and C/N ratio of the composting mixture. While, the cattle manure could be used to improve the nitrogen content for the optimum C/N ratio.

2.2 Experimental setup

An aerobic reactor consists of a cylindrical vessel of 60 litres capacity and a mixer handle for turning the compost reactor. A lab-scale study is conducted using the rubber waste with other materials in a batch system. The schematic diagram of the experimental setup is shown in Fig. 1. The total of four reactors were used in these experiments. The initial mixture in each reactor is shown in Table 2.

The mix ratio of mixed wastes was selected based on the calculation of optimum C/N ratio. The reactors were loaded with mixed wastes. To homogenize the mixed waste, any large particle size waste will be cut to approximately 1.3-5 cm in length [2,7]. A fairly small

particle size reduces the depth of oxygen diffusion and microbial advance with the particle, aids the homogenizing of material [8]. Experiments were carried out in the batch reactor. The reactor was turned manually everyday to improve the bulk porosity for better aeration. Aerobic composting was carried out in four composting reactors for 60 days.

Table 1. Properties of characteristics of raw wastes for composting

Mate-rials	Moisture content (%)	pH	Organic carbon (g/kg)	Nitrogen (g/kg)	C/N Ratio
Rubber waste	30.0-58.0	7.0-8.0	135	0.50	270
Water hyacinth	90.0-93.5	5.6-6.1	37	2.11	17.5
De-watered sludge from seafood industry	60.5-65.2	7.0-7.5	5.6	0.99	5.6
De-watered sludge from Muni-cipal WWTP	77.0	7.0-8.0	6.4	0.90	7.1
Cattle manure	33.9	7.9-8.2	27.2	1.41	19.3
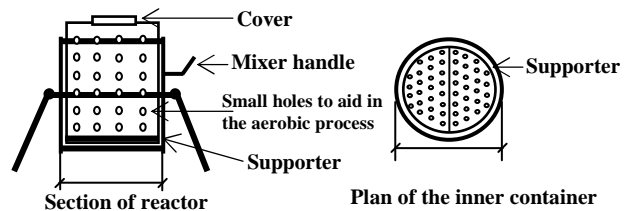
Fig.1. The aerobic compost reactor

Table 2. Prepared mixed wastes for composting

Reactor	Mixed Waste Components
1	50% rubber factory waste + 25% water hyacinth + 25% dewatered sludge from municipal wastewater treatment plant
2	25% rubber factory waste + 25% water hyacinth + 50% dewatered sludge from wastewater treatment plant of seafood factory
3	20% rubber factory waste + 40% cattle manure + 40% water hyacinth
4	50% rubber factory waste + 50% cattle manure

2.3 Performance measures

Characteristics of the mixed waste components were analyzed: moisture content, pH, nitrogen, temperature, TP, organic carbon, organic matter, E. *coli*, Ca, Mg and K before composting. During the composting, the samples were collected and analyzed again however the E. coli was not analized. The performance of the reactor was monitored every 4 days. The temperature was measured daily. The day 30, 45, and 60, the samples were analysed P, Ca, Mg and K.

The moisture content was determined at 105°C for 24 h in a hot-air oven [9]. The pH was measured by using a direct reading type pH meter with glass electrode and a calomel reference electrode. To analyze the organic carbon and organic matter, the Walkley and Black method was used. Ca, Mg and K were analyzed by ICP-OES. The nitrogen (digested), TP (digested), and E. *coli* were determined in accordance with Standard Methods [10].

3. RESULTS AND DISCUSSIONS

3.1 Mixed waste characteristics

The optimum moisture content of mixed waste is important for the microbial decomposition of the organic waste. Thus, the rubber factory waste alone produces inadequate quality compost due to low moisture, high carbon contents and high C/N ratio. The addition of rubber factory waste with high nitrogen organic wastes in composting is one of the promising ways to reduce C/N ratio and raise the moisture content of the end product. The moisture content between 50-70% is the most suitable for composting and should be maintain during the active bacterial reaction periods such as mesophilic and thermophilic growth.

Mixed wastes are created in order to reach the optimal C/N ratio and aid in achieving adequate aeration. Cattle manure is a natural organic waste with rich nitrogen, and is commonly added to other wastes to increase nitrogen content and to enrich the compost with active biomass. The initial physicochemical characteristics of the mixed wastes obtained before the composting are shown in Table 3.

3.2 Characteristics of the co-composts by different mixed wastes

Fig. 2 shows that daily temperature of each reactor during the 60-day experimental period. Note that the daily ambient temperature is also included in the figure. The temperature change during the composting has a profound effect on the efficiency of the composting process. At the starting of the composting process (day 1-4), the mesophilic bacteria contributed to the temperature rise. As the temperature increased higher than 35°C, thermophilic bacteria took over as the leading group of bacteria causing the temperature to decrease. In the final stage of the composting, mesophilic bacteria became active again. Usually, the compost obtained under thermophilic temperature is stable and pathogens free [11].

Table 3. Initial characteristics of mixed wastes for composting

| Parameter	Mixed wastes before Compost			
	Reactor 1	Reactor 2	Reactor 3	Reactor 4
Moisture (%)	66.3	65.8	58.8	42.1
pH	7.2	7.2	7.9	7.9
Organic carbon (g/kg)	69.2	77.0	109.4	92.0
Organic matter (g/kg)	119.3	132.7	240.0	210.3
Nitrogen (g/kg)	2.38	1.41	1.64	1.80
C/N Ratio	29.1	54.6	66.7	51.1
EC (mS/cm)	0.31	1.06	4.54	6.82
Nutrient elements (%)				
-Ca	2.51	0.71	0.49	1.48
-Mg	0.21	0.04	0.19	0.38
-K	0.16	0.12	0.87	1.32
-P	0.15	0.16	0.16	0.3
E.Coli (MPN/gm)	-	>1100	>1100	>1100
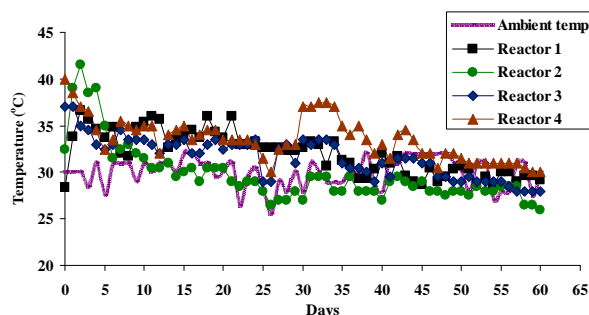
Fig.2. Variation of temperature in the mixed waste compost at various stages.

Fig 3 shows the moisture content in each reactor during the 60-day experimental period. Moisture content is an important factor to control because it influences the structural and thermal properties of the mixed wastes, as well as the rate of degradation and metabolic process of microorganisms. Composting was inhibited when the moisture content was less than 40%. On the other hand, the reactor 2 was turned into anaerobic condition at moisture content more than 70% due to the pH in the mixed wastes (rubber waste : water hyacinth : dewatered sludge from seafood industry) of the co-composting material (Fig. 3). The metabolic process of microbial is efficient when the moisture content was 40 – 60% [12]. The similar trends were observed in [13].

The pH is a parameter which greatly affects the composting process. The initial pH values of mixed wasted ranged from 7.2 to 7.9. The optimum pH values should be between 6 and 7.5 for bacterial []. During the starting period, the pH value rises to 8.3 in reactor 3 and 4. This result is due to the decomposition of proteins and the elimination of carbon dioxide. These high pH values are later reduced because the microorganisms produce

acids during the decomposition process. Typically, the pH value will first drops steadily meaning the composting material hydrolyzed very rapidly. Then the pH value will rise which show that the rate of aerobic biodegradation is faster than that of hydrolysis. After that, the pH value will not change until the end of the composting period [14].
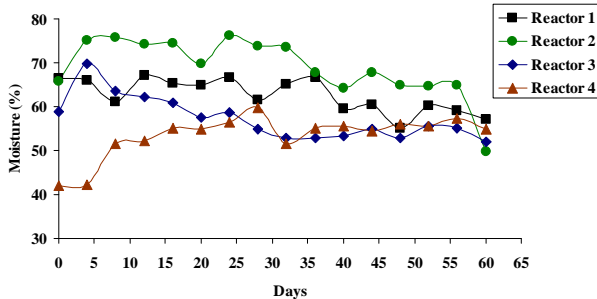

Fig.3.   Variation of moisture content (%) in the mixed waste compost at various stages.

Fig. 4 shows the pH of each reactor during the 60-day experimental period. At the beginning of composting, the pH slightly increased in the reactor 1 and 2, and decreased in the reactor 3 and 4 (Fig. 4). Nitrification in the reactor 4 may contribute to the lower pH values. After that, the pH tends to rise towards neutral again when these acids have been converted to carbon dioxide by microbial activity. In the final stage of the composting, the pH remains unchanged.
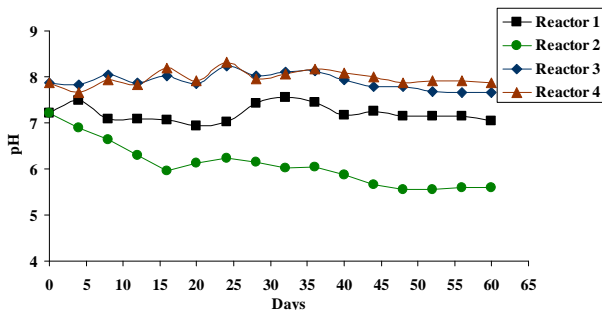

Fig.4.   Variation of pH in the mixed waste compost at various stages.

Fig. 5 shows the level of organic carbon in the mixed waste in each reactor during the 60-day experimental period. Carbon provides the preliminary energy source for the microorganism growth. Especially, bacteria, actinomycetes, and fungi need both carbon and nitrogen to grow. During composting, the organic carbon is converted into carbon dioxide and it is mainly influenced by the temperature [3].

Fig. 6 shows the level of organic matter in the mixed waste in each reactor during the 60-day experimental period. During composting process, the organic matter is decomposed by microorganisms, producing carbon dioxide and water. The breakdown of organic matter is a dynamic process achieved by microorganisms, when each group of microorganisms reaching its peak population at the optimum condition for microorganism activity. The evolution of organic matter in reactor 1, 2

and 4 was similar, they began with a rise until the 20th day, then a decline during the 35th – 45th day and a recovery at the end.

Fig. 7 shows the level of nitrogen in each reactor during the 60-day experimental period. Nitrogen is an important nutrient for composting process since the quantity of nitrogen determines the microorganism population growth. During composting, microbial activities decompose organic matter and transform complex nitrogen compounds into mineral forms such as NH_3, NH_4, and NO_3. Therefore, amount of nitrogen increases at the end of process.

Many research suggested that the composting will success when the initial C/N ratio of mixed wastes are range between 20 and 40 [2,14,15]. Fig. 8 shows the C/N ratio in each reactor during the 60-day experimental period. The C/N ratio may increase during composting period for mixed materials with a lower initial C/N ratio such as reactor 2, 3 and 4. The initial increase in C/N ratio happens when an alkaline pH combined with high temperature leads to volatilization of ammonia [16]. Such phenomenon may also happen when materials to be composted contain relatively large amounts of stable carbon compounds and easily decomposable nitrogen compounds [17].
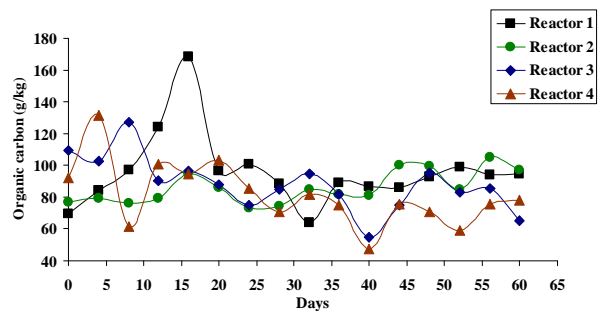

Fig.5.   Variation of organic carbon in the mixed waste compost at various stages.
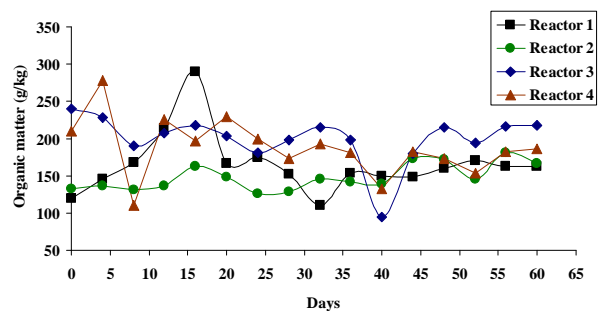

Fig.6.   Variation of organic matter in the mixed waste compost at various stages.
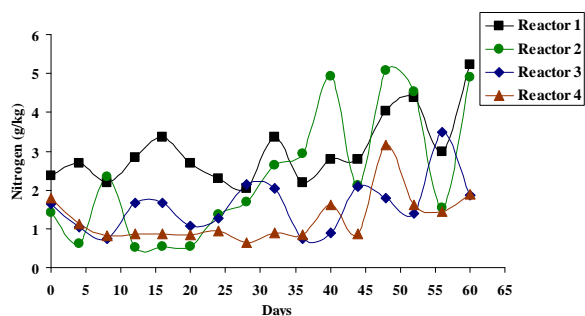
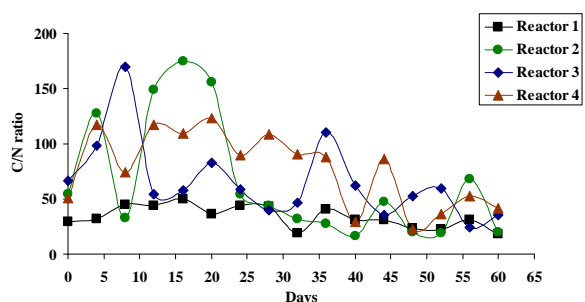**Fig.7. Variation of nitrogen in the mixed waste compost at various stages.**

Fig.8. Variation of C/N ratio in the mixed waste compost at various stages.

3.3 Stability and maturity of compost

The most important factor affecting the successful application of compost for agricultural purpose is its degree of stability and maturity [18]. Compost stability is strongly related to the decomposition rate of the organic matter, as expressed by the biological activity. Normally, there are many criteria to judge the stability and maturity of a composting process. The composted material should contain a low organic content that will not undergo further fermentation when discharged on land and the pathogens should be inactivated. Haug [2] reported the approaches to measure the degree of maturity compost to be (1) temperature declines at the end of composting; (2) decreasing in organic content as analyzed by carbon content; and (3) the C/N ratio, absence of obnoxious odor and presence of white or gray color due to the growth of actinomycetes. However, the temperature was clearly diminished to ambient temperature to about $30^{o}C$ after 35 days of composting and later remained stable that is indicated as a sign of composting stabilization [19]. Davidson et al. [20] report that composts with a C/N ratio of less than 20:1 are ideal for nursery plant production. Ratios above 30:1 may be toxic, causing plant death [21]. Le Minor [22] reported that E. *coli* is the most representative bacterium in the group of fecal coliforms.

Table 4 shows the characteristic of the final compost in each reactor. The composting in this study was marked by an important decrease in the number of E. *coli* (>1,100 to <3 MPN/gm). Note that the E. *coli* in Reactor 2 is still at 21 MPN/gm. During the composting, the moisture content in Reactor 2 is also higher than other reactors which may cause the delay in decreasing E. *coli* in this reactor. However, the E. *coli* of less than 1,000 MPN/gm can be used as a fertilizer [23].

