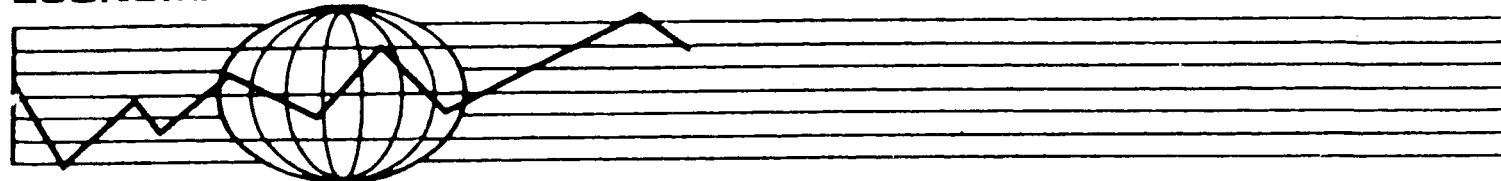


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**“VENT-FOR-SURPLUS” AS A SOURCE OF AGRICULTURAL  
GROWTH IN NORTHEAST THAILAND,  
1950-1986**

Keith Fuglie

**ECONOMIC DEVELOPMENT CENTER  
Department of Economics, Minneapolis  
Department of Agricultural and Applied Economics, St. Paul**

**UNIVERSITY OF MINNESOTA**



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IN NORTHEAST THAILAND, 1950-1986

by  
Keith Fuglie\*

March, 1989

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\*Research Assistant, Department of Agricultural and Applied Economics, University of Minnesota.

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### Abstract

This paper reviews the "vent-for-surplus" model of agricultural development, in which access to foreign markets allows "surplus productive capacity" to be exploited. The "indirect effects" of trade contribute to long-term economic growth even after the direct gains from trade are realized. How the new income streams are distributed amongst the population may also carry implications for long-term growth prospects.

The model is used to explain the rapid expansion in export crop production that has taken place in the Northeast Region of Thailand over the past twenty-five years. It is shown that the growth in export production was achieved at very little expense to the subsistence sector by employing previously underutilized land and labor resources. Growth indices are constructed to quantify the contribution of "vent-for-surplus" to the growth in agricultural product.

Institutional factors play a major role in realizing growth potential. The major demand-side impetus for Thai cassava production came from agricultural policy adjustments in the European Economic Community. Thai policies on trade and foreign investment encouraged foreign and domestic entrepreneurs to invest in marketing and processing improvements. The private sector also played a leading role in extending production technology to the farm level. The public sector played a substantial role in improving transportation services. Future growth will probably require a larger role for the public sector, particularly in agricultural research and human capital development.



"VENT-FOR-SURPLUS" AS A SOURCE OF AGRICULTURAL GROWTH  
IN NORTHEAST THAILAND, 1950-1986

Thirty years ago the Burmese economist Hla Myint (1958) introduced the concept of "vent-for-surplus" to explain the rapid expansion of exports in certain sparsely populated developing countries during the latter half of the 19th and early 20th Centuries. The essential feature of his model was that these countries possessed "surplus productive capacity" left unexploited because of a poor state of internal economic organization and an inelastic domestic demand. The function of trade, in contrast to comparative advantage theory, was not so much to reallocate resources but to provide new effective demand for the output of the surplus resources.

The closing of land frontiers in the 20th Century has resulted in a general lack of interest in "vent-for-surplus" models of agricultural development, except with perhaps historians. It is now generally assumed that additional agricultural production will have to come from increasing the intensity of land use (Hayami and Ruttan). Nevertheless, the empirical study of "vent-for-surplus" can serve to enhance our understanding of some of the important elements of economic development, such as the process by which the "surplus capacity" came to be realized as exports. Furthermore, "vent-for-surplus" may not be that much of an historical artifact after all. In this paper it is argued that the phenomenal expansion of cassava production in the Northeast Region of Thailand during the 1970s can best be explained in terms of the "vent-for-surplus" model.

In the next section of the paper the main aspects of the "vent-for-surplus" model are reviewed. The model is contrasted with comparative advantage theory and its similarities with both the labor surplus model of W. Arthur Lewis and the "staple" model of Harold Innis are drawn out. The essential feature of these models is the presence of under employed resources prior to their utilization in export production. But the expansion of trade in such an environment implies that substantial improvements are made in economic organization and human capital. The implications of these "indirect effects" of trade on long-term economic performance are also discussed in this section.

The "vent-for-surplus" model is applied to Northeast Thailand in the next two sections of the paper. The Northeast Region, which makes up about a third of the land area and population of the Kingdom (see Figure 1), has recently experienced major changes in its agricultural economy. In the space of just a few years it has gone from a subsistence economy to one with a substantial export sector. In section two, productivity indices are constructed to quantify the impact of "vent-for-surplus" on the agricultural economy of the Region. This is followed in section three by an examination of some of the key factors that led to the "export boom" of the 1970s. The final section concludes with some comments on the sustainability of agricultural growth in Northeast Thailand, now that the "slack" resources have essentially been exhausted.



