

# **An Overview of the Brick and Tile Manufacturing Industry in North West Cambodia**

by

Bas Rozemuller

March 1999

*Phnom Penh, Kingdom of Cambodia*

*Center for Advanced Study*

*UNDP/CARERE*

## **Author's Acknowledgements**

A research project like this and the subsequent research reports are always team efforts. As far as the research in the provinces is concerned, I want to thank my colleagues Mr. Kim Sedara, Ms. Nguon Sokunthea, Ms. Kin Tepmoly, Ms. Chan Kanha, Mr. Khun Sovithea, Mr. Ouk Chanthou, Mr. Chhaing Sophal and Mr. Khat Sokha. I am also grateful to CAREERE and its staff for facilitating and supporting this research project. Finally I want to thank the Brick and Roofing Tile Manufacturing Associations and the individual members for their help and hospitality during the research.

The completion of the six resulting case study reports and this occasional paper is also the result of the support of and the cooperation between a number of people, mainly within the Center for Advanced Study. I want to thank Mr. Ouk Chanthou, Mr. Chhaing Sophal and Mr. Khat Sokha for writing the individual case study reports. Especially I want to thank Mr. Khun Sovithea, who - besides writing a case study report - also did work on the final lay-out of these case study reports. In this respect I am also grateful to Mr. E Neng, Ms. Van Sovathana and Ms. Khim Kunthy for typing, editing and finalizing the case study reports. I know there was a lot of work involved.

Regarding this occasional paper I want to thank my colleague and project director Dr. William Collins for his constructive criticism and helpful support in finalizing the paper. I am also grateful to Mr. Tony Knowles, the Manager of the Private Sector Development unit of CAREERE, for his useful comments regarding earlier versions of this paper. Finally I want to thank Mr. Keo Lot for translating this occasional paper into Khmer with great care.

# Table of Contents

Chapter One	5
<b>Introduction</b>	
Chapter Two	7
<b>Brick Manufacturing in North West Cambodia</b>	
2.1 The brick and Tile Industry	7
2.2 Classification of Brick Enterprises	9
Chapter Three	15
<b>Brick and Tile Manufacturing</b>	
3.1 The Products	15
3.2 The Production Process	16
Chapter Four	25
<b>Brick Enterprises in North West Cambodia: the Case Studies</b>	
4.1 Introduction	25
4.2 General Features of the Factories Researched	25
4.3 Business Economic Aspects of the Enterprises Analyzed	28
Chapter Five	31
<b>Conclusions and Recommendations</b>	
5.1 Some Concluding Remarks	31
5.2 Some Recommendations	33
<i>Glossary</i>	37
<i>References</i>	39
<i>Map of Cambodia</i>	41
Appendix 1: Brick Factories in Cambodia	43
Appendix 2: Income Statement of a Brick Plant	47
Appendix 3: Technical Data of a Brick Plant	49

# Chapter One

## Introduction

The beginning of this decade witnessed a shift in Cambodia from a centrally planned to a market economy. This resulted in an enormous increase in entrepreneurial activities, as described in our previous study on the rice milling industry in North West Cambodia.<sup>[1]</sup> A similar development can be seen in the brick and tile producing industry, subject of this CAS Occasional Paper. One of our informants told us that when he set up his brickyard in Banteay Meanchey Province in 1990 there were only one or two other businesses engaged in the production of bricks in that area. Currently, in 1999, there are about 15 brick and tile factories in Banteay Meanchey Province. In Battambang Province a similar growth in brick related enterprises took place.

In this rapidly changing business-economic climate the Private Sector Development (PSD) unit of CARERE (Cambodia Area Rehabilitation and Regeneration Project) has supported the formation of private business associations in North West Cambodia. In 1997 the PSD Unit facilitated the establishment of two Battambang and one Banteay Meanchey Rice Millers Associations. Before long, another industrial sector in the North West, the brick and tile industry, saw similar developments: two associations of brick and tile manufacturers, one in Battambang and one in Banteay Meanchey Province, were formed.<sup>[2]</sup>

The PSD Unit commissioned the Center for Advanced Study (CAS) to conduct micro economic research at brick and tile plants operated by members of the newly formed Associations, in order to get a better understanding of the competitive state of these enterprises. CAS was well positioned to undertake this task as their small business research team just had completed a similar series of case studies of the rice mills belonging to the Rice Millers Associations in both Battambang and Banteay Meanchey Province.<sup>[3]</sup> The Executive Committees of the two Brick and Tile Manufacturers Associations identified and selected six brick factories at which CAS conducted detailed case studies.

This overview is meant to accompany the six resulting case studies. These case studies have been presented to the Associations and the management of the enterprises examined, discussing the different business-economic profiles of the plants studied. Because of the confidential character of the six case studies, this occasional paper - which is intended for general circulation independent of the case studies - does not present the detailed data included in the case studies. Chapter two describes the history of the brick industry in the North West of Cambodia and presents a picture of the differentiation of the various brickyards of the industry. The third chapter details the manufacturing process. Chapter four discusses the six case studies. The fifth chapter concludes with remarks regarding the Associations and their future role in the construction industry.

## Chapter Two

### Brick Manufacturing in North West Cambodia

#### 2.1 The Brick and Tile Industry

Although 85 percent of Cambodia's population lives in rural areas, the working population is not exclusively engaged in agricultural activities. There is an important non-agricultural or non-farm sector that is likely to grow and make a significant contribution to rural incomes. This sector includes a wide variety of economic activities in trade, transport, services and manufacturing. The latter sub-sector, rural based small scale manufacturing has been recognized as an area of great promise in private sector development in Northwest Cambodia where otherwise development efforts have largely focused on the agricultural sector. The recent establishment of private business Associations in both the rice milling and brick manufacturing sectors confirm this.

*A recently built boat kiln along the road from Battambang to Pursat*

The brick and tile manufacturing industry is very young in its present market-oriented form. After independence in 1953 until 1975 there were only a few brick plants in Cambodia. One of our interviewees told us there were only five factories in Battambang province, mainly owned by rich Chinese. During the Khmer Rouge regime only a handful factories were allowed to operate. One of these was a factory in Mongkol Borey District, now in Banteay Meanchey Province. The owner explained:

*"At that time they warned us many times. They said: 'If you can not make a good brick or if there are too many broken bricks, you will be killed!'"*

In the eighties the PRK regime (People's Republic of Kampuchea) rebuilt the destroyed pre Khmer Rouge brickyards and started to manage them as state factories. They even expanded some plants, resulting in factories with 8 to 12 kilns. During this period there was one large brick plant in Battambang Province, which supplied the whole province, which at that time still included the area that is now Banteay Meanchey Province. Banteay Meanchey became a separate province in 1989. The early nineties saw a resurgence of entrepreneurial activities in the brick and tile industry resulting from the national economic growth and the related expansion of the construction industry.

Today there are between 500 and 600 brickyards in Cambodia. In 1997 the Ministry of Industry, Mining and Energy carried out a survey on the number and type of brick factories in Cambodia.<sup>[4]</sup> The figure below shows the most important provinces in Cambodia regarding brick manufacturing and the two provinces in which the brickyards subject to this research are located, Battambang and Banteay Meanchey Province.<sup>[5]</sup>

No	Province/City	No. of Plants	No. of Factories per Production Capacity (10,000 pieces/year)						
			<20	20-50	50-100	100-200	200-300	300-500	>500
1	Kompong Cham	81	39	38	4				
2	Kandal	76	13	53	7				3
3	Phnom Penh	73	3	41	13	10	2		4
4	Kompong Thom	48		33	13	2			
5	Battambang	26	13	13					
6	Banteay Meanchey	13	11		2				
	<b>Total</b>	<b>317</b>	<b>79</b>	<b>178</b>	<b>39</b>	<b>12</b>	<b>2</b>		<b>7</b>

Figure 1: Brick Factories in six Cambodian Provinces <sup>[6]</sup>

The first four provinces in this figure, Kompong Cham, Kandal, Phnom Penh and Kompong Thom, comprise 62 % of the total number of brickyards in the Kingdom of Cambodia. Battambang and Banteay Meanchey Provinces combined have only 29 brick plants or about nine percent of the total number of brickyards. However, we should also take into account that the population of Battambang and Banteay Meanchey Province together is only 12 % of Cambodia's total population (a predominantly rural population with, in general, a low demand for bricks). The other four provinces serve the brick demand of the more urban parts of the country. These latter four provinces account for about 37 % of the total Cambodian population. <sup>[7]</sup>