Table 4. The characteristics of the final compost

Parameter	After Compost			
	Reactor 1	Reactor 2	Reactor 3	Reactor 4
Moisture (%)	57.2	49.7	52.1	54.9
pH	7.0	5.6	7.7	7.9
Organic carbon (g/kg)	94.5	97.0	65.4	78.3
Organic matter (g/kg)	162.9	167.2	217.3	186.8
Nitrogen (g/kg)	5.23	4.91	1.86	1.90
C/N Ratio	18.1	19.7	35.2	41.2
EC (mS/cm)	1.48	4.04	7.66	7.87
Nutrient elements(%)				
-Ca	2.04	2.65	1.66	3.06
-Mg	0.14	0.18	0.6	0.59
-K	0.56	0.66	1.97	1.62
-P	0.21	1.17	0.91	0.97
E.Coli (MPN/gm)	<3	21	<3	<3

Fig. 9 shows the C/N ratio during composting of each reactor. The final compost formed in all the reactors brown to brownish black color and soil-like texture after the maturation period. C/N – decomposition of organic matter is brought about by microorganisms that use the carbon as a source of energy and nitrogen for building cell structure. In the case of reactor 1 and 2, the C/N ratio indicated that it is optimum to be maturity in the composting process.

Fig. 10-13 show that the percent of phosphorus contents, potassium contents, calcium contents, and magnesium contents in each reactor, respectively. The increase in nutrients content (N, P, K and Ca) during the composting process may be caused by (i) the loss of organic fraction or volatile solids as carbon monoxide [24] and (ii) the respiration of microorganisms. From the results, the final co-composts had the N, P, K and Ca contents high enough to allow them to be denominated as a fertilizer as described in Table 5. Table 5 summarizes the level of many substances including organic matter carbon, nitrogen, phosphorus, potassium, and calcium in the typical final compost in the legal sense according to [25].
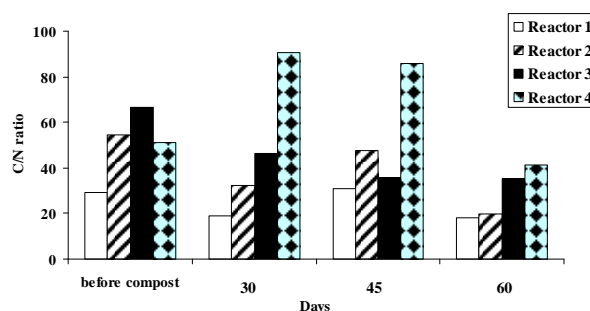

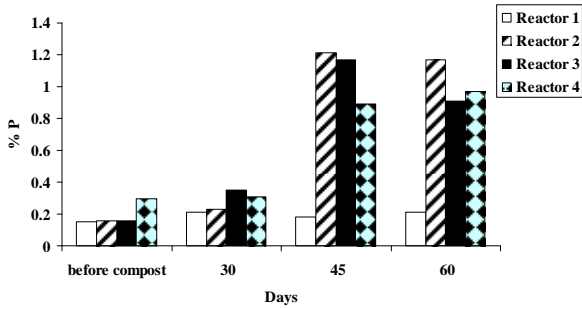**Fig.9. C/N ratio during composting**
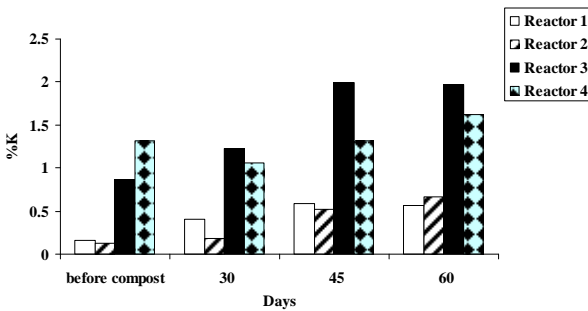
Fig.10. Phosphorus contents during composting
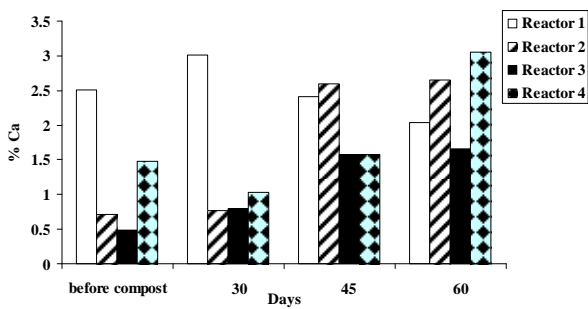

Fig.11. Potassium contents during composting

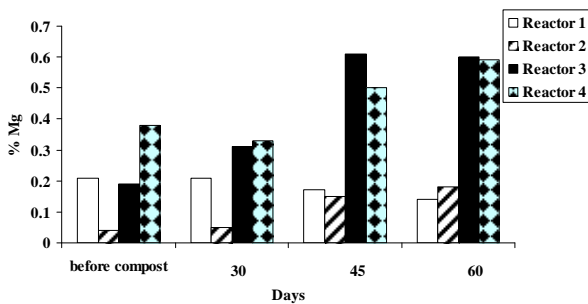**Fig.12. Calcium contents during composting**

Fig.13. Magnesium contents during composting

Table 5. The typical characteristics of compost [24]

Substances	Typical compost (% by weight)
Organic matter	25-50
Carbon	8-50
Nitrogen (as N)	0.4-3.5
Phosphorus (as P_2O_5)	0.3-3.5
Potassium (as K_2O)	0.5-1.8
Calcium (as CaO)	1.5-7

4. CONCLUSIONS

It can be concluded that the rubber factory waste contained high C/N ratio and low moisture content. The co-composting of rubber factory waste, sewage sludges, cattle manure, and water hyacinth increased the moisture and improved to suitable C/N ratio in mixed waste. The optimal mixed waste materials in the composting of the rubber factory waste with high nitrogen-containing materials in this study is the rubber factory waste, sewage sludge and water hyacinth (in reactor 1 and 2). The final compost obtained from rubber factory waste, sewage sludge and water hyacinth can be promoted to fertilizer for agriculture. The N, P, K and Ca content of the final compost is high enough to allow it to be denominated as a fertilizer in the legal sense.

The results in this study are promising because it indicates that composting can be an environmental-friendly sustainable alternative method to solve the disposal problems of two wastes (i.e., the rubber factory waste and sewage sludge).

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Community Oriented Low-Income Housing - 'Khuda-Ki-Basti', Kala Shah Kaku, Lahore – A Step Forward

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Abstract— *Incremental housing development popularly known as Khuda-Ki-Basti (KKB) in Pakistan was first tested in Hyderabad in 1986 that was replicated seven times within Pakistan having been accepted as a successful model solving urban poor's shelter problems. Housing facilities for low-income group in urban areas, particularly in the cosmopolitan cities, are next to nil while illegal land grabbers occupy thousands of acres of state land plundering the poor on count of low-cost housing schemes. Khuda-Ki-Basti, Kala Shah Kaku, Lahore Metropolitan Area, Pakistan (KKB4) is a step in the right direction at the right time to meet the low-income housing demand. KKB4 is found to be another success story efficiently providing housing facility to the target group without compromising its policies. A comparison of KKB4 with KKB1 suggests that it is not only a true replication rather it is running at a faster pace. This could further be improved with certain measures including capacity building of the available staff, provision of on-site transportation services and proper awareness. Efficient on-site transportation is a real challenge. KKB can be replicated in other parts of the country as well as accross the world opening up avenues for provision of shelter to many.*

1. INTRODUCTION

Housing and shelter is the 3rd most important necessity after food and clothing. In today's scenario the problem of housing is becoming acute in its nature, especially in the large cities, due to certain reasons. People, especially, the low-income groups, are left with no appropriate solution to their housing needs in the absence of any suitable housing program. With the passage of time, the problem becomes acute and worsens many other aspects of life along side. There is thus dire need to address the problem in its real sense to mitigate the adverse effects and consequences. To address the problem of low-income housing in the largest city of Punjab province in Pakistan, Khuda-Ki-Basti project is launched at the Kala Shah Kaku in Lahore Metropolitan Area; it is called KKB4. The project was initiated in line with a successful experiment in Hyderabad and the results here in this case are also bright as were in the case of past example in Hyderabad where the planners received even the most prestigious of its nature, Aga Khan Award of Architecture 1995 [1]. Since housing and shelter is one of the basic needs of all human beings, it needs to be catered for with due consideration. The housing backlog, especially for the low-income people suggests that specific measures should be taken in the right direction so that the low-income people also get a proper place to live. KKB4 is a step in the right direction, however proper implementation of the same needs to be well designed according to the local environment so that the replication of the project may get the fruit as it got in the

model set in Hyderabad and elsewhere in Sindh province. This paper tries to fulfill this need. Broad objective of the study is to evaluate KKB4 and devise a practicable and efficient mechanism for the effective implementation of the project; whereas specific objectives include: to study the existing situation of KKB4; to evaluate the impact of KKB4 through a study of satisfaction level; to suggest measures for making KKB4 a working project; and to suggest a viable replication system of KKB in other cities of Pakistan and elsewhere in the World. Research methodology can be briefed as starting from the stage of literature review and identification of problem in its real sense, the research followed the sequence of conducting preliminary research, preparation of questionnaires to collect relevant information from the prospective end-users, filling up the questionnaire and eventually analysis of data. Being the research related to the town planning and social research discipline, the experimentation is definitely the field investigation that included the interviews with officials undertaking the planning and implementation of the project and use of questionnaires while meeting the present dwellers of the project. That further led to analysis of data on the basis of which recommendations were made. Since the research mainly deals with the actual field fact findings, the theoretical context of the endeavor broadly pertained to the literature review regarding the past similar examples, the existing project and on the possible suggestive works in this regard. The research findings included reasons why people are not much inclined towards the project, unawareness of the target group about the project, location problems regarding the project, procedural misunderstandings and miscommunication, discovering possible steps those might attract the prospective dwellers to move to the KK4 area. On the basis of the afore-mentioned expected results an analysis was made that eventually lead to

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appropriate solutions in this context. Three Point Likert Scale was used for analysing the satisfaction level of the dwellers. Since housing is one of the burning issues of today and mostly people are stuck-up in finding out appropriate solutions but all different methodologies and techniques applied so far are unable to answer the problem adequately, it is expected that the results of this research will go a long way in finding the appropriate solution to this aspect. Thus the results can be utilized elsewhere also in the similar situations.

2. LOW-INCOME HOUSING ISSUES

'Almost everywhere in the world squatter settlements tend to be located in the areas of second choice, e.g. in riverbeds, and at the periphery of the cities' [2]. Squatter settlements mainly develop at the periphery of a city, that is to say, at those places where land values are low. However, because of the urban growth, these settlements initially located at the urban fringe, gradually become a part of the city itself. As a result of its growing potential for utilization in the production process, the value of the land rises. The more the squatter settlements are incorporated in the city, the more they start to obstruct the optimal functioning of the large-scale production process. Since the land cannot be utilized for other productive purposes like the construction of offices, hotels and apartment buildings or the construction of roads, which although in themselves not productive, are a necessary prerequisite for the satisfactory functioning of the production process [3]. KMC [4] mentions necessity for people's participation in any katchi abadi regularization and improvement programme as one of the vital lessons it has learnt from recent experiences. High infant mortality rates and widespread disease are characteristics of people with bad living conditions throughout the world [5]. Yap [6] rightly says that execution of the policy would require continuous and careful monitoring.

3. NATION WIDE LOW-INCOME HOUSING DILEMMA

'[H]ouse is a building for human habitation'[7]. Housing is shaping up as a problem also, now a days, as far as its provision is concerned, especially for the low-income poor in the urban settlements. In the economic perspective, problems related with housing are stratified for various income levels where people have to make choices out of the available commodities and services according to the sources of income they access to as well as the ideas they have got for things in their perspectives [8]. In a more general sense, housing is the layout and development of residential units in which people can live in an amiable manner due to congenial atmosphere around them. How much can people pay for housing? How much the authorities should be expected to pay? What priority does each of us attach to housing costs, tenure, dwelling type and size, location and so on? These are some personal questions but of central concern to policy-makers [9]. Housing or shelter is one of the basic human needs whose importance in improving the quality

of human life cannot be ignored [10]. According to Zaman and Ara [11], about 33% of the total population of Pakistan is presently living in urban areas. Housing and construction has been categorized as a priority industry eligible for prescribed concessions under this category [12]. In Pakistan total number of housing units is 19.3 million throughout the country; out of which 67.7% housing is in rural and 32.3% in urban areas; 39% of the total housing stock are kuchha houses, 40% semi-pukka and 21% pukka. The housing backlog of 4.3 million units is increasing by another 270,000 units annually as only 300,000 units are added annually to the stock against a demand of 570,000 units annually. To make up the shortfall 500,000 housing units need to be built annually for the next 20 years [13]. Zaidi [14] classifies housing problems as two broad categories: quantitative and qualitative. National Housing Policies (1992 and 2001) set yardsticks. The objective of the 2nd National Housing Policy was to create affordability, especially for the middle and low income people, through the use of different instruments like free land, cross-subsidy and concessionary finance, etc.

According to the 1987 satellite image, 37 per cent of the population of Karachi lived in squatter settlements; 34 per cent in semi-permanent high density housing; 7 per cent in semi-permanent houses on small plots in planned areas; 13 per cent in permanent houses on medium size plots in planned areas; 6 per cent in large bungalows and 3 per cent in apartments [15]. Katchi Abadis have been another interesting aspect in the low-income housing scenario in Karachi. The table hereafter gives a bird's eye view of the same:

	'70s (1978) (10^6)	'80 (1985) (10^6)	Most Recent (1988) (10^6)	'2000 (Projection) (10^3)
Katchi abadi Population	2	2.6	3.4	7.07
No.of Katchi abadi Households	0.227	0.356	0.465	0.96

Source: Hasan et al [16]

Lahore being an important urban center from many aspects and having a rich historical background attracts population from various parts of the country as well as the rural vicinity of its own. Development of Lahore is influenced by the changes at the federal level [17]. The quantitative and the qualitative problems are but natural to emerge in such a situation. The quantitative problems demand more dwellings to appear to cater for the needs of the homeless residents along with making room for the immigrants and the qualitative problems demand the planners to make arrangements for the up-gradation of the present stock of houses as well as the vicinity on the whole. Appearance of slums and squatter settlements is just natural for the people who have inadequate resources at their disposal. This is an area where planners need to make most of their efforts - only then the silver lining may be seen.