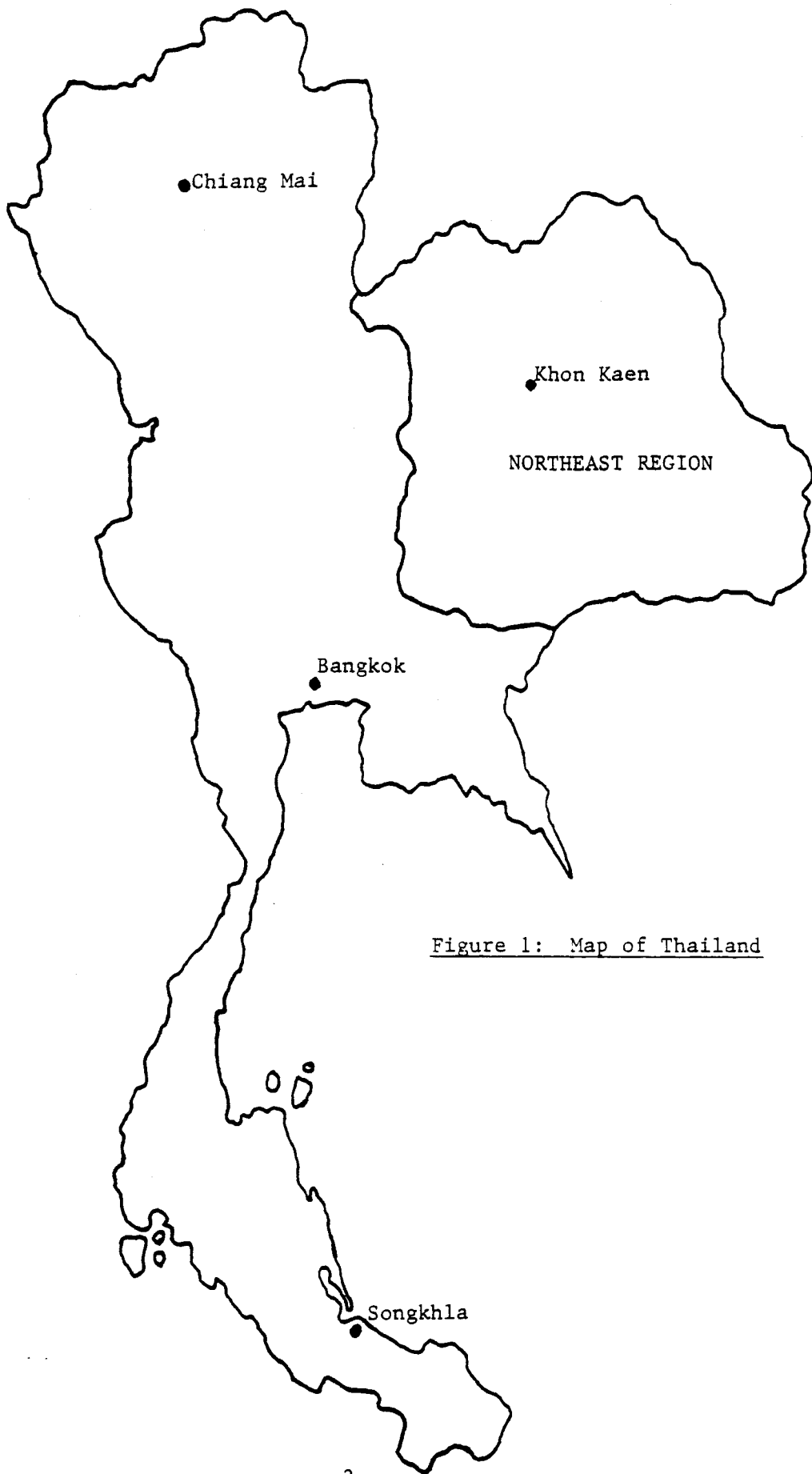


Figure 1: Map of Thailand

## I. "Vent-for-Surplus" Model of Agricultural Development

One of the first applications of the "vent-for-surplus" model was to explain the rapid growth of agricultural exports in Southeast Asia and other underdeveloped countries during the latter half of the 19th and early part of the 20th Centuries (see Myint, 1958, 1965). The essential feature of this model is that a surplus production capacity exists, above domestic consumption demand, that lies unexploited before exposure to international trading opportunities. Access to international markets then serves as a demand inducement to employ the underutilized productive capacity.

In the case of the land-abundant economies of Burma and Thailand in the mid-19th Century, rice production was significantly expanded following the opening of the Suez Canal and the increased use of steam ships. These developments reduced transportation costs to Europe, and significantly increased the demand for Asian rice in European markets. Increases in rice production came almost entirely from expanding the agricultural land area. Of course, additional supplies of labor had to be mobilized in order to work the new crop land, barring the introduction of new labor-saving techniques.

A key question posed in "vent-for-surplus" models is why should such surplus capacity exist? Classical theory would suggest that the price of the abundant resource (in the above case, land) would fall relative to other factors (such as labor) until the most scarce resource was fully employed. The "vent-for-surplus" model, on the other hand, assumes an "inelastic

domestic demand for the exportable commodity, and/or a considerable degree of immobility and specificness of resources" (Myint, 1958, p. 322). The presence of surplus production capacity is a reflection of the general underdevelopment of the economic system. In an elaboration of the "vent-for-surplus" model, Caves emphasizes that "the existence of these 'surplus' resources reflects the state of economic organization in general and not a failure of the market mechanism in any narrow sense" (Caves, p. 212).

The function of trade in the "vent-for-surplus" model differs markedly from classical comparative-costs theory. In the "vent-for-surplus" model, the international market creates an additional demand for domestically produced commodities. Growth of export production is accompanied neither "by changes in technique or the proportion of factor inputs" (Caves, p. 224). In contrast, comparative-cost theory assumes that the resources of a country are fully employed before it enters international trade. The function of trade is to allocate resources more efficiently between domestic and export production in light of the new set of relative prices now facing the country. It assumes considerably flexibility in domestic production and consumption, and a greater degree of mobility among factors (Myint, 1958).

Caves noted that the idea that excess resources exist which are not being fully exploited by a closed economy lies at the heart of other prominent models of economic development as well, such as the surplus labor theory of W. Arther Lewis and the "staple" theory as elaborated by Gordon Bertram. Lewis's dualistic model of development held that the marginal product of

labor in the traditional sector of an underdeveloped economy was at or near zero. Labor could be transferred to an emerging modern sector at little or no cost to subsistence production. Employing a "staple" theory of development, Bertram traces the progress of the Canadian economy as the successful exploitation of a series of staples, beginning with fisheries, and moving through furs, timber, dairy, grain, paper products, ores, and petroleum, and metals<sup>1</sup>. The discovery of new sources of natural resources, availability of immigrant labor, development of new technology, and shifts in world demand are some of the key factors that unleashed new waves of staple growth. The essential feature that all of these models have in common is that "they depict the effects of trade on growth as involving the exploitation of resources lacking ... any alternative use of significant economic value." (Caves, p. 213).

Many scholars of economic development emphasize that the effects of trade on economic performance are two-fold. First there is a "direct effect," in which underutilized resources are mobilized to produce for export (in the "vent-for-surplus" case), or resources are reallocated into activities that take on a higher value at the international terms of trade (the comparative-costs case). The second contribution of trade to economic growth is through "indirect effects," which include the creation of a skilled labor force and a new entrepreneurial class, the spread of new technology, improvements in transportation and

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<sup>1</sup>Bertram draws heavily upon the earlier empirical work of Harold Innis. For references to Innis's work and to other applications of the "staple" theory, see Hayami and Ruttan.

communications, economies of scale from specialization in the export market, and a greater degree of law and order (Myint, 1958, 1985). While the direct gains from trade do not imply any change in the production possibilities frontier, the "indirect effects" imply that this frontier will shift outward over time.

Myint emphasized the supply-side "indirect effects" of trade on economic growth, but of equal importance is how the income gains from trade influence domestic demand to create further impetus toward growth. This may be strongly influenced by the institutional environment of the country, particularly those factors which determine how the gains from trade are distributed among the population. A relatively even distribution of the gains from trade will contribute to future economic growth by generating a strong demand for domestically produced goods and services. However, if the bulk of new income streams are captured by a small oligopoly (whether in the private or public sector), a higher proportion of the gains from trade may be spent on imported luxury goods since these goods have a higher income elasticity of demand.

In reference to Canadian development, Bertram writes that "the expansion of the domestic market was significantly influenced by more widely distributed incomes of a commercially-oriented proprietor-farmer economy. The growth-inducing income distribution resulting from certain staple industries operated through the consequent increase in consumption and through further effects on investment" (p. 163). In a more recent study of the effects of trade on economic performance, Adelman argues that the linkages between domestically produced consumer goods

and small and middle class farmers are stronger than with large rich farmers, since "a larger marginal share of their consumption is devoted to locally produced textiles, clothing, footwear and simple consumer durables" (p. 945). In this way "vent-for-surplus" growth may not simply be a one-time gain, exhausted once underutilized resources are fully exploited, but can result in sustained economic growth through the indirect effects of trade and competition, generating new income streams for domestic consumption and investment.

