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WORKING PAPER NO. 590

THE RELEVANCE OF ADLI FOR SUB-SAHARAN AFRICA

by

Irma Adelman and Steven J. Vogel

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a critical role in disseminating market attitudes by enabling the rise of a class of commercial farmers. Johnston and Mellor (1961) emphasized that agriculture must perform many functions in support of industrial expansion: supply labor, food, raw materials, and capital to the nonagricultural sector; earn foreign exchange for imports required for industrialization; and provide markets for industrial goods. However, except for the physiocrats, no economists assigned a leading-sector role to agriculture.

II Empirical Sources of Agricultural Neglect in Development Policy

The denial that agriculture can serve as a growth pole has been based on several empirical presumptions.

1. *Stylized Facts:* One of the best-established propositions in economic development is that the more developed the country is economically the smaller the share of agriculture in value added and employment. (Kuznets 1968, Clark 1951, and Chenery and Syrquin 1975). This proposition is supported by both historical and contemporary empirical studies. Following Lewis (1954), this proposition has been interpreted in economic development as calling for a policy in which agriculture is the handmaiden of an industrialization push, in which very little of the agricultural surplus is reinvested in agriculture and agricultural terms of trade are used to transfer the lion share of economic surplus from agriculture to manufacturing and encourage rural-urban migration. It has not generally been recognized that the implications of the structural change entailed in shrinking the relative size of the agricultural sector require the transformation of agriculture from a low-productivity sector to a high-productivity sector, in order to enable a shrinking sector to provide a marketable surplus sufficient to feed an increasingly larger urban population.

2. *Technological Pessimism:* (Ricardo 1817) Technologically, agriculture suffers from two presumed disadvantages: Science-based, input-intensive agriculture is not subject to increasing returns to scale. The HYV technology is inherently scale-neutral (Lipton 1978). In addition, it was presumed that agricultural innovations disseminate slowly, are not continuous, and that rates of return to investment in agricultural innovation are lower than in manufacturing. But the scale-neutrality of agricultural innovations is actually a strength of agriculture rather than a weakness, since it enables high productivity egalitarian growth in the rural economy. Also, there is evidence (Grilliches 1958 and Evenson and Ranis 1990) that the rate of return to agricultural innovations has been

considerably higher than that in manufacturing and that, with investment of public resources in agricultural research and extension, a continuous stream of agricultural innovations can be generated.

3. *Domestic Demand Pessimism*: Engel's law established that the income elasticity of demand for food is below unity, so that the share of agriculture in value added must decline as per capita incomes increase. Also, demand functions for grains are price inelastic, so that the absorption of a small excess supply of grains requires a large drop in price. However, empirical research has indicated that at very low income levels, the income elasticity of demand for food actually rises as households move to more varied diets and that the income elasticity of demand for grains continues to rise at income levels typical of semi-industrial countries as households move to a meat-based source of proteins which is based on a much less efficient use of grains for calory-generation.

4. *Trade Pessimism*: (Nurkse 1962 and Prebisch 1962) There was presumed to be a secular tendency for prices of primary goods to fall, making primary exports a poor candidate for an export-led growth strategy. A modified version of this proposition would state that primary-export income is subject to larger cyclical fluctuations than manufactured-export income. In addition, the cyclical character of primary exports leads to exchange rate fluctuations which mitigate against import-substitute industrialization. When export-receipts from primary exports are high, the exchange rate becomes overvalued making imports a more attractive means of satisfying domestic demand than domestic production. When export-receipts are low, the exchange rate is attractive, but the supply of foreign exchange for the import of intermediates and machinery is low, making it a fiscally unpropitious time to initiate import-substitution strategies in manufacturing. The ADLI strategy, however, is not an export-oriented strategy. It is rather a domestic-food agriculture provision strategy, for which trade-pessimism is relevant only to the extent that agricultural development is so successful that it converts grain-importing countries into grain exporters (e.g. India of the 1980s).