At the time of our research - November 1998 until February 1999 - there were, according to those surveyed, approximately 30 brickyards in Battambang Province and 15 in Banteay Meanchey Province, a slight increase from the Ministry's estimate of 1997. <sup>[8]</sup> Of the 30 brick factories in Battambang Province 24 are members of the newly formed Associations. The Banteay Meanchey Brick Manufacturers' Association has 12 members. Members of both Associations expect that most brick manufacturing enterprises will eventually join, once the Associations show their merit. <sup>[9]</sup>

## 2.2 Classification of Brick Enterprises

There are several ways to categorize businesses in general and the same is true for brick enterprises. One way to do this, is to look at the output of a factory. Figure 1 above - based on the Ministry of Industry, Mining and Energy production statistics - is an example of this. Another way to classify businesses is to look at the number of employees, its total capital and whether or not the enterprise is licensed, as is shown in Appendix 1. <sup>[10]</sup>

*A loh moul or round kiln being heated by rice husk*

It is also possible to group factories by the number of extruders, i.e. the machine which extrudes the bricks out of the raw clay. <sup>[11]</sup> This can be a very decisive factor: Arghiros

mentions in his paper on the brick industry in central Thailand<sup>[12]</sup> that the number of extruders has an important impact on labor and productivity issues (Arghiros 1997,a). In fact, he distinguishes between mechanized and non- mechanized production methods:

*"In non-mechanised brickyards bricks are moulded by hand. Machines are sometimes used to mix brick earth, but never for other stages of production. Mechanised brickyards use machines (technically called extruders) to form the bricks. (.....) The operation of extruders, the output of which amounts to 15,000 bricks a day, requires a minimum of about ten workers (Arghiros 1997, a:8)."*

This distinction can not be made in either Battambang or Banteay Meanchey Province since all the brick factories are mechanized, i.e. they all use extruders. This is probably due to the fact that it is a very young industry, while those in central Thailand were set up in the seventies and eighties. In Battambang and Banteay Meanchey, however, we only observed brickyards using one extruding machine. The owners said that operating one extruder was sufficient to supply the kilns with the bricks needed to fulfil market demand. In and around Phnom Penh there are brickyards which operate two or more extruders.

This report aims to take a holistic approach, as in the first study of the rice milling sector. Instead of focusing on small enterprises as a sector, we examine the position of small businesses in relation to suppliers of input, distributors of output and its larger competitors, the so-called subsector approach (Boomgard et al, 1991). In other words, this method selects a group of businesses related to specific products, in this case bricks (and to a certain extent roof tiles) as the research focus and explores its structure. However, due to time and budget restraints we were not able to examine the whole construction materials sector. Subsequent studies should focus on the larger context of the brick plants researched in this project.

The respondents in our research use three classifiers when they judge a brickyard. The first one is the distinction between a *loh ut krusaa* or family kiln and a *loh ut krom hun* or kiln enterprise. The second distinction regards the number of brick kilns a factory has (and sometimes also the combined capacity of the kilns, i.e. the number of bricks that can be stored inside the kilns). Another way to classify brick enterprises is to look at the types of kiln they use to fire the extruded bricks.

A *loh ut krusaa*, i.e. family kiln, is a small scale brickyard that only engages family labor in its production process. These family kilns are usually located far away from the main roads and only supply bricks at the village level. According to our informants there are only a few of this type left in Battambang and Banteay Meanchey Province. *Loh ut krom hun*, or kiln enterprises, on the other hand, one can see along the main roads near the provincial capitals Battambang City and Sisophon. These factories employ labor from neighboring villages.

The distinction between *loh ut krusaa* and *loh ut krom hun* is very similar to the description of three different types of Thai brickyards provided by Arghiros (Arghiros 1997,a). He distinguishes petty commodity producers, petty capitalist producers and capitalist producers, a distinction based on their relation to labor and mechanization. Petty commodity producers are typically operated by the owner, using non-waged labor. "(...) Capital accumulation occurs through the extraction of surplus value from such labour, including that of the

owner-operator"(Arghiros 1997,a). These factories are non-mechanized or have a very low level of mechanization.

Petty capitalist producers, by contrast will have introduced greater mechanization into the brick and tile manufacturing process. Thus they will require a larger labor force with a more complex division of labor and wage payment based on the time worked, in addition to a core of family employees. The key to productivity in such a business is assuring the industrial discipline of the rural workforce by skillful management techniques of the entrepreneur.<sup>[13]</sup>

#### *The foundation of a square kiln*

Capitalist production and petty capitalist production are differentiated by both production relations and production scale. In a capitalist production method the labor is employed exclusively through wage payments (Arghiros 1997,a). As the scale of such factories increases and earth moving machinery, lift trucks and mechanized kilns are introduced, the adjective 'petty' is no longer appropriate.

The majority of the brickyards in the North West of Cambodia fall into the second category, that of petty capitalist producers. Most of them employ laborers but the owners themselves are also involved in the production. However, more than half of the production output is generated by paid labor, classifying it as a petty capitalist producer rather than a petty commodity producer (Cook and Binford, 1990). Except for the use of an extruder to shape the bricks, these Cambodian enterprises are hardly mechanized.

A second way to classify brickyards is by the number of kilns, according to our interviewees. At the plants we visited this number varied from two to four kilns. However, most of them had only two kilns in operation: one was usually being fired while the other was being packed or unpacked. The packing capacity, i.e. the number of bricks that can be loaded into the kilns, varies from 14,000 to 50,000 bricks.

#### *A brickyard with three elephant kilns*

The type of kiln used is another distinction that brick entrepreneurs in Battambang and Banteay Meanchey make. They differentiate four types: *loh chung* or *loh carre*, i.e. square kiln, *loh moul* or round kiln, *loh damrei* or elephant kiln and *loh tuuk*, i.e. boat kiln.<sup>[14]</sup> The square kiln is the most popular one, especially the last few years. Whenever we visited a brickyard and they were building a new kiln, it was a square one. The *loh carre* has no roof and because of that is very easy to pack and unpack. The disadvantage is that a substantial amount of heat is lost during the firing process increasing fuel costs.



	Type of kiln	Average Size (meter)	Storage Capacity (bricks)
1	Square Kiln	7 x 6 x 4	50,000 pieces
2	Round Kiln	5 (diameter) x 6	50,000 pieces
3	Elephant Kiln	7 x 3 x 3	16,000 pieces
4	Boat Kiln	19 x 4 x 3	45,000 pieces

*Figure 2: Four Types of Kiln*

The *loh moul* is a rather high kiln that can store large numbers of bricks. It is also suitable for manufacturing roof tiles. This type of kiln is often seen at the family operated enterprises. The disadvantage of their size is that it takes a long time to pack and unpack. The *loh damrei*, i.e. elephant kiln is so-named because the shape of the kiln and chimney resembles the trunk of an elephant. It has a stove in front of the kiln and a chimney in the back.

The fourth type of kiln is the *loh tuuk*, i.e. boat kiln. The shape looks similar to that of the elephant kiln, but it has openings for firing the bricks on both sides, which look like eyes (this kiln is also called *loh pneek* or eyes kiln). Because of these "eyes", the length of this type of kiln is in principle unlimited, while the maximum length of an elephant kiln is 7 meters, according to our informants.

# Chapter Three

## Brick and Tile Manufacturing

### 3.1 The Products

Although this chapter is titled 'brick and tile manufacturing', we mainly discuss the production of bricks. Roof tiles form a small part of the output of the factories we visited and of the industry as a whole in North West Cambodia. Brick making is nearly always the main activity of a plant. This is partly due to the fact that Cambodian tile manufacturers face severe competition from Thai and Vietnamese producers.<sup>[15]</sup> Another reason the entrepreneurs mentioned is that tile manufacturing is a much more complicated process than the production of bricks.

*Examples of the three products manufactured in North West Cambodia*

Basically, the output of this sector can be categorized into three types of product: hollow bricks, solid bricks and roof tiles. Of the two kinds of bricks, hollow bricks are by far the most popular, accounting for up to ninety percent of total output. Solid bricks are normally used for the foundation of buildings because of their weight bearing capacity. Hollow bricks usually only occupy space. In the kiln, solid bricks are used as foundation and to cover the hollow bricks. Roof tiles are normally fired in the same kiln as bricks, though the manufacturing and drying period for tiles is much longer. The sizes of the three products are standardized, with some local variation. Figure 3 indicates the average size and weight of each product.