4. KHUDA-KI-BASTI (KKB): THE NEW CONCEPT

Hyderabad Development Authority (HDA) initiated this scheme in 1986 with its Director Town Planning as the main actor. KKB is a new experiment in low-income housing where people progressively constructed their houses on self-help basis. KKB clearly establishes the concept of incremental development of housing and the services in an affordable cost-effective manner. KKB encourages the people to undertake immediate construction of houses and then develop other infrastructure on an incremental basis: this is an important distinguishing element of the project [18]. People – Land – Housing -- Infrastructure was the approach. Given security of tenure, the families build their houses and provide infrastructure incrementally, as resources become available. The incremental development scheme is entirely self-financing. Materials are available locally. Each group of four houses is served by a septic tank linked to a pumping station. Over 70 percent of the houses have individual water connections, and the rest collect water from conveniently located taps. Electricity is also supplied to the area. Residents apply for individual house connections to all utility services after they have paid the charges; monthly installments eventually repay the actual cost. KKB is also provided with education and health facilities as well as affordable transportation services. This successful effort to create affordable housing for the urban poor is a model that can be widely applied everywhere. 20 District Management Group (DMG) probationers paid a three-days visit to Karachi and stayed in KKB3 to study how the acute problem of housing for the low-income people can be resolved [19]. The sequence of development is that the poor allottees were given land at the price they could afford on minimal monthly installments and civic facilities developed after their accommodation. The land ownership rights instill confidence in them to start developing their own locality. On the other hand, communities residing in illegal housing societies do not develop a sense of ownership and development on self-help basis does not materialize. NGOs had given a role model to the government. This was how the government had initiated a low-cost housing project Sasti Basti on the pattern of KKB. This basti had schools, a mobile dispensary, basic health unit, hospital, ambulance service, 11 private clinics, two maternity homes, a library, community center, vocational training center for women, eight parks, mosques, a church and an Imam Bargah. The probationers were also told that as a government servant, they would find ample opportunity to develop an understanding about real issues so the visit will benefit them to understand district management issues. The DMG probationary officers who included six women were divided into three groups to give them an opportunity to share their observations about the settlement. They said that their visit helped them understand the issues of poor people at the grassroots level.

5. 'KHUDA-KI-BASTI', KALA SHAH KAKU, LAHORE METROPOLITAN AREA (KKB4): THE EXISTING PROFILE

According to the introductory board displayed outside the site office incremental housing development scheme (Khuda-Ki-Basti 4) is meant exclusively for the destitute homeless families. All the available plots will be allotted to the destitute applicants on first come first served basis after completion of the necessary official proceedings.
KKB4 is located 0.5 kilometer off the Grand Trunk (G.T.) Road on the southern side of the G. T. Road, near Kala Shah Kaku industrial area. The site is 14 kilometers from Yadgar Chowk and 7 kilometers from Shahdara. The location is not far away for the residences of workers in Lahore. The location is well elaborated in the site plan given hereunder:

LOCATION PLAN
SCALE · 1"=1,000'-0"
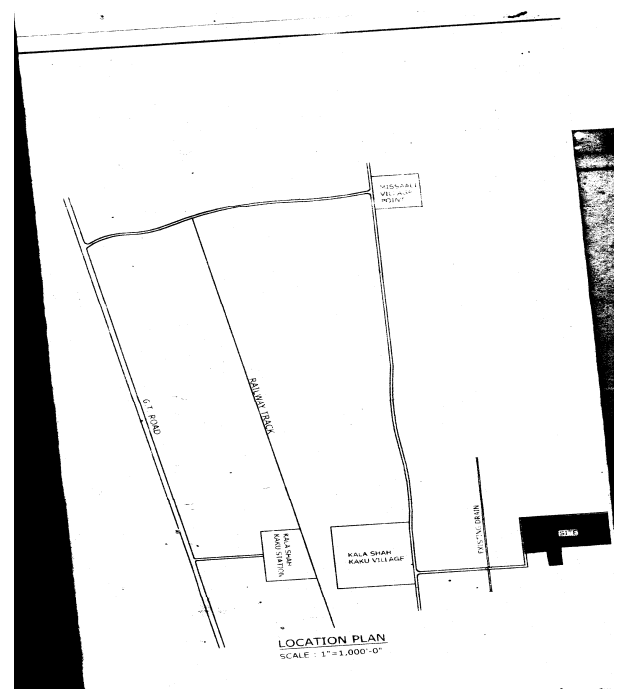
The scheme is stretched over an area of 191.52 kanals. Generally the plot size is 24'*34' with exceptional off sizing where the location so demanded. Total number of plots is 460 in the scheme. With average household size of 6, the scheme is supposed to house 2,760 persons in the scheme. A further detail of the land-uses is as hereunder:

Sr. No.	Land-Use	Area	Percentage
1	Residential	90.11	47.05
2	Open Spaces	16.17	8.44
3	Commercial	3.18	1.66
4	Public Buildings	7.64	3.99
5	Graveyards	3.84	2.01
6	Roads	70.58	36.85
Total		191.52	100.00

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Sr. No.	Category	Satisfied	Dissatisfied	Indifferent
1	Regarding House Ownership	100%	0	0
2	Location of Site	25%	50%	25%
3	Transport Provision at Site	0	92%	8%
4	Arranging Self-Help Activities' Support	92%	0	8%
5	Community Organization's Attitude	83%	0	17%
6	Awareness and Advertisement Scheme	8%	67%	25%
Total	(Adjusted for all 6)	51.34%	34.83%	13.83%

Source: Field survey 2007
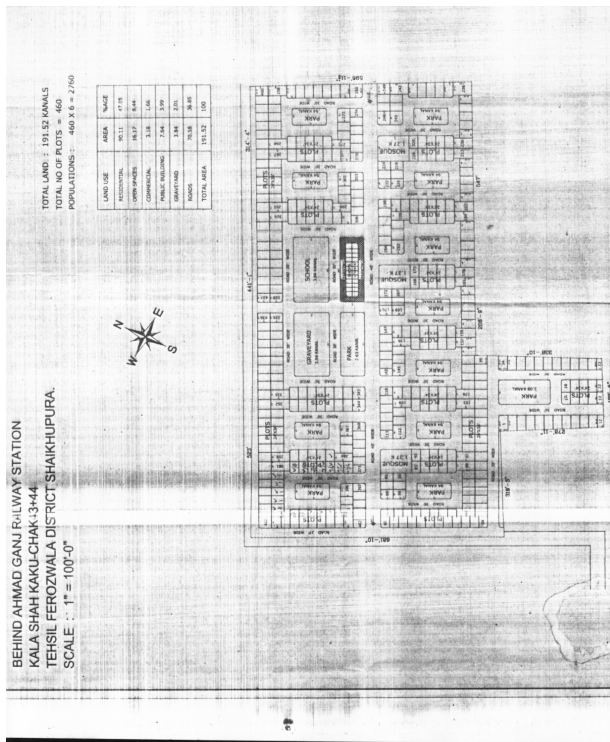
A successful applicant pays non-refundable twenty thousand rupees at the preliminary approval of the application followed by another non-refundable twenty thousand rupees on plot acquisition. Remaining payment is made in forty equal monthly installments of one thousand rupees each. The administration has also provided the facility of built houses in collaboration with the House Building Finance Corporation (HBFC). In which case seventy-five thousnd rupees is the down payment followed by monthly installments up to twenty years. Gas connection charges are not included in the price of the plot. Every allottee will have to pay Rs. 200 as maintenance charges for water supply and sewage and cleanliness etc.

The prospective applicant comes to the reception area along with his family and the household belongings. Here the Saiban staff provides them temporary shelter after verifying the household and household belongings. Here the staff issues them the application form as well. Saiban staff issues the second challan form after verifying the continuous presence of the family at the reception camp. Field officer issues a provisional allotment letter in the name of the allottee after receiving the bank receipt and approval from the allotment committee. This is a proof of provisional ownership of the plot on which the allottee has to ensure the family presence. Field officer hands over the plot acquisition to the allottee for house construction without any delay. Allotment is provisional for the initial five years. The allottee has to ensure his presence on the plot for five years in order to be given permanent ownership and transfer. After five years the plot ownership will be transferred in the name of the applicant if s/he fulfills all the terms and conditions.

Composite index of satisfaction is as hereafter:

6. EVALUATION OF 'KHUDA-KI-BASTI', KALA SHAH KAKU, LAHORE METROPOLITAN AREA

1. KKB4 was established in the second half of 2006. Till July 2007 it was observed that 31 plots had got houses built on them, out of which 5 provided temporary housing to the newcomers until they built their own house; and for another 26 scrutiny had been done and the families were about to make the first payment after which they will built house within a month. So by the month of August 2007, 57 houses would be there on the site housing families in them: this is a wonderful achievement out of 460 plots!

Sr. No.	Category	Frequency	Percentage
1	Plots housing families	57	12.4
2	Plots awaiting Families	403	87.6
Total		460	100

Source: Field Survey 2007

It is observed that the enforcement mechanism is in place. For instance, according to clauses 2 and 3 of 'Terms and Conditions':

Sr. No.	Category	Satis- fied	Dissa- tisfied	Indif- ferent
1	Regarding House Ownership	100%	0	0
2	Location of Site	25%	50%	25%
3	Transport Provision at Site	0	92%	8%
4	Arranging Self-Help Activities' Support	92%	0	8%
5	Community Organization's Attitude	83%	0	17%
6	Awareness and Advertisement Scheme	8%	67%	25%
Total	(Adjusted for all 6)	51.34 %	34.83 %	13.83%

2. Ensuring continuous presence on the plot will be must to get permanent allotment. The allotment will be deemed cancelled automatically in case of a continuous absence of 3 months from the plot without any reason. The building erect on the plot along with all the payments made so far will be held by the organization and the allotment will be made to some other applicant.

3. If an allottee is found defaulter for three continuous monthly installments, his plot will be allotted to another applicant after serving him a notice for fifteen days.

It practically happened in case of plot number 392 that was cancelled from the first allottee and is presently with Mr. Naveed.

In response to the question put regarding knowledge about KKB4, 100 per cent response was that friends/relatives informed about it. Regarding movement to KKB4, 50% response was about 2 months before, 33% respondents told that they moved in 4 months before whereas 17% respondents moved in 1 month before the survey. About the work place, two thirds of the respondents told that they worked in northern Lahore whereas half of the remaining worked in inner Lahore and within KKB4 equally. 83% respondents commuted to work by bus whereas the remaining got to work at their own; they later-mentioned were actually those who worked within KKB4. 41 % of the respondents had their relatives' abode in Lahore, 25% had their relatives living in different other parts of Punjab province, 17% respondents had their relatives living in northern Lahore/Kala Shah Kaku and the remaining 17% had their relatives living in other provinces. Household size was reported to be 3 to 4 members for 58% respondents. 25% households had a size of above 4 whereas 17% households had a size of up to 2 members. Monthly

household income was reported to be between Rs. 5001 and Rs. 7000 in case of 50% households. 42% households earned up to Rs. 5000 per month whereas only 8% households earned above Rs. 7000 per month. Interestingly spending on traveling was found to be a major head where 50% respondents spent more than Rs. 1000 per month on traveling. 33% respondents spent between Rs. 501 and Rs. 1000 monthly on household traveling whereas the figure was up to Rs. 500 per month for 17% respondent households. Previous living was reported to be in the inner Lahore for two thirds of the respondents. 17% respondents lived in the northern Lahore previously. Out of the remaining 8% each lived in different other cities of the province and other provinces.

Regarding house ownership, 100% of the respondents were satisfied. Location of site was dissatisfactory for half of the respondents whereas out of the remaining half, half were satisfied and the other half were indifferent about the location. 92% respondents demanded transport provision at the site whereas 8% were indifferent about the issue. 92% respondents were satisfied about the community organization's arrangements for self-help activities' support whereas 8% were just indifferent about it. 83% response was satisfactory regarding community organization's attitude whereas 17% was indifferent. Awareness and advertisement scheme for the project was dissatisfactory according to two thirds of the respondents where as one fourth of the respondents were indifferent about it; only 8% respondents deemed it to be satisfactory.

The following suggestions came forward by the respondents for improvement of KKB4:

Sr. No.	Category	Percentage
1	Road Construction	9
2	School starting	6
3	Public Transport	24
4	Kitchen Construction	16
5	Shops starting	23
6	Mosque construction	13
7	Graveyard marking	9
Total		100

Source: Field Survey 2007

7. A COMPARISON WITH KHUDA-KI-BASTI HYDERABAD

A very interesting picture comes forward when we compare the 'Khuda-Ki-Basti', Kala Shah Kaku, Lahore Metropolitan Area (KKB4) with the very first Khuda-Ki-Basti Hyderabad (KKB1):

Sr	KKB1	KKB4
1	KKB1 started in 1986	KKB4 started in the later half of 2006
2	KKB1 was a part of	KKB4 is an independent

	the 5,500 acres Gulshan-e-Shahbaz	scheme on 191.52 kanals
3	KKB1 houses almost 2,800 families	KKB4 is planned for 460 families
4	KKB1 offered a plot of 80 square yards (720 square feet) plot to a family	KKB4 offers 816 square feet plot to a family
5	In KKB1 water was supplied through water tankers	In KKB4 ground water is available for every house; however, for better quality drinking water, there is a plan to drill down and supply households through pipelines soon
6	At KKB1 the in-coming families are provided with reception area where they can stay up to 6 weeks until their own house is ready for living	At KKB4 also the in-coming families are provided with reception area where they can stay up to 6 weeks until their own house is ready for living.
7	At KKB1 prospective resident had to pay Rs. 1,000 that covered the full cost of the plot	At KKB4 the prospective resident pays Rs. 20,000 at the start and another Rs. 60,000 subsequently to cover the full cost of plot as Rs. 80,000 in all
8	In KKB1 a plot is repossessed if found unoccupied	In KKB4 also a plot is repossessed if found unoccupied
9	In KKB1 location is a disadvantage; it is located at about half an hour distance by public transport from the nearest big city	In KKB4 also location is a disadvantage; this is also located at about half an hour distance by public transport from the nearest big city

10	KKB1 has the advantage of being close to the nearby industrial area wherefrom the residents can earn their daily wages	KKB4 also has the advantage of being close to the nearby industrial area wherefrom the residents can earn their daily wages
11	The residents are experienced to spend a substantial budget on transportation for one reason or the other	The residents are experienced to spend a substantial budget on transportation for one reason or the other
12	About 18,000 persons live in KKB1 (@over 6 persons per household)	2,760 is the target population for KKB4 (@ 6 persons per household)
13	Some 2,500 families (84.7% of total) settled in KKB1 during the first three years after its establishment and 2,800 families had settled within 8 years	57 houses (12.4 % of total) serve the families in KKB4 in less than a year of its establishment
14	The resident families fall in the income bracket of Rs 500-1,500 ($25-75 then) in KKB1	The resident families fall in the income bracket of Rs. 3,000 –10,000 ($50-160) in KKB4
15	A strong community organization and community spirit is found in KKB1	A strong community organization and community spirit is found also in KKB4
16	KKB1is financially viable	KKB4 is also financially viable
17	Over 35% of the inhabitants obtained their plots from actors other than HDA in KKB1	All the inhabitants are to obtain their plots through non-governmental agency in KKB4
18	A vast majority of the inhabitants supports	A vast majority of the inhabitants also supports

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	cancellation of vacant plots/houses in KKB1	cancellation of vacant plots/houses in KKB4
19	No rural urban migration has been experienced in KKB1; that is a positive aspect	No rural urban migration has been experienced in either KKB4; that is again a positive aspect
20	Land open to the sky is found in KKB1 more than the requirement; in the form of open spaces as well as roads/streets; this is perhaps due to the reason that the scheme had to be within the available standards; however, a better utilization of the land was possible with more planning expertise	Land open to the sky is found in KKB4 also more than the requirement; in the form of open spaces as well as roads/streets; this is perhaps due to the reason that the schemes had to be within the available standards; however, a better utilization of the land was possible with more planning expertise
21	Smaller building blocks and semipublic spaces have enhanced the community cohesion	In KKB4 also smaller building blocks and semipublic spaces have enhanced the community cohesion
22	KKB1 was initiated by HDA and was handed over to an NGO Saiban	KKB4 was solely initiated and run by Saiban
23	KKB1 was followed by seven similar replications throughout the country	Whereas KKB4 is itself a replication of KKB1 although it is also followed by some 3 more replications after its inception
24	KKB1 was provided at the public land	Whereas the KKB4 is developed on the land purchased

		from private owners
25	After 8 years of inception it was found that at KKB1: 5 doctors provided health services. A permanent health care unit of Family Planning Association of Pakistan operated. Private buses plied every 30 minutes. 110 shops served the daily needs of the inhabitants. More than 247 carpet-looms provided jobs to at least 600 persons. Residents collected and spent some 5 million rupees in water supply, sewerage and electrification. All allottees occupied their plots, built houses and resided. Loans ranging between Rs. 2,500-25,000 were disbursed without any collateral for family enterprises.	Whereas it is too early for these aspects to appear in KKB4 (all of these are, however, expected and awaited here too at a proper stage)

In the light of the afore-mentioned points, it seems quite justified to say that KKB4 is a true replication of the KKB1 and is on the right track to reap the benefits in due course of time.

