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EDUCATION AND AGRICULTURAL PRODUCTIVITY

PROBLEM

Assessing the direct impact of formal education on technology transfer and agricultural productivity is a complex theoretical and methodological issue. The problem must be broken down into three elemental questions:

1. Which level of formal schooling yields the highest social and private rates of return per investment?

2. What evidence exists linking educational attainment (number of years of formal schooling) to increased levels of food production and/or greater farming efficiency?

3. What aspects of formal education contribute to improved agricultural practice?

RATES OF RETURN TO EDUCATIONAL INVESTMENT

Rates of return on educational investment have been estimated for over fifty countries.[1] These analyses reveal several consistent patterns about the relationships between the costs and benefits of education:

1. Social rates of returns are consistently lower than private rates of return.

2. Returns to primary education are higher than the returns to secondary or higher education.

3. Rates of return in LDCs are higher than those in industrialized nations.

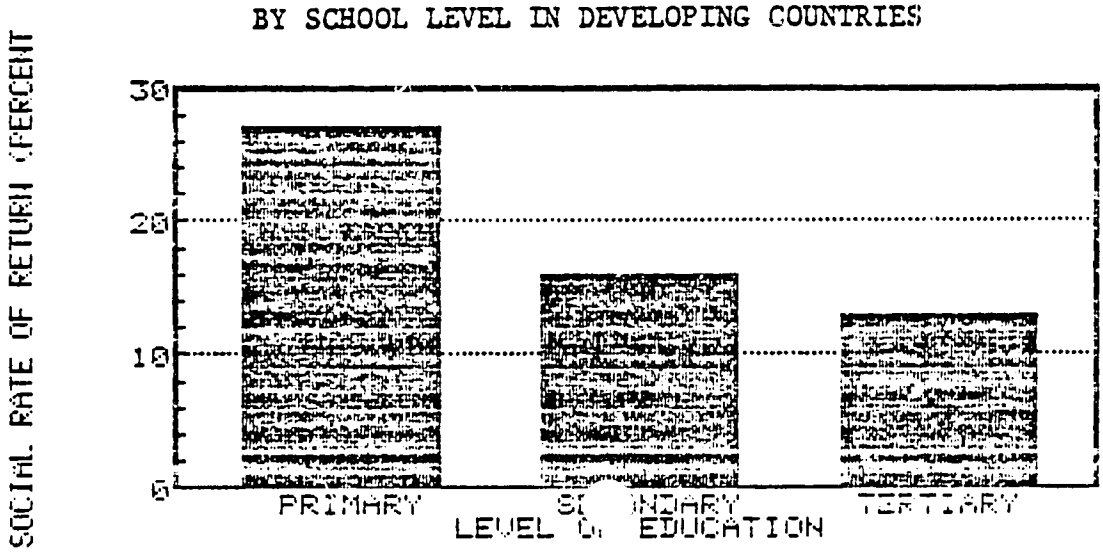
4. Investments in education in the LDCs yield higher returns than investments in physical capital.

5. Rates of return to educational investment are well above 10 percent, the traditional yardstick used to measure the opportunity cost of capital.

Rates of return to investment in education in twenty-two developing and eight intermediate countries are listed in Table 1, and the findings summarized by educational level in Figure 1. The data clearly indicate that primary education should be AID's top education investment priority, but not to the exclusion of secondary and higher education which, also provide substantial returns.

FIGURE 1

THE SOCIAL RETURNS TO INVESTMENT IN EDUCATION
BY SCHOOL LEVEL IN DEVELOPING COUNTRIES



("Developing countries" refers to 22 African, Asian & Latin American countries.)

Source: Psacharopoulos (1981), pg. 33

FORMAL EDUCATION AND AGRICULTURAL PRODUCTIVITY

Rates of return to educational investments made by farming families are particularly difficult to accurately estimate since small-scale, third world farmers are engaged in essentially non-competitive labor markets. Wages/income are unreliable measures of productivity in non-wage occupations. Thus, physical measures of output (e.g., yield per hectare planted) are better indices of production differences between farmers than is profit.