No	Product Type	Size of the Product			Weight
		Length	Width	Height	
1	Hollow Brick	190 mm	90 mm	90 mm	1.5 kg
2	Solid Brick	190 mm	90 mm	45 mm	1.0 kg
3	Roofing Tile	320 mm	210 mm	20 mm	2.0 kg

*Figure 3: Characteristics of North West Cambodian Bricks and Roof Tiles* <sup>[16]</sup>

In general, bricks can be described as blocks of tamped clay molded to suitable shapes and sizes while still in a plastic condition (Surendra Singh 1987:32). Bricks are broadly classified into the two categories of sun-dried bricks and burnt bricks. The first type of bricks are dried in the sun after molding and can only be used in the construction of temporary structures. This brick manufacturing method is very common in Africa and for example India, but is not used in Cambodia to our knowledge.

The brickyards in Battambang and Banteay Meanchey Province without exception use the second producing method of burning or firing the bricks. The resulting brick is one of the oldest and most extensively used local construction materials. Bricks are popular as a material for construction because they are locally available, cheap, strong, durable and have insulating properties against heat and sound (Surendra Singh, 1987:32).

Tiles are thin slabs used for covering roofs, for flooring or for making drains (Surendra Singh, 1987:62). In Battambang and Banteay Meanchey Province only the first type, the roofing tile is produced. The other two tile types are imported from Thailand and can be bought at local markets. Tiles can either be formed of brick-earth burnt in kilns or concrete. The enterprises we visited used the same kilns for both bricks and roof tiles. [\[17\]](#)

### 3.2 The Production Process

Producing bricks, and even more so for roof tiles, is time consuming. None of the plants we visited manufactured these products in less than a month. In the wet season it takes a longer time, since the drying period of the extruded clay bricks takes longer. Although there are many different operational practices at the factories we studied, there are always seven steps involved in the manufacturing process of both hollow and solid bricks. Figure 4 below indicates the separate phases of the process.

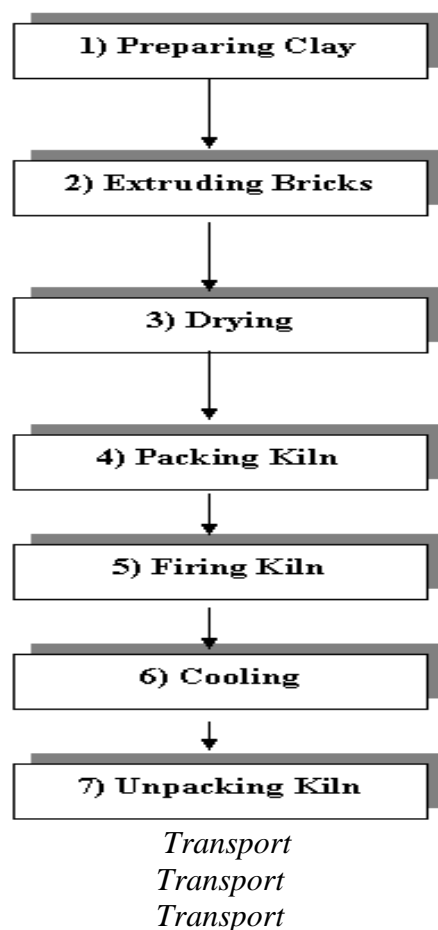


Figure 4: The Phases of the Brick Manufacturing Process [\[18\]](#)

In fact, there is one more phase at the beginning of the process to assemble the raw materials, before the preparation of the clay. But since this may be undertaken either by the brick making enterprise or by an outside contractor, we did not include it in the manufacturing process. Raw clay may be extracted from a clay pit on the factory's property by either hand labor or a rented bulldozer or - as often is the case - bought externally. Many plants purchase clay - even though they have large clay reserves of their own - since the price of clay is very low.<sup>[19]</sup> Once clay has been stockpiled at the factory site, the manufacturing process of bricks can commence.

### *Phase 1: Preparing the Clay*

Preparation of the clay is the first phase of the manufacturing process. In this phase the non-clay substances like grass, stones and rocks are first separated from the raw material. After this, the clay is moistened with water. The next day the workers start to dig up the clay for extruding. If the clay is too wet they add some ash to make it more suitable for extruding. Sometimes they also add sand or rice straw.<sup>[20]</sup> The workers, usually four to six persons, mix these substances with their feet and hands before the resulting clay mixture is taken to the extruding machine.

Extruding bricks from the clay is the next step in the manufacturing process. Usually, six people are needed to operate the extruding machine: one worker digs the clay up and gives it to the second worker who puts it in the extruder. The third laborer cuts the bricks that emerge from the extruder and the fourth puts the resulting bricks on a cart. Two other workers take the cart to the storage area. Daily they can produce - on average - about four thousand hollow bricks or eight thousand solid bricks (depending on the capacity of the extruder).

### *Phase 2: Extruding the Bricks*

The third phase is the drying period. In this period, which can last ten to twenty days, depending on the weather and the quality of the clay, the extruded bricks are stored under sheds at the site of the plant.<sup>[21]</sup> During the drying period the bricks are moved several times: the first few days the bricks are stored vertically in pairs of six together (not stored on each other because of the weakness of the just-extruded bricks). The next period of time the extruded bricks are stored horizontally in layers of six. The last couple of days they can be stacked as high as ten to twelve layers high.<sup>[22]</sup> The exact number of days in these different positions varies from factory to factory. In general the stacking and restacking is done by three to four people.

### *Phase 3: Drying the Bricks*

The next step is taken when the extruded bricks are dry enough to put them into the kiln. This can take three to ten days, depending on the size of the kiln and the weather conditions. The combination of small kilns and dry weather requires only a few days, while large kilns combined with wet weather might involve nine or ten days of work. After the kiln is filled with bricks, the doors are sealed with clay and ash. In the square and open kilns laborers

also put a layer of ash on top of the extruded bricks. Usually, six to ten laborers are involved in this part of the manufacturing process.

*Phase 4: Packing the Kiln*

*Phase 5: Firing the Kiln*

Once the kiln is packed, the process of firing can start. In Cambodia, two types of fuel are used for this purpose: fire wood and rice husks. In Battambang Province most of the brick plants burn wood to fire their bricks, while in Banteay Meanchey Province factories utilize both wood and rice husks.

The firing process can be subdivided into different phases: the small fire (*pleung touc*), the medium fire (*pleung kandal*) and the big fire (*pleung thom*).<sup>[23]</sup> The length of time of these phases varies from kiln to kiln and sometimes there is no *pleung kandal*. Usually the process takes ten to twelve days. The first few days the kiln is fired with husks or wood in small quantities ("*pleung touc*") in order to get the humidity out of the bricks. The next phase is the *pleung kandal* or medium fire which lasts a couple of days and now much more husk or wood is added to really bake the bricks. The last few days the firing temperature is raised to maximum levels ("*pleung thom*") to give the bricks the needed hardness.

<b>Production Phase</b>	<b>Production Time</b> <sup>[24]</sup>	<b>Laborers Involved</b>
<b>1. Preparing Clay</b>	a few hours	4-6 people
<b>2. Extruding Bricks</b>	10 -12 days	6 people
<b>3. Drying</b>	10 - 20 days	3-4 people
<b>4. Packing Kiln</b>	3 -10 days	6-10 people
<b>5. Firing Kiln</b>	10 -12 days	2 people
<b>6. Cooling</b>	6 - 8 days	not relevant
<b>7. Unpacking Kiln</b>	4 - 8 days	6-10 people
<b>Total:</b>	<b>49 - 70 days</b>	<b>21 - 28 people</b> <sup>[25]</sup>

*Figure 5: Features of the Manufacturing Process*

There are two ways to check the quality of the bricks while they are still being heated in the kiln. The first is to look at the color of the smoke out of the chimney of the kiln: if it is black, the bricks are not ready yet. If the color of the smoke is white, the heating process can be stopped. The second way is to examine the stove, said one of the plant owners. If the color of the fire is white and light, the bricks will have a good quality.

### *Phase 6: Cooling Down*

After this firing period is complete, the bricks must be cooled. This phase takes about six to eight days at most factories. The last day of the cooling period the doors of the kiln are opened to let some of the heat out. [\[26\]](#)

### *Phase 7: Unpacking the Kiln*

In the final phase of the manufacturing process a team of six to ten workers unpack the kiln. This phase usually lasts four to eight days, depending on the size and the type of the kiln. Open square kilns are much easier to unpack (and pack) than the other types of kiln. The bricks are normally stored in front of the plant, ready to be sold.

