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**ACCELERATING AFRICA'S STRUCTURAL TRANSFORMATION:  
LESSONS FROM EAST ASIA**

**BY**

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## ABSTRACT

In most countries in sub-Saharan Africa at present, the majority of the population is engaged in agriculture, with economies in the very early stages of structural transformation - the process whereby a predominantly agrarian economy is transformed into a diversified and productive economy dominated by manufacturing and services. These countries are characterized by low levels of farm productivity, limited growth of non-farm employment and high rates of population growth.

This paper focuses on the factors involved in fostering a country's structural transformation. This process of transformation has many dimensions. Among these we emphasize interactions between four factors: increased agricultural productivity, rural industrialization, the expansion of agricultural markets, and the demographic transition. All of these are critical to reducing agriculture's share in the total labor force and promoting broad-based economic growth.

In this paper, we assess the relevance of the East Asian experience, primarily that of Taiwan, for the task of determining priorities for agricultural and rural development in the countries of sub-Saharan Africa, in spite of their very different historical and cultural antecedents and physical environments. Important lessons emerging from the East Asian experience are that the transformation of the structure of a predominantly agrarian, semi-subsistence economy cannot be achieved without substantial increases in agricultural

productivity. Second, the structural transformation process must take advantage of the positive interactions between agricultural and industrial development. These interactions depend on the expansion of the marketed share of agricultural output, which enables farm cash incomes to rise. Finally, we emphasize that demography matters in that increasing the growth of non-farm employment relative to the growth of the total labor force can accelerate structural transformation.

## INTRODUCTION

In most countries in sub-Saharan Africa at present, the majority of the population is engaged in agriculture, with economies in the very early stages of structural transformation—the process whereby a predominantly agrarian economy is transformed into a diversified and productive economy dominated by manufacturing and services. These countries are characterized by low levels of farm productivity, limited growth of non-farm employment, and high rates of population growth, usually close to 3 percent or more, because sharp declines in mortality have not been followed by significant declines in birth rates.

This paper focuses on the factors involved in fostering a country's structural transformation. The process of structural transformation has many dimensions. Among these, we emphasize the interactions between four factors: increased agricultural productivity, rural industrialization, the expansion of agricultural markets, and the demographic transition, which are critical to reducing agriculture's share in the total labor force and promoting broad-based economic growth.



In this paper, we assess the relevance of the East Asian experience, primarily that of Taiwan, for the task of determining priorities for agricultural and rural development in the countries of sub-Saharan Africa, in spite of their very different historical and cultural antecedents and physical environments. Important lessons emerging from the East Asian experience are that the transformation of the structure of a predominantly agrarian, semi-subsistence, economy cannot be achieved without substantial increases in agricultural productivity. Second, the structural transformation process must take advantage of the positive interactions between agricultural and industrial development and depends on the expansion of the marketed share of agricultural output, which enables farm cash incomes to rise. Finally, we emphasize that demography matters in that increasing the growth of non-farm employment relative to the growth of the total labor force can accelerate structural transformation.

#### RECENT EXPLANATIONS FOR WEAK ECONOMIC PERFORMANCE IN AFRICA

Many attempts have been made in recent years to explain the economic performance of sub-Saharan African economies. Ndulu and van de Walle (1996) identify a half dozen factors responsible for the economic crisis of the past 15-20 years: the lack of human and institutional capital; policy distortions such as overvalued exchange rates and artificially low interest rates; the lack of

diversification; political instability and civil strife; weak governance, including corruption and rent-seeking; inadequate attention to “poverty alleviation;” and failure to achieve broad-based growth.

Eicher (1999) singles out five reasons for the failure of African leaders to cope with the food crisis that began with the 1968-74 drought in the Sahel. These reasons are: the emphasis on industrialization as the key to prosperity; the distorting effects of the Cold War on the priorities of both donor and recipient countries; the limited political power of farmers; the ready availability of food aid; and a shift in donor assistance strategies in the 1970s from an emphasis on economic growth and long-term institution-building to enthusiasm for Integrated Rural Development and efforts to directly and rapidly address the problems of the poorest of the poor.

Other recent attempts to explain Africa’s weak performance have been undertaken by Collier and Gunning (1999) and Platteau and Hayami (1998). A striking feature of these and virtually all recent attempts to explain the poor performance of African economies is the lack of attention to the adverse effects of a prolonged period of rapid growth of a country’s labor force on the structural transformation process (Hayami and Ruttan, 1985; Tomich, Kilby, and Johnston, 1995).

LESSONS FROM EAST ASIA

In recent years there has been a flood of literature on the lessons to be derived from the development experience of Taiwan and other East Asian countries. In the case of Taiwan, apart from references to land reform, most of that literature virtually ignores the key role of Taiwan's agricultural and rural development in the 1950s and 1960s in paving the way for the impressive export-oriented development of the 1970s, 1980s, and 1990s. Taiwan's experience is especially interesting because it confirms key lessons from earlier experience in Japan. Three features of the agricultural and rural development strategies pursued in Taiwan and also Japan have great significance for today's late-developing countries.

First, agricultural output was increased within the framework of their existing small-scale farming system. Technological innovations that were labor-intensive and involved divisible inputs, especially the improved seed-fertilizer combinations that were later to be the core of the Green Revolution, spread widely. These innovations enabled very significant increases in total factor productivity—increases in output per unit of total inputs—within the agricultural sector, which played a major role in the total economy. Because the innovations could be adopted incrementally by small-scale farm units, a large and growing percentage of the farm population was involved in the increases in farm productivity and output. This led to a broad-based pattern of agricultural development, which was reinforced by the postwar land reforms, although both Japan and Taiwan had

achieved a rather uniform size distribution of farm operational units prior to World War II through tenancy arrangements.

Second, closely linked with the growth of agricultural output, the rural non-farm economy expanded considerably. The pull for the expansion of rural industrialization came from broad-based rural demand, resulting from increased farm cash incomes as agricultural productivity and commercialization rose. In both Taiwan and Japan, rural industrialization was based on the widespread emergence of small- and medium scale enterprises (SMEs), with an average of eight employees. These SMEs played a key role, not only in fostering the structural transformation, but also in providing the basis for the industrial strength of Taiwan and Japan in years to come.

Third, Taiwan appears to have been the first developing area to experience the rapid rates of growth of population and labor force that became commonplace among less developed countries in the decades following World War II. Because of earlier declines in mortality, Taiwan's labor force was already increasing at 2.3 percent a year in the 1930s. In the 1950s, its rate of natural increase was over 3 percent with a total fertility rate as high as 6.3. In this period, fertility began to decline with remarkable speed as a result of concerted efforts to promote family planning that were facilitated by positive changes in

socioeconomic factors, notably the spread of education and the reduction of infant and child mortality.

Taiwan's remarkable economic progress is especially relevant to the quote with which Mellor opens the 1995 volume *Agriculture on the Road to Industrialization*, borrowed from his 1966 book, *The Economics of Agricultural Development*: "the faster agriculture grows, the faster its relative size declines."

## ORGANIZATION OF PAPER

We proceed in the following section by presenting a conceptual framework that links the demographic structure and non-farm employment growth to the structural transformation process and by reviewing descriptive evidence on structural transformation in selected countries in sub-Saharan Africa and in Taiwan. With the objective of drawing lessons from the Taiwanese experience, we focus on agricultural productivity growth in Section 3, rural industrialization in Section 4, agricultural marketing in Section 5, and the fertility transition in Section 6. The final section concludes by addressing the issue of the relevance of the Taiwanese experience for sub-Saharan Africa today.

## 2. THE STRUCTURAL TRANSFORMATION PROCESS

### THE STRUCTURAL TRANSFORMATION TURNING POINT

Dovring (1959) called attention to the fact that structural transformation was likely to be much more difficult in less-developed countries entering the demographic transition after World War II. In the latter-half of this century, population growth rates of many less-developed countries have been 3 percent or more, compared to the 1 to 1.5 percent rates of growth that characterized the “rapid growth phase” of the demographic transition in the industrialized countries. Thus, the absolute size of the farm population and labor force in the less-developed countries would increase considerably even with rapid growth of job opportunities in their non-farm sectors, limiting the structural transformation of these countries.

It is of considerable interest to examine the effects of the structural and demographic factors on the timing of a country’s “structural transformation turning point,” when the size of its agricultural labor force begins to decline. The number of years required to reach that turning point is sensitive to three parameters. These parameters are the initial share of agriculture within the total labor force ( $\frac{L_a}{L_t}$ ), the rate of growth in the total labor force ( $L\phi$ ), and the rate of growth of non-farm employment ( $L\phi$ ). Of these three parameters, the growth of

the total labor force and the growth of non-farm employment can be considered policy instruments.

For the purposes of illustrating the relationship between these three parameters and the point at which the size of the agricultural labor force begins to decline, we assume a closed-economy, two-sector setting, in which the agricultural sector is assumed to be the residual employer. With the simplifying assumption that the rates of population growth and non-farm employment growth remain constant, the rate and direction of change in the agricultural labor force can be expressed as a function of the above parameters in the following identity:

$$(1) \quad L'_a \equiv (L'_t - L'_n) \frac{1}{L_a / L_t} + L'_n$$

As long as the rate of non-farm employment growth exceeds the rate of total labor growth, the share of agriculture labor and the rate of growth of the agricultural labor force begin to decline over time. The structural transformation “turning point” is reached when the rate of agricultural labor growth becomes negative.

The above identity serves to emphasize several important points. First, the higher agriculture’s initial share in the total labor force, the longer it takes to reach the turning point. Thus, for countries with an initial agricultural share of 80 percent and a labor force growth rate of 3 percent, it would take 142 years to reach this turning point, even with rapid growth of 4 percent of non-farm

employment. Second, the higher the rate of total labor growth, the longer it takes to reach the turning point. If the total labor force growth were lowered from 3 percent to 2 percent, with an initial agricultural share of 80 percent and 4 percent growth of non-farm employment, the number of years needed to reach the turning point would be reduced from 142 years to 47 years. Third, the higher the difference between non-farm employment growth and total labor force growth,  $(L_n^c - L_t^c)$ , the less time required to reach the turning point. Thus, if non-farm employment growth were increased from 4 percent to 5 percent, holding all else constant, the number of years needed to reach the turning point would be reduced from 142 years to 62 years. Hypothetical growth paths over a fifty-year period for the farm, non-farm, and total labor force under different assumptions are further illustrated in the Appendix.