5. *Linkage Pessimism*: Ever since the early input-output studies of Chenery and Watanabe (1958) it has been assumed that in developing countries the backward linkages of agriculture are small relative to those of manufacturing Hirschman (1958). The presumed small linkages make agriculture an unlikely growth pole. We contend below that this linkage pessimism is factually unjustified.

6. *Institutional Pessimism*: (Baldwin 1958, Hirschman 1958, Morris and Adelman 1988) The political concomitant of an agrarian, primary-export based economy is a powerful large-landowner class. When traditional agrarian elites are politically powerful they promote land-tenure arrangements which work against the development of owner-operated, medium size farming structures. Since owner-operated farming is the tenure form most conducive to an agriculture responsive to economic incentives, the land-tenure forms encouraged by traditional elites lead to either stagnant or dualistic food-farming. Traditional elites also encourage investment and education strategies which mitigate against industrialization. They stimulate investment in roads, railroads and water-transport that link production centers primarily with export nodes and do not link the countryside with smaller cities and towns. They promote educational pyramids which are narrow, and limited to a small elite. When traditional elites are powerful, income distribution is very unequal and the distribution of benefits from export-growth is narrow. The institutional pessimism of a primary-export based strategy is thus justified. But the ADLI strategy should not be confused with a primary-export strategy. Rather, ADLI is a strategy aimed at improving the productivity of food-agriculture for domestic markets that is implemented on small and medium-size owner-operated farms. This form of agricultural development has the opposite political effects from staple-export-oriented agricultural strategies. It creates an agrarian middle class and a mass domestic market necessary for ultimate successful industrialization.

III The General Case for Agricultural Development Led Industrialization

The essence of the agricultural development led industrialization (ADLI) strategy consists of improving the productivity of food agriculture on small and medium-size farms. Basically, the ADLI strategy views agriculture as a leading sector whose expansion induces concomitant growth in consumer goods and agricultural input industries. The ADLI strategy is implemented through investments in agricultural infrastructure, both physical and institutional, through the dissemination of appropriate agricultural technology and through agricultural research focused on small-scale food production. The twin policy objectives of overcoming technological and institutional barriers in food agriculture form the structural core of the ADLI strategy (Singer, 1979; Adelman, 1984; Mellor 1986). The primary mechanisms through which the ADLI strategy works are the generation of induced demand for industrial output through increased demand for industrial inputs and

through increased consumption of manufactures by farmers. The key to a successful agricultural led industrialization strategy is therefore found in the linkage effects of agriculture with industry.

Simulations with models of newly-industrialized countries such as Korea (Adelman 1984) and Turkey (Yeldan 1989) indicate that the ADLI strategy has many positive macroeconomic consequences: It generates economic growth, employment, industrialization and foreign exchange savings, while improving the size distribution of income and increasing the supply of basic-needs goods to both poor and rich. In the particular contexts studied, the ADLI strategy surpassed the industrial export-led growth strategy in all these respects.

Successful implementation of the ADLI strategy presumes: high intersectoral linkages, supply-responsiveness in both agriculture and industry, and the existence of agro-technologies appropriate to specific food crops, soils, topology and climatic conditions. Additionally, successful implementation of ADLI requires careful management of the agricultural terms of trade, so as to enable farmer-incomes and farm-profits to increase (rather than fall) with improvements in agricultural productivity. Finally, successful implementation of ADLI also presumes that land-tenure arrangements encourage farmer-responsiveness to price incentives and the adoption of more productive technologies.

Adelman (1984) viewed ADLI as a mechanism for breaking the eventual bottleneck reached by first-phase import-substitution. Once the initial import-substitute industrialization phase has satisfied demand in domestic markets, the strategic options are: slower growth, export of consumer goods, import-substitution in producer goods, or widening the scope of the domestic market. Adelman called for the ADLI strategy as a means of promoting further industrialization by enlarging the size of the domestic market for light manufacturing. She argued that prospects for export-led growth had diminished due to a general slowdown in import-growth by the OECD countries and that there was substantial scope for import-substitution in food grains in semi-industrial countries. Singer (1979) viewed ADLI as an aspect of balanced growth.