The immobility of resources and the lack of effective demand to spur the production of exportable surpluses appears to be relevant to many developing countries today. In his application of the "vent-for-surplus" model to Nigeria, Helleiner suggests that land-surplus and labor-surplus areas can coexist within a country due to institutional restrictions on factor mobility:

"In Nigeria, despite considerable seasonal labor movements, rural and urban-rural mobility of labor on a permanent basis seems limited by tribal and cultural differences, traditional attitudes to land and tenure arrangements, and inadequate infrastructure in the underpopulated areas" (Helleiner, 1966, p. 191).

In a more recent study of the evolution of African farming systems, poor access to markets is seen as a major demand-side constraint to increasing production in traditional farming systems. Better roads and transport facilities are shown to have a positive effect on the intensity of land use, since higher prices and an elastic demand for tradable goods mean greater marginal rewards to the farmer's effort (Pingali, et. al.).

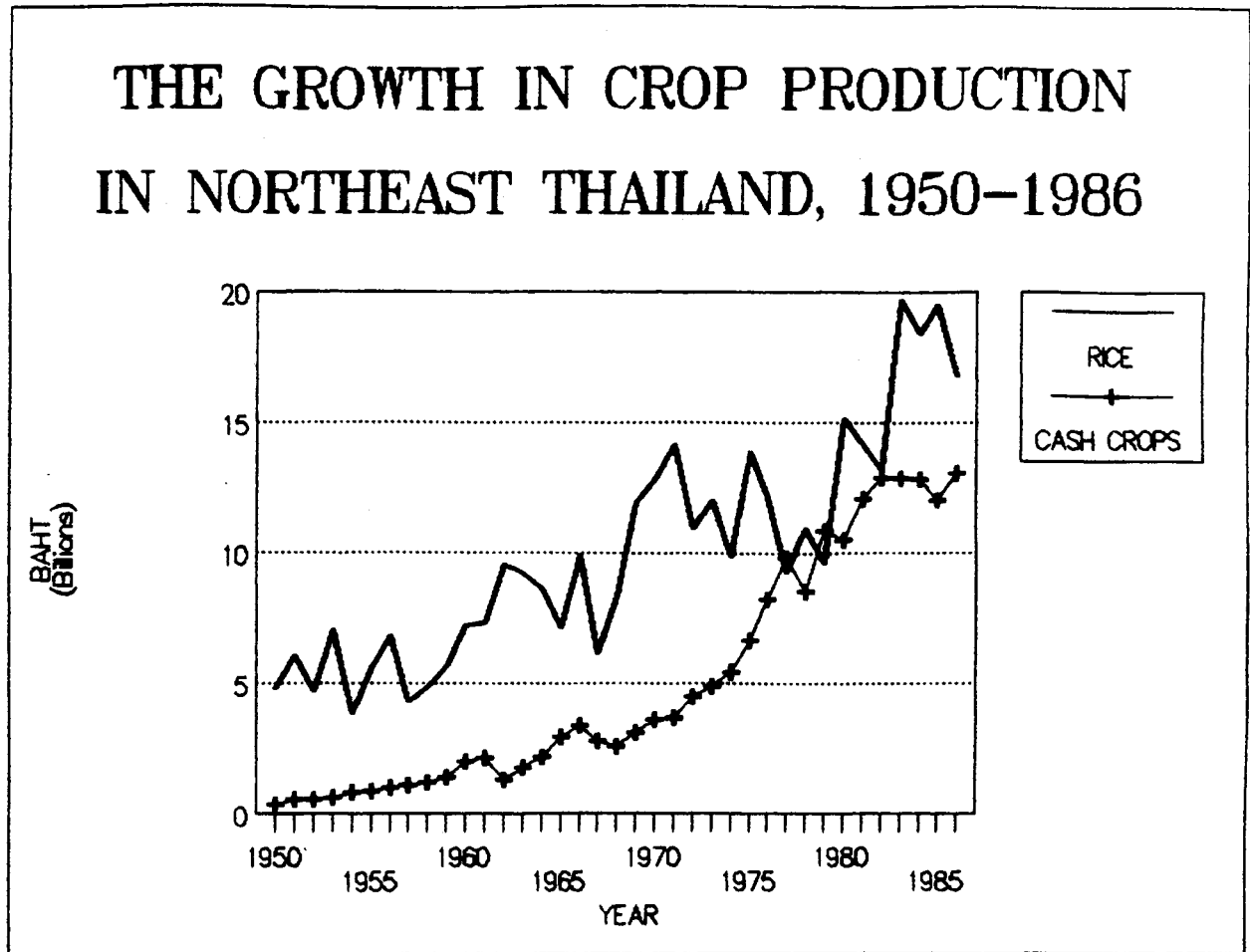
## II. "Vent-for-Surplus" in Northeast Thailand

During the period between 1950 and 1986, the agricultural economy of Northeast Thailand changed from a nearly wholly subsistence economy to one in which subsistence and commercial crop production were weighted about equally. Most of this transition took place between 1968 and 1982 (see Figure 2). The interesting features of this transformation are that growth in commercial crop production was achieved at little or no expense to the subsistence sector and that agricultural expansion was due almost entirely to small-scale farming using traditional technology and resources. In this section of the paper, we trace the growth in crop production and examine how new resources were mobilized within the traditional sector to meet the growing demand for agricultural exports. Partial productivity indices are constructed to quantify the contribution of "vent-for-surplus" and other sources to the total growth in production. Finally, the implications for rural welfare are discussed.

Rice has long been the major crop of the Region and is by far the most important staple food for the population. However, rice has never been produced in sufficient quantities to make it an important export of the Region. Almost all production is consumed locally. As late as 1965, 95 percent of the Region's crop land was devoted to rice.

The responsiveness of Thai farmers to commercial opportunities was clearly demonstrated by Behrman over 20 years ago. Behrman found strong supply responsiveness for maize and kenaf in the Northeast using data from the 1950s. But in absolute

Figure 2





terms the production of commercial crops was small and limited to areas which were served by transportation facilities.

The transportation network within the Region at the time of Behrman's study was almost non-existent. The first all-weather road (the Friendship Highway) linking the Region to the rest of the country had only been completed in 1958, complementing a rail line that had been established prior to World War II. The lack of rural roads was a severe constraint to the expansion of commercial crop production, especially for perishable commodities such as cassava.

Despite these initial shortcomings, commercial crop production in Northeast Region underwent a tremendous rate of expansion in the 1970s, and in 1980 the value of commercial crops temporarily exceeded that of rice. Most of this growth was due to the expansion in cassava acreage, which went from a mere 9,000 hectares in 1968 to 733,000 hectares ten years later. In 1978, cassava production was 9.7 million tons fresh weight, or over 60 percent of national production. Average annual growth rates in production, area planted, and yield for the major crops of the region are presented in Table 1.