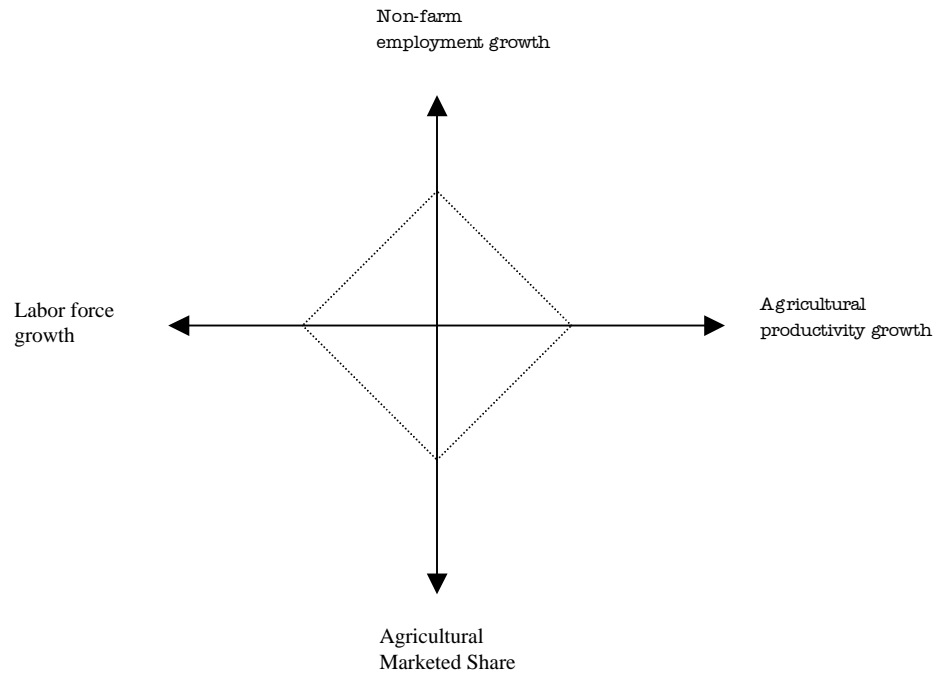
An important caveat is that, in reality, structural transformation is a dynamic process in which neither the rate of total labor growth or rate of non-farm employment growth will remain constant. Indeed, there is likely to be significant endogeneity between a country's rate of population growth and the employment opportunities presented to its labor force. Thus, by highlighting these interactions, the above analysis serves to emphasize the significance of policies aimed at increasing non-farm employment as critical to the structural transformation process. As will be explored in further sections, these policies



include both efforts to increase agricultural labor productivity and raise farm cash incomes as well as efforts to directly promote rural-based industrialization.

More broadly, structural transformation depends on the interactions among four key factors: the rate of agricultural productivity growth, the rate of non-farm employment growth, the extent of marketed agricultural surplus, and the growth of the total labor force. Figure 1 represents these relationships along a quadrant, representing the structural transformation “diamond”.

Figure 1-Structural Transformation Relationships



### STRUCTURAL TRANSFORMATION IN SUB-SAHARAN AFRICA

As noted earlier, much of sub-Saharan Africa remains in the early stages of structural transformation. However, significant differences exist between countries, in terms of their relative stages of structural transformation and selected structural transformation parameters. Table 1 provides a comparison of the share of the labor force in agriculture with a number of structural transformation indicators related to demography, agricultural productivity, non-farm growth, and commercialization. In this table, total fertility rate levels are used to distinguish countries. Thus, the 5 countries in Group A are considered to

have recently entered the declining-fertility phase of their demographic transition and, in these countries, the use of modern contraceptives has reached 27.5 percent, and the total fertility rate (TFR) has been reduced modestly to 5.1 as an average for those countries (Kirk and Pillet,1998). In the Group B and C countries, estimated TFRs average 6.1 and 7.0 respectively and the use of contraceptives is extremely limited.<sup>1</sup>

Countries with relatively lower fertility rates are further along in their structural transformation, with lower shares of agricultural labor. Thus, Group A countries had, on average, 59 percent of their labor force in agriculture in 1990 compared to 72 percent and 93 percent for Group B and Group C countries, respectively. Second, agricultural labor productivity in Group A countries is also higher, with \$662 per worker in 1990, compared to \$523 and \$206 for Group B and Group C countries, respectively.

Evidence suggests that non-farm employment in the selected countries has not kept pace with total labor force growth. Using industrial valued added growth as a proxy for non-farm employment growth, on average, labor force growth in the 1990-97 period was higher than the rate of industrial expansion for all three groups of countries. Interestingly, some of the Group C countries had relatively

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<sup>1</sup> Kirk and Pillet (1998) base their analysis on recent Demographic and Health Surveys, ranging from 1986 in Liberia to 1994 in Zimbabwe.

high rates of industrial growth, suggesting that their structural transformation may have begun to accelerate.

Finally, using the proportion of paved roads as a proxy for the degree of agricultural commercialization, the data suggest that Group A countries have higher market infrastructure (24 percent), relative to Group B and C countries, with 16 percent and 12 percent respectively.

Table 1-Structural Transformation Indicators for Selected African Countries

	Agricultural Labor Share (%)		Total Fertility Rate <sup>a</sup>	Labor Force Growth (%)		Industrial Growth (%)		Agricultural value added per worker (1987 \$)		Paved Roads (% of total)
	1980	1990		1980-90	1990-7	1980-90	1990-7	1979-81	1994-6	
<b>Group A</b>	<b>68</b>	<b>59</b>	<b>5.1</b>	<b>3.2</b>	<b>2.5</b>	<b>2.9</b>	<b>2.1</b>	<b>667</b>	<b>662</b>	<b>24</b>
Botswana	64	46	4.9							
Ghana	61	60	5.5	3.1	2.7	3.3	4.3	813	684	24
Kenya	83	80	5.4	3.6	2.7	3.9	2.0	268	240	14
Namibia	56	49	5.2	2.4	2.5	1.1	2.9	1295	1458	12
Zimbabwe	74		4.3	3.6	2.3	3.2	-0.8	294	266	47
<b>Group B</b>	<b>76</b>	<b>72</b>	<b>6.1</b>	<b>2.9</b>	<b>2.7</b>	<b>2.3</b>	<b>1.0</b>	<b>526</b>	<b>523</b>	<b>16</b>
Cameroon	73	70	5.8	2.4	3.0	5.9	-3.8	861	827	13
Côte d'Ivoire	65	60	5.7	3.1	2.3	4.4	4.2	1527	1354	10
Madagascar	85	84	6.1	2.5	2.8	0.9	1.1	190	178	12
Nigeria	55	43	6.0	2.6	2.8	-1.1	0.5	479	684	19
Rwanda	93	92	6.2	3.2	2.3	2.5		306	206	9
Senegal	81	76	6.0	2.5	2.6	4.1	3.7	328	375	29
Tanzania	86	84	6.3	3.2	2.8					4
Togo	69	66	6.4	2.6	2.7	1.1	2.0	404	461	32
Zambia	76	75	6.5	3.1	2.8	1.0	-2.6	116	100	18
<b>Group C</b>	<b>91</b>	<b>93</b>	<b>7.0</b>	<b>2.5</b>	<b>2.5</b>	<b>3.6</b>	<b>2.3</b>	<b>216</b>	<b>206</b>	<b>12</b>
Burkina Faso	92	92	6.9	2.0	2.1	3.7	1.9	155	182	16
Burundi	93	92	6.9	2.6	2.6	4.5	-8.0	218	177	7
Malawi	88	95	6.7	3.0	2.4	1.9	3.5	162	156	19
Mali	93	93	7.1	2.3	2.6	7.0	2.1	251	259	12
Niger	93	94	7.4	3.0	2.9	-1.7	1.3	292	256	8
Uganda	89	93	7.4	2.2	2.7	6.0	13.0			

Source: Kirk and Pillet, 1998; World Development Report 1997; World Development Report 1998.

<sup>a</sup> Total Fertility Rate is the number of children a woman would bear if her lifetime fertility corresponded to the prevailing age-specific rates and she lived to the end of her reproductive years.

## STRUCTURAL TRANSFORMATION IN TAIWAN

In the period between 1895 and 1960, Taiwan's population increased fourfold from 2.6 million to 10 million, with an acceleration of its growth following World War II (Lee, 1971). Because of its swift fertility transition, discussed in Section 6, the upsurge in the rate of Taiwan's total labor force was of relatively short duration. In addition, the annual rate of growth of the non-farm labor force increased significantly in the 1930s from 1.5 percent to 3.9 percent and accelerated in the late 1950s to nearly 5 percent. As seen in Table 2, the rate of growth of non-farm employment was higher than that of the total labor force, enabling the share of agricultural labor to decline and structural transformation to occur.