IV How Applicable is the ADLI strategy to sub-Saharan Africa?

In principle, the general arguments for the pursuit of an ADLI strategy presented above are just as applicable to sub-Saharan Africa as they are to more developed

developing countries. However, the magnitudes of critical parameters may be such as to affect the desirability and feasibility of the ADLI strategy in sub-Saharan Africa. In particular, with primitive agricultural technologies typical of sub-Saharan Africa, linkage effects through production may be too small; with the near-subsistence income levels typical of sub-Saharan Africa, demand for manufactured goods may be too low; with the rudimentary industrial capacity typical of sub-Saharan Africa the supply elasticities of domestically produced manufactured wage goods may be too low; and the propensity of African farmers to respond to market incentives and adopt productivity-enhancing technologies may be too small.

In this section, we present empirical evidence on the linkage effects between agriculture and the rest of the economy in sub-Saharan Africa. This evidence reinforces the arguments in favor of the adoption of an ADLI strategy in sub-Saharan Africa by indicating that the structure of production and expenditures in sub-Saharan Africa generates surprisingly large linkages between agricultural expansion and demand for non-agricultural output. In the next section, we present evidence on supply elasticities in sub-Saharan Africa; these indicate the need for additional policy measures in support of an ADLI strategy in sub-Saharan Africa.

IV.1 Linkage Effects in sub-Saharan Africa

Our analysis of linkage effects is based on comparisons of relevant multipliers in Social Accounting Matrices (SAMs) of six sub-Saharan African Countries. The six country SAMs for sub-Saharan Africa are Botswana (1975), Cameroon (1980), Ivory Coast (1980), Kenya (1976), Lesotho (1981), and Swaziland (1972). As low-income developing economies, Botswana, Kenya, and Lesotho have real per capita incomes under \$600. Middle-income developing countries with real per capita income at or under \$1200 are Cameroon, Ivory Coast, and Swaziland. All these countries exhibit low levels of development in which most of the population lives in the countryside and works in subsistence agriculture. On the average, 76.8 per cent of the labor force works in agriculture, a sector which is only 6 per cent as efficient as the non-agricultural industrial sector. This compares unfavorably to Latin America for which agriculture is three to five times more productive (Vogel, 1991). Except for Botswana and the Cameroon, the other sub-Saharan countries also rely primarily on export agriculture to earn foreign exchange.

IV.1.1 The Social Accounting Matrix and SAM multipliers.

The social accounting matrix (SAM) is an accounting framework in matrix form which encapsulates aggregate structural interrelationships among the various agents in an economy. It maps the circular flows of income and expenditures on the one hand, and supply of goods and services on the other. The ij -th entry in the SAM represents the payment by account j to account i for services rendered or goods supplied or an income transfer from account j to account i . The sum of the entries in the i -th column represents total expenditures made by account i to all the other accounts. Similarly, the i th row total represents all income payments to account i made by the other accounts in the SAM. Naturally, for each account total gross income equals total gross expenditures; that is, all corresponding row and column sums are equal to each other. A typical SAM appears as follows:

[SAM SCHEMATIC HERE]

The submatrices of this SAM delineate the endogenous circular flow of commodities, incomes, and expenditures: They map production through the table of input-output flows (A) to the distribution of factor incomes from production activities (V -value added) ; they then allocate factor incomes to their institutional owners, the households and firms, (Y) and modify the households incomes through transfers to other households and firm incomes through the redistribution of profits ($R1$); and, finally, they map the institutional incomes into consumption expenditures on final demand for goods and services (C).

Superimposed upon these endogenous flows of goods and services is a vector of flows to and from exogenous institutional categories: the government, the capital account, and the foreign account (ROW). In addition to payment for factor services and intermediate products, production activities also pay for imported goods (Im) and pay out various indirect taxes and tariffs ($T1$). Households allocate income to savings and taxes, private firms pay corporate taxes, and public enterprises deposit profits into the government's treasury ($T2$). The exogenous institutions make expenditures on production: government expenditures (G), investment (I), and exports (Ex). Households receive government income transfers ($R2$) and income remittances from abroad ($R3$).