An important feature of this growth was that it was achieved at very little cost to the subsistence sector. Even during the heyday of the cassava boom, rice acreage continued to expand between 3 to 4 percent annually. The take-off in commercial crop production was achieved by mobilizing new resources that previously had little economic value. Acreage expansion went into areas that had been forested and in the upper reaches of watersheds ("upland"). This land was generally not suitable for

growing rice, which requires the heavier, inundated soils of bottom lands.

The labor requirements for these crops also generally do not conflict with rice cultivation. This is especially true for cassava. Farmers begin plowing their sandy upland fields with the onset of the summer monsoon rains in April or May. Once they have established their upland crop, they devote very little attention to it until harvest the following February or March.<sup>1</sup> The cultivation of kenaf proceeds in a similar manner, except that harvesting takes place in September. Kenaf also undergoes initial processing (retting) at the farm level. But it is not as perishable as cassava, and post-harvesting activities can usually be postponed until after the rice harvest is completed. Meanwhile, farmers begin plowing their rice paddies in June, once enough rainfall has accumulated to soften the heavier bottom land soils. Transplanting usually takes place in July and August, depending on rainfall conditions. The rice harvest begins in late October and continues to early January. Rice transplanting and harvesting require considerable labor over short periods. The availability of labor for these activities served as a constraint to rice acreage and farm size.

These characteristics of cassava (and to a lesser degree kenaf) enabled producers to expand export production using surplus land without sacrificing production of their subsistence

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<sup>1</sup>Although cassava spoils quickly once harvested if not dried and processed, the length of its growing season is very flexible. It can be harvested anywhere from 7 to 18 months after planting, although it becomes fibrous and of poorer quality if left in the ground for prolonged periods (Cock).

crop of rice. Even though farm labor was being fully utilized during peak periods (rice transplanting and harvesting), it lay relatively unproductive during the rest of the season. Additional labor for cassava production was mobilized by employing family members during these slack periods.

Table 2 shows the growth rates for total crop output and for the factors of production (land, labor, and capital services). The measure of capital includes service flow estimates for bullocks, agricultural machinery, and fertilizer. The growth rate for output and each factor of production are also calculated for each decade using spline regressions. The Appendix discusses data sources and measurement procedures.

Total crop production, which includes the both subsistence and commercial crops, grew at an annual rate of 5.4 percent and showed little sign of diminishing, even as late as the 1980s. The expansion of planted acreage was especially rapid during the 1970s, when it exceeded 5 percent annually. But by the 1980s, it appears that the land frontier was reached and area expansion slowed to under 1 percent. Increased growth of the rural population in the 1960s attributed to faster growth in the agricultural labor force in the 1970s and 1980s. This should begin to slacken in the 1990s and beyond due to successful family planning efforts and increased migration out of the Region.

The growth rates for agricultural productivity indices are reported in Table 3. From 1950 to 1986, the index of total productivity (total output/total input) grew by 2.6 percent per year. This reflects several factors, an important one being the greater intensity of labor use. As noted above, the expansion

into commercial crops was achieved at little conflict to rice production by employing farm labor during slack periods. Since farm labor is measured as the total number of workers, an increase in labor supply per worker would appear as an increase in the total productivity index. Another component of the growth in this index is the greater land share devoted to higher valued crops. Since the commercial crops grown in the Northeast generally have a higher gross value per hectare than rice,<sup>1</sup> a fall in the land share of rice will contribute to growth in total productivity. This is discussed in greater detail below where the contribution from "vent-for-surplus" to aggregate output growth is measured.

The partial productivity indices can be used to identify important sources of growth in total output in the following manner. Total output can be expressed by the identity relation:

$$(1) \quad Y = L * (Y/L) * (A/L)$$

where Y is output, L is the size of the labor force, and A is planted acreage. Differentiating with respect to time and dividing through by Y decomposes total output growth into the sum of these components:

$$(2) \quad \frac{\dot{Y}}{Y} = \frac{\dot{L}}{L} + \frac{\dot{(Y/A)}}{(Y/A)} + \frac{\dot{(A/L)}}{(A/L)}$$

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<sup>1</sup>Using average yields for 1950-1986 and 1979 farm prices, the gross value per hectare from cassava and sugar cane lie between \$390-\$450, while rice, maize, and kenaf yield around \$120-\$170. This, of course, is not a measure of the relative profitability of the various crops since production costs and the effects of heterogeneous land quality are not considered. What these figures do demonstrate, however, is that the rate of growth in the gross value of farm production will increase as cassava and sugar cane increase their share of planted acreage.

where the dot stands for the time derivative of the term in parentheses. In equation (2), each term  $\dot{x}/x$  express the percentage growth in  $x$  per year. Thus, the rate of output growth is the sum of the growth rate in the labor force, the growth rate in output per hectare, and the growth rate in hectares per worker.

Referring to Table's 2 and 3, we can see that the aggregate growth rate in crop production of 5.4 percent per year can be attributed to a 2.3 percent rate of growth in the labor force, a 1.8 percent growth in output per hectare, and a 1.2 percent growth in area per worker (allowing for rounding error). The growth in area per worker was especially rapid in the 1970s, which reflects the tremendous expansion in cassava acreage.

Let us now consider the contribution of "vent-for-surplus" to the growth in agricultural production. The increase in crop area per farm worker is one clear source of "vent-for-surplus" growth. This grew at an annual rate of 1.2 percent for the entire 1950-86 period and at 2.3 percent during the 1970s when most of the expansion in cassava production occurred.

But the productivity indices calculated above hide another important component of "vent-for-surplus". The reported growth in aggregate output per hectare (1.8 percent per year over the whole period) is really made up of two parts. One part is due to increases in yields of individual crops. This can be attributed to using improved inputs and better cultural management (what we can call factor-augmenting technical change). A second part is due to the changing crop mix. Although both the acreage of rice and of commercial crops grew over the 1950-1986 period, the area

growth of commercial crops was much higher. Since these crops on average yield a substantially larger gross value per hectare than rice, the increase in land shares devoted to commercial crops shows up as an increase in aggregate output per hectare. This part of the growth can be attributed to "vent-for-surplus."

To quantify these two components of aggregate yield growth we can proceed as follows. Aggregate yield can be written as

$$(3) \quad X = \sum_i L_i * X_i \quad (i = 1, 2, \dots, n; n = \text{number of crops})$$

where  $X = (Y/A)$ , or average aggregate yield, and  $L_i$  and  $X_i$  measure the land share and yield of the  $i$ th crop. In other words, aggregate yield is the average of individual crop yields, weighted by the land share (individual crop yield is measured as gross revenue per hectare, not in quantity units). Taking the time derivative of (3) and dividing through by  $X$  gives

$$(4) \quad \frac{\dot{X}}{X} = \sum_i \frac{\dot{X}_i}{X_i} \frac{(L_i X_i)}{X} + \sum_i \frac{\dot{L}_i}{L_i} \frac{(L_i X_i)}{X}$$

But note that  $(L_i X_i / X)$  is simply the revenue share of the  $i$ th crop (denote this as  $R_i$ ). So (4) becomes

$$(5) \quad \frac{\dot{X}}{X} = \sum_i R_i * \frac{\dot{X}_i}{X_i} + \sum_i R_i * \frac{\dot{L}_i}{L_i}$$

Equation (5) expresses the growth in aggregate yield as the sum of two parts. The first part accounts for the changes in individual crop yields and the second part accounts for the changes in the crop mix (due to "vent-for-surplus").