8. CONCLUSION

Concluding, unanimously all the resident families responded that they were feeling happy due to a feeling of ownership. On a composite index of satisfaction, 51.34% of the overall response was about satisfaction. Literature and records are not readily available for the public or research use regarding Lahore due to many reasons, so a true picture could hardly be obtained in our particular endeavor. 83 % of the residents commuted to their work places by bus. Provision of public transport at the site and shopping facilities were the most demanded suggestions by the residents. Two-thirds of the residents

had moved from inner parts of Lahore to KKB4 whereas some had moved from different other cities and even other provinces. 50% of the residents earned between Rs. 5000 and Rs. 7000 per month whereas 42% earned less than Rs. 5,000. Expense on traveling was a common element for all the residents. 58% of the residents were 3-4 member families. The site is remote for most of the target group that is why they are reluctant to get there. Awareness campaign about the project is very weak that has resulted in a situation where people hardly know about it. The staff appointed by the executing agency, Saiban, is neither adequate in number nor is well trained on the requirements of the project. Similarly, some responsible staff members who could really make the project a success are over-burdened by some other responsibilities on them other than the project. As reported, some new sites have been allocated in Mian Channu and Islamabad for similar replications and proceedings for procurement of land in Haripur are on as well [20]. Mian Channu will be another replication within the province whereas Haripur will open up avenues of replication in another province i.e. NWFP.

KKB1 demanded people to reside there for long to retain their ownership whereas KKB4 demands the residents to ensure their residence at the allotted plot for 5 years; both limits seem to be unrealistic. An in-between duration of 30 years is recommended that is normally the active working life for a generation. Micro-finance activities should also be started at KKB4 as were done in KKB1 or some other replications of the same. It will on one hand enhance interest of the resident families and the on-coming families and on the other hand will help the members contribute towards family expenses. The Saiban staff appointed for the project should include some personnel who have already worked on some previous KKB project so that in the light of their experience over other places, they may replicate the present project in real sense. When going for replication, a proper consideration be given to the aspect that on one hand it is utmost important to appoint staff which has already gone through the endeavor elsewhere and on the other hand some local staff should also be engaged that is aware of the local needs as well as the appropriate ways to meet those needs in accordance with the local customs and traditions. Collective house building approach that was practiced in Building Together Project of Thailand may also go a long way where people build houses together and through balloting they are allotted one of the 10 houses built by their collective labour. However, in spite of blocks, bricks are a viable solution in KKB4 case due to atmospheric conditions.

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Regional Integration in the GMSR, Changing Competitive Advantage and Its Impact on Labour Markets and Society: Evidence from Chiang Rai Province, Thailand

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Abstract— *As regional integration within the Greater Mekong Subregion (GMSR) intensifies, the location of competitive advantage will inevitably change and this will have considerable impact upon the locations in which economic activities take place and upon the type of work that will take place in the region. Some production activities will be required to move to respond to the comparative advantages (climate, natural resources and manpower, for example) while others will cease altogether. Inevitably, winners and losers will be created by these forms of creative destruction. The role of government will be to protect those who are vulnerable to these changes, particularly workers who find it difficult to respond to the changing circumstances. Using in depth interviews and secondary data collected from across the region, this paper investigates which types of industry will be required to move and which industries are likely to collapse. The focus is upon the Chiang Rai province of northern Thailand but the analysis also covers the wider GMSR as a whole. The implications of the changes for local labour markets are observed and recommendations made for modifying labour market policies with a view to dealing with expected future changes in additional to unpredicted external shocks.*

1. INTRODUCTION

In common with other developing countries, Thailand has taken the steps that will lead it from being a predominantly agricultural economy to one in which manufacturing, services and knowledge predominates. The capital city of Bangkok has been in the forefront of these changes, while regions outside the centre have continued to be left behind. That there have been two, dual tracks of development has had many effects on outlying regions and has had powerful implications in terms of political and social development in the country. Since 2001, with interruptions, the Thai government has sought to reduce the inequalities in development that have occurred. Regional integration, spurred by transnational institutions such as the Asian Development Bank (ADB), has provided new tools by which inequalities might be considered and problems tackled. A problem, from government's point of view, is that the power to use these tools must be shared with transnational institutions and market-based partners, not to mention the inefficiencies that have bedeviled Thai government actions for as long as they have been reported. All actors have their own agendas and the results of actions in a complex environment are rarely predictable with any accuracy. Consequently, it is not clear that changes now taking place will improve conditions along the lines desired by government agencies or, indeed, will benefit specific geographical areas at all. It is not clear, as will be described below, that linking areas with wider networks of production and exchange will necessarily increase the type and quality of opportunities available to local people, although intuitively or in concordance with pro-market ideology this would seem necessarily to be the case. This paper looks at how such changes have affected a specific area, which is the northern province of Chiang Rai in Thailand. The paper continues with a summary of the policies which have brought Thailand to the situation in which it now finds itself in terms of economic development and then continues with a description of the study which provided the results for this research. The analysis and then discussion of those results then follow.

After WWII, Thailand took greater advantage of its alliance with the western powers, especially the USA, in gaining access to overseas export markets and by hosting various facilities during the Korean Civil War (1950-3) and the two Indochinese Wars, when western interests required stable bases in the region. The model of rapid development pursued was similar to that seen elsewhere in the second half of the twentieth century and referred to generally as the East Asian Economic (or Development) Model. This model focused on generally outward-oriented, export-oriented, import-substitution and inward investment-encouraging policies characterised by mass manufacturing relying for competitiveness on low labour costs. In Thailand, Japanese investment was particularly influential in shaping this competitive advantage and Thailand benefited from the Japanese policy of off-shoring much of its low value-adding manufacturing activities. This development model was cemented in place during the authoritarian reign of Field Marshal Sarit in the late 1950s [3].

This policy continued until the 1990s, when the economy was shocked by the 1997 financial crisis, referred to locally as the Tom Yum Crisis. Factors contributing to the crisis in Thailand included excessive leverage of local companies in foreign-denominated debt, unsustainable asset-price inflation (particularly in the real estate sector), inefficiencies in the banking and finance industries and the policy of the central bank towards exchange rate changes. The results included

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numerous bankruptcies and retrenchments of workers, many of whom were obliged to enter the informal sector or return from closed factories to village family homes and subsequent under-employment. Confidence was shaken at every level of society and the economy. A new Constitution promulgated in the same year explicitly focused on the need to foster local, indigenous skills and capacities instead of the large-scale promotion of inward investment that had been the previous focus.

In 2001, the Thai Rak Thai (TRT) party of Thaksin Shinawatra swept aside the Democrat government of Chuan Leekphai and its neoliberalist response to the crisis, which was widely believed to be inadequate. Prime Minister Thaksin had created a set of economic policies which became known as Thaksinomics and which was based on the understanding that productivity had been falling in Thailand during the 1990s (suggesting the end of the usefulness of the East Asian Economic Model)[1] and the potential impact of the continued rise of China, which was increasingly a source of low cost manufactured items and a magnet for inwards investment [6]. The Thaksinomics program recognised that the extreme openness of Thailand (in common with many Southeast Asian countries) made the country overly vulnerable to external shocks which affected export sales. While not closing the country to the continued effects and changes brought about by globalisation, Thaksin placed a much greater emphasis on developing internal competencies and sources of competitive advantage, especially in the provinces outside of the capital Bangkok, thereby dampening the impact of internal migration in the country and its negative effect on social cohesion. Other policies focused on the promotion of Small and Medium Sized Enterprises (SMEs), especially those which offered the potential for competitive advantage through the use of indigenous knowledge and skills, village level funding aimed at identifying projects which would boost local income and careers opportunities, local community production schemes including OTOP – One Tambon One Product and the promotion of privatization. Second stage policies included the de Soto-esque [4] plan to reclassify assets, including intangible assets, to enable people to leverage them efficiently; this built on earlier policies which were aimed at enabling what were considered to be under-leveraged consumers the ability to boost their consumption of household goods by providing greater levels of consumer credit.

These problems have proven to be hugely popular in electoral terms but have received fierce opposition from ideological opponents in the political and traditionally powerful classes. Such problems as were experienced tended to result from difficulties in implementation rather than conceptual limitations. However, to continue to drive the economy forward and towards the ideal of the knowledge-based economy (KBE), it is necessary to identify and nurture those industries which might offer

significant and sustained competitive advantage based on local competencies and skills. It is certainly true that the proportion of workers involved in agriculture and its importance to the economy has continued to decline. Thailand is threatened with the middle income trap, in which competitiveness from the model described above has declined and the ability of the country and its workforce to take the next step is in doubt.

The GMSR has been home to endemic warfare throughout much of its history. The bitterness of the fighting in the post-WWII period, in addition to that provided by earlier periods and occasionally used as a pretext for nationalism by certain factions subsequently, continues to act as a problem in state relations. Relations have been improved through the mechanism of the Association of Southeast Asian Nations (ASEAN), which took as its founding philosophy the forbidding of public speech concerning occurrences within other countries, together with the restriction of agreements primarily to the economic sphere, leaving out the political and social realms. The latter is a tactic also employed elsewhere in the world, such as in the case of the Asia-Pacific Economic Confederation (APEC) and in early iterations of the European Union (EU). In the case of the Greater Mekong Subregion (GMSR) – Thailand, Burma, Laos, Cambodia, Vietnam and Yunnan and Guangxi provinces of China – it has meant that an economic agenda has been adopted without concomitant attention paid to the social and political issues, particularly equity issues. This has meant that integration to the extent that it has taken place has been possible but it also limits the goals that it can achieve.

2. THE STUDY

The research reported on in this paper has been based on a series of qualitative interviews conducted in Chiang Rai and Bangkok, largely during November 2007. Face to face interviews were supplemented by telephone interviews when it proved difficult to obtain access or for other practical details. More than 60 interviews have been completed to date and this work is part of a larger doctoral research program. Interviewees included many local business owners and operators, workers and labourers, government officials and other knowledgeable persons. Interviews resulted from a mixture of formal and informal contacts. Formal contacts occurred when the interviewers identified suitable individuals before the period of fieldwork and approached them for an interview. Informal interviews occurred during the fieldwork when relevant individuals were approached on an opportunistic basis. The interviews were supplemented by ethnographic observation and the accumulation of secondary data.

Interviews were conducted in either Thai or Chinese as appropriate and subsequently transcribed from notes made at the time and translated into English. The interview transcripts were entered into a database with other relevant materials and subjected to critical and content analysis. In concordance with the principles supporting grounded theory, the researchers became immersed in the data with a view to permitting theories

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[1] Aggregate productivity growth during the 199s was attributed to capital accumulation rather than total factor productivity (TFP) increases.

to emerge from the data, rather than following a quantitative method which begins with the formulation of hypotheses and then seeks means to test these through data collected. This method, combining in depth personal interviews with personal observation and the integration of secondary data and statistics has yielded good results in other cases (e.g. [7], [8]). Through continuous interrogation and re-interrogation of the research materials, the researchers were able to recognise repeated elements or phrases which gave rise to structures which then coalesced into emergent theories. This is the method pioneered by grounded theory researchers [5].

It is clear that the timing of the interviews had an impact upon the opinions of many respondents. Thailand suffered a military coup in September 2006, which interrupted a period of significant economic growth for the Kingdom and also the reduction of income inequalities. Investor confidence, particularly international investor confidence, was strongly shaken by the coup and by a number of policy decisions made by the junta-appointed assembly thereafter. Respondents looked forward to the general election scheduled for December 23rd, 2007 as the start of a new period of confidence and growth but it was not entirely certain that this would arise. Had the interviews taken place at a different time, then it is quite likely that many respondents would have had different opinions. However, the economic and political situation affected all respondents in the same way.

3. CHIANG RAI

Chiang Rai province is composed of 16 amphurs and two semi-amphurs, with a total area of some 11,678,369 square metres or 7,298,981 Rai.[2] The distance from Bangkok is about 729 kilometres. The region is bounded by Burma to the west, Laos to the east and Chiang Mai Province to the south. The total population of Chiang Rai is just 1¼ million people. There are some 1,233,559 people in Chiang Rai or 610,205 male and 623,354 female. The labour force in Chiang Rai is about 714,094 people and 225,435 workers are in the private sector, with only 43,723 workers registered for social security, since the economy of Chiang Rai is based on agriculture and is largely informal in nature. Casual labour patterns extend throughout the province with average daily wages of between 80-120 baht. Barter and labour exchange is also common. A principal source of labour is the hill tribes people who mostly live in mountain villages, together with Thai workers aged over 40 - most younger workers have migrated elsewhere for work.

Few large scale enterprises exist in the Chiang Rai region, especially in the private sector. Young people with good qualifications, especially at undergraduate level, customarily have to move away from the region in order to find employment opportunities commensurate with their abilities and experiences. This results from not just the lack of opportunities in the local market but also

the seniority-based salary system prevailing in Thailand, as elsewhere in East Asia. This means that people are paid more, on an automatic basis, according to their initial qualifications (and any subsequently obtained) as well as increments based on length of service. A consequence is that individuals with undergraduate degrees will routinely expect to receive more than one with a vocational qualification, irrespective of the fact that the latter will normally be rather more ready to contribute to a business, especially a small or medium-sized business, than the former from the beginning. This situation is exacerbated by the fact that individuals graduating with undergraduate degrees every year greatly outnumber those with vocational degrees. Some efforts have been made to increase the number of vocational students in the Chiang Rai region but these suffer from the problem of over-centralization of decision-making, which means that a number of the courses offered are inappropriate insofar as subsequently locally-available employment opportunities are concerned. Other problems also exist, largely as a result of mismatches between supply and demand and lack of resources and capacity on behalf of service providers. Gek-Boo Ng, former head of the Asia-Pacific Office of the ILO, has more than once commented on the importance of technical capacity for gathering, redacting and disseminating labour market statistics and this is one particular area where enhanced capacity could be of direct assistance [11].