To focus on the important agricultural linkages, we reduced the six original SAMs to the same simple structure.¹ The endogenous flows in our SAM matrices include only

SAM SCHEMATIC

Social Accounting Matrix

| ACCOUNTS: | PA | V A | INST | GOV | K A | ROW |
|-----------------------|----------------|-----|----------------|----------------|-----|----------------|
| Production Activities | A | 0 | C | G | I | Ex |
| Factor Income | V | 0 | 0 | 0 | 0 | 0 |
| Institutions | 0 | Y | R ₁ | R ₂ | 0 | R ₃ |
| Government | T ₁ | 0 | T ₂ | 0 | 0 | 0 |
| Capital Account | 0 | 0 | Sp | SG | 0 | SF |
| Rest of the World | I m | 0 | 0 | 0 | 0 | 0 |

two production categories, agriculture (AGRIC) and non-agriculture (NONAG); and two household categories, rural (RHH) and urban (UHH). In addition, since our African countries are small, open economies, in which international trade and income remittances are important, we included the foreign sector (Rest of the World - ROW) in the endogenous flows.²

As in the input-output framework, the balance of commodity and income flows equals the sum of endogenous plus exogenous demands. In matrix notation, this multisectoral balance can be expressed as

$$(1) \quad z = B \cdot z + x,$$

where z is the vector of endogenous quantities that support the vector of the row sums of exogenous accounts (x), and B is the shares matrix corresponding to the SAM. The multisector SAM matrix multiplier is then easily obtained as:³

$$(2) \quad z = (I-B)^{-1} \cdot x = M \cdot x,$$

where $M = [m_{ij}]$. Each sectoral multiplier represents the induced income flow to account i for services performed for account j as a result of one unit of exogenous expenditure placed on j or one unit of exogenous income transferred to sector j . Direct multipliers lie along the diagonal of M while the indirect multipliers are the off-diagonal elements. Each column vector of M represents the direct impact on sector j and the indirect effects on the other sectors ($i \neq j$) associated with exogenous expenditure on sector j . If the exogenous demand generates a one-unit increase in demand for goods, the multiplier becomes a production multiplier. If the exogenous flow generates a unit increase in the income of a household, it becomes an income/transfer multiplier. This income/transfer multiplier also includes the indirect household expenditure multipliers on production and the inter-household transfer multipliers.

IV.1.2 SAM Linkages and Development in Sub-Saharan Africa.

The ADLI development strategy is designed to take advantage of strong agricultural production, income, and consumption linkages to the rest of the economy. Taken together, these linkages provide the mainspring for structural change and growth in the economy during development. By plotting the systematic changes of these linkages against per capita income, we can observe the typical average changes in linkage patterns between agriculture and the rest of the economy that accompany the

development process of sub-Saharan African countries. To derive the graphs, we fit an equation of the form

$$(3) \quad m = a + b \log y + c \log \text{pop}$$

to each multiplier m , where y is per capita income in 1980 US dollars and pop is population in millions in 1980. The plots trace the average changes in multipliers with changes in per capita income at the mean population value for the sample.

Graph 1 plots the fitted values of the non-agricultural-activities expenditure-multiplier on agricultural inputs (m_{12} : agriculture's forward linkage) together with the multiplier of agricultural expenditures on non-agricultural inputs (m_{21} : agriculture's backward linkage). The forward multiplier appears to be constant with a mean of 0.70. That is, a \$1 increase in non-agricultural production generates as much as \$0.70 in increased derived demand for agricultural output. This large induced effect is explained by the large share in total manufacturing of industries based on agricultural inputs, such as food processing and textiles, in sub-Saharan Africa.