Table 4 presents the results from this decomposition. Using farm-level prices for 1979 and the geometric means of the

revenue shares, the two components of equation (5) were computed. From Table 3 we saw that aggregate output per hectare rose at an annual rate of 1.75 percent between 1950 and 1986. Changes in the crop mix accounted for 0.82 percent while changes in individual crop yield accounted for another 0.97 percent. The fact that these two components slightly overstate aggregate yield growth is probably due to errors introduced by using constant relative prices and revenue shares, which actually changed over the period (in other words, the index number problem).

As the agricultural economy of the Northeast Region moved into the 1980s, it appears that the increased use of capital services began to make a significant contribution to output and productivity growth. Capital services are measured as the sum of livestock and machinery services plus the value of fertilizer applied to crops. Very little fertilizer or machinery were used prior to the 1970s, however, so capital services up to this time are composed mainly of livestock (water buffalo) services. The growth of the capital-labor ratio ( $K/L$ ) in the 1960s may reflect more intensive use of livestock for plowing as commercial crop acreage was expanded. In the 1970s and 1980s the growth in ( $K/L$ ) is due mainly to the increased use of fertilizer and machinery (tractors, water pumps, and threshing machines). The increased use of capital services has enabled labor productivity to continue to grow into the 1980s, even after the closing of the land frontier.

The increased use of fertilizer and machinery also accounts for the rise in the capital-land ratio ( $K/A$ ). The negative growth

rate in this index in the 1970s followed by a very high growth rate in the 1980s may be overstated by measurement errors. There are significant inconsistencies and gaps in the data series on machinery use. The figures used in this analysis probably underestimate the number of tractors used to clear new land in the 1970s, so they underestimate the growth rate during this period and overestimate the growth in the 1980s.

We conclude this section with a brief discussion of how the welfare of the rural sector has fared over this period. The Northeast Region has long been noted for its poverty problem, and per capita income lags significantly behind the rest of the country. Nevertheless, over the past 25 years there has been a real increase in per capita income and a notable decline in the occurrence of absolute poverty. A World Bank (1979) study estimated that the percentage of the rural population subsisting below an absolute poverty level fell from 77 percent in 1963 to 45 percent by 1976, despite a population increase of around 50 percent during the period.

Two major factors have contributed to the decline in rural poverty. One is the growth in the value of agricultural production per farm worker and another is the growth in non-agricultural income. The analysis presented here suggests that this grew at an average annual rate of about 3 percent between 1950 and 1986.<sup>1</sup> A direct consequence of the availability of

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<sup>1</sup>Although this analysis has only included the value of crops in calculating agricultural production, it is probably a fairly good reflection of the changes in the agricultural sector, since crop production accounts for about 85 percent of total agricultural output of the Region.



surplus land has been that farm size has been relatively evenly distributed and a landless peasantry has not yet emerged to any significant degree, despite large population growth. This, plus the fact that most farm households plant both subsistence and commercial crops, has meant that the gains in agricultural productivity have been widely distributed among the rural population. The second major factor contributing to the decline in rural poverty has been a growth in off-farm employment opportunities, especially during the dry season.<sup>1</sup> By the mid-1970s, off-farm employment contributed more than 25 percent of total rural income (World Bank, 1983).

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<sup>1</sup>The expansion of off-farm employment is reminiscent of Lewis's model of surplus labor. Although Lewis's model was criticized for assuming that the marginal product of labor in traditional agriculture was zero, this assumption may not be that inaccurate if one takes into account the seasonal nature of many agricultural activities. The dearth of income-generating activities during the dry season in rural Northeast Thailand was one of the reasons that cassava production was able to expand without reducing rice production. Seasonal migratory labor is another response, and has been an effective means of increasing the productivity of rural labor in many countries (Myint, 1971, p. 332-3). For a detailed discussion of seasonal off-farm employment in rural Thailand, see Akrasanee, et. al.

### III. Factors Underlying the Growth of Agricultural Exports

The growth of agricultural production for export in Thailand's Northeast Region was the result of several factors which induced favorable shifts in both demand and supply. Below, some of the major sources of these shifts are identified. In particular, the respective roles and contributions of the public sector, local entrepreneurs, and foreign investment are discussed. The emphasis will be on the factors which caused the rapid growth of cassava production in the 1970s.

The major demand-side impetus for cassava came in 1968 when the European Economic Community (EEC) implemented its Common Agricultural Policy (CAP).<sup>1</sup> Under the terms of the CAP, variable import levies were introduced to support cereal grain prices at rates substantially above world levels. This significantly increased the price of feed grains (maize in particular) facing EEC livestock producers. At the same time it created a demand for feed grain substitutes,<sup>2</sup> which were allowed to enter duty-free or at low tariffs. The duty for cassava was fixed at six percent, and was bound under the General Agreement of Tariffs and Trade. The high price set for feed grain in the CAP created a huge, albeit artificial, demand for cassava within the European livestock industry.

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<sup>1</sup>Although the objectives of the CAP were spelled out in the Treaty of Rome in 1957, it was not until 1967 that a common set of prices and procedures were agreed upon, and not until 1968 that they were put fully into effect. For a discussion of these and other CAP policies, see Bureau of Agricultural Economics.

<sup>2</sup>Cassava supplemented with soybean meal serves as a perfect substitute for grain in a wide range of feedstuffs. Substitution occurs when the price of cassava falls to 20 percent below the price of soybeans or corn (Koester).

In 1968, cassava production in Thailand was fairly modest, being concentrated in the eastern seaboard provinces where relatively good transportation and processing facilities existed. The potential for expansion in these areas was quite limited, however. In order to take advantage of the newly created demand for cassava within the European feed industry, several supply-side constraints had to first be overcome.

A major constraint was the absence adequate processing technology. In the late 1950s, inexpensive and small-scale cassava chippers had been developed to produce dried cassava chips directly from fresh roots. But cassava chips are bulky and expensive to transport. In 1968, German entrepreneurs invested \$1 million in a cassava pelletizing plant in Thailand, and the first pellets left port the following year. Cassava pellets are almost as dense as cereals (680 grams/liter). Later developments in pellet technology reduced serious dust problems that arose during ship loading and unloading (Cock). The number of pellet processing plants grew to 618 by 1978, and pellet exports expanded from 750,000 tons to 5.8 million tons over the same period (Titapiwatanakun).