There is also a qualitative or psychological aspect to the labour market of the Chiang Rai region, which is similar to that found in most of the rest of Thailand and other parts of the GMSR. This may be described, in the demotic, as the 'sabai sabai' culture. This term indicates a feeling of ease and relaxation which precludes preoccupation with stress or concern with the future. The extent to which this really exists depends upon anecdotal evidence as much as anything else but it is widely believed to be a widespread phenomenon, especially away from the urban areas and it appears to be believed more particularly by overseas investors and executives The Chiang Rai area combines a number of traditional businesses based on low labour costs and with little value-added (e.g. tea plantations) together with newer business opportunities based on development of the infrastructure in the region following the signing of a Free Trade Agreement with China and the opening of the Asian Highway, which links the Chinese mainland via Kunming, capital of Yunnan Province, with Singapore in the south. This highway passes through parts of Burma [Myanmar] and Laos, as well as Thailand. Upgrading of port and customs facilities at Chiang Saen also promotes riverine trade along the Mekong. Various Chinese dialects are used in the Chiang Rai region, including Yunnanese and hilltribe dialects for people who had migrated from China, perhaps via Burma. It is important to note that the various groups of Chinese in the north of Thailand are not always on good terms with each other or with their neighbours across the border in mainland China. The Kuomintang factions, for example, have no wish to deal with representatives of the People's Republic of China but will export their goods to political

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[2] Figures are provided by the Statistical Office of the Province of Chiang Rai.

allies in Taiwan. Indeed, it is ethnic Chinese from this region who are brought to Bangkok and tourist regions to be guides for Taiwanese tourists visiting the Kingdom [12]. In short, this is an area of numerous mixed ethnic groups dealing with a variety of environmental factors of greater or lesser hostility to them.

4. CHANGING COMPARATIVE AND COMPETITIVE ADVANTAGE IN THE GMSR

The concept of comparative advantage derives from the work of the economist David Ricardo, who pointed out that different countries had different distributions of economically exploitable resources as a result of geographic, climatic and other factors. Thailand, for example, has comparative advantage in growing rice and tropical fruits over China, for example, owing to the plentiful water and weather conditions. The distribution of comparative advantages can change over time as conditions change and as certain resources become more valued or scarce than they previously had been. To some extent, governments can change the nature and extent of comparative advantages in their states by such means as improving infrastructure, preparing a better trained and skilled workforce and so forth. While comparative advantage is available to all organisations able to take advantage of it, competitive advantage resides within a specific organisation (whether in the public or the private sector) and, in order to be sustainable, should not be easily replicable by competitors. It is generally more efficient for governments to promote comparative rather than competitive advantages because that leads to a greater efficiency in the distribution of resources and because it is very difficult to distinguish between nationally-owned and internationally-owned organisations in this respect. With respect to comparative and competitive advantages at the provincial level, the research indicated changes in the Chiang Rai region that have been summarized in four separate areas. These are: infrastructure, institutional change, government policy and macroeconomic and macrosocial change. These are detailed individually below.

Infrastructure

The principal improvements to the infrastructure have taken place in transportation. The River Mekong has been improved for trade on the Chinese side of the border (although there are various environmental concerns associated with this), while port and customs facilities have been built at Chiang Saen and Chiang Khong. Industrial estates are being created at both towns. Three existing border checkpoints (Mae Sai with Ta Chi Lek (Burma), Chiang San with Ton Purk (Laos) and Chiang Kong with Huay Sai (Laos)) are being supplemented by the North-South Corridor, which will link Kunming with Bangkok. This includes the already built R3W, which passes through Burma and is often closed for political reasons and the yet to be completed R3E, which will pass through Laos and will require a bridge across the Mekong. It was scheduled for completion in 2011 but this may be postponed because of the 2006 coup. Research indicates that, while

infrastructure as a whole is associated in East Asia with higher levels of economic growth, the provision of transportation, specifically roads, is more problematic [9], [10]. Research found that riverine transportation is hampered by lack of skilled personnel to operate the customs procedures and this caused a bottleneck such that traders switched their cargoes to R3E where possible. The National Electronics and Computer Technology Centre (NECTEC) and National Science and Technology Development Agency (NSTDA) are planning to open an 'IT Valley' to help train workers for relevant industries, in partnership with the private sector [2]. This will take some time to complete and further years before graduates are available for the local labour market. It is not clear whether supply and demand factors in the employment market have been included in planning.

Institutional Change

The Asian Development Bank (ADB) has been leading the way in fostering regional cooperation and economic integration in the GMSR. It observes: "The regional cooperation strategy and program (RCSP) for the Greater Mekong Subregion (GMS)1 aims to help achieve the GMS vision of an integrated, harmonious, and prosperous subregion. It has four strategic pillars: (i) strengthening connectivity and facilitating cross-border movement and tourism; (ii) integrating national markets to promote economic efficiency and private sector development; (iii) addressing health and other social, economic, and capacity-building issues associated with subregional links; and (iv) managing the environment and shared natural resources to help ensure sustainable development and conservation of natural resources" [1]. The ADB has worked with the Association of Southeast Asian Nations (ASEAN) and individual country governments to push through various agreements aimed at furthering the vision outlined above. Additionally, multilateral and bilateral Free Trade Agreements (FTAs) have changed the relations of production. In particular, the China-Thailand FTA, together with completion of the North-South Corridor, has enabled a large amount of Chinese agricultural produce to be retailed through the multiple retail chains that are now a significant aspect of Thai consumer society. This has had the effect of making much of agricultural cash crop production in Chiang Rai uncompetitive and increasing rural unemployment.

Government Policy

As described previously, government policy from 2001-6 and 2007-8 has featured redistribution of resources to the provinces to an unprecedented extent. While this has had some benefits, they take time to accrue and talented young people are still drawn away from the region because of lack of opportunities for qualified individuals. More attention is required to eliminate replication of duties and jurisdiction between government agencies and in matching supply and demand in the employment market. The education system requires a major overhaul and the enormous and entrenched bureaucracy of the relevant ministry has defeated government reform [13]. A further negative constraint in enhancing

competitiveness is the limit to the enforcement of the rule of law. Numerous groups of migrant workers, unofficial border crossings and informal employment all conspire to lower wages (often to below the legal minimum) and inhibit value-adding activities and upgrading of human resources and of other business resources. Greater enforcement of existing legislation would improve the situation, although it would cause some dislocation to patterns of existing competitive advantage as businesses currently active would need to reconfigure themselves.

Macroeconomic and Macrosocial Change

The increasing importance of both China and Vietnam as production centres, together with increases in Thailand's overall economic development, has led to changes in the expectations and experiences of Thai people at many levels of society. The society itself is ageing, although the effects of this are not yet severe. Since 2001, an ever-increasing number of people have become involved more extensively in consumer society by leveraging their assets to purchase items through credit usage. This has been controversial as a resurgent religious right influential in the media has criticized credit as excess and morally incorrect. Political divisions dogged Thailand throughout 2006-8 and seriously hampered the government's ability to produce and implement policies. Lack of investor confidence has meant that many investment decisions have been postponed and in other cases the decision has been taken to move the investment elsewhere. Continued macroeconomic turbulence, particularly with respect to high oil and commodity prices and the crisis in the international banking system have also acted to destabilize the economy across the whole country.

5. IMPLICATIONS

Border regions such as Chiang Rai may become central actors when cross-border integration takes place and they may also become bridges or conduits through which people and goods pass without leaving much or any benefit behind. The construction of the transportation network passing through the province might increase the likelihood that it will become a conduit rather than a destination and this is, perhaps, one of the reasons why increasing the stock of infrastructural goods (especially with respect to roads) does not always lead to positive growth results. Indeed, it may be that it is in removing bottlenecks and constraints to growth that infrastructure works and, consequently, such develop may result in negative results for the area concerned. The Thai government has sought to counter this possibility by developing local institutions that add value to pre-existing local economic activities and look to produce higher quality resources in the future. The provision of space for industrial development and agricultural processing, as has occurred in the Special Border Zone of Chiang Saen and Chiang Khong may facilitate cross-border investment which will increase this tendency. However, it is not likely that there will be much high-value investment from Laos or Burma in the foreseeable

future and it will be from China that any such project will emerge. The many Chinese labourers active in the region, building the R3E in Laos and the many infrastructure projects in Burma, for example, also seem interested in settling in the region and establishing their own businesses. It may be possible to attract some of these people to Chiang Rai or, at least, to establish network relationships with them.

The level of public and political discourse in the region remains low, as judged by its ability to include rather than exclude people. Most people in central areas of each state are able to ignore peripheral areas and routinely to consider neighbours as irrelevant or perfidious. Those outlying people whose lives accept a different reality in which cross-border transactions of all sorts are an ever present and largely positive aspect of life are mostly ignored by those central polities. Improving this state of affairs requires enhancing the ability of all involved to understand the conditions in which they live and recognizing their legitimate power, such as it is expressed by the law of each country. This will be a lengthy undertaking requiring the cooperation of many elements in society.

Chiang Rai province is a largely forested and mountainous province and this has considerable impact on both the types of economic activity that take place there and the ways in which integrative functions can occur. Its tourism industry is developing, along the lines of multiple-goal tourism: that is, it includes aspects of eco-tourism, ethnic minority tourism, cultural and urban tourism. Each of these requires specific improvements in infrastructure, education and business and organizational environment. Greater technical capacity at local government offices is also required, while the increase in the number of university and vocational school seats is making a contribution in these areas.

6. CONCLUSION

Balancing power between the centre (or centres) and peripheral regions remains perhaps the most pressing issue in Thai politics and its has a significant impact on the social and economic development of regions remote from the capital Bangkok. It is at the heart of current controversies in the Kingdom, in which various groups aim to bring down a democratically-elected government with a stated policy and proven commitment to redistributing resources away from Bangkok and to the remaining provinces. Numerous elite groups conspire to prevent this from happening and, through various means, have had important successes in their efforts. The struggle for justice and equality continues.

In Chiang Rai province, regional integration has taken the form of transportation changes, merging of workforces and increasing institutional closeness arising from Free Trade Agreements on a bilateral and multilateral basis. Development of riverine trade along the Mekong, in particular, has changed the geography of the province, stimulating the growth of local industrial parks and the port facilities themselves. This has had mixed impacts on the labour force, since there remains an imbalance between the skills and competencies

required for new positions and those available in local people. Temporary labour migration, both internal and external in nature, has if anything increased as a result. More attention is required from relevant government agencies to deal with this situation.

As ever, more research is required to understand and identify emergent opportunities in industries which might become competitive in the Chiang Rai of the future, as well as in identifying the resources, particularly in terms of human resources, which those industries may require. This research is proceeding.

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Transport Corridors for Economic Development in the GMS

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Abstract— *The general objective of this study is to assess how transport corridors contribute to economic development in the GMS (The Greater Mekong Subregion). Four transport corridors were selected to examine the impacts in Cambodia, Yunnan Province of PRC, Thailand, and Viet Nam. By using secondary data available from international agencies and statistical divisions of respective countries, correlations and impacts were analyzed in the study area.*

On the basis of analysis, the potential of transport cum economic corridors in the study area has been presumed and illustrated from "regional dynamics" point of view by means of three scenarios – Scenario 1: Dominances of PRC and Thailand continue to expand, Scenario 2: Viet Nam comes to the force in the short run, and Scenario 3: Cambodia and Lao PDR increase their expectations.

1. INTRODUCTION

According to the World Bank estimate, the global population living less than $1 a day was 986 million as of 2004 [1]. Most of them are living in developing countries, and provision of infrastructure is extremely limited in those countries. It is reported that per capita stock of infrastructure in low income countries remains almost one tenth of high income countries [2].

Meanwhile, in the recent context of globalization, the demand of regional cooperation has been increasing. Most countries cannot manage several issues by themselves because of their complex connections with the world.

In Asian region, the important regional cooperation program "The Greater Mekong Subregion (GMS) Economic Cooperation Program" was initiated by Asian Development Bank in 1992. The main objective of this program is to develop transport corridors and transform them subsequently to economic corridors in the GMS [3].

The GMS, which consists of Cambodia, Yunnan Province of People's Republic of China (PRC), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand and Vietnam have approximately 320 million of population as of 2005 and have approximately 2.5 million km2 total land area. The population of the GMS is larger than the USA having approximately 300 million in 2006, and the total area is almost equal to Western Europe with approximately 2.3 million km2. However member of the GMS countries are categorized at different levels of economy, as from least developed country to newly industrialized country.

2. OBJECTIVE

2-1. General Objective

The general objective of this study is to assess how transport corridor development contributes to economic development in the GMS, and to presume potential of the GMS.

2-2. Specific Objectives

The four specific objectives are as follows. Firstly, it is to examine the planning of the infrastructure among the GMS member countries with focus on policy and state of progress of transport corridor development. Secondly, it is to find out similarity among the people in the study area by using similarity points matrix to grasp the motivation of people's movement in terms of culture, economy and climate. Thirdly, it is to examine the direct impacts on the provinces passing four selected corridors with specific indicators in terms of trade and commerce, tourism and population. And finally it is to examine the differences of development process with time lag among the GMS countries by using development process model and regression analysis so as to understand economic and social changes.

3. METHODOLOGY

This study assesses the contribution and potential of the transport corridors for economic development in the study area on the basis of existing time series data. These secondary data were obtained from each country and international organizations. This study provides a picture of socioeconomic changes and their process by transport corridor developments.

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3-1. Selection of Transport Corridors

In this study, the transport corridors to be examined were selected by means of following criteria.

- Passing through three countries
- Connecting port city
- Passing through major cities
- Passing near the tourism spots

According to above criteria, the examined four corridors were selected as below.
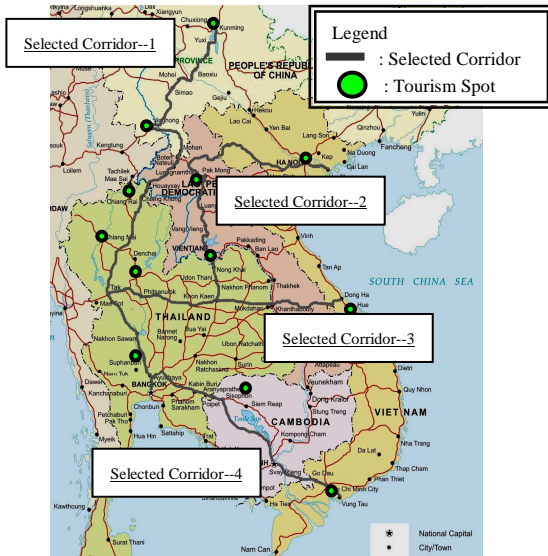
Source: [4]

Map 1. Selected Transport Corridors

Myanmar was excluded in this study.

Table 1. Items, Contents and Indicators

No.	Items	Contents	Indicators
1. Correlation Analysis			
1-1	Planning for Infrastructure by Organization	-Policy -Progress State	-Length of Upgraded Road (km) -State of Upgraded Road (%)
1-2	Similarity among People	-Culture	-Language -Ethnics -Religion -Dietary
		-Economy	-DAC Category
		-Climate	-Rainy Season
2. Impact Analysis			
2-1	Direct Impact on Provinces	-Trade and Commerce	-Industrila Establishment -Gross Provincial Products -Industrial Ouput
		-Tourism	-Hotel and Restaurant Establishment -Retail Sales
		-Population	-Population Density
2-2	Development Process by Country	-Economic Impact -Social Impact	-R^2 Value -Time Lag

3-2. Items of Analysis

This study comprises two main sorts of analyses, namely "Correlation Analysis" and "Impact Analysis". Table 1

shows the items, contents and indicators of analyses in this study. Different data sets were used to satisfy followings as shown in Table 1.