Table 2-Labor Force Changes in Taiwan, 1905-1966

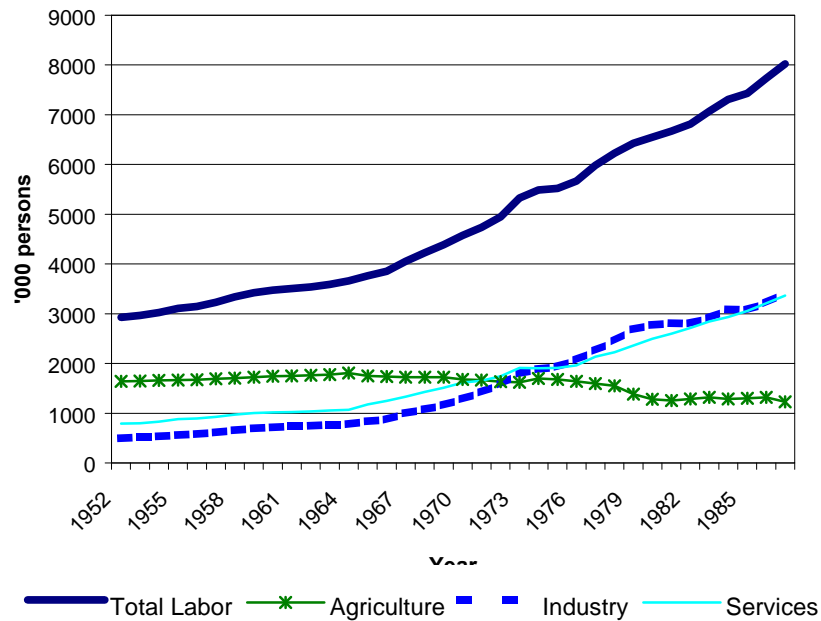
Year	Agricultural Labor Share (%)	Labor force growth (%)	Non-farm labor growth(%)
1915	70.9	1.58	1.52
1920	69.5	-.07	0.90
1930	67.7	.90	1.46
1940	62.4	2.29	3.87
1952	61.0		
1956	59.9	0.66	1.40
1960	56.1	2.62	4.96
1964	54.2	2.63	3.76
1966	53.0	2.13	3.47

Source: Johnston and Kilby, 1975

Thus, between 1895 and 1960, the relative share of the agricultural labor force declined from 78 percent in 1895 to 56 percent in 1960 (Lee, 1971). Taiwan

reached its structural transformation turning point in 1964, when the absolute size of the agricultural labor force peaked, after which it began to decline, causing its relative share in the total labor force to decline rapidly to 37 percent in 1970 and only 15 percent in 1987 (Figure 2). In 1974, roughly one decade after the structural transformation turning point, both employment in industry (mining, manufacturing, construction, and utilities) and in services (communications, transport, and other services) surpassed employment in agriculture.

Figure 2-Employment by Sector in Taiwan



Source: Taiwan Statistical Data Book, Council for Economic Planning and Development, 1988.

In the period from 1952 to 1980, Taiwan made very impressive gains in transforming its economy from a primarily agrarian-based to a diversified economy. As shown in Table 3, the relative share of agriculture in domestic output declined from 38 percent in 1953 to 6 percent in 1987. Similarly, the share of agricultural labor declined from 56 percent in 1953 to 15 percent in 1987 and per capita income increased almost eight-fold in constant prices.



The real net domestic product of agriculture increased by about 80 percent during the 1952-64 period, at an average annual rate of 5 percent, even as the share of agriculture in net domestic product declined from 36 percent to 28 percent (Kuo et al, 1981). Because the agricultural population only increased by one-third over the whole period, the 5 percent annual growth in agricultural output assured a net agricultural surplus and enabled structural transformation to proceed rapidly.

Table 3-Changes in the Economic Structure of Taiwan, 1953-1987

	1953	1970	1987
Production Structure (NDP) (%)			
Agriculture	38.4	18.0	6.3
Industry	17.7	34.5	47.5
Services	43.9	47.5	48.2
Labor Structure (%)			
Agriculture	55.6	36.7	15.3
Industry	17.6	28.0	42.7
Services	26.8	35.3	42.0
Per capita national income			
NT\$ at 1981 prices	17,863	45,081	142,733
US\$ at current prices	159	360	4,630

Source: Taiwan Statistical Data Book 1988 in Mao, 1992

How did Taiwan achieve these gains? The transformation of agriculture into a source of economic surplus was achieved primarily through the result of increased yields of traditional crops and the introduction of new crops. Fixed

capital expanded by 34 percent, mainly irrigation and flood control facilities, working capital increased by 140 percent, and fertilizer use grew by 91 percent (Table 4).

In the same period, Taiwan's industrial sector grew at an average annual rate of 11 percent, relative to the 7 percent growth of net domestic product. By 1964, the net domestic product was 250 percent higher than in 1952, and the share of industry in total NDP increased from 18 percent to 28 percent (Kuo et al, 1981). This industrial growth is attributed to the emergence of a manufacturing subsector, which was highly concentrated in food processing and textiles, and other light manufactures.

Table 4-Agricultural Employment, Production, and Development in Taiwan, 1952-1964

	1952	1956	1960	1964
Indices:				
Agricultural population	100.0	110.4	126.2	132.7
Agricultural employment	100.0	100.1	104.7	112.2
Total agricultural production	100.0	121.0	142.8	178.7
Agricultural crop production per worker	100.0	115.4	126.1	142.4
Fixed capital	100.0	107.5	116.6	133.6
Working capital	100.0	151.5	169.7	240.2
Multiple cropping	171.9	175.5	183.6	188.0
Diversification	3.54	4.07	4.01	5.75

Source: Kuo, Ranis, and Fei, 1981.

The specific elements of Taiwan's structural transformation are taken up in further detail in the following sections, which address Taiwan's experience in increasing agricultural productivity, expanding agricultural markets and rural non-farm employment, and in curbing rapid population growth.

### 3. AGRICULTURAL TRANSFORMATION

The classic problem of diminishing returns in agriculture resulting from growth of the farm population with little scope for expanding the area under cultivation is applicable to only limited areas in sub-Saharan Africa such as Rwanda and Burundi, where population densities are very high. More widespread problems have been related to the shortening of fallow periods leading to declining crop yields and to soil erosion and related problems in low potential semi-arid areas. Probably the most general problem, as stressed by Hayami (1997), is the great difficulty of adapting technologies and local institutions to the new conditions created by a doubling of population every 25 years. Limited growth in agricultural productivity poses a constraint on increasing farm cash incomes and in expanding agricultural commercialization, both of which are critical to the structural transformation process.

#### AGRICULTURAL PRODUCTIVITY GROWTH: LABOR VERSUS LAND

An international comparison of changes in agricultural productivity between 1960 and 1980 for 44 countries reveals that a large and growing gap between

agricultural labor productivity in developed countries and in low-income developing countries was powerfully influenced by structural and demographic factors (Hayami and Ruttan, 1985). In the 12 countries with the lowest per capita income among the 44 included in their analysis, total agricultural output increased at an average rate of 2.9 percent compared to 1.9 percent in the developed countries. However, increases in the agricultural labor force minimized the growth in agricultural labor productivity in the low-income countries. The growth in the agricultural labor force increased from a rate of .6 percent between 1960 and 1970 to 1.9 percent between 1970 and 1980. The increased rate of growth of agricultural labor resulted in a *decline* in the rate of growth of agricultural labor productivity from 2.3 percent in the 1960s to only 1.0 percent in the 1970s. In contrast, agricultural labor productivity grew by 5.4 percent in the developed countries during that decade. The low-income countries increased land productivity by 2.5 percent, compared to 2.0 percent in the developed countries.

Hayami and Ruttan also note that accelerated growth of the agricultural labor force in the low-income countries resulted mainly from rapid growth in the total labor force, which in turn resulted from the acceleration of total population growth during the first two decades after World War II.<sup>2</sup> The rapid growth of the agricultural labor force was also caused by inadequate absorption of labor by the

industrial and service sectors, due to factor price distortions caused by macroeconomic and trade policies, and the small share of the total labor force in the non-farm sectors.

The impact of structural and demographic factors is particularly dramatic in the contrasting changes in the United States and Bangladesh. Both countries increased output per hectare by about 40 percent between 1960 and 1980. But in Bangladesh the agricultural workforce increased by 57 percent from 12 to 19 million while in the United States it declined by 55 percent from 3.8 to 1.7 million. As a result, the area cultivated per worker increased dramatically in the United States to 247 hectares while it declined from .8 to .5 hectares per worker in Bangladesh. The net outcome was a threefold increase in agricultural labor productivity in the United States and a 10 percent decline in Bangladesh in spite of impressive progress in increasing crop yields (Table 5).

Table 5-Agricultural Labor Productivity in Bangladesh and U.S. 1960-1980

	Bangladesh	United States
Output/hectare growth	40%	40%
Agricultural labor growth	57%	-55%
Ha./worker in 1980	0.5	247

<sup>2</sup> Hayami and Ruttan, 1985, p.419.

Output/worker growth	-10%	200%
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Source: Hayami and Ruttan, 1985

## LABOR-INTENSIVE PRODUCTIVITY GROWTH IN TAIWAN

Accelerated expansion of non-farm employment in the 1930s and again in the 1950s made important contributions to the decline in the share of agriculture in the total labor force from 68 percent in 1930 to 56 percent in 1960. Even so, the number of farm households doubled between 1930 and 1960, and the average holding fell from about two hectares to one hectare. By the mid-1960s, however, Taiwan had reached its “structural transformation turning point,” when the size of the farm labor force began to decline at an accelerating rate.

The annual rate of increase in agricultural labor productivity of 3.3 percent between 1952 and 1966 was nearly three times higher than the 1.2 percent rate during the period 1901-50. The rate of change in output per worker ( $Y/L$ ) is roughly equal to the sum of the rates of change in area cultivated per worker ( $A/L$ ) and in yield ( $Y/A$ ). Using that partitioning, the average rates of change in the two periods are shown in Table 6.

Table 6- Annual Rates of Change in Agricultural Labor Productivity in Taiwan

Period	Output per Male Worker Y/L	Area cultivated per worker A/L	Yield per hectare cultivated Y/A
1901-50	1.2	0.4	0.8
1952-66	3.3	-0.8	4.1

Source: Tomich, Kilby, Johnston, 1995

Thus, during the half-century ending in 1950, yield increases were twice as important as increases in area cultivated per worker. Between 1952 and 1966, extraordinary yield increases made possible a substantial increase in labor productivity despite a decline of more than 25 percent in the cultivated area available per worker.

Data presented by T. H. Lee in his 1971 book *Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960* permit an interesting analysis of the components of Taiwan's agricultural progress between 1911-15 and 1956-60. Particularly noteworthy is the fact that underemployment in agriculture was substantially reduced in spite of the fact that the 49 percent increase in the size of the farm labor force was nearly twice as large as the 27 percent increase in the cultivated land area over that 45-year period. The expansion and improvements in irrigation enabled a 96 percent increase in the cropped area, as a result of increased multiple cropping. This increase was much larger than the 27 percent increase in cultivated land area.