A second constraint to cassava expansion was transportation costs. The need for good rural transportation networks has long been recognized as an important factor in promoting agricultural development<sup>1</sup> and this is especially true for a perishable

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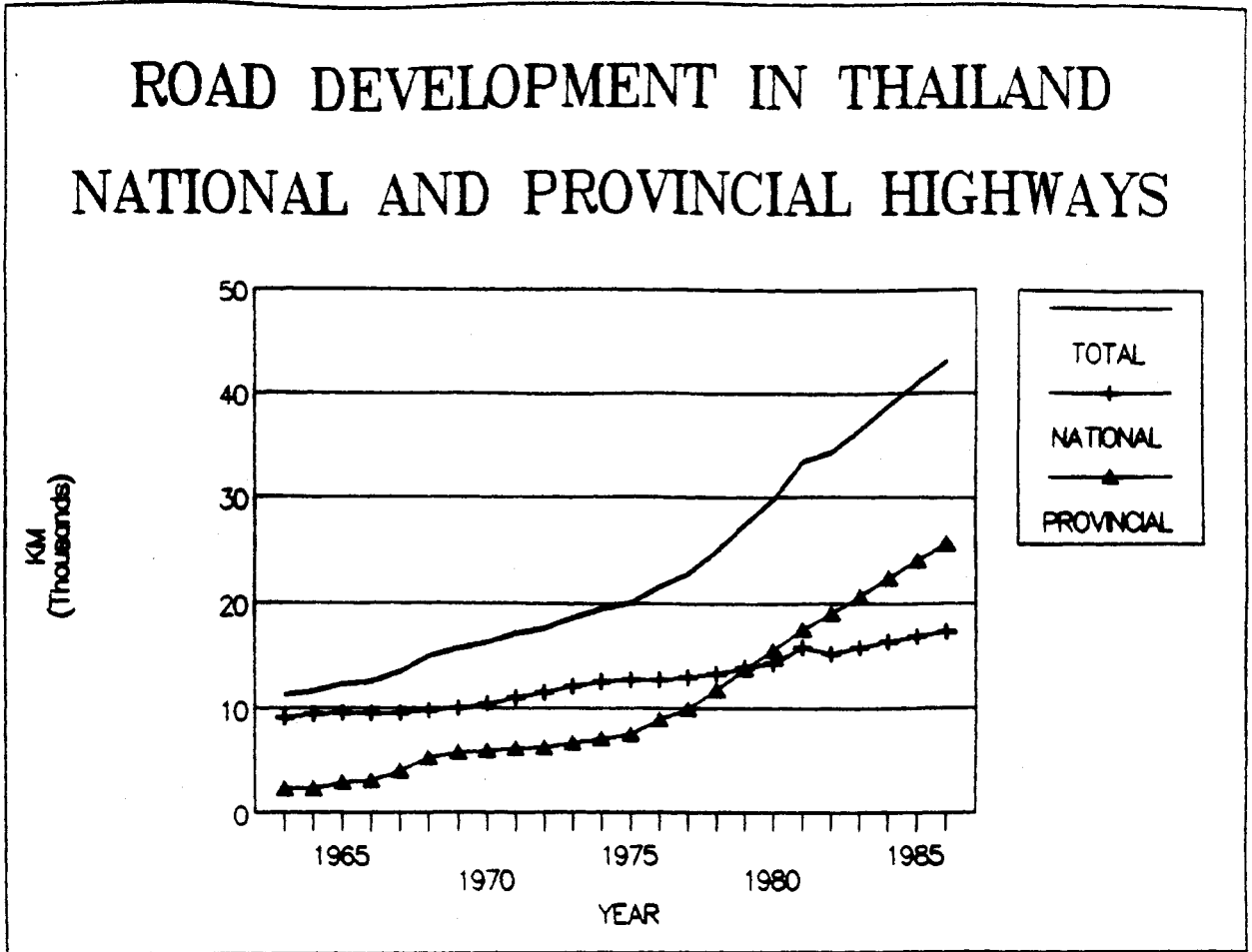
<sup>1</sup>Mellor emphasizes the importance of rural infrastructure in reducing transportation costs and raising farm prices. Liang presents a quantitative study of the farm supply response to rural transportation development in prewar China. For case studies of the relationship between the development of rural roads and the spread of commercial crops in Thailand, see Hafner (1970) and Thung (1972).

commodity such as cassava. In this regard, the public sector played a major role. During the 1970s and continuing into the 1980s, the Thai government made a major effort to develop rural transportation infrastructure. Initially, emphasis was placed on the national highway system. Later, priority shifted to provincial and rural feeder roads (see Figure 3). Much of the new rural road construction was carried out in the North and Northeastern Regions, and was strongly motivated by insurgency problems (USAID, 1980). The final result of these investments was to dramatically improve market access and the incentives to produce exportable commodities in these Regions.

Further reductions in transportation costs were achieved by investments in ship loading facilities, which were carried out by the private sector. The world's largest conveyer-belt loading pier began operating at Mabookrang in 1977, which increased the daily ship loading speed from 2,000 tons of cassava pellets to as much as 32,000 tons. This permitted the use of large capacity ships, which significantly reduced per unit freight costs. These market and transportation investments have given Thailand a strong comparative advantage over other cassava exporting countries such as Brazil and Indonesia (Titapiwatanakun).

A final factor affecting the growth of cassava production, and certainly not the least important, was the activity of local merchants in promoting new production, developing local processing facilities, and establishing market linkages down to the farm level. These "middlemen," usually of Chinese descent, played a crucial role in diffusing cassava and other commercial crops within the Region. Local merchants would disseminate

Figure 3



Source: Asian Development Bank. Figures for 1982-86 are planning projections.

planting materials and crop management advice, extend credit, quote prices, and promise a market for the harvested crop (Rigg). Small-scale entrepreneurs actually had been active in the Region for some time, promoting kenaf and maize in areas with adequate market access, such as along the Friendship Highway. Until the developments in the EEC and the investments in rural transportation, however, the promotional activities of middlemen were constrained by high marketing costs and the lack of effective demand.

In summary, the rapid growth in commercial crop production in the Northeast Region can be attributed to four main factors: (1) the increase in demand for feed grain substitutes as a result of European agricultural policies; (2) investments in processing innovations by foreign and domestic entrepreneurs; (3) the construction of rural transportation infrastructure by the public sector; and (4) aggressive crop promotion and the provision of marketing services to farmers by local merchants. An important lesson from this analysis is the complementary role played by the several parties. The absence of export taxes on cassava and relatively few restrictions of foreign capital certainly provided additional incentives for private sector innovation and investment.

#### IV. "Vent-for-Surplus" and Sustainable Growth

In the previous sections of the paper the expansion of agricultural production in Northeast Thailand was documented and some of the key factors behind this development were identified. It was argued that the rapid growth in export production closely followed a "vent-for-surplus" model, as first articulated by Myint. But the question remains as to whether or not the rapid growth in agricultural production of the past decades can be sustained into the future, now that the "slack" resources (especially surplus land), have essentially been expended.