4.   PROFILE OF STUDY AREA

The Mekong is one of the typical international rivers in Asian region which originate in Tibetan Plateau and it flows through six countries along the Indochinese Peninsula, that is, Yunnan province in PRC, Myanmar, Thailand, Lao PDR, Cambodia and Vietnam. It is 4,350 km long with 795,000 km2 watershed area.

4-1. Population

The population has been increasing in this study area. Figure 1 shows the population density changes in whole study area and each country. The whole growth rate of population reached 13.7 % from 1995 to 2005. It accounted for almost 3.3 % of the world population as of 2005. In the same way, it was 3.3 % also in 2000; it is almost proportional to the world population size.

In 2005, the total amount of population in the study area was accounted for 39.2 % in Viet Nam, 30.6 % in Thailand, 21.0 % in Yunnan PRC, 6.5 % in Cambodia and 2.7 % in Lao PDR. Likewise in 1995, it was composed of 38.6 % in Viet Nam, 31.9 % in Thailand, 21.4 % in Yunnan PRC, 5.6 % in Cambodia and 2.5 % in Lao PDR respectively. Therefore, the population structure in the study area had not changed largely for the last decade.
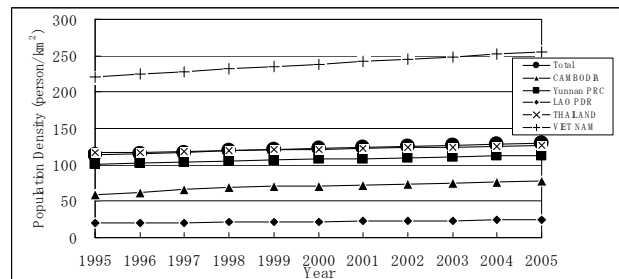

Source: [5] to [17]

Fig. 1. Population Density Change.

4-2. Road Network

The road network facilitates various people's activities. Figure 2 shows the total road density change in the whole study area and in each country. The total road length includes both paved and unpaved roads.

In terms of road density, Yunnan PRC and Viet Nam have more than 0.4km/km^2 but Thailand and Lao PDR have less than 0.15km/km^2. There exists a gap among countries in the state of road network development.

The total road length has been greatly expanding in this area; as a result it amounted to approximately 427.6 thousand km. The growth rate of it reached 47.3 % from 1995 to 2004. However, when compared to road network status in developed countries, the total road length in this study area is almost equal to total road length of Italy which has 484.7 thousand km as of 2004 [5]. Although the road network in the study area has been expanding, it is not yet adequate.
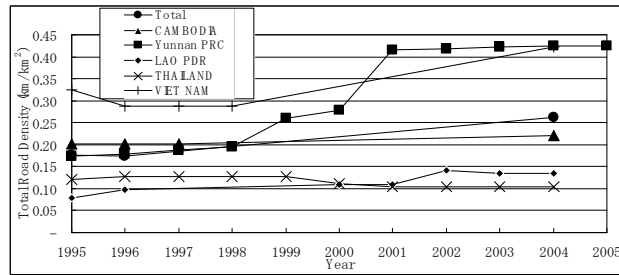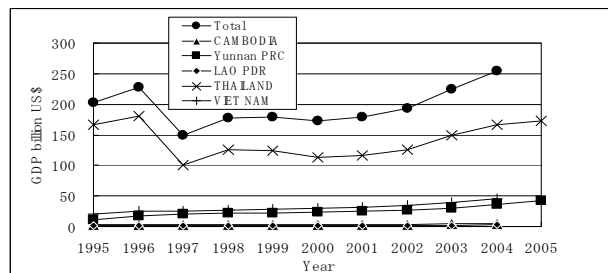
Source: [6] to [18]

Fig. 2. Total Road Density Change.

4-3. Economy

The Gross Domestic Product (GDP) was estimated as a result of people's economic activities facilitated to a larger extent by transport network. Figure 3 shows the total GDP changes calculated at current prices in US$ in the whole study area and for each country.

It is obvious that the impact of the Asian Financial Crisis in 1997 was realized in the whole study area. The annual growth rate of GDP in total recorded -34.4% in 1997 and it could not recover until 2004. The total growth rate reached 25.4 % from 1995 to 2004. With regard to the data of each county, the total amount of GDP in the study area was accounted for 65.4 % in Thailand, 17.8 % in Viet Nam, 14.0 % in Yunnan PRC, 1.8 % in Lao PDR and 1.0 % in Cambodia as of 2004.

There lies large gap in GDP among countries. Also, it can be observed the close relationship between the GDP change in total study area and Thailand.

Source: [6] to [18]

Fig. 3. GDP Change.

5. FINDINGS

5-1. Correlation Analysis

5-1-1. Plannning for Infrastructure by Organization

(1) Cambodia

In the Government of Cambodia, regional and international integration is regarded as one of the key pillars of their development agenda. Since Cambodia has border with three countries, which Lao PDR, Thailand and Viet Nam, it is said that the regional integration will provide Cambodia the socioeconomic development by attracting investment, creating employment, increasing income, and reducing poverty.

Table 2 shows the state of transport corridor progress in Cambodia. Approximately 50 % of total network had been accomplished, and the achievement of selected corridor-4 was 89.9 % as of 2006.

Table 2. Transport Corridor Progress State in Cambodia

1996	2006	2015 (Plan)
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 1,590 km	Length: 3,010 km
State: 0 %	State: 52.8 %	State : 100 %
Selected Corridor – 4 (Inside Dotted Line ······)		
Length: 0 km	Length: 620 km	Length: 690 km
State: 0 %	State: 89.9 %	State : 100 %

(2) People's Republic of China (Yunnan Province)

The PRC Government has been investing heavily on infrastructure developments to promote and support the high economic growth rate. Especially, the western region's development is an important component of overall development policy in the PRC.

Table 3 shows the transport corridor progress status Yunnan PRC. Approximately 50 % of total networks had been accomplished, and the achievement of selected corridor -1 was 59.7 % as of 2006.

Table 3. Transport Corridor Progress State in Yunnan PRC

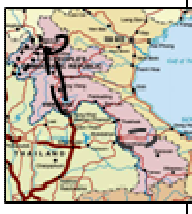| 1996	2006	2015 (Plan)
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 1,200 km	Length:2,360 km
State: 0 %	State: 50.8 %	State : 100 %
Selected Corridor – 1 (Inside Dotted Line ······)		
Length: 0 km	Length: 370 km	Length: 620 km
State: 0 %	State: 59.7 %	State : 100 %

(3) Lao People's Democratic Republic

The government of Lao PDR has regarded economic cooperation as an important means for supporting sustainable economic growth. Lao PDR is located at the heart of the GMS and surrounded by all GMS countries - Cambodia, PRC, Myanmar, Thailand and Viet Nam. Therefore for this landlocked country, the regional cooperation is vital to their sustainable economic growth. They will be able to connect to sea port by way of these transport corridors.

Table 4 shows the transport corridor progress status in Lao PDR. Approximately 45 % of total network had been accomplished, and the achievement of selected corridor -1 was 0 %, selected corridor -2 was 76.5 %,

and selected corridor -3 was 100 % as of 2006 respectively.
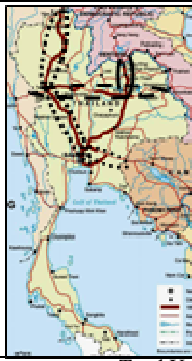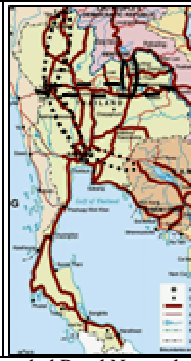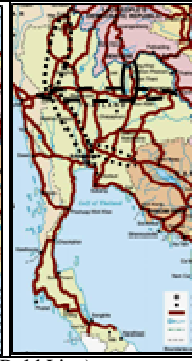
Table 4. Transport Corridor Progress State in Lao PDR

1996	2006	2015 (Plan)
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 1,660 km	Length: 3,790 km
State: 0 %	State: 43.8 %	State : 100%
Selected Corridor – 1 (Inside Dotted Line ·········)		
Length: 0 km	Length: 0 km	Length: 220 km
State: 0 %	State: 0 %	State : 100 %
Selected Corridor – 2 (Inside Dotted Line ▬ ▬)		
Length: 0 km	Length: 520km	Length: 680 km
State: 0 %	State: 76.5 %	State : 100 %
Selected Corridor – 3 (Inside Dotted Line ▬ ▬ ·)		
Length: 0 km	Length: 260km	Length: 260 km
State: 0 %	State: 100 %	State : 100 %

(4) Thailand

Thailand has been supporting neighboring countires by regional economic framework policy, "from the battle fields to the market".

Table 5 shows the transport corridor progress situation in Thailand. Approximately 90 % of total network had been accomplished, and the achievement of selected corridor -1, 2, 3, and 4 were 86.9 %, 100 %, 100 % and 37.5 % as of 2006 respectively.

Table 5. Transport Corridor Progress State in Thailand

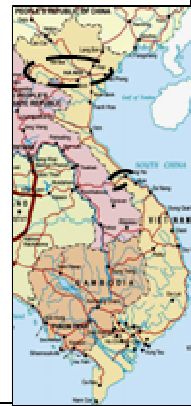| 1996	2006	2015 (Plan)
Total Upgraded Road Network (Bold Line)		
Length: 2,360 km	Length: 8,120 km	Length: 8,770 km
State: 26.9 %	State: 92.6 %	State : 100 %
Selected Corridor – 1 (Inside Dotted Line ······)		
Length: 930 km	Length:930 km	Length:1,070km
State: 86.9 %	State: 86.9 %	State : 100 %
Selected Corridor – 2 (Inside Dotted Line ▬ ▬)		
Length: 180 km	Length: 180 km	Length:180 km
State: 100 %	State: 100 %	State : 100 %
Selected Corridor – 3 (Inside Dotted Line ▬ ▬ ▬)		
Length: 450 km	Length: 860 km	Length: 860 km
State: 52.3 %	State: 100 %	State : 100 %
Selected Corridor – 4 (Inside Dotted Line ········)		
Length: 120 km	Length: 120 km	Length: 320 km
State: 37.5 %	State: 37.5 %	State : 100 %

(5) Viet Nam

The Government of Viet Nam regards regional cooperation and integration as important to achieve their development goals in the "Vietnam's Five-year Socioeconomic Development Plan (SEDP) 2006 -2010". Especially, the poorest border districts/provinces in Viet Nam will be highly influenced by regional cooperation with Cambodia, the PRC, and Lao PDR.

Table 6 shows the transport corridor progress status in Viet Nam. Approximately 40 % of total networks had been accomplished, and the achievement of selected corridor -2, 3, and 4 were 26.3 %, 100 %, and 38.1 % as of 2006 respectively.

Table 6. Transport Corridor Progress State in Viet Nam

1996	2006	2015 (Plan)
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 2,610 km	Length: 5,740 km
State: 0 %	State: 39.5 %	State : 100 %
Selected Corridor – 2 (Inside Dotted Line ▬ ▬)		
Length: 0 km	Length: 150 km	Length: 570 km
State: 0 %	State: 26.3 %	State : 100 %
Selected Corridor – 3 (Inside Dotted Line ▬ ▬ ·)		
Length: 0 km	Length: 90 km	Length: 90 km
State: 0 %	State: 100 %	State : 100 %
Selected Corridor – 4 (Inside Dotted Line ········)		
Length: 0 km	Length: 80 km	Length: 210 km
State: 0 %	State: 38.1 %	State : 100 %

5-1-2. Similarity among People

It is possible that social differences and similarities among countries affect to people's activities. For example, if people use same language, they can interact with less restriction. Moreover, if they are same level of economy, they will be able to move without worrying about price differences.

Therefore, the analysis to examine similarity between and among countries from people's point of view is important to understand the background of socioeconomic change by transport corridor developments. In this analysis, culture, economy and climate were selected as contents of this analysis to reveal factors of spontaneous movements of goods and services by people's intention, not by government's strategy.

(1) Definition of Similarity

The similarities in all contents are defined below in the table 7. If two countries have same item in some subject, point 1 is given. If they have some similar item, then point 0.5 is given; and if they have different item, then point 0 is given for this purpose.

Table 7. Definition of Similarity

Contents	Indicators	Country A		Country B	Point
Culture	Language	Official	-	Official	1
		Official	-	Other	0.5
		Other Combination			0
	Ethnic	Majority	-	Majority	1
		Majority	-	Minority	0.5
		Other Combination			0
	Religion	Primary	-	Primary	1
		Other Combination			0
	Dietary	Rice	-	Rice	1
		Other Combination			0
Economy	Category	Least Developed Country	-	Least Developed Country	1
		Low Middle Income Country	-	Low Middle Income Country	1
		Other Combination			0
Climate	Rainy Season	May to September	-	May to September	1
		Other Combination			0

(2) Similarity among People

The total points indicate the relative evaluation of similarities among counties. The higher total points indicate more similarities between countries. The highest points (4.5) are obtained in the relationship between Lao PDR and Thailand, followed by 4.0 points between Cambodia and Lao PDR. On the other hand, the lowest points (2.0) are observed to reflect the relationship between PRC and Viet Nam.

Table 8. Similarity Points Matrix

Country[a]	Item		PRC	LAO	THA	VIE
CAM	Culture	Language	0	0	0	0
		Ethnic	0.5	0	0	0.5
		Religion	0	1	1	1
		Dietary	1	1	1	1
	Economy	Category	0	1	0	0
	Climate	Rainy Season	1	1	1	1
		Total Points	2.5	4	3	3.5
PRC	Culture	Language	—	0	0	0
		Ethnic		0.5	0	0
		Religion		0	0	0
		Dietary		1	1	1
	Economy	Category		0	1	0
	Climate	Rainy Season		1	1	1
		Total Points		2.5	3	2
LAO	Culture	Language	—	—	0.5	0
		Ethnic			1	0
		Religion			1	1
		Dietary			1	1
	Economy	Category			0	0
	Climate	Rainy Season			1	1
		Total Points			4.5	3
THA	Culture	Language	—	—	—	0
		Ethnic				0
		Religion				1
		Dietary				1
	Economy	Category				0
	Climate	Rainy Season				1
		Total Points				3

Note: a CAM = Cambodia, LAO = Lao People's Democratic Republic, PRC = People's Republic of China, THA = Thailand, VIE = Viet Nam.
Source: [19] to [21]

5-2. Impact Analysis

In this analysis, the impacts on provinces where passing corridor have been examined by using figures and maps that show socioeconomic changes by country. These provincial data collected for each country are varied in nature from country to country in terms of type, category, year and so forth. Therefore, data used in this analysis are not uniform among countries.