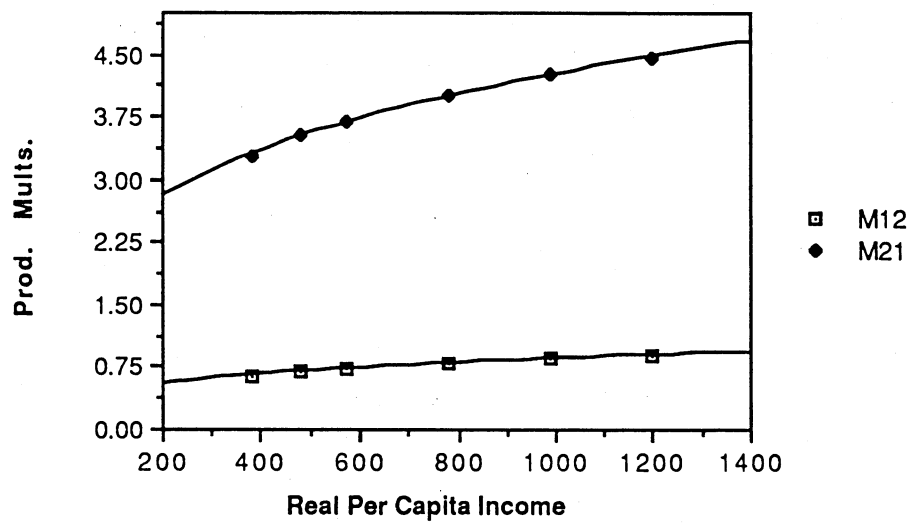
[Graph 1 Here]

In Graph 1, agriculture's backward multiplier (m_{21}) dominates its forward linkage (m_{12}). The backward multiplier of agriculture is more than four times the size of its forward multiplier. Even at the lowest levels of development, the production linkages of agriculture to industry through consumption of industrial inputs and services is quite strong. Thus, a \$1 increase in agricultural production generates almost \$4 in demand for industrial production.

Furthermore, as evident in Graph 1, the backward multiplier rises rapidly with per capita income. The rising trend in the value of the backward linkage indicates that non-farm input-use increases rapidly during development. Farm production initially uses few chemical industrial inputs and few manufactured farm implements. But, with development, the use of manufactured inputs increases. The increased agricultural demand for inputs leads, in turn, to the emergence of nonfarm enterprises specialized in food processing, agricultural implement repair services and transportation that were previously provided by the farm households themselves. Economies of scale thus lead to greater diversification out of agriculture, with increased nonfarm activities performed in rural villages and small towns (see Haggblade, Hazell, and Brown 1989).

The significance of these results for Africa cannot be overstated. The magnitude

Graph 1: Agricultural Forward (M12) and Backward (M21) Multipliers



5

and increasing strength of agriculture's forward linkage becomes a key production lever to trigger investment in industry. That is, agriculture represents an ideal "leading sector industry" according to Hirschman's criterion (1958). Investment in agriculture brings forth induced development of industry; investment in industry, in turn, generates substantial, though smaller, induced demand for inputs in the rural hinterland, leading to a mutually reinforcing growth process in both sectors.

On the demand side, the ADLI strategy exploits strong rural expenditure linkages. Graph 2 compares the rural and urban household expenditure multipliers on agriculture. Graph 3 compares the rural and urban household expenditure multipliers on non-agricultural production of goods and services.

[GRAPH 2 HERE]