The manufacturing process of roofing tiles is rather similar to that of bricks. There is only one difference, which is the additional extrusion that is needed. The first extrusion step is the same, apart from the fact that the shape of the extruded clay pieces are round instead of rectangular. These 'rolls' of clay are taken to a hand press machine, which shapes the roofing tiles. During the following period the tiles are stored in wooden frames, before being heated. According to our informants, the best quality roofing tiles are burnt in either elephant or boat kilns (closed kilns). Square kilns cannot be utilized for the production of roof tiles.

# Chapter Four

## Brick Enterprises in North West Cambodia: the Case Studies

### 4.1 Introduction

Commercial brick and roofing tile manufacturing emerged relatively recently in North West Cambodia. The factories we studied either started in the late eighties or in the nineties. This fact one should bear in mind while reading the overview of the six case studies we conducted in Battambang and Banteay Meanchey Province. In business economic terms these enterprises can be defined as start-up companies (Rachman 1990:60). Though these companies are rather young, the experience of the entrepreneurs involved often dates back several decades, as the narratives in the case studies show.

This chapter will examine the characteristics of the six different brick and tile factories we researched. It will first present a schematic overview of these businesses belonging to the two industry Associations in North West Cambodia and focus on the similarities and differences. Subsequently, Section 4.3 will continue the overview of the various enterprises involved by looking specifically at the business economic aspects.

### 4.2 General Features of the Factories Researched

One of the most striking characteristics of a brick and tile plant is the number and the type of kilns. The largest plant we visited in Battambang and Banteay Meanchey Province was government owned, located near Battambang City. It has been producing bricks since the early eighties. Currently, only a few of the ten kilns on the site are operated.

The six brick businesses studied either had two or three kilns in operation. The most common kiln type was the square kiln without roof. Some plants also had an elephant kiln or a boat kiln. None of the plants we researched operated a round kiln. Figure 6 below shows some of the kiln' characteristics.

Factory	Number of Kilns	Type of Kiln	Capacity (Bricks/Kiln)	
Factory 1	3 kilns	- 2 square kilns - <u>1 elephant kiln</u> - 3 kilns:	15,000 + 23,000 16,000	38,000 pieces <u>16,000 pieces</u> 54,000 pieces
Factory 2	2 kilns	- 2 square kilns	2 x 50,000	100,000 pieces
Factory 3	2 kilns	- 2 square kilns	2 x 42,000	84,000 pieces
Factory 4	2 kilns	- 2 square kilns	2 x 50,000	100,000 pieces
Factory 5	2 kilns	- 2 boat kilns	2 x 45,000	90,000 pieces
Factory 6	3 kilns	- 3 elephant kilns	3 x 14,000	42,000 pieces
<b>Total:</b>	<b>14 kilns</b>	<b>14 kilns</b>		<b>470,000 pieces</b>

Figure 6: Features of the Kilns

In the small group of companies we researched there seemed to be no positive correlation between the number of kilns a plant has and the overall production output. Rather, there seemed to be a negative relation as the figure below on production statistics show. The two factories with three kilns process the smallest quantity of bricks, which is partly the result of their sizes. Two similar kilns - making possible an efficient routing of the product - seem to increase the output. As one can see, only two of the researched factories are involved in roof tile production. For factory 5 roof tiles are a substantial part of total production (about a quarter of the total). For plant 6 roof tiles account for only adds up to about 5 percent of production. The revenue derived from roof tiles is, however, more substantial, as we will see in Section 4.3.

Case Study	Brick Production						Tile Production		Total Production (pieces)
	Hollow Bricks	%	Solid Bricks	%	All Bricks	%	Roofing Tiles	%	All Products
1	217,677	94	12,685	6	230,362	100	-	0	230,362 pieces
2	534,000	90	60,000	10	594,000	100	-	0	594,000 pieces
3	622,212	96	28,930	4	651,142	100	-	0	651,142 pieces
4	487,000	76	150,000	24	637,000	100	-	0	637,000 pieces
5	363,200	60	111,150	18	474,350	78	131,390	22	605,740 pieces
6	300,500	72	99,700	24	400,200	96	18,500	4	418,700 pieces
<b>Total</b>	<b>2,524,589</b>	<b>80</b>	<b>462,465</b>	<b>15</b>	<b>2,987,054</b>	<b>85</b>	<b>149,890</b>	<b>5</b>	<b>3,136,944 pieces</b>

Figure 7: Annual Production of Factories in Case Studies

The output of hollow bricks is by far the largest, 80 % of production of the selected factories. Solid bricks amount to fifteen percent of the total production of these six enterprises, leaving only five percent for the roof tiles. An important factor affecting the productivity of these brick and tile businesses seems to be the availability of storage space. After the bricks or tiles have been extruded, they need a period of time to dry before they can be put in the kiln. The area available for storing differs widely from plant to plant. As one can see in Figure 8 below, there are large differences regarding space usage. Some have to be very efficient because of the lack of space, while others do not have to economize on space because they have room enough for stacking and restacking. Figure 8 shows the variety in storage capacity of the six enterprises researched, based on the information provided by its managers.



Factory	Estimated Storage Capacity		
	<i>Measurable Storage Area (m<sup>2</sup>)</i>	<i>Maximum Quantity Stored (pieces)</i>	<i>Calculated Pieces/square meter</i>
<b>Factory 1</b>	440 m <sup>2</sup>	50,000 pieces	113 pieces/m <sup>2</sup>
<b>Factory 2</b>	900 m <sup>2</sup>	60,000 pieces	66 pieces/m <sup>2</sup>
<b>Factory 3</b>	1,410 m <sup>2</sup>	113,500 pieces	80 pieces/m <sup>2</sup>
<b>Factory 4</b>	720 m <sup>2</sup>	40,000 pieces	55 pieces/m <sup>2</sup>
<b>Factory 5</b>	3,014 m <sup>2</sup>	125,000 pieces	41 pieces/m <sup>2</sup>
<b>Factory 6</b>	420 m <sup>2</sup>	58,000 pieces	138 pieces/m <sup>2</sup>

*Figure 8: Storage Capacity of the Businesses Involved*

The manufacturing process of both bricks and tiles is very labor-intensive. Section 4.3 shows that labor expenses take up a large part of the plant's budget. This rural type of enterprise usually employs in between 15 and 30 people. Figure 9 below shows the number of workers in the factories studied. It also presents the time it takes to manufacture one kiln load of output for each plant.

Factory	Number of Employees <sup>[27]</sup>	Production Cycle (days) <sup>[28]</sup>	Output of Bricks
<b>Factory 1</b>	15 - 20 people	45 - 55 days	16,000 pieces
<b>Factory 2</b>	25 - 30 people	50 - 60 days	50,000 pieces
<b>Factory 3</b>	20 - 27 people	35 - 45 days	42,000 pieces
<b>Factory 4</b>	15 - 25 people	40 - 50 days	50,000 pieces
<b>Factory 5</b>	20 - 25 people	40 - 45 days	45,000 pieces
<b>Factory 6</b>	15 - 16 people	30 - 40 days	14,000 pieces
<b>Total</b>	<b>110 - 143 people</b>		

*Figure 9: Time and Labor Involved in the Production Process*

*Rice Husk is one of the Fuel Sources of Brick and Tile Plants*

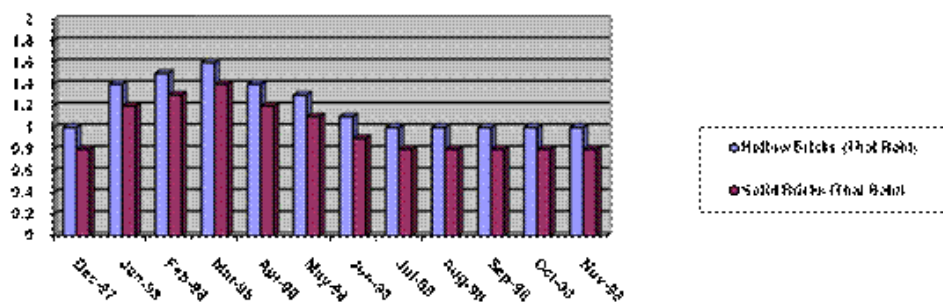
Factory	Fuel Usage			Clay Usage	
	Fire Wood	Rice Husk <sup>[29]</sup>	Diesel	Own Clay (m <sup>3</sup> )	Purchased Clay (m <sup>3</sup> )
Factory 1	460 m <sup>3</sup>	-	500 l	-	300 m <sup>3</sup>
Factory 2	12 m <sup>3</sup>	18,000 bags	3,000 l	1,000 m <sup>3</sup>	
Factory 3	75 m <sup>3</sup>	27,000 bags	3,232 l	1,500 m <sup>3</sup>	
Factory 4	59 m <sup>3</sup>	23,000 bags	1,405 l	949 m <sup>3</sup>	
Factory 5	850 m <sup>3</sup>	-	2,419 l		1,038 m <sup>3</sup>
Factory 6	240 m <sup>3</sup>	10,800 bags	1,837 l		738 m <sup>3</sup>
<b>Total</b>	<b>1,696 m<sup>3</sup></b>	<b>78,800 bags</b>	<b>12,393 l</b>	<b>3,449 m<sup>3</sup></b>	<b>2,076 m<sup>3</sup></b>

*Figure 10: Fuel and Raw Material Statistics*

Rice husk and fire wood are the most popular sources of fuel for kiln firing in Cambodia. Four of the six factories studied use a combination of husk and wood to fire the kiln products, with rice husk being the main fuel. Figure 10 presents the total fuel usage of these plants, including diesel utilized for extruding the bricks. It also shows whether or not factories use their own clay or whether they purchase the raw material elsewhere. It turned out that the three brick plants in Battambang Province (plant 1, 5 and 6) purchase clay, while the plants in Banteay Meanchey Province use clay from their own plots of land.