5-2-1. Direct Impact on Provinces

(1) Cambodia

a. Trade and Commerce

The Map 2 below shows that industry establishments by province as of 2000 along the selected transport corridor-4. The achievement state of selected transport corridor-4 development in Cambodia can be seen in Table 2. Many industries had been established around Phnom Penh but few industries also were established in the bordering provinces to Thailand and Viet Nam as of 2000.
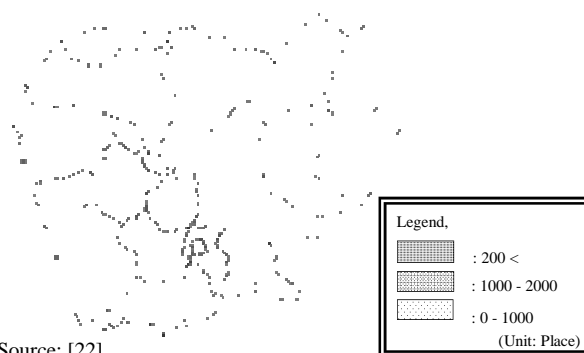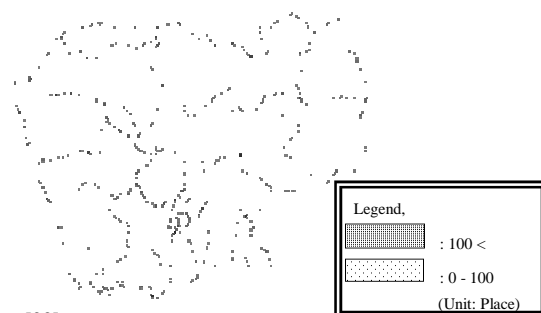

Source: [22].

Map 2. Industry Establishments in Cambodia as of 2000.

b. Tourism

Map 3 shows that hotel and restaurant establishments on provinces along the selected corridor-4 as of 2000. According to this map, it cannot be observed any distinct contribution on provinces by transport corridor-4 development to tourism sector as the number of hotel and restaurant establishments concentrated only in Phnom Penh.
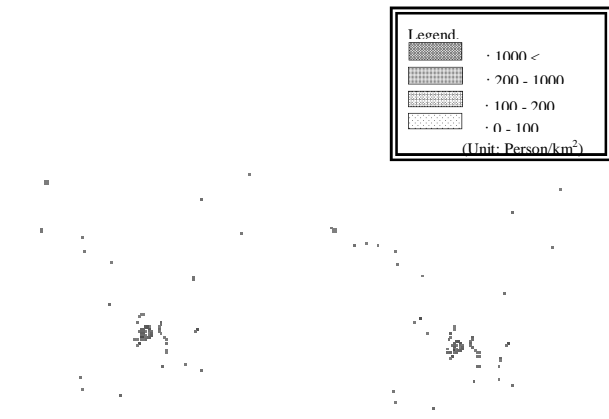

Source: [22].

Map 3. Hotel and Restaurant Establishments in Cambodia as of 2000.

c. Population

Map 4 shows the population density by provinces as of 1994 and 2006. The achievement state of selected transport corridor-4 development can be seen as 0 % and 90 % respectively in table 2. It can be observed that population density increases in proportion to the progress of transport corridor development on bordering provinces to Thailand and Viet Nam. The socioeconomic

conditions in both areas might be improved due to transport corridor development.
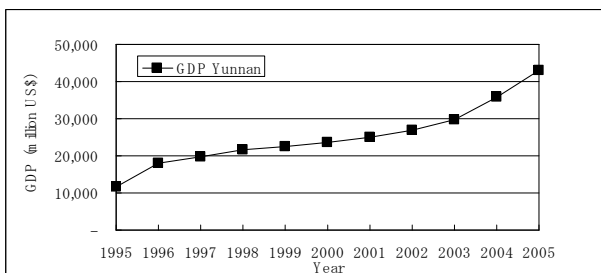

Source: [22].

(a) As of 1994　　　　　**(b) As of 2006**

Map 4. Population Density in Cambodia.

(2) People's Republic of China (Yunnan Province)

a. Trade and Commerce

Next figure 4 shows the GDP change in Yunnan province from 1995 to 2005. It shows the trend of GDP change which had been increasing without any stagnation. The growth rate of GDP recorded about 270 % during this period.

Source: [6] to [18]

Fig. 4. GDP in Yunnan Province PRC.

b. Tourism

Yunnan province has famous tourism sites, such as "Shangri La", registered as a world heritage by UNESCO. Figure 5 shows the number of international tourist arrivals and exchange earnings on Yunnan province from 1995 to 2005. Although there were some fluctuations, the general trend of foreign tourists had been increasing. Its growth rate reached approximately 110 % from 1995 to 2005.

c. Population

In Yunnan province, population had not changed so much from 1995 to 2005. The population growth rate was 12 % during this period. In comparison with the high growth rate of GDP shown in figure 4, and foreign tourist arrivals in figure 5, population had been stable.
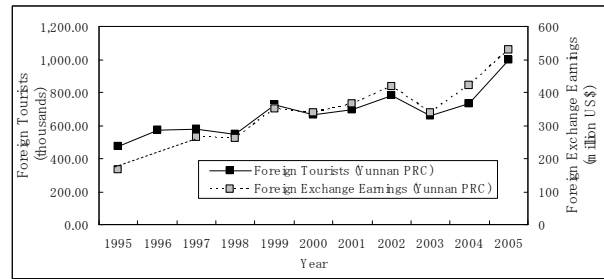
Source: [6] to [18]

**Fig. 5. Foreign Tourists and Exchange Earnings in Yunnan Province PRC.**
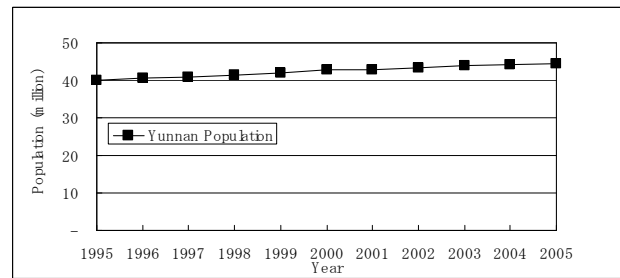
Source: [6] to [18]

Fig. 6. Population in Yunnan Province PRC.

(3) Lao PDR

a. Trade and Commerce

The following map 5 shows the number of industry establishments in provinces where selected corridor-1, 2, and 3 are passing as of 1995 and 2004. The achievement status of selected transport corridor-1, 2, and 3 in Lao PDR are given in table 4. We can clearly observe that the number of industrial establishments in north part of Lao PDR had been increasing in proportion to transport corridor development.
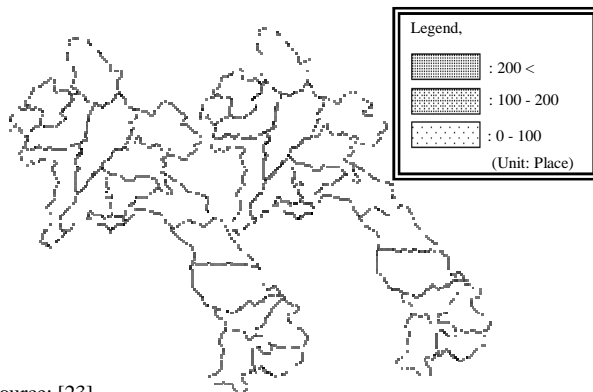

Source: [23].

(a) As of 1995　　　　**(b) As of 2004**
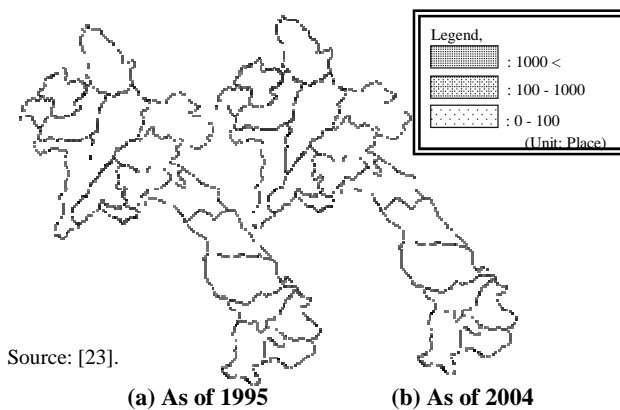
Map 5. Industry Establishments in Lao PDR.

b. Tourism

Map 6 shows the hotel and restaurant establishments in provinces along the selected corridor-1, 2, and 3 as of 2002 and 2005. The achievement status of selected transport corridor developments can be seen in table 4. It can be observed that contribution of transport corridor developments to tourism sector in provinces along the selected corridors in terms of the hotel and restaurant

establishments had spread in proportion to transport corridor developments.

Source: [23].

(a) As of 2002   (b) As of 2005

Map 6. Hotel and Restaurant Establishments in Lao PDR.

c. Population

Map 7 shows the population density of 1995 and 2005. The achievement status of selected transport corridor-1, 2, and 3 are given in table 4. The population density change had been increasing along the selected transport corridors. However, in comparison with the direct impact to tourism, the contribution of transport corridor developments to population change is not largely influenced in Lao PDR.
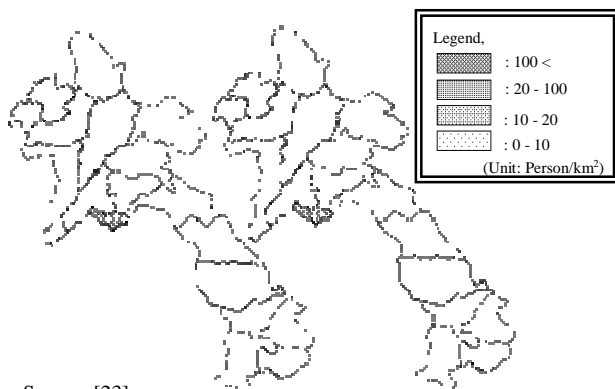
Source: [23].

(a) As of 1995   (b) As of 2005

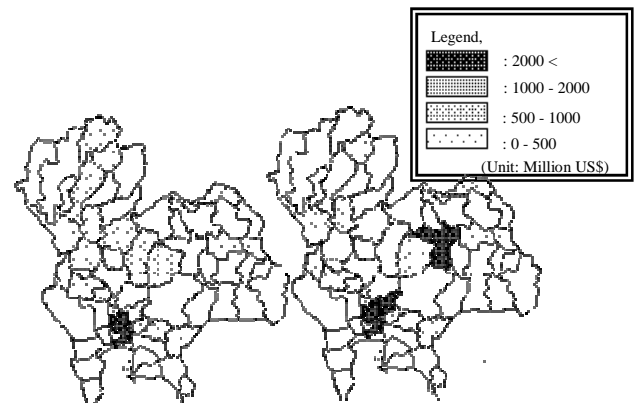**Map 7. Population Density in Lao PDR.**

(4) Thailand

a. Trade and Commerce

Map 8 shows the Gross Provincial Products (GPP) as of 1998 and 2005 along the selected transport corridor-1, 2, 3, and 4. The achievement status of selected transport corridor developments in Thailand are given in table 5. GPP had increased on provinces where meet two corridors and bordering provinces to Cambodia and PRC.

b. Tourism

Map 9 shows that hotel and restaurant establishments in provinces along the selected corridors as of 1998 and 2005. According to these maps, the contribution of transport corridor development to tourism sector in provinces along the selected corridor are observed as the
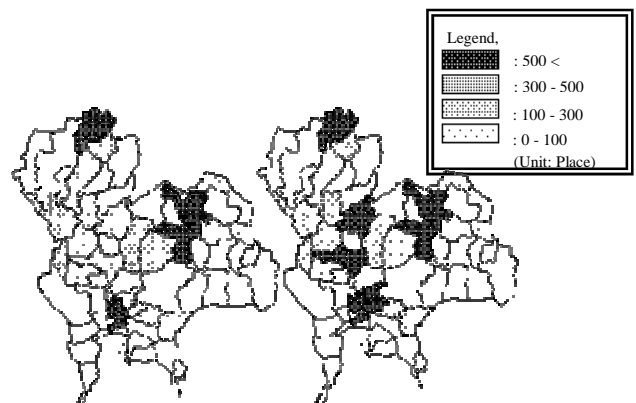
hotel and restaurant establishments are spread in proportion to transport corridor developments. Especially, the provinces, where two selected transport corridors meet, were remarkably increasing

Source: [24].

(a) As of 1998   (b) As of 2005
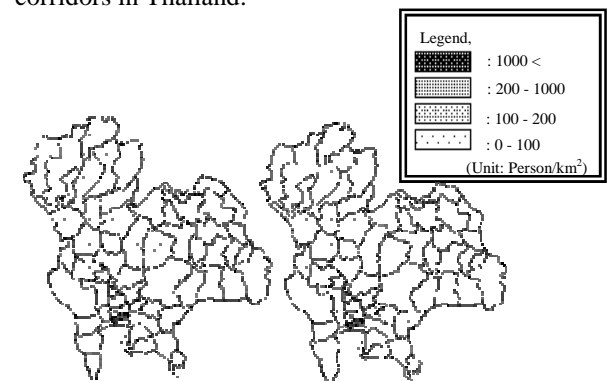
Map 8 Gross Provincial Products in Thailand.

Source: [24].

(a) As of 1998   (b) As of 2005

Map 9. Hotel and Restaurant Establishments in Thailand.

c. Population

Map 10 shows the population density changes as of 1998 and 2005. Distinct changes are observed regarding population in provinces along the selected transport corridors in Thailand.
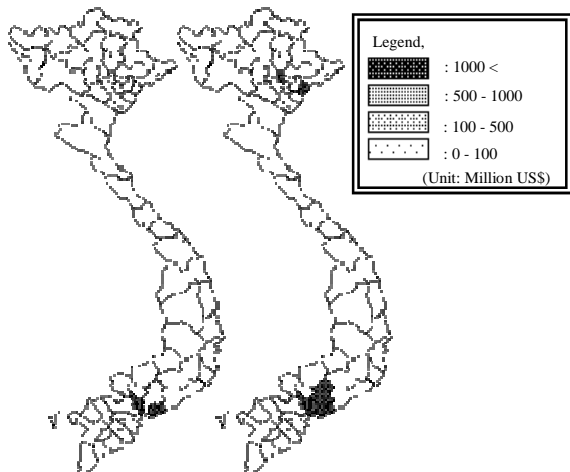

Source: [24].

(a) As of 1998   (b) As of 2005

Map 10. Population Density in Thailand.

(5) Viet Nam

a. Trade and Commerce

Map 11 shows the industrial output value as of 1996 and 2006 along the selected transport corridor-2, 3, and 4. The achievement status of selected transport corridor-2, 3, and 4 developments in Viet Nam are given in table 6. The industrial output value had been increasing in provinces along the selected corridors-2 and 4.
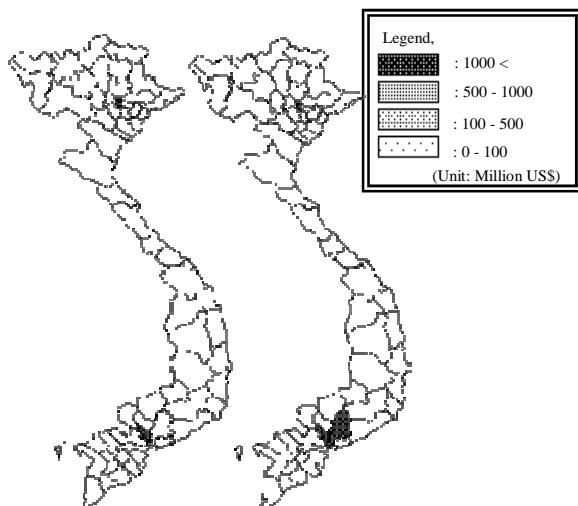

Source: [25].

