2. LITERATURE REVIEW

2.1 Paddy Rice Market

The result of an investigation on the behavior and the reasons behind farmer choice of rice varieties in the wet season of the Chiang Mai Valley areas suggested that 69 percent of the farmers chose to grow only glutinous rice while 11 percent grew only non-glutinous rice (Shinawatra, 1993).

There are two methods of classifying rice mills. Siamwalla and Na-ranong (1990) classified rice mills as the small-scale mills with capacity of 1-12 tons per day, the medium-scale mills with capacity 13-59 tons per day and the large-scale mills with capacity more than 60 tons per day. However, the Office of Industry (1998) classified rice mill into three categories. (1) the small-scale rice mills with the capacity of less than 5 tons per day; (2) the medium-scale rice mills with the capacity of 5 to 20 tons per day; and (3) the large-scale rice mills, which can process rice grain more than 20 tons per day.

Both of the medium-scale and large-scale mills are taking notable roles in the rice market. On the other hand, the small-scale mills do not have significant role in the market activity. They mainly function as service providers for milling process. Roonprabhan (1983) reported an inefficient and low milling recovery of small-scale mills which wasted a lot of energy in processing rice. The miller can reap excess profit by over milling rice. General customers of the small-scale mills are farmers who get less in term of nutrients, as well as low quality of milled rice in return. Another problem is the quality of white-rice that is extracted by the small-scale's milling process that cannot meet the standard requirement of the market. In addition, the quality of the by-product mostly bran from the milling process also cannot satisfy the standard requirement of bran oil processing factories.

The raw material buying method of mills in Chiang Mai has two patterns. The traders, village rice collectors and farmers ship rice from the production area and sale it to the mill. The trader, who acts as a representative of the mill, or the mill owner, will travel to the village or production area to collect paddy rice from the farmers. The large mills and some medium mill can handle their paddy supply volume by the first pattern through the whole year. The first buying pattern occurs in every mill at the beginning of harvesting period, with the huge number of rice production. The mill will use the second pattern or both patterns when lack of paddy supply in the cultivation period. The mills that achieve the first buying pattern get advantage by cutting off the transportation cost from their process. Inyasom (1999) reported the processing characteristics of a medium mill called Chai-Nimitra at Hangdong district, which may represent of other mills in same scale. She estimated that 80 percent of processing involved glutinous rice while the rest was the non-glutinous rice. This mill is operated for 20 to 25 days and demand about 8 to 12 ton of rice monthly.

The main flow of rice was from farmers to the mills through the local trade mechanism. Roonprabhan (1983) pointed out that the marketing of rice was handled mainly by private enterprises. Opastrakul (1996) estimated that approximately 73 percent of paddy was handled by the traders. About 61 percent of paddy was sold to the traders as soon as it was harvested (Sri-On, 1984). Individual traders and millers collect paddy from farmers are act as intermediaries between farmers and consumers or exporters (Roonprabhan, 1983). Middlemen, traders and rice millers act as buying agents, they control domestic markets and export by storing the paddy for 4-8 months and speculate for price fluctuations. The flow of rice in the market follows the general pattern described by Siamwalla (1990) as shown on Figure 2.1.