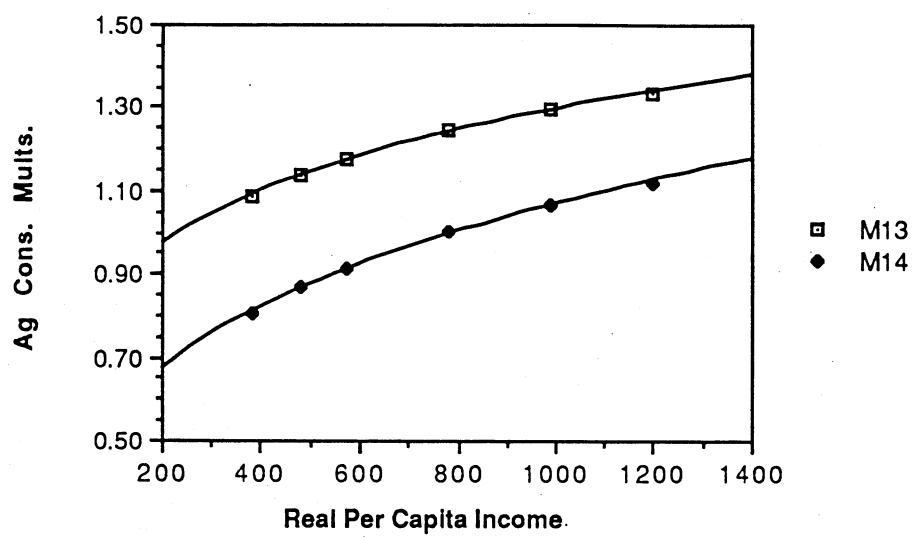
In graph 2, both expenditure multipliers on agriculture rise with development, and the rural expenditure multiplier dominates its urban counterpart. At the low levels of development represented by sub-Saharan Africa, Engel's law does not hold for rural households: a \$1 of new rural income leads to a more than \$1 increase in rural expenditure on agricultural production. By contrast, an increase in expenditures by urban households generates a multiplier for agricultural products which is less than unity. The higher expenditure multiplier on agricultural production of agricultural households is due to the fact that rural households' food consumption is mostly non-processed and is based on own-production and domestic supply, whereas urban households also tend to consume processed foods, which are part of manufacturing, and imports. Urban households also have higher incomes.

In graph 3, we observe that the rural and urban expenditure multipliers on non-agricultural production are almost four times as large as their agricultural expenditure multipliers. Thus increases in both rural and urban incomes generate strong increases in demand for non-agricultural manufactured products. However, the rural expenditure multiplier on manufactured products again dominates the urban one. As Haggblade, Hazell, and Brown (1989) show, rural household consumption patterns favor small-scale, domestic production of goods and services. In contrast, urban households purchase a greater proportion of imported manufactured consumer goods. This again offers a strong argument for ADLI in the sub-Saharan African context.

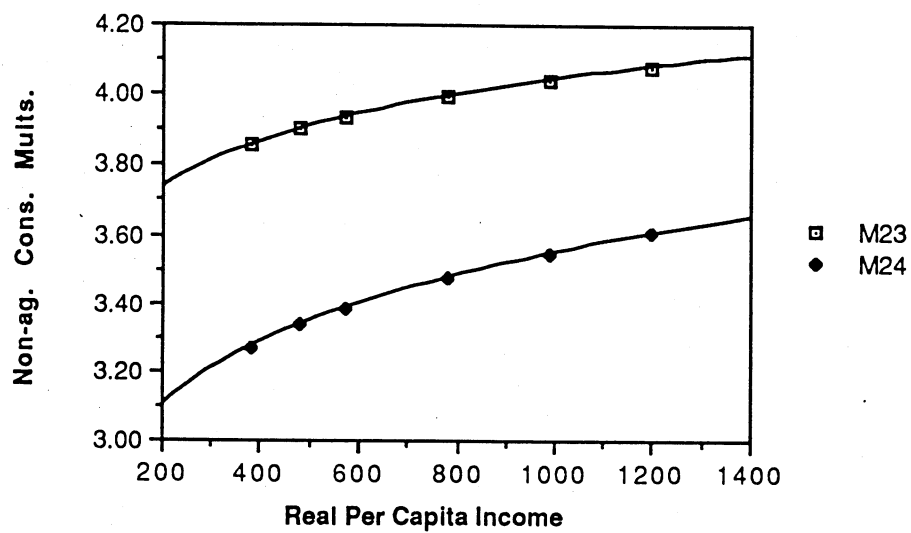
[GRAPH 3 HERE]

These strong rural expenditure multipliers become the key demand-side levers in

Graph 2: RHH (M13) and UHH (M14) Exp. Mults. on Agriculture



Graph 3: RHH (M23) and UHH (M24) Exp. Mults. on Non-agriculture



an ADLI development strategy. These expenditure multipliers tie industrial production to the expanding needs of the rural hinterland, leading to closer rural/urban integration. Together with agriculture's strong backward linkage, these rural household expenditure linkages allow ADLI to take advantage of the structural features of African economies. Unlike other development strategies which cater to international demand, ADLI is uniquely capable of stimulating balanced, equitable growth in the economies of sub-Saharan Africa.