### 4.3 Business Economic Aspects of the Enterprises Analyzed

The financial analyses in the six case studies presented detailed descriptions of the micro economic state of affairs at these enterprises. These analyses concluded that all of the plants studied were in financially healthy positions. Only one of the plants had meager results, but this was probably due to the fact that it was only in its first year of operation. In general, the businesses are faring well. This section intends to disclose some of the micro economical aspects of the brickyards and the business environment in which they operate.



*Figure 11: Prices of Hollow and Broken Bricks (Thai Baht per Brick)*

Although neither bricks nor tiles are agricultural products, there seems to be a seasonal influence on the prices of these items. The price is high in the dry season and low in the wet season (an opposite fluctuation to rice prices). This is mainly due to the fact that the dry season (January-May) is also the main construction season, therefore demand for both bricks and tiles is high. Figure 11 shows the monthly price trend for bricks, based on the account books of one of the participating brick enterprises in Banteay Meanchey Province.

Production expenses, on the other hand, are lower in the dry season than in the wet season. Production periods are shorter because of the dry weather, rice husk is cheap because of its abundance at the rice mills resulting from the harvest, fire wood is cheaper due to easier and faster transport possibilities. We expected labor to be more expensive in the dry season - because of high rural labor demand during harvest time -, but this was not the case. The plant managers agreed that workers were harder to recruit during this period, but only one plant paid more for labor during harvest time. Given the lower production costs and the higher selling prices, one could say that the dry season is the money making season for brick entrepreneurs.

Production Phase	Costs per Kiln Load <sup>[30]</sup> (16,000 Bricks)			Economic Value Added per Brick <sup>[31]</sup>
<b>1. Preparing Clay</b>	- clay: 80,000 Riel	800 Baht		
<b>2. Extruding Bricks</b>	- labor: 112,000 Riel	1,120 Baht	14 Riel/brick	0.14 Baht
	- diesel: 32,000 Riel	<u>320 Baht</u>		
	total: 224,000 Riel	2,240 Baht		
<b>3. Drying</b>	- labor: 120,000 Riel	1,200Baht	7.5 Riel/brick	0.075 Baht
<b>4. Packing Kiln</b>	- labor: 36,000 Riel	360 Baht	2.25 Riel/brick	0.0225 Baht
<b>5. Firing Kiln</b>	- labor: 36,000 Riel	360 Baht		
	- firewood:460,000 Riel	<u>4,600Baht</u>	31 Riel/brick	0.31 Baht
	total: 496,000 Riel	4,960Baht		
<b>6. Cooling</b>	no labor or other costs	-	-	-
<b>7. Unpacking Kiln</b>	- labor: 36,000 Riel	360 Baht	2.25 Riel/brick	0.0225 Baht
<b>Total:</b>	<b>912,000 Riel</b>	<b>9,120Baht</b>	<b>57 Riel/brick</b>	<b>0.57 Baht</b>

Figure 12: Factory 1: Illustrative Kiln Costs and Value Added

The major components of the above mentioned production costs are expenditures for fuel and labor, successively 54 % and 37 %. The value of clay is the remaining 9 percent of the cost price and is rarely mentioned in the income statements<sup>[32]</sup> of brick and tile plants, since the owners regard the clay as their property and hence not a cost.

Fuel expenses can be subdivided into rice husk, fire wood and diesel costs. Diesel consumption is not a large part of the total production expenses (in this case only 7 percent of the fuel costs or 4 percent of the total costs). If fire wood is the main fuel for firing the kilns - like at factory 1 -, it can amount to more than 30 percent of the total expenses. Rice husk is much cheaper than fire wood, but is considerably harder to obtain in the rainy season.

Labor expenses are, in general, at least 35 percent of the total operating expenses. However, at some of the plants labor costs totaled up to 70 percent of the expense budget. The labor activities are usually divided amongst a number of groups of workers. The number of groups can vary from four to six, based on whether certain activities are combined or not. For example, often the laborer team packing the kilns is the same team that unpacks it. Likewise, often the preparation of the clay is done by the same team which does the extrusion of the bricks.

Factory	Average Production Costs		Average Selling Price		
	Brick <sup>[33]</sup> (Thai Baht)	Roofing Tile (Thai Baht)	Hollow Brick (Thai Baht)	Solid Brick (Thai Baht)	Roofing Tile (Thai Baht)
<b>Factory 1</b>	0.57 Baht	-	1.06 Baht	0.96 Baht	
<b>Factory 2</b>	0.67 Baht	-	1.20 Baht	1.00 Baht	
<b>Factory 3</b>	0.32 Baht	-	1.16 Baht	0.94 Baht	
<b>Factory 4</b>	0.60 Baht	-	1.36 Baht	1.07 Baht	
<b>Factory 5</b>	0.44 Baht	0.67 Baht	1.17 Baht	0.96 Baht	3.20 Baht
<b>Factory 6</b>	0.63 Baht	0.76 Baht	0.98 Baht	0.93 Baht	3.29 Baht
<i>Average:</i>	<i>0.54 Baht</i>	<i>0.72 Baht</i>	<i>1.16 Baht</i>	<i>0.98 Baht</i>	<i>3.25 Baht</i>

Figure 13: Average Cost and Selling Prices at the Different Factories

It is interesting to see the differences in cost price at the factories researched, due to different circumstances and different ways of handling these. The variation in selling price results from different markets: plant 1, 5 and 6 are located in Battambang Province, the others in Banteay Meanchey Province.

Factory	Profit Margin					
	Hollow Brick (Thai Baht)		Solid Brick (Thai Baht)		Roofing Tile (Thai Baht)	
	Value (Thai Baht)	%	Value (Thai Baht)	%	Value (Thai Baht)	%
<b>Factory 1</b>	0.49 Baht	46 %	0.39 Baht	41 %		
<b>Factory 2</b>	0.53 Baht	44 %	0.33 Baht	33 %		
<b>Factory 3</b>	0.84 Baht	72 %	0.62 Baht	66 %		
<b>Factory 4</b>	0.76 Baht	56 %	0.47 Baht	44 %		
<b>Factory 5</b>	0.73 Baht	62 %	0.52 Baht	54 %	2.53 Baht	79 %
<b>Factory 6</b>	0.35 Baht	36 %	0.30 Baht	32 %	2.53 Baht	77 %
<i>Average:</i>	<i>0.62 Baht</i>	<i>53 %</i>	<i>0.44 Baht</i>	<i>46 %</i>	<i>2.53 Baht</i>	<i>78 %</i>

Figure 14: Average Profit Margins per Product

Selling hollow bricks generates the highest revenues, due to the large quantities sold. Revenues from selling solid bricks usually amounted to 10 percent of the total revenues, with 90 percent from selling hollow bricks. Furthermore, the factories also earn a bit more per piece of hollow brick sold: on average 53 % of the selling price of hollow bricks is profit, while this margin for solid bricks is 'only' 46 %, as figure 14 shows. However, the profit margin per piece sold is by far the highest for roof tiles, on average around 78 %. Despite considerable investment, manufacturing roof tiles is an extremely profitable business, according to our data.