Similarly, an increase of labor inputs of 98 percent in working days was almost identical to the 96 percent increase in cropped area. Thus, Taiwan's impressive increases in farm labor productivity were made possible by fuller as well as more efficient utilization of the available farm workforce. Total farm output increased 3.4 times between 1911-15 and 1956-60, reflecting increases in output per cropped acre as well as the increases in cropping intensity. A five-fold increase in use of divisible current inputs, including a 13-fold increase in fertilizer consumption, accounted for almost all the increase in purchased inputs associated with the 3.4-fold expansion of farm output.

#### THE ROLE OF INSTITUTIONS AND INFRASTRUCTURE IN TAIWAN'S AGRICULTURAL DEVELOPMENT

The redistributive land reforms in Japan and Taiwan, which were carried out under very special circumstances, made a very significant contribution toward increasing equity by enabling former tenants to retain the economic rent associated with the land they cultivated. However, it was the size-distribution of *operational units* that was critical to achieving a broad-based structure of agricultural development which fostered significant increases in total factor productivity associated with fuller as well as more efficient use of a large and (for Taiwan) growing farm labor force. Although farms in Taiwan and Japan were not

uniformly small, differentiating factors such as tractor subsidies for large-scale, modern farm units were avoided.

Government initiatives to build public institutions and infrastructure were particularly important. The establishment of strong agricultural research, extension, and other support institutions, along with a steady commitment to strengthening the rural infrastructure, provided the essential foundation for the productivity growth in agriculture and the commercialization of the rural economy.

From the period of Japanese rule, the orientation and quality of agricultural research, the broad coverage of support services, and the strengthening of rural infrastructure were indispensable to creating Taiwan's broad-based pattern of agricultural development. Fixed capital outlays by the Japanese administration averaged about 25 percent of expenditure by the Japanese colonial administration, and half or more of that expenditure went to the construction and improvement of railways, harbors, and roads. The production of electricity, which grew by about 15 percent annually between 1920 and 1943, was especially important for fostering the development of geographically dispersed rural industries.

Investment in irrigation rose sharply during the 1920s, accounting for almost 15 percent of total investment in Taiwan during that period. Large-scale irrigation

projects were carried out by the colonial administration, but grants, loans, and technical assistance to local irrigation associations for small-scale systems were more important. Those associations organized, managed, and maintained the irrigation systems. In addition, a network of agricultural associations enabled the government to carry out an effective agricultural extension program at low cost. Government subsidies covered only a part of the salaries of extension workers and technicians employed by the associations. The fact that the rest was paid by the farmers made the extension agents directly accountable to the farmers they served.

#### JOINT COMMISSION ON RURAL RECONSTRUCTION

Among the many public and private institutions that contributed to Taiwan's economic development, one of the most influential was the Sino-American Joint Commission on Rural Reconstruction (JCRR), which played an especially important catalytic and coordinating role. With the transfer of the JCRR from mainland China to Taiwan in 1949 and the reactivation of U.S. economic aid in 1951, the JCRR became the agricultural arm of the U.S. mission to Taiwan. Approximately one-third of the total aid of \$1.5 billion provided by the U.S. between 1951 and 1965 went into agriculture, for building infrastructure and promoting agricultural and human resources. Very little aid was allocated to industrial development, which was by and large left to private enterprise (Mao and Schive, 1995).

As a well-funded and flexible organization with semi-independent status, the JCRR was able to exert a strong influence on policy, seizing opportunities to support promising pilot projects implemented by governmental or non-governmental organizations at any level. The JCRR was the only agency that sought to combine the implementation of research, extension, and irrigation through revitalizing and strengthening farmers' associations. With its focus on "rural reconstruction" and the wellbeing of rural people, the JCRR was able to provide an integrated perspective on the formulation and implementation of policies for agricultural and rural development, including agriculture-related rural industries and rural health.

The JCRR also supported the reorganization of the landlord-dominated agricultural associations established during the colonial period into multipurpose Farmers' Associations that have since provided effective extension, credit, and marketing services to farmers. The close relationship between farmers and their farmers' associations (as well as irrigation associations and fruit marketing cooperatives) improved farmer access to inputs, markets, information, and technology.

A key characteristic of the JCRR is its combination of the planning function with the implementation of research, extension, irrigation, and institution-building. This brought a greater realism to the planning process (Mao, 1992). Second, the JCRR was very effective in operating at the local level in a relatively decentralized manner, involving local farmers in the planning and implementation process.

#### FARMERS' ORGANIZATIONS

Four main types of rural organizations were designed to implement rural development policies, with the full support of political and administrative leaders: farmers' associations, irrigation associations, fishermen's associations, and agricultural cooperatives (mainly for fruit marketing). Among these, the farmers' associations were the most important, serving as a cooperative designed to solve farming, financial, and marketing problems faced by farmers. In all cases, the associations serve as a bridge between rural producers and the government.

#### INCREASING AGRICULTURAL PRODUCTIVITY IN SUB-SAHARAN AFRICA

How transferable is Taiwan's experience for sub-Saharan Africa? In contrast with Taiwan, the physical environment for agriculture, as defined by climate and soil conditions, is extremely heterogeneous in sub-Saharan Africa. Hence, agricultural research programs have to contend with a large number of crops, including crops such as cassava, yams, and sorghum that have received much

less attention world-wide than rice, wheat, or maize. There is also great variation in the extent to which different areas have moved from being “land surplus” to “labor surplus” areas. Sparseness of population can be an obstacle to improving rural infrastructure because the population base for investing for roads and public services is small as well as poor (Platteau and Hayami, 1998).

Efforts to increase production by use of chemical fertilizers has often been difficult because of a need to simultaneously promote the adoption of new, fertilizer-responsive crop varieties in order for fertilizer application to be attractive to farmers. In fact, the challenge of moving from a traditional resource-based agriculture to a science-based agriculture requires simultaneously pursuing several objectives: introducing a new crop variety, promoting fertilizer use, while also promoting terracing or tie-ridging to obtain more efficient utilization of available rainfall.

It also needs to be recognized that labor-intensive, yield-increasing innovations are much more easily developed for irrigated farming, so that investments in fertilizers are not subject to the risk of uncertain rainfall. There is a widely held view that African countries simply “must” expand irrigation. It appears, however, that physical limitations—notably the lack of a water surplus and flat terrain as in the Sahel, which makes proper drainage impossible—restrict the areas in which irrigation makes economic sense (Moris and Thom, 1987). A more recent IFPRI

review by Rosegrant and Perez (1997) also stresses the problems involved in expanding irrigation in the sub-Saharan Africa region, noting that irrigation will not be the main source of increased food production. However, Rosegrant and Perez emphasize that selective and economically efficient development of new sources of water and more efficient utilization of existing water supplies can make a very significant contribution.

Several lessons emerge from the experiences of both Taiwan and Japan in increasing agricultural productivity. First, Taiwan and Japan adopted an integrated perspective that was adapted to its unique historical and physical conditions and met the organizational requirements for rural development. Thus, the agricultural development strategy that was developed was supported by targeted investments in infrastructure and institutions, such as the JCRR in Taiwan. Second, a broad-based strategy was implemented that built on and strengthened an agrarian structure that emphasized small-scale farm units. The lack of differentiating factors for large-scale farm units avoided a dualistic agrarian structure in which atypically large, capital-intensive, farms dominate the use of arable land, farm output, and commercial sales.

#### 4. RURAL INDUSTRIALIZATION AND FARM- NON-FARM LINKAGES

The farm cash income constraint that limits the purchase of fertilizer, farm equipment, and other inputs that enhance the productivity of a farm household's own resources of land and labor also has serious adverse effects on the positive interactions between agricultural and non-agricultural development. The general lack of monetary income in a semi-subsistence agricultural economy clearly limits the emergence of new manufacturing and service activities. It also limits the tax base needed for the support and expansion of schools, health and family planning programs, and investment in roads, electric power, communication facilities, and the other types of infrastructure critical to economic growth.

In general, a broad base of rural income growth maximizes consumption demand for local services and simple consumer items that are labor intensive and suited for small-scale enterprises. Research in other countries has found that the highest expenditure elasticity for rural households is for local nonfood goods and services. Moreover, these elasticities are higher for rural-based production than from large-scale urban production (Chuta and Liedholm, 1990; Haggblade, Hazell, and Brown, 1989; Hazell and Roell, 1983).



## AGRICULTURAL-INDUSTRIAL LINKAGES IN TAIWAN

Because Taiwan's broad-based pattern of agricultural development was based on innovations and inputs that could be adopted incrementally by small-scale farm units, a large and growing percentage of the farm population was involved in the increases in agricultural productivity and output. Despite consistent extraction of resources from the agricultural sector, the importance of raising rural incomes was always recognized as an important policy goal in its own right (Lee, 1978). As agricultural production and rural incomes grew rapidly in the 1960s, small and medium enterprises (SMEs) also mushroomed rapidly in this period.

Thus, rising rural consumption demand triggered the early development of Taiwan's small and medium enterprises (SMEs), laying the foundation for a fast-learning, highly adaptive, and dynamic sector which continued to be of major importance as Taiwan moved on to a later phase of development dominated by industrial exports.

Although Taiwan is best known for its export-led growth, domestic demand played a critical role in the 1950s and 1960s, a point often neglected. The expansion of domestic demand, particularly in the period from 1952 to 1986, was far more important than export growth in terms of labor absorption (Park and Johnston, 1995). The share of domestic demand in the expansion of total

output was 61.6 percent in 1956-61, grew slightly to 63.2 percent in 1961-66, before gradually falling to 34.7 percent in 1971-76, as export growth came to dominate the growth of output (Table 7).

Table 7-Sources of GDP Growth Expansion in Taiwan, 1956-76

Period	Domestic Demand Expansion (%)	Export Expansion (%)	Import Substitution (%)	Technological Change (%)
1956-61	61.6	22.5	7.7	8.2
1961-66	63.2	35.0	0.5	1.3
1966-71	51.4	45.9	4.7	-3.0
1971-76	34.7	67.7	-2.4	0.0

Source: Kuo, Ranis, and Fei (1981).