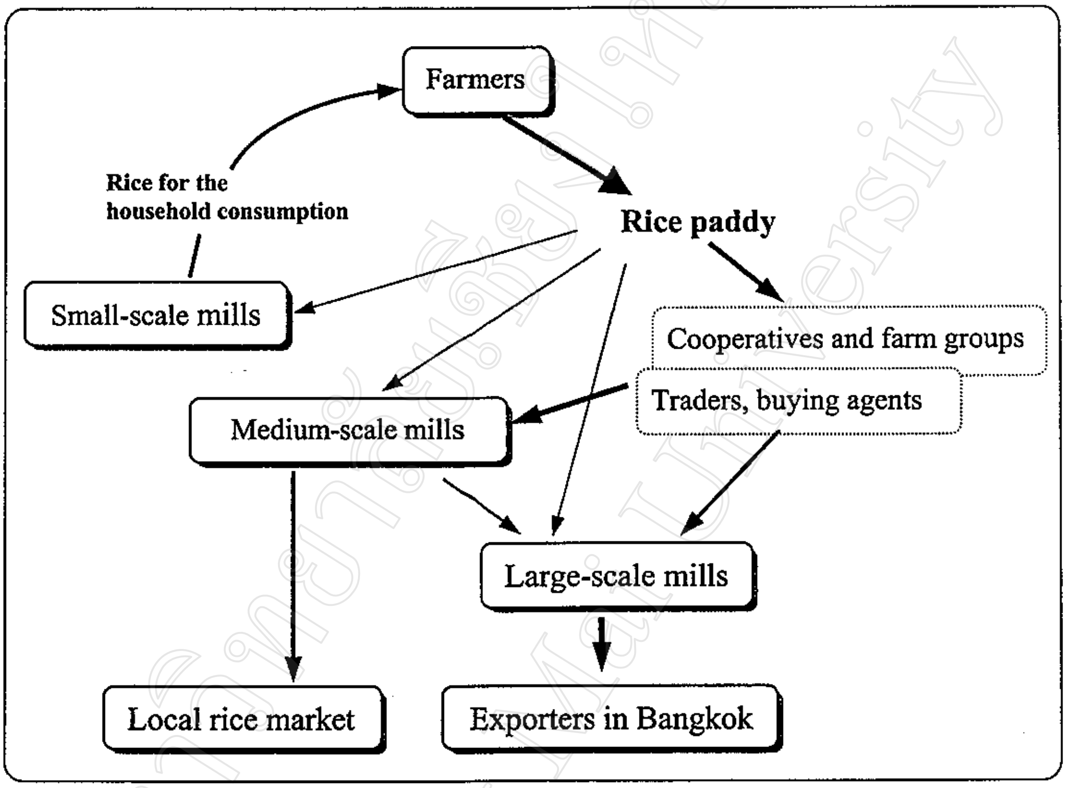

Figure 2.1 Flow of rice from farm to market.

Elber (1997) investigated the robustness of the tendency for Hotelling duopolists to use spatial price discrimination. He showed the quadratic transportation costs in a model and pricing was found to emerge as the unique equilibrium outcome when firms commit to a price policy before choosing locations and price levels.

Litman (1997) summarized the research of full-cost that applied to urban transportation and described a computer software program which can be used to incorporate full-cost analysis into transportation decision-making. He reviewed several studies that estimated the magnitude and distribution of transportation costs. The results of study indicated that a significant portion of costs was external and the costs of transportation were fixed. He also expressed that both external and fixed costs cause underpricing, which encouraged inefficient and inequitable travel patterns. The pricing reforms are essential in reducing transportation problems. The least cost transportation-planning base on full-cost accounting can assist decision-makers identify optimum investment strategies and policies.

The study of Gehrig (1994) employed the two-dimensional spatial competition to analyze the notation of competition between market places. He expressed that one dimension can be interpreted as geographical distance, the other is some product characteristic. In his model the agglomeration economies arise endogenously due to saving in transportation cost for the customers. The entrants firms may prefer to settle in existing markets rather than setting up their business somewhere in between. Emergence of a new market place is less likely as transportation costs decline. Though, the strong forces towards agglomeration, multiple markets will arise under free entry of the firms when markets are large enough.