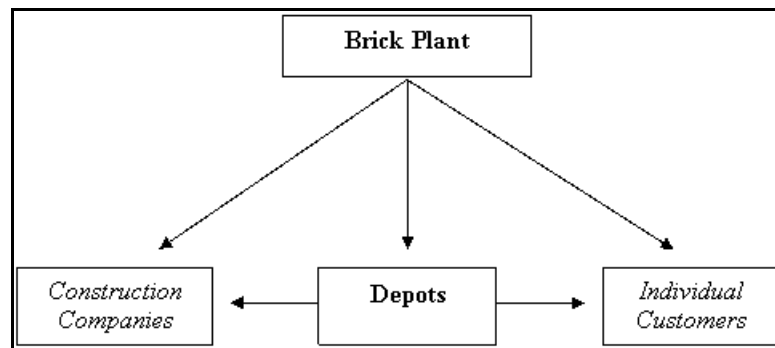
# Chapter Five

## Conclusions & Recommendations

### 5.1 Some Concluding Remarks

The past ten years have been rather successful ones for the six brick and tile factories studied, due to the "booming" economy of the nineties after two decades of civil war. It is interesting to note that there were three short, but relatively difficult, periods for this industrial sector, all related to political occurrences. The elections in both 1993 and 1998 and the political events of July 1997 caused some uncertainties in the construction market. These political occurrences can be easily identified in the accounting records of these businesses. Decreasing quantities sold and lower prices are clear evidence of the relation between the political and the business economic environment.

The construction markets in which these enterprises operate can be characterized as having short distribution channels, i.e. the route that products follow on their way from the producer to the end user (Rachman 1990:346). The products move either directly from production plant to end user or indirectly via a *depot*, or construction materials shop at the retail level.<sup>[34]</sup> The brick and tile plant itself plays the role of wholesaler. Apart from the local retailers there are no other middlemen involved in distribution. The figure below illustrates these channels.



*Figure 15: Distribution Channels of Brick Plants*

Brick and tile factories have three types of customers: local retailers, construction companies and individual customers. At most of the plants the retailers are the largest customers, i.e. they purchase the main part of the factory's output. Construction companies either buy their bricks from a retail "depot" or - if they are large - from the plant directly. Individual customers usually purchase "large" quantities, i.e. to build a house, at the factory or at a depot. For "small" quantities - when they need some additional bricks for miscellaneous purposes - they visit a depot.

There are significant differences between the provincial markets of Battambang and Banteay Meanchey. In general the prices of both bricks and roof tiles are higher in Banteay Meanchey than in Battambang Province. The average price level of, for instance, hollow bricks at plants in Banteay Meanchey during December 1997 to November 1998 was around 1.20 Thai Baht, while in Battambang Province it was only around 1.00 Thai Baht. According to our informants the prices in Banteay Meanchey were higher because of the combination of a higher demand and a relatively small number of brick factories. Their relatively isolated location due to poor road conditions protected them from cheaper products from Battambang Province. Recently, some bricks have arrived from Battambang Province and in some cases even from Phnom Penh, where the average selling price is even lower: around 75 Riel for a hollow brick (about 0.75 Thai Baht). It is reported that Phnom Penh shippers use their empty trucks, which are destined to pick up cargo from Thailand in Poipet, to transport bricks to both Battambang and Sisophon on the journey from Phnom Penh.<sup>[35]</sup> Once the government of Cambodia has upgraded its rural infrastructure, the members of the Brick and Tile Manufacturers Associations in the North West will face increased competition from cheaper bricks made in the Phnom Penh area.

## **5.2 Some Recommendations**

Cooperation among rural industries can be very useful in improving the efficiency of the enterprises involved. In both developing and developed countries there is mounting evidence that networking and clustering small- and medium-sized manufacturers helps raise their competitiveness (Humphrey & Schmitz, 1996). A study by H. Sandee of the roof tile industry in Central Java, Indonesia, revealed that successful innovation in the industry required joint action through collaboration of the involved entrepreneurs (Sandee, 1995:179). In the Kingdom of Cambodia, the newly formed Rice Millers Associations in Battambang and Banteay Meanchey Province are successful in bidding for rice tenders and negotiating bulk fuel supplies.

Regarding the brick industry, a report of the Food and Agriculture Organization of the United Nations (FAO, 1993) recommended that government and development specialists support the setting up of national brick manufacturers' associations throughout Asia. The rationale for this suggestion is that entrepreneurs could share information and technology and pressure their respective governments to improve the conditions of the industry (Arghiros, 1997,a). Arghiros mentions justly that such support for the industry is "laudable", but that equal attention should be given to the interests and needs of the laborers (Arghiros, 1997, a:15). This occasional paper did not focus specifically on labor issues at brick plants so far. However, a few remarks are included here.

The labor conditions at most plants can be described - certainly at specific phases of the production process - as dangerous to workers' health. The extruding machines lack any safety devices. At each factory one heard stories of laborers who have been injured while operating extruding machines. Accidents also happen when packing and unpacking the kiln; laborers may be ordered to go into kilns to take the bricks out to speed up the production process, when the temperature is still too hot for safety.

### *Working at a Brick Plant*

Child labor is not as common in the brick and tile industry as one might expect. Only one out of six factories seemed to make use of child labor in a systematic way. It looks as if the factories just utilize whatever labor is available around the plant's site, regardless of age. The allowable minimum age for wage employment is set at fifteen years, according to article 177 of the Cambodian Labour Law. However, this article also mentions that "the minimum allowable wage for any kind of employment of work, which, by its nature, could be hazardous to the health, the safety, or the morality of an adolescent, is eighteen years" (Cambodian Labour Law, Article 177.2). As rule of law becomes more established and as international standards become more important in Cambodia in the future, the brick plant owners and their Associations must pay more attention to these issues. The brick plant managers must learn that the well-being of their laborers is related to the success of their companies.

Another problem facing individual brick entrepreneurs and the Associations in general relates to the usage of fuel, especially the use of fire wood. When we paid our last visit to the brick factories under study in Battambang Province, it turned out that the government's ban on the logging of wood had turned into a prohibition of wood transport and usage in the province. This posed a problem for many of the brick plants in the area, since their kilns are designed for the use of wood. A switch to rice husk burning involves a small, but important investment. One of the brick plant managers we visited had already begun to rebuild his kiln to adjust to new operating conditions.

### *Reconstructing a kiln for use of rice husk*

The original purpose of both the Brick and Tile Manufacturers Associations is to improve the trading and producing of bricks and roof tile products (Statute of the Association of Bricks and Roofing Tiles Manufacturers, 1998). According to this statute, the Association and its Executive Committee shall:

**Information Collection:** Collect and make available to Association members, market and technology production information from different sources.

**Represent Association Members:** Represent Association Members and facilitate discussions with customers, investors' bankers, NGOs, Development Agencies and government partners.

**Marketing:** Organize and coordinate a marketing strategy and activities to support brick and roof tile selling activities.

**Financial Analysis:** Complete cash flow analysis of members' operations and liaise with banks and financial institutions to develop improved access to lines of credit.

**Production Technology:** Make contact with development agencies, technical institutes and other organizations that can provide assistance in evaluations and transfer of improved production technology to upgrade member's product quality, efficiency and yield.



Until now, the main gain of the Associations has been the trust it has created amongst the members, according to our respondents. One of them said:

*"Before I was always reluctant to visit other brick and tile plants in this area, but now, since I know most of them better, I go to other brickyards more often."*

This gained trust goes so far that they have also started to negotiate selling prices. Some of the involved entrepreneurs see the Associations as perfect mechanisms to set price agreements and keep products from other provinces out. One of the aims of a cartel like that would be to persuade Provincial Authorities to put up trade barriers around their respective provinces, in order to keep cheaper products out. The Associations should beware of this, because in the end they will only really benefit from open markets.

One of the ways to improve the success of the individual entrepreneurs and the Associations as a collective, is to upgrade their business management knowledge through training in accounting, marketing and other related subjects.<sup>[36]</sup> The six case studies will be useful to develop real life, customer oriented brick plant manager training curriculum. The managers of the individual plants can be trained to prepare business plans for their companies, creating eligibility to get access to credit. Subsequently, a business plan at large could be written at the Association's level, providing guidelines for joint future activities.