## THE EMERGENCE OF RURAL-BASED INDUSTRY

It is telling that the list of the major industrial categories of small and medium enterprises during the early stages of Taiwan's economic development closely corresponds with the pattern of demand of *rural*, rather than urban, households (Park and Johnston, 1995). In 1954, most small industrial enterprises were in food, beverage, and tobacco manufacturing; textiles and apparel, wood, bamboo, and nonmetal furniture; transportation equipment (including bicycles); machinery; and metal and metal products (Table 8). Each of these categories is related to rural consumption or input demand. It is also telling that, by 1981,

industrial priorities had shifted and diversified to export goods, such as paper products, plastics, and electrical and electronic equipment.

The dominance of rural-based small enterprises catering to the rural population was a critical feature of Taiwan's early development. These small enterprises emerged during the period in which broad-based farm cash income growth was made possible by agricultural productivity growth. Evidence of non-manufacturing activities in the same period further confirms the importance of these rural demand linkages. In the 1950s and 1960s, most enterprises were engaged in commerce and other service activities. In this period, only 34 percent of non-agricultural employment was created by manufacturing. Thus, most employment creation was focused on the domestic market.

Clearly, rising rural consumption demand triggered the early emergence of the SMEs. In turn, a unique feature of the dominance of SMEs in Taiwan is their role in leading industrial development from a rural demand-based output to an advanced stage, oriented for export production. The technological linkages stemming from the production of agricultural inputs is a case in point. Metalworking shops producing simple agricultural tools later diversified into production of spare parts and more complicated equipment. For example, a farm input company, visited in 1992, had progressed from initially producing

hand sprayers to power sprayers to transmissions for power tillers to power tillers to transport vehicles.

Another important factor in the success of SMEs was the large pool of ambitious entrepreneurs. In the early decades, most of the new entrepreneurs came from farm backgrounds, often had only primary education, and launched new firms in a hiving-off process after acquiring on-the-job experience. Finally, decentralized decision-making by individual farmers and entrepreneurs in rural manufacturing and service enterprises was critical to the widely dispersed and rapid growth of Taiwan's rural economy. It was of great importance that the price signals and incentives that guided their decisions were not distorted by ill-advised macroeconomic policies.

Table 8-Numbers of Small and Medium Enterprises by Industrial Category in Taiwan

Industrial Category	1954	1981
Food, beverage, tobacco	12,200	8,697
Textile and apparel	7,043	8,943
Leather and fur	202	1,053
Wood, non-metal furniture	4,989	8,662
Paper and printing	955	6,426
Chemical and energy	850	2,528
Rubber and plastic products	395	8,672
Nonmetallic mineral	1,935	3,712
Machinery	3,007	19,430
Metal and metal products	1,112	10,473
Electrical and electronic products	729	4,818
Transport equipment	3,443	3,150
Other	2,888	4,846

Source: Park and Johnston, 1995

An unusual feature of the rapid growth of Taiwan's manufacturing sector was that it was the result of mushrooming growth of new firms rather than growth in existing firms. Between 1966 and 1976 the number of firms increased 2.5 times, while the number of employees per firm increased by only 29 percent. This rapid growth in the number of small and medium enterprises contributed significantly to Taiwan's decentralized industrial expansion, which strengthened the positive interactions between agriculture and industry. It was also the key to the remarkably rapid growth of non-farm employment, especially in rural industries. The contrast in annual growth rates of employment in manufacturing in Taiwan as compared to the Philippines, where the economy has been dominated by

large firms in metropolitan Manila, is remarkable (Hayami, 1998). Thus, in Taiwan, manufacturing employment grew at roughly equally rates in both rural and urban sectors, though actually higher in the rural sector. In contrast, urban manufacturing employment growth outstripped rural growth in the Philippines by close to 3 times between 1967 and 1975, and even the urban growth was only a small fraction of the rates in Taiwan (Table 9).

Table 9-Annual Growth of Manufacturing Employment in Taiwan and the Philippines (average annual percentage rates)

	Rural	Urban
Taiwan		
1956-1966	4.99	4.94
1966-1980	10.28	9.40
Philippines		
1967-1975	0.57	1.42
1975-1988	2.03	4.81

Source: Hayami, 1998

#### LACK OF POLICIES TO PROMOTE SMALL AND MEDIUM-SCALE ENTERPRISES

The government's basic policy toward the ownership of industry was to retain control of the utilities, considered vital to the country's defense interests, and of the large industries held for revenue purposes, such as the wine and tobacco bureau. All other industries were left in private hands (Mao and Schive, 1995).

Thus, the private sector became an important force in the 1950s and was able to capture the benefits of the later export boom in the 1960s.

In the early 1950s, the government preferred to encourage large private companies, in the belief that small firms were unable to take advantage of economies of scale. For this reason, low-cost loans were granted mainly to large enterprises for fertilizer, sugar, and cement. Small and medium enterprises (SMEs) were not encouraged explicitly, but they were tolerated. These small firms relied primarily on informal financing but thrived, nonetheless, because of their flexibility and competitiveness.

#### THE ROLE OF HUMAN CAPITAL

The high quality of human capital owed a great deal to the strong commitment to education both during and after the Japanese occupation. Human capital development was also influenced by the knowledge, experience and attitudes acquired through social and economic interactions, including employment on family farms experiencing significant economic and technical progress.

A strong educational system, launched during the period of colonial rule, was the starting point for creating a literate labor force that improved management on farms, increased labor mobility, and produced an easily trainable, skilled industrial workforce. The existence of such a labor force was crucial to the

success and adaptability of Taiwan's small and medium industrial enterprises (SMEs). Expansion of public education began during Japan's colonial rule. By 1950, the school enrollment rate for 6-12 year-olds was already 80 percent, increasing to 97.5 percent by 1967. During the post-War period, education expenditures grew continuously from 1.7 percent of GNP in 1951 to 5.4 percent of an enormously expanded GNP in 1982. Primary education was extended to 9 years in 1968, and its quality was already high. The employment shares of workers with secondary and higher education went from 8.8 percent and 1.2 percent in 1952 to 41.7 percent and 11.5 percent in 1981. Vocational education also became increasingly important, with 316 vocational training institutes established by 1971.

Learning-by-doing was also of great importance in improving the quality and cost-competitiveness of products initially produced for the domestic market, but which then became important exports as Taiwan began to pursue export-based growth in the 1960s. The utilization and upgrading of its human resources was of great importance because one of Taiwan's main resources during the 1950s and 1960s was its abundant supply of labor.



## RURAL INDUSTRIALIZATION IN SUB-AFRICAN AFRICA

Despite the strong interest expressed by African governments in industrialization, industrialization efforts have suffered from limited demand, low average productivity, limited investment incentives, and high costs of technical inputs (van Dijk, 1992). At the conclusion of the first Industrial Development Decade for Africa (IDDA) in 1990, five major shortcomings were identified as: 1) over-expansion of industrial capacity relative to agricultural production; 2) over-extension of public ownership; 3) over-investment in import-substitution relative to domestic demand and export-oriented industries; 4) over-investment in final stage consumer goods relative to raw materials processing; and 5) excessively high import and capital components in production costs (Wohlmuth, 1992).

Recently, considerable attention has been given to the role of non-farm, income generating, activities of farm households in Africa. Rural household surveys show that the rural non-farm economy accounts for 25-40 percent of rural income (Haggblade et al., 1989). In contrast to South Asia and Latin America, the share of non-farm income is higher at higher household incomes, suggesting that wealthier households are more likely to overcome the credit barriers required to start non-farm activities (Reardon et al, 1992). Abdulai and Delgado (1999) demonstrate that access to credit, education, population density, and infrastructure have a positive effect on the probability of households' participation in non-farm activities and in the supply of labor to the non-farm sector.

Based on a survey of 30,000 small enterprises in five African countries, Liedholm et al. (1994) find that three-quarters of new rural non-farm jobs come from the creation of small enterprises, with the remaining coming from the expansion of existing firms. Net firm expansion is more likely to result if enterprises start small; are younger; are engaged in non-trade sectors, and headed by males. They also note the high overall growth rates of existing small enterprises in rural areas, 6.9 percent in rural areas and 8.8 percent in rural towns. Over 85 percent of these small enterprises started out as “microenterprises,” with one to four workers. Finally, they find, although not tested empirically, that agricultural growth provides a demand-pull that stimulates the growth of rural enterprises.

The Agricultural-Development Led Industrialization (ADLI) strategy views agriculture as providing the push for increased growth of consumer goods and input industries (Adelman and Vogel, 1992). Primarily, the ADLI strategy depends on generating induced demand for industrial inputs and increased consumption of manufactures by farmers. Thus, ADLI requires that both forward and backward linkages be sufficient to generate the needed multiplier effects and that both agricultural and industrial supply are sufficiently responsive or elastic in response to changes in demand. Adelman and Vogel conduct an analysis of these linkage effects, based on comparisons of relevant multipliers in the Social Accounting Matrices (SAMs) of six sub-Saharan countries. The results of this analysis are that agriculture’s backward linkages are considerably

greater than its forward linkages. Agriculture is linked forward in that a \$1 increase in non-agricultural production leads to a \$.70 increase in derived demand for agricultural production. A strong backward linkage is evidenced in that a \$1 increase in the value of agricultural production leads to a \$4 increase in induced demand for non-agricultural inputs. This backward multiplier rises rapidly with per capita income, suggesting that non-farm input increases significantly during growth.

However, on the supply side, the responsiveness of non-agricultural output to growth in agriculture can only satisfy a fraction (0.16) of the induced demand for manufactured output. Given this weak supply response, combined with the weak performance of agriculture, Adelman and Vogel conclude that the applicability of the ADLI strategy in sub-Saharan Africa depends on the ability to initially address these supply-side considerations, particularly the capacity to increase agricultural output.

## 5. AGRICULTURAL MARKETS

An outstanding feature of Taiwan's agricultural development is the early expansion of the share of agricultural output that was marketed. According to Lee (1971), some 56 percent of total agricultural output was marketed as early as 1911-15, and that marketed share rose to 64 percent in 1921-25 and to 72 percent in 1931-35 (Table 10). In the period up to 1940, the largest share of total farm cash sales was to domestic processors. During the decades prior to World War II this consisted mainly of sales of cane to sugar mills that exported most of their production. In the period beyond 1950, as Taiwan's structural transformation accelerated, sales to non-farm households rose to assume the majority of all sales. Looking at total farm purchases, the purchases of fertilizer and other current inputs grew from 18 percent in 1911-15 to nearly one-third of total purchases in 1936-40.