The model of agricultural development that was sketched in Section one suggests that the "indirect effects" of trade will generate new opportunities for economic growth once the gains through "vent-for-surplus" have been exhausted. The improvements to the domestic economic organization, especially the investments in human capital, should speed the transfer of technology and enable local producers to respond vigorously to new opportunities in world trade. The model also predicts that farmers will continue to devote a larger share of their land and labor resources to the production of commercial products. In fact, the "indirect effects" will continue to be important "so long as a considerable proportion of resources in the traditional sector still remains in subsistence production" (Myint, 1985, p. 238).

The results presented in Table's 2 and 3 suggest that this process may already be under way. Agricultural productivity continued to grow in the 1980s, after the land frontier had been reached. This growth appears to have come mainly from the

increased use of capital services, especially fertilizer and farm machinery. However, the impact of modern agricultural technology has been constrained by the lack of irrigation facilities and limited local agricultural research capacity.

The discussion in section three detailed some of the key factors that removed production constraints during the "vent-for-surplus" process. The private sector was very successful in extending marketing services to the farm level. The public sector, on the other hand, had a major role to play in developing transportation infrastructure. The tremendous success achieved in expanding agricultural export production suggests that these were and are appropriate roles for each sector. The private sector will continue to have a strong comparative advantage in marketing services, leaving the public sector to concentrate on the provision of public goods.

The "indirect effects" of trade emphasized the importance of education and technology transfer in realizing continued economic growth. This suggests that the composition of public services will need to give more emphasis to human capital formation, especially to rural education and agricultural research. Although impressive gains have been made in extending primary education to the rural areas and in establishing crop and livestock research stations, much remains to be done. The technical and scientific capacity of local research stations remains weak and funding is far too dependent upon the support of foreign donor agencies. Significant growth in the support of the Thai government to agricultural research will be needed if economically and environmentally sound technology is to be forthcoming.



Table 1: Annual Rate of Growth for Specific Crops, 1950 to 1986

```

*****
Crop
Productivity
Measure      Rice      Maize      Cassava  Sugar Cane  Kenaf
*****
Production   3.72     12.74     27.12     4.49        9.38
Area Planted 2.67     10.88     26.20     2.59        10.06
Yield        1.03     1.67      0.73      1.84        -0.62
*****
Numbers give the average annual growth rate in percent
    
```

Table 2: Agricultural Growth Indices, 1950 to 1986

```

*****
Period      Crop      Planted   Labor     Capital   Total
            Output   Area     Force     Services  Inputs
*****
1950s      4.33     2.01     2.18     2.39     2.07
1960s      6.23     3.71     2.03     4.09     2.52
1970s      4.92     5.00     2.60     3.93     3.27
1980-86    5.85     0.81     2.59     5.29     2.38
-----
1950-86    5.38     3.57     2.30     3.80     2.67
    
```

\*\*\*\*\*  
 Numbers give the average annual growth rates in percent.  
 Growth rates for each decade were estimated using spline  
 regressions.  
 Capital services include service flows from livestock,  
 machinery, and fertilizer.

Table 3: Agricultural Productivity Indices, 1950 to 1986

```

*****
Index
Period
      Y/X      Y/A      A/L      Y/L      K/L      K/A
*****
1950s    2.21    2.28    -0.17    2.10    0.20    0.38
1960s    3.61    2.42    1.65    4.11    2.01    0.36
1970s    1.61   -0.07    2.34    2.27    1.30   -1.02
1980-86  3.39    5.00   -1.73    3.18    2.63    4.44
-----
1950-86  2.64    1.75    1.24    3.02    1.47    0.22

```

```

*****
Numbers give the average annual growth rates in percent.
Growth rates for each decade were estimated using spline
regressions.
Y = aggregate crop output;
A = total area planted;
L = economically active agricultural labor force;
K = value of capital services (from livestock, machinery,
and fertilizer);
X = total value of inputs (land, labor, and capital
services);
Y/X = index of total productivity;
Y/A = average value of crop output per hectare planted;
A/L = hectares planted per worker;
Y/L = average value of crop output per worker;
K/L = capital services per worker;
K/A = capital services per hectare.

```

Table 4: Decomposing Aggregate Yield Growth

```

*****
Crop          Revenue Share      Land Share      Crop Yield
              (geometric mean)    (growth rate)  (growth rate)
*****
Rice          0.83                -0.9           1.0
Cassava       0.06                19.2           0.7
Maize         0.03                7.0            1.7
Sugar Cane    0.04                -1.0           1.8
Kenaf         0.04                6.2            -0.6
*****

```

Components of Aggregate Yield Growth

```

Changing Crop Yields          0.97
  (technical change)
Changing Land Shares          0.82
  (vent-for-surplus)         -----
Total Compute Change
in Aggregate Yield          1.79    (actual change = 1.75)
*****

```

The difference between the sum of the components of aggregate yield growth (1.79) and actual yield growth (1.75) is probably due to index number errors. The revenue shares (used as weights in the aggregation procedure) changed considerably over this period. The share of gross revenue of rice, for example, fell from 94% to 56% between 1950 and 1986.

## APPENDIX: Sources and Manipulation of Data

It is challenging enough to compile long time-series data for national agricultural statistics in Thailand. Government publications often offer conflicting data series, and explanations on original sources, methods of collection, and assumptions made in compiling the numbers are usually absent. As James Ingram has pointed out,

"The economist who wishes to study the economy of Thailand is faced with [a] dilemma -- he can proceed to use questionable statistics to draw questionable conclusions, or he can do nothing, except possible to rely on impressions gained from personal observations. The latter alternative seems even less attractive than the former" (Ingram, 1971, p. 220-1)

The problem is compounded when one wished to undertake regional or provincial level analysis. The best solution seems to be to proceed with the analysis, and check the findings against the impressions of a wide body of knowledgeable individuals.

Since 1973, both the Office of Agricultural Economics (OAE) and the Department of Agricultural Extension (DOAE) have been collecting independent data series on agriculture. OAE bases its statistics on annual farm surveys and is making a substantial effort to improve the reliability of its statistics using crop-cut surveys and satellite imagery. The DOAE bases its statistics on interviews with village leaders. These numbers are then aggregated for each district, province, and region. OAE statistics are probably more reliable and are improving over time. More recent statistics are undoubtedly more accurate than older numbers.

## A. Quantity Data

Most data are taken from OAE publications (which used DOAE data prior to initiating it's own data collection efforts). The main source is Agricultural Statistics of Thailand (annual yearbooks) and a supplementary source is Selected Economic Indicators Relating to Agriculture (annual bulletins). From these sources data on crop production, area planted, and livestock holdings are taken. In this paper, crop yield was calculated as production per rai planted (1 rai = 0.16 hectares), which differs from the OAE definition of yield as production per rai harvested. Difference between planted and harvested area can be quite significant, especially for rice.