## Glossary

<i>depot</i>	retail shop
<i>loh ut</i>	brick plant/kiln
<i>loh ut krusaa</i>	family kiln
<i>loh ut krom hun</i>	kiln enterprise
<i>loh carre</i>	square kiln
<i>loh damrei</i>	elephant kiln
<i>loh moul</i>	round kiln
<i>loh pneek</i>	'eyes'- kiln
<i>loh tuuk</i>	boat kiln
<i>loh chrung</i>	square kiln
<i>pleung touc</i>	small fire
<i>pleung kandal</i>	medium fire
<i>pleung thom</i>	large fire
<i>rooteh seh</i>	horse cart
<i>kbung</i>	roofing tile
<i>ut</i>	brick

## References

- *Brick factories in Cambodia*  
Ministry of Industry, Mining and Energy, Phnom Penh, Cambodia, 1997.
- *Child Labour in Cambodia: an overview*  
International Programme on the Elimination of Child Labour, International Labour Office, Bangkok, 1998.
- *General Population Census of Cambodia 1998*  
National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia, 1998.
- *Labour Law*  
Ministry of Social Affairs, Labour and Veteran Affairs, Phnom Penh, 1997.
- *Status and Development Issues of the Brick Industry in Asia*  
Food and Agriculture Organization (FAO), Regional Wood Energy Development Programme in Asia, Rome, 1993.
- *Statute of Banteay Meanchey Bricks and Roofing Tiles Manufacturers Association*  
Association of Banteay Meanchey Bricks and Roofing Tiles Manufacturers, Mongkol Boreiy, February 1998.
- *Summary Report on Various Industries in Banteay Meanchey Province*  
Department of Industry, Mining and Energy, Sisophon, Banteay Meanchey Province, September 1998.
- Arghiros, Daniel  
*Rural Industry and Development in Central Thailand: an alternative approach*, in The Journal of Entrepreneurship, 6,1, Sage Publications, New Delhi/Thousand Oaks/London, 1997, a.
- Arghiros, Daniel  
*The Rise of Indigenous Capitalists in Rural Thailand: profile of brickmakers in the central plains in Small Business Entrepreneurs in Asia and Europe: towards a comparative perspective*, edited by Mario Rutten and Carol Upadhyya, Sage Publications, New Delhi, India, 1997, b.
- Boomgard, J.J. & S.P. Davies & S.J. Haggblade & D.C. Made  
*A Subsector Approach to Small Enterprise Promotion and Research*, in Gemini Workpaper No. 10, Gemini, Washington D.C., 1991.
- Cook, Scott and Binford, Leigh (eds.)  
*Obliging Need: rural petty industry in Mexican capitalism*, University of Texas Press, Austin, 1990.

- Humphrey, J. and H.Schmitz  
*The Triple C Approach to Local Industrial Policy*, Institute of Development Studies, University of Sussex, United Kingdom, 1996.
  
- Rachman, D.J.  
*Business Today*, McGraw-Hill, Inc., New York, 1990.
  
- Rozemuller, H.B.  
*From Pig Rearing to Stock Marketing: rice milling, a broad spectrum of entrepreneurial activities*, CAS Occasional Paper Series No.1, May 1998.
  
- Rozemuller, H.B.  
*Overview of Rice Millers Associations in North West Cambodia*, CAS Occasional Paper Series No.4, October 1998.
  
- Sandee, Henry Mickel  
*Innovation Adoption in Rural Industry: technological change in roof tile clusters in Central Java, Indonesia*, Ph.D. Thesis, Vrije Universiteit, Amsterdam ,1995.
  
- Singh,Gurcharan  
*Building Materials*, Standard Publishers, Delhi, 1996.
  
- Singh, Surendra  
*Engineering Materials*, Konark Publishers, Delhi 1987.

## Appendix 1

### Brick Factories in Cambodia (1997) [\[37\]](#)

#### Appendix 1.1

##### Number of Enterprises, License and Capital

No	Province/City	No. of Factories	License			Capital (USD)	
			Ministry	Dept.	(none)	Fixed	Total
1	Kompong Thom	48	18	2	28	305,156	335,480
2	Svay Rieng						
3	Takeo	5		5		42,000	44,999
4	Prey Veng	5	1		4	28,092	32,206
5	Banteay Meanchey	13	7	2	4	96,760	109,210
6	Krongkep						
7	Stung Treng	5	5		5	5,592	7,712
8	Ratanakiri	3	1		2	11,945	13,611
9	Koh Kong	6	1	2	3	207,795	235,324
10	Siem Reap	20	3		17	41,478	49,880
11	Kompong Chhnang	18	2	14	2	21,229	25,802
12	Kratie	26	2	11	13	60,688	82,092
13	Pursat	23		4	19	23,266	29,103
14	Kandal	76	64	9	3	1,023,384	1,178,231
15	Kompong Cham	81	10	64	7	298,870	442,838
16	Battambang	26	20	3	3	79,707	93,720
17	Kompong Speu						
18	Kampot	13		8	5	41,687	52,314
19	Phnom Penh	73	36	22	15	1,304,150	1,635,300
20	Sihanoukville	5	2	3		186,562	211,520
21	Preah Vihear						
22	Mondul Kiri						
	<b>Total</b>	<b>446</b>	<b>172</b>	<b>149</b>	<b>130</b>	<b>3,778,361</b>	<b>4,579,342</b>

## Appendix 1.2

### Number of Factories by Production Capacity

No	Province/City	No. of Factories	No. of Factories per Production Capacity (10,000 pieces/year)							
			< 20	20 - 50	50 - 100	100 - 200	200 - 300	300 - 400	400 - 500	500 >
1	Kompong Thom	48		33	13	2				
2	Svay Rieng									
3	Takeo	5	2	3						
4	Prey Veng	5		5						
5	Banteay Meanchey	13	11		2					
6	Krongkep									
7	Stung Treng	5								
8	Ratanakiri	3	3							
9	Koh Kong	6	5		1					
10	Siem Reap	20	19	1						
11	Kompong Chhnang	18	14	3				1		
12	Kratie	26		7	18	1				
13	Pursat	23	23							
14	Kandal	76	13	53	7					3
15	Kompong Cham	81	39	38	4					
16	Battambang	26	13	13						
17	Kompong Speu									
18	Kampot	13	2	10	1					
19	Phnom Penh	73	3	41	13	10	2			4
20	Sihanoukville	5	2	3						
21	Preah Vihear									
22	Mondul Kiri									
	<b>Total</b>	<b>446</b>	<b>149</b>	<b>210</b>	<b>59</b>	<b>13</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>7</b>

## Appendix 1.3

### Number of Factories by Number of Laborers

No	Province/City	No. of Factories	No. of factories by No. of Laborers			
			< 9	9-20	21-50	51-100
1	Kompong Thom	48	21	10	15	2
2	Svay Rieng					
3	Takeo	5	2	1	2	
4	Prey Veng	5		4	1	
5	Banteay Meanchey	13	12	1		
6	Krongkep					
7	Stung Treng	5	1	4		
8	Ratanakiri	3	2	1		
9	Koh Kong	6		3	3	
10	Siem Reap	20	18	2		
11	Kompong Chhnang	18	16	2		
12	Kratie	26	5	21		
13	Pursat	23	22	1		
14	Kandal	76	34	42		
15	Kompong Cham	81	11	67	3	
16	Battambang	26	11	13	2	
17	Kompong Speu					
18	Kampot	13	6	7		
19	Phnom Penh	73	11	49	13	
20	Sihanoukville	5	5			
21	Preah Vihear					
22	Mondul Kiri					
	<b>Total</b>	<b>446</b>	<b>177</b>	<b>228</b>	<b>39</b>	<b>2</b>

## Appendix 2

### Brick Plant X

### Income Statement

March 1998

<b>A. Revenues</b>		
- selling hollow bricks:	44,500 x 1.6 Baht =	71,200 Baht
- selling solid bricks:	5,000 x 1.4 Baht =	<u>7,000 Baht</u>
Total Revenues:		<b>78,200 Baht</b>
<b>B. Expenses</b>		
- salaries laborers group 1:	8 x 30 x 30 Baht =	7,200 Baht
- salaries laborers group 2:	6 x 30 x 30 Baht =	5,400 Baht
- salaries laborers group 3:	3 x 30 x 30 Baht =	2,700 Baht
- salaries laborers group 4:	10 x 30 x 25 Baht =	7,500 Baht
- salary worker (kiln heater):	1 x 30 x 100 Baht =	3,000 Baht
- diesel:		4,000 Baht
- husk:	1,500 bags x 4 Baht =	<u>6,000 Baht</u>
Total Expenses:		<b>35,800 Baht</b>
<b>C. Profit:</b>		
- gross profit:		42,400 Baht
- tax expenses:		<u>500 Baht</u>
<i>Net profit March:</i>		<b>41,900 Baht</b>