Table 10-Marketed Shares and Resource Transfers from Agriculture in Taiwan  
(millions of Taiwan dollars at 1935-37 prices)

	1911-15	1921-25	1931-35	1936-40	1950-55	1961-65	1966-69
Agricultural Output	163.9	238.0	361.4	422.5	513.3	801.6	1,044.9
% Marketed share	56.3	63.8	71.7	71.4	58.0	60.6	61.9
% Resource transfer	30.5	26.1	24.8	21.1	22.0	13.4	13.8
Total farm cash sales	91.6	151.7	259.3	301.6	297.8	485.8	646.8
% Sales to non-farm households	32.6	26.7	23.2	22.6	46.4	40.6	42.5
% Sales to foreign countries	16.9	23.2	34.4	32.3	5.5	7.4	8.2
% Sales to processors	50.5	50.3	45.1	45.1	48.1	52.0	49.3
Total farm purchases	42.1	92.6	169.8	212.5	185.0	378.5	502.4
% Current inputs	18.3	27.4	32.3	31.6	32.2	32.6	35.6
% Fixed capital	2.3	7.9	5.6	3.6	3.3	10.4	15.6
% Consumer goods	79.4	64.7	62.1	64.7	64.5	57.0	48.8

Source: Lee, 1971.

Reflecting the emphasis on labor-using, capital-saving technologies, outlays for fixed capital did not reach 10% of total purchases until 1961-65. Rapid expansion of agricultural exports, notably rice and sugar to Japan, were key to that early and rapid commercialization of Taiwan's agricultural economy. Between 1911-15 and 1936-40, Taiwan's agricultural exports (at constant prices) increased fourfold. In the early 1920s, when the non-farm population was only 30 percent, agricultural exports contributed twice as much to farm cash earnings as did domestic sales. Exports thus lifted the ceiling on output expansion that would otherwise have been imposed by the small size of the non-farm population dependent on purchased food.

The rapid expansion of exports and growth of farm cash income had other benefits for overall economic growth. Enlarged earnings of foreign exchange from agricultural exports helped finance imports of industrial equipment. Even more important, a substantial net outflow of capital from the agricultural sector helped to finance investments outside agriculture.

The net capital outflow from agriculture (including terms of trade effects) was slightly over 30 percent of the value of agricultural production in 1911-15 and was still over 20 percent in 1931-35, by which time the real value of output had increased by 150 percent. Most of the net outflow prior to World War II was a net outflow of funds, mainly land rent, interest, taxes, and net transfers to financial institutions. This pattern thus demonstrated that “the more of an economy’s productive activities are carried out through market transactions and the more savers hold financial rather than real assets—so the more likely savings will be moved through financial institutions into uses in which their real return is highest” (Wade, 1990).

Such large net transfers were possible because of the large share of output that was marketed and the fact that the increases in agricultural output were achieved with relatively small increases in purchased inputs. Inputs were only about 18 percent of the value of agricultural production in 1936-40 and a mere

13 percent in 1950-55. Input purchases were only about 35 percent of total farm purchases as late as 1950-55 and were almost entirely for variable inputs. It was technological change and fuller and more efficient use of the farm work force, along with this judicious expansion of purchased inputs that made possible substantial increases in total factor productivity.

Crop production in Taiwan grew at an average of about 3.5 percent both before and after World War II; and it is estimated that total factor productivity increased at about 2.5 percent in 1920-39 and at about the same rate between 1951 and 1964. The large resource transfers certainly meant a significant squeeze on agriculture, but even so the rapid growth of output permitted a rise in per capita rural consumption of about 0.9 percent per year in this period.

After the 1953 land reform, the transfer of funds out of agriculture for land rents and interest payments was reduced sharply from about 75 percent of funds transferred before 1940 to a quarter of the total transferred. Tax payments and irrigation fees rose from 20 percent to over 50 percent in the 1950s. With farm household income up sharply in the 1960s, voluntary savings became the major route for inter-sectoral transfer. By 1966-70, the resource-transfer share had declined from 22 to 14 percent, although the amount of resources transferred was greater because of the large expansion in total farm output. Farm cash receipts more than doubled between 1950-55 and 1966-69, but the increase in

the off-farm income of farm households was even greater. By 1966 over one-third of the total income of farm families was coming from nonagricultural sources, and that share was rising rapidly because of structural transformation and especially the mushrooming growth of small- and medium-enterprises in Taiwan's rural non-farm economy. And by 1980 the share of farm family income coming from agriculture was down to 30 percent and the non-farm share had reached 70 percent.

#### MARKET EXPANSION IN AFRICA

The growth of farm cash income in sub-Saharan Africa, much like Taiwan in the early part of this century, has depended heavily on production for export. Between the end of World War II and the mid-1960s, the growth of export crops in sub-Saharan Africa was associated with increases in Africa's share in world production of coffee and other export crops, but in recent years, Africa's share has declined. Growth of domestic commercial demand has accounted for an increased share of commercial production, but the increase has been limited by the slow rate of structural transformation.

According to an FAO study published in 1968, between 40 and 45 percent of agricultural output was marketed in 1962, with sales to domestic consumers accounting for a little less than half of the total commercialized production. Inter-



country variations within sub-Saharan Africa in the share of output marketed are large and are related to differences in the importance of crop production for export as well as variations in the importance of internal markets (Anthony et al., 1979).

Crucially important for the choice of strategy for agricultural development is the fact that farm households in late-developing agrarian economies face a cash income constraint on the use of purchased inputs. The potential for expanding production of export crops can ease that constraint to some extent. But it is growth of the *internal* market for food that is key to enabling a large and growing percentage of farm units to increase their cash receipts and to expand their use of a widening array of purchased inputs. An important lesson emerging from Taiwan's experience is that the promotion of commercialization through initially promoting agricultural exports and later expanding domestic markets effectively lifted the ceiling on output expansion.

Recently, an extensive literature on agricultural markets in Africa has attempted to understand the constraints to market performance in the wake of market reforms initiated by structural adjustment programs (Barrett, 1997; Jayne and Jones, 1997; Jones, 1996). An emerging consensus in this literature is that complex marketing arrangements have not developed following reforms and that private food markets have only a limited capacity to reduce market risks for producers, consumers, and traders (Beynon et al, 1992). Major constraints to

market performance have been identified as: limited trader investment, thin markets, weak transport and other infrastructure, lack of public market information, high transaction costs, and high inland transport costs (Fafchamps and Minten, 1999, Gabre-Madhin, 1998; Staatz et al, 1989; Coulter and Golob, 1992).

## 6. DEMOGRAPHIC TRANSITION

The latter half of this century has been marked by historically unprecedented rates of population growth, concentrated mainly in the developing countries. This rapid population growth in the developing countries in the post-World War II period resulted from rapid declines in mortality, due to advances in medical knowledge and public health systems and expanded education, while fertility remained high.

It is estimated that, in 1980, fertility in 47 low-income countries averaged 6.3 children per woman. For the 49 low-income economies, including China and India, the weighted-average fertility was 4.3 because, by 1980, fertility rate was down to 2.5 children per woman in China and to 5.0 children per woman in India. By 1995, the average fertility for the 47 countries (excluding China and India) was down to 5.0. In 1995, fertility in China, India, Bangladesh, and a number of other low-income countries in Asia was down to 3.5 or lower. In contrast, fertility in most of sub-Saharan Africa was still 6 or more children per woman. In 1995, fertility had fallen as low as 5 children per woman only in Zimbabwe and Kenya (World Bank, 1995). In contrast, fertility in the industrialized countries had

declined to close to “replacement” level, or roughly two children per couple by the 1970s, as these countries completed their demographic transition (Birdsall, 1988).

#### ACCELERATED FERTILITY TRANSITION IN TAIWAN

The fact that Taiwan was the first developing country to experience a swift fertility transition—from a Crude Birth Rate (CBR) of 46.1 per thousand in 1952 to 27.2 per thousand in 1970—is well known. During the period of Japanese rule, the Crude Death Rate (CDR) fell from roughly 40 per thousand to an average of 18.5 in 1941-43. In the years following World War II, health programs became considerably more effective with the availability of antibiotics and advances in medical knowledge and in public health technologies. As a result, the CDR fell from 18 per thousand in 1947 to less than 7 per thousand in 1960. Birth rates fell from about 46 to 40 per thousand between 1952 and 1960. However, with the continuing decline in death rates the drop in the rate of natural increase during the 1950s was limited—from an extremely high annual rate of 3.67 percent in 1952 to a still very high 3.25 percent in 1960.

At that time family planning was very controversial, and until the early 1960s was considered too sensitive to be promoted by government. Some of the opposition to government support for family planning stemmed from the view that Taiwanese peasants were too traditional to adopt such an alien practice so that

a government-supported family planning program would probably be an embarrassing failure. In addition, some officials felt family planning was contrary to the teaching of Sun Yat-sen, founder of the Republic of China (Yager, 1988). K. T. Li, one of the principal architects of Taiwan's economic success, stresses that the policy process with respect to family planning illustrated the fact "that a vocal, persistent minority can delay, if not stop, smooth implementation of an urgently needed policy" (Li, 1988). During the 1950s, according to Li, the Chairman of the Joint Commission for Rural Reconstruction and the Vice-Chairman of CUSA, the Council on US Aid, were the principal government officials to openly support family planning. In particular, the Rural Health Division of the JCRR played a key role in promoting family planning, aided by the fact that it was not technically part of the government. The JCRR Report for 1961 avoided any reference to family planning, only noting that "excessive and too close pregnancies are detrimental to the health of mothers as well as of children." This was the basis for a Pre-Pregnancy Health Program "by which information and knowledge concerning pregnancy and child birth are disseminated to the housewives in rural areas" (JCRR, 1961).