V Supply Elasticities

The multiplier calculations in the previous section make a strong case for an ADLI strategy in sub-Saharan Africa. However, these calculations assume that the supply of agricultural and non-agricultural commodities is quite elastic in response to increases in demand. This may not be the case in sub-Saharan Africa.

V.1 The Elasticity of Supply of Manufacturing

There is reason to doubt that the elasticity of supply of manufacturing is high in sub-Saharan Africa, where manufacturing production capacity is quite limited, a large array of consumer goods are not produced domestically, and most intermediates and machinery need to be imported. To estimate the supply responsiveness of manufacturing production to increases in agricultural production and rural incomes, Fetini (1991) fitted a regression equation to combined cross-section and time-series data for all sub-Saharan African countries between 1955 and 1980. The data base for the regression consisted of 673 observations. The form of the regression is:

$$(4) \quad \log V_m = -.117 \log t + .853 \log y + .160 \log V_a \quad R^2=.99$$

$$(.026) \quad (.039) \quad (.037)$$

where V_m is value added in manufacturing, t is time, y is per capita income, and V_a is value added in agriculture. This regression indicates that a 1% increase in agricultural value added induced only .16% increase in manufacturing value added. Since our multipliers for agricultural value added on non-agricultural value added were about 4, the regression indicates that increases in agricultural production and incomes are likely to generate large excess demand for manufacturing commodities. This excess demand will either leak into imports or generate inflationary pressures or some combination of both. To avoid this undesirable outcome requires combining ADLI with continued import-

substitution industrialization efforts in consumer goods and simple agricultural inputs. This, in turn, means that foreign exchange has to be made available to sub-Saharan countries for this purpose and that they have to be allowed to impose tariffs for infant-industry development.

V.2 The Elasticity of Supply of Agriculture

The agricultural performance of sub-Saharan Africa has been dismal, even before the Sahel droughts. Between 1966 and 1986 food production per capita declined 14 percent (United States Department of Agriculture 1986 and 1988). Food imports have risen to 7 percent of food consumption; by year 2000 they are projected to become 30 percent! (Paulino 1986). Even with these imports, in 1980, the average daily calorie consumption was 20 percent below the Economic Commission for Africa's (1983) norm. There is thus a crisis in African agriculture.

The African agricultural crisis is due to many reasons (Eicher and Baker 1982): colonial legacies, government neglect, agricultural terms of trade policies discriminating against farmers, exchange rate policies discriminating against farm-exports, as well as neglect of small farmers and herders in agricultural research. But these policies can be reversed.

In addition, however, due to its climate and soil, sub-Saharan Africa has special technological problems in intensifying agriculture. Tropical agriculture is not well-suited to the type of input-intensive agricultural technology developed for temperate-climate, alluvial soils. This is especially true of agricultural intensification on hilly, marginal plots which have traditionally been farmed with slash and burn technologies in which periods of cultivation have rotated with fallow periods. As fallow periods shorten, due to more intensive cultivation, soil fertility is reduced, land becomes more compacted, forests are cleared, water runoff strips land of topsoil, and there is a tendency towards desertification. Since the late 1960s the Saharan desert has expanded into the Sahel, because of irresponsible land use caused by a combination of inappropriate technology and population growth (Eckholm and Brown 1977). Overcultivation, shortening of fallow periods, deforestation, and overgrazing, have all left their mark.

In large parts of Africa, intensification of agriculture is fraught with danger: fertilizer-intensive technologies leach some African soils. Commercialization reduces the natural genetic variety of pest-resistant racemes and the extent of crop interplanting required to

break up parched and compacted soil.