Regional-level use of fertilizer is generally not reported, but an OAE bulletin gave regional breakdowns for 1978 to 1981 ("Some Important Fertilizer Information," Ag. Econ. Report No. 37, 1983, -- in Thai). Over this period, the Northeast Region consumed 22-23 percent of fertilizers used nationally. Based on this, the 22 percent figure was used to impute regional consumption for the entire period. This crude method is not as dangerous as it may seem, since national fertilizer consumption has never amounted to much (compared with other Asian countries) and was insignificant before the late 1960s. National fertilizer figures, which list tons of nitrogen, phosphate, and potassium used in agriculture, are available in the OAE statistical yearbooks mentioned above.

The main types of agricultural machinery for which statistics are reported in Thailand are two-wheel power tillers,

four-wheel tractor under 45 horse-power, four-wheel tractors over 45 horse-power, water pumps, and threshing machines. OAE publications do not include continuous time series for the number of machines used in agriculture, and it's own publications are not consistent. The earliest available data is for 1975. Annual figures are given till 1980, and then again for 1985 and 1986. To build a continuous time series, it was assumed that no machines were used prior to 1970, and then a regular rate of growth was used to impute numbers for missing years. More recent publications no longer distinguish between large and small four-wheel tractors, and this is where the major data discrepancy lies, since more recent statistics report a smaller total number of 4-wheel tractors. It seems likely that the data underestimate the number of large tractors being used for land clearing, especially in the 1970s.

Labor statistics were adopted from population and labor force surveys that were conducted in 1947, 1960, 1970, and 1980. Data for 1970 and 1980 are from the Population and Housing Census (National Statistics Office). The agricultural labor force is defined as all males and females 11 years or older engaged in crop, animal husbandry, forestry, fishing, or hunting activities. Labor force data for 1960 was taken from Thailand Population Census 1960 (National Economic and Social Development Board). The 1947 figures are from the Statistical Yearbook of Thailand 1945-1955 (Office of the National Economic Council), which reports only the total number of economically active persons 14 years and older both rural areas and towns. It was assumed that 95 percent of this population were engaged in agriculture. Estimates of the

labor force for non-census years were then extrapolated from the census data by assuming a constant rate of growth between census years. For example, between 1947 and 1960, the labor force was assumed to grow at 2.18 percent per year, between 1960 and 1970 at 2.02 percent, and between 1970 and 1985 at 2.59 percent.

## B. Price Data

Farm-level prices for agricultural inputs and outputs were used as aggregation weights in constructing the productivity indices. Unfortunately, adequate time-series do not exist for these prices. Producer prices for crops are available only as far back as 1969, and data on input prices are generally unavailable altogether, except for fertilizers. Several sources were drawn upon in order to compile a set of price weights that could be used.

Farm-level prices for crops were taken from Agricultural Statistics of Thailand 1985/86 (OAE). Producer price for 1979 were selected for this analysis. The 1979 relative crop prices are very similar to the 1976-1985 average and no significant trends were observed in relative prices over this period. These crop prices are reported in Table A1.

Input prices were taken from numerous sources. Farm-level fertilizer prices for major nutrients (nitrogen, phosphate, and potassium) were taken from the FAO Fertilizer Yearbook 1981. The average yearly wage for agricultural labor was derived from the figures reported in the Rural Off-Farm Employment in Thailand (Akrasanee, et. al., 1983). Average daily wages were multiplied

by the average number of days spent on agricultural activities per year to get the yearly wage. The data originates from surveys conducted in Khon Kaen and Roi Et provinces in the Northeast Region.

For stock inputs such as land, livestock, and machinery, what is desired are "service-flow" values, such as annual rental rates, rather than asset values. Since the latter are usually what is available, the former have to be imputed from them or derived by some other means. Yotopoulos (1967) presents some simply imputation procedures for machinery and livestock assets, which require some assumptions on the discount rate and productive lifetime of the asset.

For machinery assets, the annual service flow (or the value of capital services, as they are referred to in the text) is computed by

$$(A1) \quad R = (r*V) / ((1 - \exp(-r*T)))$$

where R is the annual one-hoss-shay service flow (i.e. constant over the asset's lifetime), r is the discount rate, V is the purchase value, T is the lifespan of the machine, and exp is the exponential function. Farm machinery retail prices for 1979 were taken from Farm Mechanization in Asia, (Asian Productivity Organization, 1983), Annex Table 10. A discount rate of 12 percent and an average lifespan of 20 years was assumed.

It would be inappropriate to use equation (A1) to derive the annual service flows for livestock, since these service flows are not constant over the lifetime of the animal. Before maturity, the net service flow from the livestock is likely to be negative, as feed and care are required but it will be too young



for plowing or other productive activities. Service flows will increase as the livestock matures but may again diminish as the animal ages. Yotopoulos developed a procedure for measuring the annual service flow from livestock based on the purchase value of the livestock at different ages. Using this method, the annual service flow is

$$(A2) \quad R_t = r \cdot V_t - (V_{t+1} - V_t)$$

where  $R_t$  is the service flow in year  $t$ ,  $r$  is the discount rate and  $V_t$  is the purchase value of the livestock in year  $t$ . The values per age for buffalo and cattle were taken from Deboer (1972) and the age distribution for livestock holdings in the Northeast Region are from the Agricultural Census, 1978 reported in Prapertchob and Kachamart (1982). Assuming that these age distributions don't vary overtime, the average service flow for each animal can then be computed.

Annual service flows for land were derived from results reported in Priebprom (1985). Using a linear programming model (developed from data collected in Khon Kaen Province), Priebprom estimated the shadow value of irrigated and rainfed land. These estimates correspond well with the author's casual observations of land rental values during visits to the Region.

All input prices were adjusted by the producer price index to obtain 1979 prices. Input prices are reported in Table A2.

Table A1: Producer Prices of Outputs (1979 Prices)

OUTPUTS	PRICE	UNIT
Paddy Rice	2.61	baht/kg of paddy
Maize	2.09	baht/kg
Cassava	0.79	baht/kg of dried root
Sugar Cane	0.39	baht/kg
Kenaf	3.67	baht/kg
Cotton	9.15	baht/kg
Soybeans	5.26	baht/kg
Groundnuts	5.72	baht/kg in shell
Mungbeans	4.77	baht/kg of beans, dried
Sesame	11.32	baht/kg
Sorghum	1.91	baht/kg
Castor bean	5.39	baht/kg
Tobacco	2.50	baht/kg of fresh leaf

Table A2: Prices or Annual Service-Flows of Inputs (1979 prices)

INPUTS	PRICE	UNIT
Labor	2200	baht/person/year
Land: rice	224	baht/rai
upland	122	baht/rai
Livestock: buffalo	476	baht/head (weighted average)
Fertilizer: N	14122	baht/ton of N in ammonium sulfate
P	13524	baht/ton of P in superphosphate
K	10856	baht/ton of K in potassium sulfate
Machinery:		
2 wh tractor	2791	baht/unit/year
4 wh tractor	32993	"
water pump	1834	"
power thresher	3035	"

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