As a means of supporting family planning efforts, the JCRR and the provincial government's Health Department gave financial support to an unofficial China Family Planning Association (FPA) set up in 1954. Survey data and visits by FPA volunteers to rural households guided the expansion of the family planning

program. Interest in methods of avoiding additional births differed among social, economic, and demographic subgroups, and family planning activities were adapted to existing cultures by selecting target groups in a step-by-step program. The increase in the percentage of illiterate women practicing family planning was particularly dramatic—from 19 to 78 percent in 11 years (Freedman, 1987).

The decline in Taiwan's crude birth rate from 40 in 1960 to 23 in 1970 was a remarkable achievement. Clearly, that dramatic acceleration of the demographic transition is not to be attributed solely to the introduction and expansion of family planning. Both the sharp reduction in infant and child mortality and the expansion of education were major factors in creating demand for family planning. Li singles out the pressure of rising population on the education system as one of the factors that convinced policymakers of the need for policies to slow population growth. In contrast, Mueller (1971) and others argue that socioeconomic conditions played a more important role. Thus, rising aspirations among the great majority of farm households, related to widespread technical and economic progress, meant that families embraced many new attitudes and practices. These practices included adopting new crop varieties, investing in better education for their children, and purchasing new farm inputs and consumer goods, in addition to conscious action to limit family size.

## THE DEMOGRAPHIC TRANSITION IN AFRICA

At present, most of the countries of sub-Saharan Africa have yet to enter the declining- fertility phase of the demographic transition, making it the only major region where fertility has remained high for a prolonged period despite substantial declines in mortality (Table 11). Overall, the rate of natural increase of the population in sub-Saharan Africa has *risen* steadily from 2.1 percent in 1950 to 2.7 percent in 1965 to 3.1 percent in 1980.<sup>3</sup> African countries with the highest fertility rates are characterized with higher infant mortality rates, a lower proportion of educated women, and a higher incidence of poverty (Table 11).

Two factors appear to have contributed to the persistence of high fertility in sub-Saharan Africa. One is the strength of traditional social mores that have extolled and reinforced the value traditionally attached to high fertility, implying that the fertility decline in Africa may occur at lower levels of child mortality than elsewhere (Caldwell, 1991).

A more important factor has been the widespread perception in many African countries that land was available in abundance. Indeed, in many rural areas, paucity of population was a problem, most notably because it limited the tax base and supply of labor available for the construction and maintenance of roads and other types of rural infrastructure (Hayami and Platteau, 1998). The average

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<sup>3</sup> More recently the decline in mortality has been slowed and even reversed in some countries because of the spread of HIV and AIDS.

population density for sub-Saharan Africa remains below the world average and considerably below that of South Asia, although there are significant differences between countries, with highest population densities in the group C countries, with high fertility rates. However, comparisons based on agro-climatic population density, which controls for agricultural production potential measured in kilocalories, project that most countries of sub-Saharan Africa will have a higher agricultural labor density than India in 2025 (Binswanger and Pingali, 1988).

The Taiwanese experience reinforces the view that fertility behavior is not independent of the socioeconomic factors that have been discussed in other sections, which reinforce each other in the process of structural transformation. Thus, policies that are aimed at enhancing agricultural productivity, increasing farm incomes through expanding markets, increasing non-farm employment through the promotion of rural industrialization, are part and parcel of an integrated strategy to slow the growth of the labor force, which in turn accelerates structural transformation.

Table 11-Demographic and Economic Indicators for Selected sub-Saharan African Countries

	Total Fertility Rate <sup>1</sup>	Under 5 Mortality Rate <sup>2</sup>	Women with no education (%)		Public Health Spending (% GDP) <sup>3</sup>	GNP per cap. (1997 \$)	Population density (per sq.km) <sup>4</sup>
			20-24	45-49			
<b>Group A</b>	<b>5.1</b>	<b>86</b>	<b>11</b>	<b>47</b>	<b>2.2</b>	<b>918</b>	<b>38</b>
Botswana	4.9	53	15	48			
Ghana	5.5	119	26	67	1.3	370	75



Kenya	5.4	96	6	57	1.9	330	47
Namibia	5.2	83	7	36	3.7	2220	2
Zimbabwe	4.3	77	3	29	2.0	750	28
<b>Group B</b>	<b>6.1</b>	<b>155</b>	<b>33</b>	<b>75</b>	<b>1.7</b>	<b>392</b>	<b>71</b>
Cameroon	5.8	126	32	78	1.0	650	29
Côte d'Ivoire	5.7	150	50	90	1.4	690	44
Madagascar	6.1	163	13	41	1.1	250	23
Nigeria	6.0	192	42	85	0.3	260	122
Rwanda	6.2	150	24	72	1.9	210	259
Senegal	6.0	131	67	94	2.5	550	43
Tanzania	6.3	141	16	74	3.0	210	34
Togo	6.4	155	45	93	1.7	330	76
Zambia	6.5	191	11	46	2.4	380	12
<b>Group C</b>	<b>7.0</b>	<b>220</b>	<b>64</b>	<b>87</b>	<b>1.8</b>	<b>237</b>	<b>83</b>
Burkina Faso	6.9	187	78	95	2.3	240	38
Burundi	6.9	152	79	87	0.9	180	244
Liberia	6.7	220	49	88			
Malawi	6.7	234	42	72	2.3	220	104
Mali	7.1	247	82	98	2.0	260	8
Niger	7.4	318	85	99	1.6	200	7
Uganda	7.4	180	30	67	1.6	320	96
<b>World</b>	<b>2.8</b>	<b>132</b>			<b>3.2</b>	<b>5130</b>	<b>44</b>
East Asia & Pacific	2.2	75			1.7	970	108
South Asia	3.4	174			1.2	390	260
L.America & Caribbean	2.8	82			2.9	3880	24
Sub-Saharan Africa	5.6	193			1.6	500	25

Source: Kirk and Pillet, 1998; World Bank, 1998.

<sup>1</sup>Total Fertility Rate is the number of children a woman would bear if her lifetime fertility corresponded to the prevailing age-specific rates and she lived to the end of her reproductive years.

<sup>2</sup> Under five mortality rate is the probability of dying before age five per thousand live births.

<sup>3</sup> 1990-95 period

<sup>4</sup> 1997

## 7. TRANSFERRING LESSONS TO SUB-SAHARAN AFRICA

This review of Taiwan's experience has stressed the importance of an *integrated perspective* that includes agricultural productivity enhancement, rural industrialization, market expansion, and accelerated fertility transition. The integrated perspective that guided Taiwan's rural development recognized the importance of concurrent progress in increasing farm productivity, in strengthening rural infrastructure, and in improving human resources through investments in education and health as well as a family planning program that slowed population growth.<sup>4</sup>

Taiwan's approach ensured progress in a range of complementary activities that merited priority without attempting the impossible task of administratively integrating diverse activities such as agricultural research and a maternal and child health program. Like all developing countries, it faced the dilemma that everything cannot be done at once. Taiwan's response was to try to achieve

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<sup>4</sup> That integrated perspective is not to be equated with the integrated rural development programs that became fashionable in the 1970s.

proper sequencing of activities in a phased approach. In terms of the specific lessons emerging from Taiwan's development experience, this study emphasized:

- (1) technological progress based on increases in farm labor productivity supported by an effective agricultural research program oriented to the needs of small farmers;
- (2) a broad-based agricultural development strategy supported by rural infrastructure and institutions to foster widespread increases in farm cash incomes, rather than a dualistic structure favoring large-scale units;
- (3) rural industrialization based on rising rural demand that provided a source of non-farm, rural employment growth;
- (4) rapid commercialization of the agricultural sector based on both exports and growth of the internal market in response to an expanding non-farm population dependent on purchased food; and,
- (5) a commitment to education and the strengthening of human capital, including a priority for maternal child-health programs to improve child survival prospects, in order to provide a basis for industrial growth and to promote changes in fertility behavior.

## SECRETS AND "MISSING LINKS" IN ECONOMIC DEVELOPMENT

An insightful essay on Taiwan's development experience by Hsieh (1990) considers that, with the many failures and only limited successes in worldwide

economic development efforts, there must be some undiscovered secrets to the successes and missing links in the failures. In Hsieh's view, the first missing link is the *how*. That is, while we know a great deal about "what" and "why", determining "how" to adapt transferred knowledge of development from different circumstances and environments to a given country setting poses an enormous challenge.

The second missing link is the question of *timing*. Often, the appropriate sequencing or phasing in, of development activities is ignored. In Taiwan, for example, the success of efforts to increase farm productivity is largely due to the appropriate sequencing of activities. First of all, emphasis was given to developing minimum infrastructure such as irrigation and feeder roads. Second, activities focused on the introduction of high-yielding varieties and inputs, followed by the establishment of farmers' organizations, cooperative marketing, and extension. Had these activities been undertaken simultaneously or in a different sequence, the economic history of Taiwan might be radically different today.

The third missing link is the need for *integration*. That is, development strategies require a perspective that cuts across disciplines, across sectors, across private and public boundaries, across physical and social infrastructure. While Taiwan's

economic development followed the Japanese model closely, much of Taiwan's success can be attributed to getting these three links right, *in its own unique context*. This is perhaps the most significant lesson to draw for the challenge of accelerating structural transformation in Africa at present.