The relationship between education and agricultural productivity must be analyzed along two dimensions: 1.) level of educational attainment and attitudinal and behavioral characteristics associated with school attendance; and 2.) content of the curricular matter the child is exposed to.

TABLE 1

RETURNS TO EDUCATION BY LEVEL AND REGION OR COUNTRY TYPE
(in percentages)

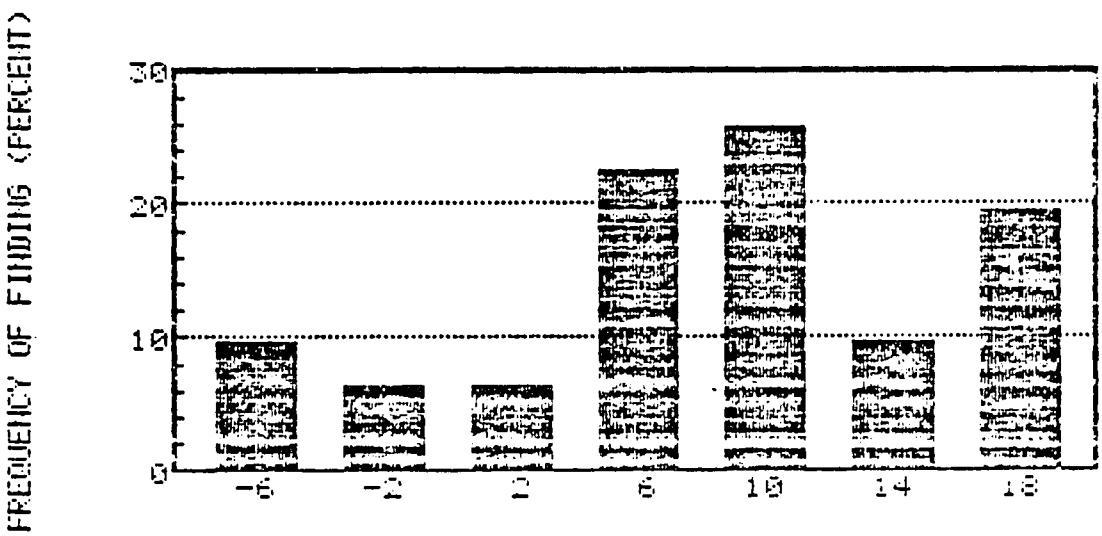
		Rate of Return by Educational Level					
		Private			Social		
Country	Survey Year	Primary	Secondary	Higher	Primary	Secondary	Higher
Developing							
Africa							
Ethiopia	1972	35.0	22.8	27.4	20.3	18.7	9.7
Ghana	1967	24.5	17.0	37.0	18.0	13.0	16.5
Kenya a/	1971	28.0	33.0	31.0	21.7	19.2	8.8
Malawi	1978					15.1	
Morocco	1970				50.5	10.0	13.0
Nigeria	1966	30.0	14.0	34.0	23.0	12.8	17.0
Rhodesia	1960				12.4		
Sierra Leone	1971				20.0	22.0	9.5
Uganda	1965				66.0	28.6	12.0
Asia							
India	1965	17.3	18.8	16.2	13.4	15.5	10.3
Indonesia	1977	25.5	15.6				
South Korea	1967				12.0	9.0	5.0
Malaysia	1978		32.6	34.5			
Philippines	1971	9.0	6.5	9.5	7.0	6.5	8.5
Singapore	1966		20.0	25.4	6.6	17.6	14.1
Taiwan	1972	50.0	12.7	15.8	27.0	12.3	17.7
Thailand	1970	56.0	14.5	14.0	30.5	13.0	11.0
Latin America							
Brazil	1970		24.7	13.9		23.5	13.1
Chile	1959				24.0	16.9	12.2
Colombia	1973	15.1	15.4	20.7			
Mexico	1963	32.0	23.0	29.0	25.0	17.0	23.0
Venezuela	1957		18.0	27.0	82.0	17.0	23.0
Intermediate							
Cyprus	1975	15.0	11.2	14.8			
Greece	1977	20.0	6.0	5.5	16.5	5.5	4.5
Spain	1971	31.6	10.2	15.5	17.2	8.6	12.8
Turkey	1968		24.0	26.0			8.5
Yugoslavia	1969	7.6	15.3	2.6	9.3	15.4	2.8
Israel	1958	27.0	6.9	8.0	16.5	6.9	6.6
Iran	1976		21.2	18.5	15.2	17.6	13.6
Puerto Rico	1959		38.6	41.1	21.9	27.3	21.9