However, the plant location of each mill scale is assumed as the best location base on its strategy. The large-scale mills with higher capacity are located nearby the main road in the big city to absorb the flow of paddy from production areas in Chiang Mai and from the nearby provinces. The medium ones, with smaller capacity, are located their plants close to the rice production area to minimize the transportation cost. Averbakh *et al.* (1998) explained the plant location problem, also known as the incapacitated facility location problem, that it is required to locate a number of facilities on the transportation network so as to minimize the service company's cost of satisfying the demand for some commodity or service. The total cost is comprised of the total setup cost of establishing the facilities and the total cost of transportation between facilities and customers. He expressed that the setup cost of a facility can not only depends on the chosen location for the facility, but it should also depend on the number of customers served by the facility. The objective of making a decision is where to locate the plants and also to determine the size of the plans. There are two major costs that need to be considered in the analysis which are transportation cost and fixed (setup) cost. The transportation cost is a function of the distance or travel time between the plants and clients (gasoline, traveling time, etc.). The fixed cost depends on the size of the plant which is a function of the number of customers it services. Therefore, it should also make decision on which customers should be allocated to which plants. This decision will affect the size of the plants as well as their locations.

Stollsteimer (1968) implemented an economic model of optimum solution for location and allocation of agricultural products developed by Isard (1956) and Lefeber (1958). The related concept of fruit-process industry was explained by Bressler and King (1970), who used two-region and multi-region cases to explain how transportation process was involved with the commodities' price equilibrium. The commodity prices move toward equality, but equilibrium can be reached when prices differ exactly by transportation cost. It is possible and profitable for traders to run their trade mechanism as long as the original difference in price is greater than transfer costs. In order to do the analysis of trade, it is not only demand and supply but also the precise trade flows and the related transfer cost over active trade route must be known.

2.2 Network Analysis

Network analysis is a set of techniques used for the analysis of the systems represented by networks. These techniques include maximum flow analysis, traveling salesman problem, allocation of resources, and optimum path (Bonham-carter, 1994).

The spatial relationship can be stored in a geographic information system (GIS) and described as linear networks. The network analysis is one of many techniques for examining spatial relationship (Lupien *et al.*, 1987).

The transportation system, in term of spatial organization, comprises of two basic structure elements of the network, nodes and linkages. Nodes in transportation system usually represent the sites connected to each other by a particular set of linkages. Hence, a node in rice's transportation system can represent a paddy area or a mill where rice is loaded to the trucks or unloaded from the trucks. The linkage may be represented by the facilities such as the waterways, highways, railroads and airways, or the flows over these facilities, e.g., the number of vehicles, passengers, or commodities passing through them in a given period (Taaffe *et al.*, 1996). The linkage of rice transportation nodes in Northern Thailand may be represented by trucklines through the road network.

Spatial interaction and gravity model can be used to explain the interactions between a paddy land and the mill to understand and to predict the location of activities and the movement of paddy from production areas to mills. As more general models of spatial interaction emerged, the gravity model is called by various names such as a far more varied treatment of distance-decay, propulsive and attractive forces, and spatial structure (Taaffe *et al.*, 1996). The distance-decay function in form of power function derived from Newton's famous law of gravity is supported by the study of interaction over a large distance.

The computed accessibility index is a relative measurement to compare between locations. It can also be used to evaluate the location of existing mills to the potential rice production bases and to compare that with how much of the market share they can capture. It can use a search radius to limit the computation of accessibility, and the accessibility index can generate locations that may be suitable for regional rice mills.

The network analysis model in ARC/INFO (ESRI, 1992) presents the method that predict the flow of resources or determine the accessibility of a site using a geographic network. The analysis can identify the shortest or fastest path between two locations. It can determine the distribution area for a facility, find the nearest facility to the interested location, or determine the most efficient route to target stop. It also can find the service area from the origin along the network and build up the isocost line by the specific costs, which can be called accessibility or trade zone.

The accessibility of each origin can be computed from the attractiveness index of market center divide by destination between the location and the market.