## APPENDIX: SIMULATION OF GROWTH PATHS OF FARM, NON-FARM, AND TOTAL LABOR

The powerful effects of differences in the rate of growth of a country's total labor force and in the initial share of agriculture in the labor force are illustrated in Figures 1a and 1b. Each panel compares hypothetical growth paths for the farm, non-farm, and total labor force in countries with an initial labor force of 10 million. The two columns of panels in Figure A1a assume a modest 1 percent rate of growth of the total labor force, with initial shares of agriculture of 80 percent in the first column and 50 percent in the second column. The two columns of panels in Figure A1b assume a rapid 3 percent rate of growth of the total labor force and initial shares of agriculture of 80 percent and 50 percent respectively. Each column compares three scenarios of non-farm employment growth, between rates of 1.5, 3.0, or 4.5 percent (very few countries have had sustained growth of non-farm employment as high as 4.5 percent).<sup>5</sup> The hypothetical growth projections presented in Figure A1a-1b reinforce the earlier assertion that the process of structural transformation will be extremely slow when the total labor force is growing at 3 percent. It is striking that, with 3

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<sup>5</sup> The assumption that the size of the farm labor force can be computed as a residual determined by rates of change in the total and non-farm labor force is fairly reasonable during the early phase of growth when the economy is primarily agrarian. This assumption becomes increasingly implausible as the relative importance of the non-farm sector increases.

percent population growth and agricultural labor shares of 80 percent, the structural transformation turning point is not reached within the 50-year period under any of the scenarios of non-farm employment growth. Even with agricultural labor shares of 50 percent, the turning point only occurs in the 50-year period when non-farm employment is growing by 4.5 percent. In contrast, for countries with modest population growth of 1 percent, hypothetical growth paths indicate that, even with initial agricultural shares of 80 percent, the size of the farm labor force will begin to decline if non-farm employment grows by at least 3 percent.







## REFERENCES

- Abdulai, Awudu and Christopher Delgado, 1999. "Determinants of Time Spent in Non-Farm Employment by Farmers in Northern Ghana," in *Food Security, Diversity and Resource Management: Refocusing the Role of Agriculture?* (eds. G. Peters and J. von Braun), Proceedings of the Twenty-third International Conference of Agricultural Economists, Hants, England: Ashgate Publishing.
- Adelman, Irma and Steven Vogel, 1992. "The Relevance of ADLI for Sub-Saharan Africa" in *Industrialization Based on Agricultural Development: African Development Perspectives Yearbook 1990/91* (eds. H. Bass et al.), Bremen: Research Group on African Development Perspectives.
- Anthony, Kenneth R. M., B. F. Johnston, W. O. Jones, and V. C. Uchendu. 1979. *Agricultural Change in Tropical Africa*, Ithaca: Cornell University Press.
- Barrett, Christopher, 1997. "Food Marketing Liberalization and Trader Entry: Evidence from Madagascar," *World Development* 25: 763-777.
- Beynon, Jonathan, Stephen Jones, Shujie Yao, 1992. "Market Reform and Private Trade in Eastern and Southern Africa," *Food Policy* 17: 399-408.
- Binswanger, Hans and Prabhu Pingali, 1988. "Technological Priorities for Farming in Sub-Saharan Africa," *World Bank Research Observer* 3(1): 81-98.
- Birdsall, Nancy. 1988. "Economic Approaches to Population Growth" in *Handbook of Development Economics, Volume I* (ed. H. Chenery and T.N. Srinivasan).
- Caldwell, John C., 1991. "The Soft Underbelly of Development: Demographic Transition in Conditions of Limited Economic Change," in *Proceedings of the World Bank Annual Conference on Development Economics 1990*, Washington, DC: The World Bank.

- Chuta, Enyinna and Carl Liedholm, 1990. "Rural Small Scale Industry: Empirical Evidence and Policy Issues," in *Agricultural Development in the Third World* (eds. C. Eicher and J. Staatz), Baltimore: Johns Hopkins Press.
- Collier, Paul and Jan Willem Gunning. 1999. "Explaining African Economic Performance," *Journal of Economic Literature*, March.
- Coulter, John and Peter Golob, 1992. "Cereal Marketing Liberalization in Tanzania," *Food Policy* 17: 420-430.
- Dovring, Folke. 1959. "The Share of Agriculture in a Growing Population," *FAO Monthly Bulletin of Agricultural Economics and Statistics* 8(8).
- Eicher, Carl. 1999. "Institutions and the African Farmer," CIMMYT Economics Program, Third Distinguished Economist Lecture, February.
- Fafchamps, Marcel and Bart Minten, 1999. "Property Rights in a Flea Market Economy," MSSD Discussion Paper 27, Washington,DC: International Food Policy Research Institute.
- Freedman, Ronald, 1987. "The Contribution of Social Science Research to Population Policy and Family Planning Program effectiveness," *Studies in Family Planning* 18 (2): 57-82.
- Gabre-Madhin, Eleni Z. (1998), "Transaction Costs, Institutions, and Contractual Choices in the Ethiopian Grain Market," unpublished Ph.D. dissertation, Stanford University.
- Haggblade, Steven, Peter Hazell, and J.Brown, 1989. "Farm-Non-farm Linkages in Rural Sub-Saharan Africa," *World Development* 17: 1173-1201, August.
- Hayami, Yujiro, 1997. *Development Economics: From the Poverty to the Wealth of Nations*, Oxford: Clarendon Press.
- Hayami, Yujiro and Vernon W. Ruttan. 1985. *Agricultural Development: An International Perspective*, 2d ed.
- Hazell, Peter and A. Roell, 1983. *Rural Growth Linkages: Household Expenditure Patterns in Malaysia and Nigeria*. Research Report 41, Washington,DC: International Food Policy Research Institute.

- Hsieh, S.C. 1990. "JCRR/ADB Experience and Approaches to Economic Development in LDCs," Paper presented at seminar held at the Department of Agricultural and Applied Economics of the University of Minnesota, September.
- Jayne, T.S. and Stephen Jones, 1996. "Food Marketing Policy and Pricing Policy in Eastern and Southern Africa: A Survey," *World Development* 25:1505-1527.
- Johnston, Bruce and Peter Kilby, 1975. *Agriculture and Structural Transformation: Economic Strategies in Late-Developing Countries*, New York: Oxford University Press.
- Joint Commission on Rural Reconstruction, 1961. *Twelfth General Report*. Taipei, Taiwan: Republic of China.
- Jones, Stephen, 1996. "Food Markets in Developing Countries: What Do We Know?" Food Studies Group, Working Paper 8, Oxford.
- Kirk, Dudley and Bernard Pillet (1998), "Fertility Levels, Trends, and Differentials in Sub-Saharan Africa in the 1980s and 1990s," *Studies in Family Planning*, Volume 29, Number 1, March.
- Kuo, Shirley, Gustav Ranis, John Fei (1981). *The Taiwan Success Story: Rapid Growth with Improved Distribution in the Republic of China 1952-1979*, Boulder: Westview Press.
- Lee, T.H. 1971. *Intersectoral Capital Flows in the Economic Development of Taiwan 1895-1960*, Ithaca: Cornell University Press.
- Li, K.T., 1988. *The Evolution of Policy Behind Taiwan's Development Success*. New Haven: Yale University Press.
- Liedholm, Carl, Michael McPherson, and Enyinna Chuta, 1994. "Small Enterprise Employment Growth in Rural Africa," *American Journal of Agricultural Economics* 76: 1177-1182.
- Mao, Yu-Kang, 1992. "Institutional Organizations in Taiwan's Agricultural Development" in *Rural Development in Taiwan and Mainland China* (eds. Peter Calkins, Wen Chern, Francis Tuan), Boulder: Westview Press.

- Mao, Yu-Kang and Chi Schive, 1995. "Agricultural and Industrial Development in Taiwan" in *Agriculture on the Road to Industrialization* (ed. by John Mellor), Baltimore: Johns Hopkins University Press.
- Mellor, John (ed.), 1995. *Agriculture on the Road to Industrialization*, Baltimore: Johns Hopkins University Press
- Moris, John R. and D. J. Thom. 1987. *African Irrigation Overview: Main Report*, Africa/USAID Water Management Synthesis II Project, WMS Report 37. Logan: Utah State University.
- Mueller, Eva, 1971. "Agricultural Change and Fertility Change: The Case of Taiwan," mimeograph, Ann Arbor: University of Michigan.
- Ndulu, Benno and Nicolas van de Walle. 1996. "Overview: Africa's Economic Renewal: From Consensus to Strategy" in *Agenda for Africa's Economic Renewal* edited by Benno Ndulu and Nicolas van de Walle, O.D.C. U.S.-Third World Policy Perspectives. No. 21
- Park, Albert and Bruce Johnston. 1995. "Rural Development and Dynamic Externalities in Taiwan's Structural Transformation," *Economic Development and Cultural Change*, Chicago: University of Chicago Press.
- Platteau, Jean-Philippe and Yujiro Hayami, 1998. "Resource Endowments and Agricultural Development: Africa versus Asia" in *The Institutional Foundations of East Asian Economic Development* (eds. Yujiro Hayami and Masahiko Aoki), Proceedings of the International Economic Association held in Tokyo, Japan.
- Reardon, Thomas, C. Delgado, and P. Matlon, 1992. "Determinants and Effects of Income Diversification among Farm Households in Burkina Faso," *Journal of Development Studies*, 28: 264-96.
- Rosegrant, Mark W. and Nicostrao D. Perez. 1997. *Water Resource Development in Africa: A Review and Synthesis of Issues, Potentials, and Strategies for the Future*. EPTD Discussion Paper No. 28, September 1997, Environment and Production Technology Division, IFPRI.
- Staatz, John, Josue Dione, and Nango Dembele, 1989. "Cereals Market Liberalization in Mali," *World Development* 17: 703-718.

- Timmer, C.Peter, 1988. "The Agricultural Transformation" in *Handbook of Development Economics, Volume I* (ed. H.Chenery and T.N. Srinivasan).
- Tomich,Thomas, Peter Kilby, and Bruce F.Johnston. 1995. *Transforming Agrarian Economies: Opportunities Seized, Opportunities Missed*, Ithaca: Cornell University Press.
- Taiwan Statistical Data Book, 1988. Council for Economic Planning and Development, Taipei, Taiwan: Republic of China.
- van Dijk, Meine Pieter 1992. "What Relevance Has the Path of the NICs for Africa?" in *Industrialization Based on Agricultural Development: African Development Perspectives Yearbook 1990/91* (eds. H.Bass et al.), Bremen: Research Group on African Development Perspectives.
- Wade, Robert. 1990. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*, Princeton: Princeton University Press.
- Wohlmuth, Karl, 1992. "Introduction" in *Industrialization Based on Agricultural Development: African Development Perspectives Yearbook 1990/91* (eds. H.Bass et al.), Bremen: Research Group on African Development Perspectives.
- Yager, Joseph, 1988. *Transforming Agriculture in Taiwan*, Ithaca: Cornell University Press.