(a) As of 1996   **(b) As of 2006**

Map 11. Industrial Output Value in Viet Nam.

b. Tourism

Map 12 presents the retail sales in provinces along the selected corridors as of 1996 and 2006. According to this map, it reflects the contribution of all selected transport corridor-1, 2, and 3 developments as the retail sales had been increasing.
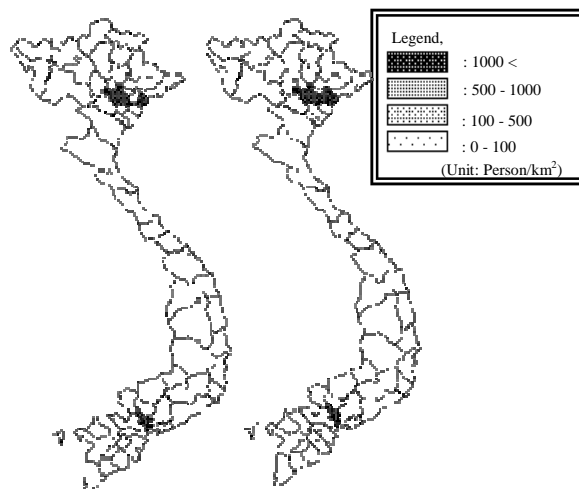

Source: [25].

(a) As of 1996   **(b) As of 2006**

Map 12. Retail Sales in Viet Nam.

c. Population

Map 13 shows the distribution of population density of 1996 and 2006. No distinct changes are observed

regarding population density in provinces along the selected transport corridors.

Source: [25].

(a) As of 1996   **(b) As of 2006**

Map 13. Population Density in Viet Nam.

5-2-2. Development Process by Country

(1) Development Process Model

In this analysis, the impacts to socioeconomic changes by country from transport corridor developments have been examined. Figure 7 shows development process model modified to suit this study on the basis of the model proposed by Nakamura [26]. And regression analysis which confirms the extent of probabilistic correlataion between two events in the development process model was used.

All the data used in this analysis were obtained from international organizations [6 and 7]. Therefore, by usigng same formatted date, the differences of development process due to transport corridor developments among countries in this study area could be compared. And the results were shown in arrows which hatched by three types ($\boxed{}$ $0.8 \square R^2 \square 1.0 \square$ $\boxed{}$ $0.5 \square R^2 < 0.8$ and $\boxed{}$ $0.0 \square R^2 < 0.5$) so as to understand the extent of correlation between two events.
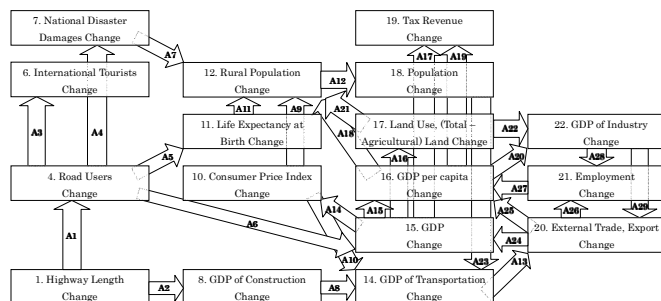
Source: [26].

Fig. 7. Development Process Model.

(2) Regression Analysis

The regression analysis concerns the correlation between two variables with the object of identifying, estimating,

and validating. The strength of a linear relation "R^2" is measured by following formula (1).

$$R^2 = \frac{\left[\sum (x - \overline{x})(y - \overline{y})\right]^2}{\left[\sum (x - \overline{x})^2\right]\left[\sum (y - \overline{y})^2\right]} \quad (1)$$

where,　　x = data of independent variable
　　　　　$\overline{x}$ = average of independent variable
　　　　　y = data of response
　　　　　$\overline{y}$ = average of response

If the result of R^2 value is more than 0.8, the correlation between two events is concluded as "significant" in this analysis.

(3) Time Lag on Development Process by Country

The road network development has two main important roles, that is to say, job provision to related industries (from arrow A2 to A3, in Fig.7) and sustainable road network use for people's activities (from arrow A1 to A3, A4, A5, A6 in Fig.7). In terms of sustainable use of road network, it is thought that time lag between the events are generated.

(4) Cambodia

Figure 8 shows the results of regression analysis considering time lag. In Cambodia, the time lag between "1.Highway Length Change" and "4.Road Users Change" is 0 year with significant correlation. And, the time lag between "4.Road Users Change" and "15.GDP Change" is 3 years, further, between "4.Road Users Change" and "6.International Tourist Change" is 4 years in significant correlation. A number of significant correlation between two events is 16 out of 29.

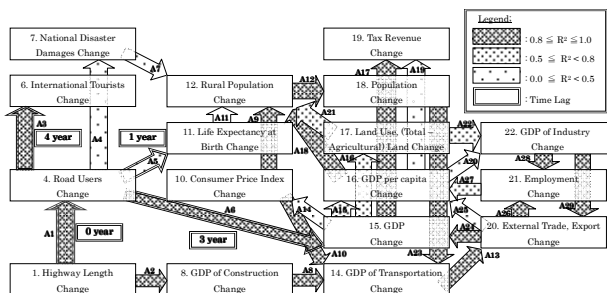Transport corridor development had been contributed for road user benefits with time lag in Cambodia.

Fig. 8. Development Process with Time Lag in Cambodia.

(5) Lao PDR

Figure 9 shows the results of regression analysis with time lag in Lao PDR. The time lag between "1. Highway Length Change" and "4. Road Users Change" is 3 years supported by significant correlation. However, the time lag between "4. Road Users Change" and "15. GDP Change", "4. Road Users Change" and "6. International Tourist Change", "4. Road Users Change" and "11. Life Expectancy at Birth Change" has close to significant correlations.   A number of significant correlations between two events is 10 out of 29.
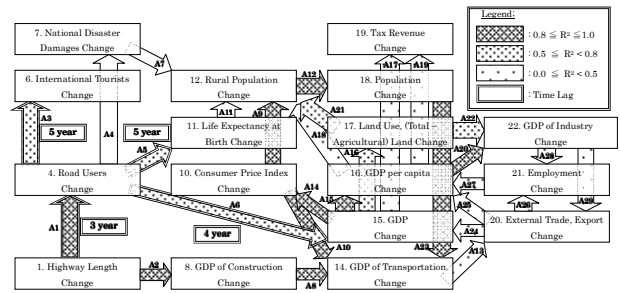

Fig. 9. Development Process with Time Lag in Lao PDR.

In Lao PDR, it is found that transport corridor developments had not contributed for user benefit even when the time lag is taken into account.

(6) Thailand

Figure 10 shows the results of regression analysis considering time lag in Thailand. The time lag between "1.Highway Length Change" and "4.Road Users Change" is 2 years with significant correlation. Time lag between "4.Road Users Change" and "15.GDP Change" is 5 years. A number of significant correlation between two events is 8 out of 29.

Transport corridor developments had contributed only for road user increment. However, it is clear that transport corridor development had contributed for GDP increase with five years time lag.
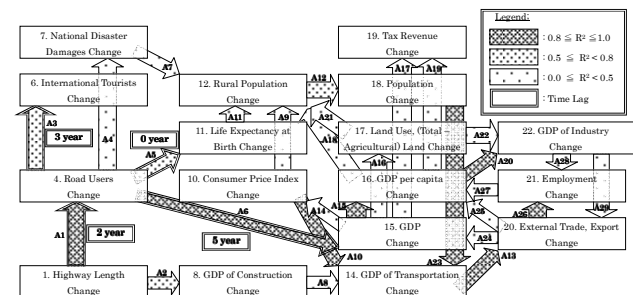

Fig. 10. Development Process with Time Lag in Thailand.

(7) Viet Nam

Figure 11 shows the results of regression analysis with time lag in Viet Nam. The time lag between "1.Highway Length Change" and "4.Road Users Change" is 4 years, the time lag between "4.Road Users Change" and "6.International Tourists Change" is 1 year, the time lag between "4.Road Users Change" and "11.Life Expectancy at Birth Change" is 4 years, the time lag between "4.Road Users Change" and "15.GDP Change" is 0 year with significant correlation values. A number of significant correlation between two events is 25 out of 29.

In Viet Nam, almost all links had significant correlation considering time lag. It can be said that this is the good example of socioeconomic development by using transport corridor development.
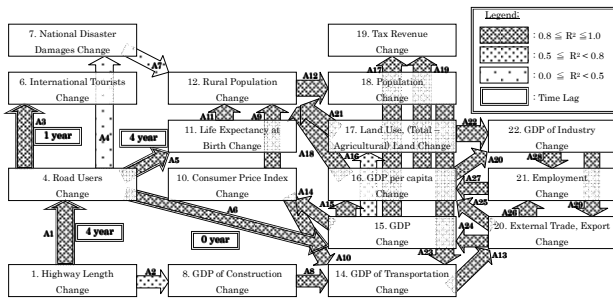
Fig. 11. Development Process with Time Lag in Viet Nam.

6. CONCLUSION

6-1. Overall and Key Conclusion

In the Greater Mekong Subregion, although there are some differences among countries, the socioeconomic situation and transport corridors have been improving since 1995.

The key conclusions in each analysis are as follows.

6-1-1. Planning for Infrastructure by Organization

All countries in this study area have positive policy for transport corridors development. However, differences exist in transport corridor development progress status among countries.

6-1-2. Smilarity among Pople

Bordering countries have more similarities among people than other countries. Especially, Cambodia and Lao PDR have similarities with their surrounding countries.

6-1-3. Direc Impact on Provinces

Thailand classified as "Low Middle Income Country" by DAC (Development Assistance Committee) has been increasing GPP in provinces where two corridors meet.

Similarly Viet Nam is classified as "Low Income Country". This has been increasing in trade and commerce, tourism and population changes in provinces along the corridors.

And Cambodia and Lao PDR are classified as "Least Developed Country". They have reflected changes in increasing in population or tourism in provinces along the corridors.

6-1-4. Develpment Process by Country

It is reported that the effect of infrastructure development investment is not so large in low developed economy. It becomes effective in middle developed economy and less effective in high developed economy [2]. In this study, similar trend of results have been observed.

Cambodia and Lao PDR have medium correlation between transport corridor development and socioeconomic changes (10 and 16 significant arrows out of 29 in Figure 8 and 9 respectively).

Viet Nam has highest correlations between transport corridor development and socioeconomic changes (25 significant arrows out of 29 in Figure 11).

Thailand has lowest correlation between transport corridor development and socioeconomic changes (8

significant arrows out of 29 in Figure 10).

6-2. Scenario

On the basis of these results obtained in this study, three scenarios are presumed for countries by DAC category.

Scenario 1: PRC and Thailand dominances continue to expand

Scenario 2: Viet Nam comes to the force in the short run

Scenario 3: Cambodia and Lao PDR increase their expectations

It is necessary to notes that political changes, natural disasters, economic crises or other uncertain factors are not taken into account in following scenarios.

6-2-1. PRC and Thailand Dominances Continue to Expand

For low middle income countries, PRC and Thailand have played important roles in the GMS as pioneers of economic development and providers of financial and technical assistance to other GMS member countries. They have high transport corridor accomplishments rate, and made transport corridors as functional in line with their economic activities. That is to say, PRC and Thailand had linked with selected corridor-1, with 61.9 % accomplishment rate as of 2006, and both countries were highly dependent on each other as trading partner. This is the model of an economic corridor.

In Thailand, these transport corridors can be used for risk reduction. In 1997, Thailand was highly affected by Asian Finance Crisis. It is commonly said that economy has cycle with "boom", "bust", "recession", "depression" and "recovery". To reduce the risk of impact by this cycle, Thailand can utilize transport corridors. For example, if Thailand shifts some of their industrial production functions (factories) to neighboring countries, it may become possible to reduce or avoid the economic risk. This will be good for neighboring countries in terms of capital investmen.

Map 18. Scenario -1: PRC and Thailand Dominance Continue to Expand.

The transport corridors connect to seaport in Viet

Nam. This is the greatest potential for Yunnan province of PRC. Most countries relate with PRC as trading parners. In addition to current economic dominant position of PRC in this region, the transport corridor can connect to large markets beyond the GMS.

6-2-2. Scenario -2: Viet Nam Comes to the Force in the Short Run

Viet Nam, low income country is located east side of the study area with a long coastal line. Therefore, Viet Nam can work as threshold of the GMS. When the transport corridor is complete, Viet Nam will be able to play an important role for trade within and outside the GMS trough port towns, and thus will gradually increase their impact on Cambodia and Lao PDR. This will place Viet Nam in more competitive position with Thailand.

Viet Nam had been improving its economy without negative impact so far after Asian Financial Crisis in 1997. Moreover, the prominent characteristic of GDP growth of Viet Nam is well balanced. Although, the agricultural sector had low or negative growth rates in other countries, Viet Nam had high growth rate and it was close to service sector. The agriculture sector was not so much affected by Economic Crisis. Therefore, it would be possible for Viet Nam to continue a stable economic growth country.

Furthermore, transport corridor network development had been significant correlation between and among socioeconomic events. In other words, tranport corridor network development had been working well for socioeconomic developments in Viet Nam. The completion status of transport corridor had remained low level as of 2006; but Viet Nam will be able to expect more socioeconomic improvement by its own transport corridor developments inside the country.

PDR are located between PRC, Thailand and Viet Nam, which are relatively better off in terms of economic growth and development. A number of transport corridors have been planned to pass through each capital cities and currently under development. This will be able to expand the economic potential because of their location by offering transit and production centers of various other activities. In fact their employment in secondary sector and corresponding GDP have been increasing more than other sectors. From this point of view, four selected corridors in this study will keep playing continuously important role.

In terms of Cambodia, they had the highest growth rate in international tourist arrivals in this study area. Although, the completion status of selected transport corridor-4 was 67.2 % as of 2006, more tourist arrivals are expected in proportion to transport corridor development due to its tourism potential.

Moreover, Cambodia has already fulfilled its transport corridor network development functions in relation to socioeconomic changes. Cambodia had the least per capita GDP in this study area as of 2004. However, they will be able to improve their socioeconomic status by utilizing transport corridor developments and by young workers who were born after baby boom in 1980's.

With regard to Lao PDR, the country has very close relationship with Thailand. Some area in Lao PDR, people can communicate with Thai people by using same language. In comparison with Thai GDP per capita, Lao PDR remains still low. Therefore, Lao PDR can expect investment from Thai companies which are looking for low expenses and this will boost secondary sector economy by establishing industries. On this point of view, transport corridor will play very important role.

Map 19. Scenario -2: Viet Nam Comes to the Force in the Short Run.

Map 20. Scenario -3: Cambodia and Lao PDR Increase their Expectations.

6-2-3. Scenario -3: Cambodia and Lao PDR Increase their Expectations

Least developed countries such as Cambodia and Lao

Furthermore, many transport corridors have planned to pass though Lao PDR. Therefore Lao PDR can utilize their location as transit center of the GMS. At present total upgraded road network accomplishment remains

low (43.8 %), but the situation will improve dramatically when transport corridors are fully accomplished in this land-linked country.

7. RECOMMENDATION AND IMPLICATION

In this study, the contributions of transport corridor development in the GMS to economic development in constituent countries and the potential of the GMS are examined by using secondary data. It has been confirmed the existence of correlation between transport corridor development and economic development components. It is observed that the impacts from the transport corridor development to socioeconomic changes are diversified from one country to another. However, since these results include many external factors, it is complex to conclude more precisely the impact of transport corridor development on economic development.

Therefore, it is necessary to apply multivariate statistics technique or detailed regional analysis and so on to identify exact impacts in the future subject to availability of right type of data. However, the analysis from people point of view as demonstrated through "Similarity among People" should be more rigorously done.

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