The computations for accessibility can be specified in mathematical function as follow (ESRI,1992) :

$$P_i = \sum_{j=1}^{n} \frac{w_j}{d_{ij}^{\beta}} \qquad (1)$$

Where:

P_i is the accessibility at point i

W_j is the attractiveness of location j

d_{ij} is the distance between location i and j

β is the exponent for distance decay

n is the number of location in the region

The attractiveness index of each mill may be estimated from many attributes that make its attraction. The index can be assessed from price offering, loan, honor, cash payment and paddy's inventory. However, traders and the millers always check the information about the current market price. Therefore, the price offering from particular mill is almost the same. While information about loan, honor and cash payment could not be conducted from the field since it is a very sensitive information and hard to collect and verify.

The accessibility explains an aggregate measure at a location, information on the expected or predicted interaction between mill and rice production areas are also required. Spatial interaction is a technique that generates a list of interaction between mills and rice production areas. The result is a matrix of data that list the possible interaction between each pair of a mill and a rice production area. The interaction (I) assumes a distance-decay function, exponent of 1.5 is assumed. The interaction function can be represented by the following formula:

$$I = \frac{\text{Production of Rice Area} * \text{Attractiveness of Mill}}{(\text{Distance})^{1.5}} \qquad (2)$$

The Huff model is another method that uses the idea of total gravity model interaction (Taaffe *et al.*, 1996). The model evaluates the probability of movement from a given origin i to any one of a set of destinations j. The model can use some measure that reflects the attractive power of that center, referred to as S_j values. It can calculate S_j/dij for the probability of movement of customer at i to the shopping center j. However, it has to compare this probability with the Sj/d_{ij} ratios for all the other competing centers. The result of S_j/d_{ij} was divided by the summation of S_j/d_{ij} of all centers:

$$P_{ij} = \frac{S_j / d_{ij}}{\sum_{j=1}^{n} S_j / d_{ij}} \qquad (3)$$

Where: P_{ij} is the probability of flow from resident area i to shopping center j,

S_j is an attractiveness index at shopping center j, and

d_{ij} is the distance from resident area i to shopping center j.

The result indicates that probability of consumer at i visiting center j may be obtained by dividing the gravity model expectation at i for that center by the total gravity model expectations for all competing centers.

Liu and Seong (2000) explained the concept of accessibility as the opportunity that an individual or type of person at a given location possesses to take part in a particular activity or set of activities. The accessibility is associated with an appreciation for the type or quality of the transportation system and patterns of land usė as well as the availability of satisfactory potentials in destinations. They used 'Huff model' to find the potential at a specify point. The potential at *i* location indicates the intensity of possible contact between people in *i* and those in all other locations. The closer the opportunity, the more it contributes to accessibility. They also pointed out that the impedance function takes on many forms, and the negative exponential form has been used more often. However, the potential still have no meaning and difficult to interpret. Consequently, they applied the modify model of Geertman and Ritsema Van Eck (1995) to solve these problems. The modified potential mode is:

$$T_i = \frac{\sum_j (M_j / d_{ij}^{a-1})}{\sum_k (M_k / d_{ik}^{a})} \qquad (4)$$

Where: T_i is the probability of flow from resident area i to shopping center j, k.

M_j is an attractiveness index at shopping center j, and

M_k is an attractiveness index at shopping center k.

d_{ij} is distancing from resident area i to shopping center j.

d_{ik} is distancing from resident area i to shopping center k.

a is an exponent of a decay function.

The equation is providing only difference between two sets which is the distance decay parameter that should be exactly a factor +1 larger in the second set, and the result will be potential values expressed as a weighted average travel time from location *i* to all surrounding centers. The analogy to physical gravitation and potential suggests subtract 1 from this value, other has recommended taking an *a* priori value like 1 or 2.

Peterson (1997) expressed the successions of retail business who use trade areas as a basic requirement in choosing new location and provide competitive advantage for effective marketing and merchandising. With trade zone information, the business can answer important locational questions. Trade areas represents customers' geographic proximity to the market place. A clear understanding of trade area methodologies is a key to making effective business decision.