## Appendix 3

# Technical Data Brick Plant X

**Name:** X Plant  
**Location:** X Village, X Commune, X District, X Province

### Details:

- 1) **Number of Bricks/Cubic Meter of Clay:** - 800 hollow bricks  
- 1,200 solid bricks
- 2) **Ingredients of Extruded Material:**
  - clay
  - water
  - sand
  - ash
- 3) **Number of Extruders:** 1
- 4) **Output of Extruder:**
  - 3,000 - 5,000 hollow bricks/day (8 hours)
  - 6,000 - 10,000 solid bricks/day (8 hours)
- 5) **Power Source:** Chinese diesel engine (7 hp)
- 6) **Diesel Consumption:**  $\pm$  1.5 liter/hour (12 liter/day)
- 7) **Storage Capacity:**
  - 50,000 bricks
  - 440 square meter
- 8) **Energy Need of Kiln:**
  - small kilns: 60 cubic meter of firewood
  - large kiln: 80 cubic meter of firewood

### In General:

- 1) **Number of Kilns:** 3 kilns
- 2) **Type of Kilns:** 2 square kilns, 1 *damrei* (elephant) kiln
- 3) **Total Capacity of Kilns:**
  - $\pm$  54,000 bricks
  - (15,000 + 23,000 + 16,000)
- 4) **Type of Products:**
  - 1) 1 type of hollow brick (90 x 90 x 190 mm)
  - 2) 1 type of solid brick (45 x 90 x 190 mm)
- 5) **Production Time:**
  - small kiln: 44/45 days
  - big kiln: 49/59 days
- 6) **Number of Laborers:** 15 - 20 laborers

- [1] H.B. Rozemuller, "From Pig Rearing to Stock Marketing: rice milling, a broad spectrum of entrepreneurial activities", CAS Occasional Paper Series No.1, May 1998.
- [2] For detailed information regarding this formation I refer to the statutes of both the Association of Banteay Meanchey Brick and Tile Manufacturers and the Association of Battambang Brick and Tile Manufacturers.
- [3] H.B. Rozemuller, "Overview of Rice Millers Associations in North West Cambodia", CAS Occasional Paper Series No.4, October 1998.
- [4] Ministry of Industry, Mining and Energy, "Brick factories in Cambodia", Phnom Penh, Cambodia, 1997.
- [5] Appendix 1 shows the total number of factories and their features of all provinces in Cambodia.
- [6] Ministry of Industry, Mining and Energy, "Brick factories in Cambodia", Phnom Penh, Cambodia, 1997.
- [7] National Institute of Statistics, Ministry of Planning, "General Population Census of Cambodia 1998", Phnom Penh, Cambodia, 1998.
- [8] However, a 1998 report of the local Department of Industry, Mining and Energy in Sisophon mentioned only 11 brickyards (8 registered, 3 not yet) in Banteay Meanchey Province in 1998. Such discrepancies are usual in government publications, due to different timeframes. Our intention was not to carry out a provincial survey.
- [9] We will come back to the industry Associations in a later section of this paper.
- [10] There are many more ways to distinguish brickyards, as we indicated in the six case studies. For example, one could group operators by the type of fuel (fire wood or rice husk) that is used to fire the kilns, whether or not the business uses its own clay, whether it only manufactures bricks and also roof tiles et cetera.
- [11] Extruders are mostly manufactured locally and use second-hand diesel engines as power source.
- [12] Arghiros, Daniel, "Rural Industry and Development in Central Thailand: an alternative approach", in The Journal of Entrepreneurship, 6,1, Sage Publications, New Delhi/Thousand Oaks/London, 1997.
- [13] Arghiros writes in another article (Arghiros 1997,b) a paragraph on brickyard entrepreneurs as employers. He states that brickyard owners take steps to ensure that workers are productive as well as loyal (Arghiros 1997, b: "The Rise of Indigenous Capitalists in Rural Thailand: profile of brickmakers in the central plains" in *Small Business Entrepreneurs in Asia and Europe: towards a comparative perspective*, edited by Mario Rutten and Carol Upadhy, Sage Publications, New Delhi, India, 1997).
- [14] Some people mentioned a fifth type of kiln, the *loh barang* or French kiln. This is in fact a boat kiln, but it is built on a slope for an optimal heat circulation. This kiln type is rather rare, however. The only example we saw was at the JSRC project brickyard along the road from Battambang City to Pailin.
- [15] This situation may be explained as a 'chicken or egg' -problem: either local factories are not producing roof tiles because there is too much competition from Thai and Vietnamese tiles, or these tiles are imported because there is no local Cambodian roof tile supply.
- [16] About the common size of a brick the Indian author Gurcharan Singh mentions in his book 'Building Materials': "Bricks are always rectangular in shape and of such proportion that the length is generally twice the width plus the thickness of the mortar joint. Thickness of the brick is less than or at the most equal to the width of the brick" (Gurcharan Singh, *Building Materials*, Standard Publishers, Delhi, 1996).
- [17] We also visited an organization which manufactured concrete roofing tiles. This was the Vocational Training Center of the Lutheran World service (LWS) in Battambang City. They produce them for the Battambang construction materials markets, while at the same time training Cambodian students in construction.
- [18] These are the phases for manufacturing bricks. The production of roofing tiles involves one more step of extruding. Interestingly, this is done with hand press technology at most of the enterprises, instead of with power press technology as is used with the extrusion of bricks.
- [19] Our informants told us that many farmers these days want to raise fish. They ask the brick makers to come to their plot of land and dig a pond, after which the brick makers can keep the resulting clay.
- [20] According to our informants one gets the best results if one blends the clay with water, sand, clay and some rice straw. Careful mixing does not occur very often, however, since workers are usually paid per number of bricks extruded and so want to hurry to earn more money. A different pay system might give incentives to increase the quality through better preparation.
- [21] Brick factories near Phnom Penh, however, store their extruded bricks outside. The same thing happens in Thailand. According to brick plant managers we talked to in Battambang and Banteay Meanchey Province it is not possible to do the same thing in the Northwest of Cambodia because the type of clay is different there. Outdoor storage of extruded bricks in the Northwest would result in many cracked bricks according to the brick entrepreneurs, because of overexposure to sun and rain. Thai experts visiting the area in 1998 dispute this fact. They say the cracking that occurs during drying is caused by poor mixing in preparation, not sun or rain effects.
- [22] The main reason to move these bricks around is that the ones on top always dry the fastest.
- [23] If the factories utilize rice husk as the main fuel, there usually is another phase of wood burning in the beginning of the heating process. One kiln owner said: "We need wood to heat up the kiln, because it is still cold. Rice husk is not suitable at this stage, because it can not provide the necessary flames".
- [24] Both the variables 'Production Time' and 'Laborers Involved' are calculated for an average kiln.

<sup>[25]</sup> Usually, the workers who pack the kiln are the same ones who unpack the kiln.

<sup>[26]</sup> In case of square and open kilns the penultimate day the workers take off the ash of the top layer of bricks. They also remove three upper layers of solid bricks. The last day they take off the remaining two top layers of solid bricks.

<sup>[27]</sup> In general there is a big variation in staff at the brick factories, depending on the activities which need to be carried out at various times. The information concerning labor in this table is somewhat misleading, because employees are involved in different batches of production during the mentioned manufacturing time.

<sup>[28]</sup> There is a large variety in the number of days needed for production, due to seasonal influences (both the weather influence on the bricks and the seasonal labor) and the use of different kilns.

<sup>[29]</sup> One bag contains about 20 kilograms of rice husk.

<sup>[30]</sup> Of course we acknowledge that costs per kiln vary per kiln type and size. The net result of these differences can however be considered marginal.

<sup>[31]</sup> It was - based on our data - impossible to calculate the economic value added for every single phase of the manufacturing process. Therefore we sometimes had to combine two phases in this table.

<sup>[32]</sup> See Appendix 2 for an example of an Income Statement of a brick factory.

<sup>[33]</sup> The production costs of hollow bricks and solid bricks are nearly the same.

<sup>[34]</sup> The difference between the depot/retail price and the factory price is only small: usually the depots add 0.10 Thai Baht to the factory price.

<sup>[35]</sup> In the construction materials *depots* in Battambang City they also sell Vietnamese roof tiles. According to our respondents these tiles are transported from Vietnam to Phnom Penh by boat and then are transported by truck to Pursat and Battambang Province.

<sup>[36]</sup> Another thing the Associations might do is set up a revolving credit fund. As Arghiros mentions in his study on the brick industry in Central Thailand, the Association itself can also provide financial services to the members in the form of a revolving credit association (Arghiros, 1997,b). Each of the participants contributes a fixed sum each month and bids to borrow the sum. The sum is not so significant in terms of initial capital, but is considered useful for funding the purchase of extra machinery or solving cash flow problems, as Arghiros remarks in his article on the brick industry.

<sup>[37]</sup> Taken from document "*Brick factories in Cambodia*", Ministry of Industry, Mining and Energy, Phnom Penh, Cambodia, 1997.