Unfortunately, the technology appropriate for sustainable tropical agriculture is not at hand. As a result, it may well be dangerous to intensify agriculture on the fragile soils that are typical of great, currently underpopulated, land-masses in sub-Saharan Africa. There are, of course, also large subtropical regions in parts of Africa that are suitable for traditional European-type commercial farming. The implementation of ADLI should therefore be limited to the subtropical areas of Africa and to terrains which are not subject to desertification. And a great deal of effort should be devoted to research into sustainable agricultural technologies for food agriculture in tropical areas.

VI. Conclusion

The implications of the evidence presented in this paper for the applicability of the ADLI strategy to sub-Saharan Africa are mixed. On the one hand, Africa sorely needs to expand food production and has a population which is about three quarters rural. Moreover, the linkage multipliers of agriculture with non-agriculture are quite large. This indicates clearly that, from the demand side, the ADLI strategy would impart a strong impetus for industrialization and income growth in African countries, were it to be implemented.

On the other hand, the supply side considerations are not nearly as encouraging. The regression presented in section V.1 indicates that, in sub-Saharan Africa, the responsiveness of non-agricultural output expansion to growth in agricultural value added allows for the satisfaction of only a fraction of the induced demand for manufactured output from domestic sources. Thus, at least initially, in sub-Saharan Africa much of the induced demand for manufacturing would have to be satisfied by imports. This would eat into the availability of the very scarce foreign exchange required for industrialization. Moreover, to the extent that there is not enough foreign exchange to import consumer goods in sufficient quantities to satisfy the non-agricultural income multiplier, inflation would be the inevitable result.

In sub-Saharan Africa, therefore, ADLI must be accompanied by concerted import-substitution efforts in industry and supported by an ample availability of foreign exchange for the import of manufacturing and non-competitive consumer goods. Thus, in the African regional context, the ADLI strategy must be viewed as one of big-push, balanced growth. Its success is necessarily predicated on the availability of ample foreign aid and

technical assistance.

In addition, in sub-Saharan Africa, there is a potential for ecological disaster lurking in the universal dissemination of traditional high-yield agricultural technologies. This requires limiting the implementation of ADLI strategies to those African countries and ecological zones that can sustain chemical-input intensive agriculture and are not prone to desertification. Otherwise, quick enlargement of the Sahel will be the inevitable result.

Is such self restraint on the part of policy makers and international donors a realistic prospect? Is the policy establishment ready for a differentiated, selective policy message? These are the basic issues raised by a call for ADLI in sub-Saharan Africa. If there is some doubt about the answers to these questions, a better short-term strategy for sub-Saharan Africa may well be the continuation of industrial import-substitution strategies through the end of their first phase coupled with intensified research on technologies for sustainable, high productivity food-agriculture in fragile tropical ecological environments.

Adelman's original advocacy of the ADLI strategy was formulated in the context of semi-industrial countries that had already completed the first phase of import substitution rather than as a lever to induce a start on industrialization. Neither sub-Saharan African industry nor the current state of agronomy are as yet ready for a widespread implementation of the ADLI strategy in the African context. Most importantly, since the ecological damage caused by agricultural intensification in fragile ecological environments is largely irreversible and since we doubt that selectivity and restraint in application are credible messages to policy makers, we regretfully conclude that, currently, advocacy of ADLI for sub-Saharan Africa is probably premature. And premature adoption of ADLI is likely to cause more medium term damage than the short term damage imposed by the slower short-term growth it is designed to avoid.

Endnotes:

- 1 In reducing the size of the SAM, one eliminates entire sets of accounts from the SAM table, while preserving the row and column totals of the new reduced SAM. The method of apportionment accomplishes this task (Pyatt, 1988).
- 2 The inclusion of an exogenous account in a SAM, although unusual, is not unprecedented. Robinson and Roland-Holst (1987) incorporated the capital account into the endogenous block of their United States SAM.
- 3 The multiplier matrix can be viewed as placing an upper bound on the endogenous responses to exogenous stimuli. The SAM multipliers are likely to be upper limits on the "true" responses in view of the underlying SAM assumptions of fixed prices, perfectly elastic supply response, and "marginal=average" propensities.

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