Source: Psacharopolous, 1981, pg. 335

1. Ample evidence exists which demonstrates that formal education is positively correlated with agricultural productivity. Estimates establish this relationship as modest but nearly universal. A review of 18 studies conducted in 13 low-income countries showed that in four-fifths of the cases examined, the relationship between years spent in school and agricultural output was positive. [2] Holding important social/environmental factors constant, four years of schooling, on average, increase output by an estimated 8.7 percent. These findings are graphically depicted in Figure 2.

Figure 2:

Results of 31 Data Sets Relating Schooling to Agricultural Productivity



Percentage increase in productivity from 4 years of education

Source: Jamison & Lau, 1982, pg.9

If allowance is made for the availability of complementary inputs required for improved farming techniques, the effect of education is increased when farmers use those techniques. The additive effect of availability of modern techniques on the relationship between formal schooling and productivity is shown in the top half of Table 2.

Table 2:

Farmer Education and Farmer Productivit

Study	Estimated percentage increase in annual farm output due to four years of primary education rather than none
With complementary inputs[a]	
Brazil (Garibaldi), 1970	18.4
Brazil (Resende), 1969	4.0
Brazil (Taquari), 1970	22.1
Brazil (Vicosa), 1969	9.3
Colombia (Chinchina), 1969	−0.8
Colombia (Espinal), 1969	24.4
Kenya, 1971–72	6.9
Malaysia, 1973	20.4
Nepal (wheat), 1968–69	20.4
South Korea, 1973	9.1
Average (unweighted)	13.2
Without complementary inputs	
Brazil (Candelaria), 1970	10.8
Brazil (Conceicao de Castelo), 1969	−3.6
Brazil (Guarani), 1970	6.0
Brazil (Paracatu), 1969	−7.2
Colombia (Malaga), 1969	12.4
Colombia (Moniquira), 1969	12.5
Greece, 1963	25.9
Average (unweighted)	8.1
No information on availability of complementary inputs	
Average of eight studies (unweighted)	6.3

a. Improved seeds, irrigation, transport to markets and so on.

Source: World Bank, World Development Report 1980, p.41

When complementary inputs were available, the annual output of a farmer who had completed fours of primary schooling was 13.2 percent higher, on average, than that of a farmer who had not been to school.

Productivity cannot be meaningfully studied in isolation from efficiency, the direct and indirect costs of producing output at a certain level. Agricultural efficiency is linked to two farmer characteristics: a) productive ability as measured by technology-specific skills such as evaluating what to produce, how much of each crop to produce, and how much of what to use to produce an output; b) allocative ability or, the capacity to adjust to new opportunities and technological change, and to choose among mixes of resource inputs and marketing alternatives.

2. No evidence exists which clearly suggests that performance-related skills or basic knowledge of agronomy gained in primary school contribute directly to higher levels of farming productivity. The observed relationship between schooling and productivity does not explain whether education raises farmer output by imparting skills and changing attitudes, or whether education is simply correlated with other attributes that determine farmers' productivity.

Data from Thailand, Korea, and Malaysia indicate that educational level does affect farmers' allocative and market efficiency, particularly with regard to use of fertilizer. Moreover, research conducted in Nepal suggests that efficiency increases only after the completion of seven or more years of schooling and that a negative effect exists for the one to six year category of school attainment. [3] The question of whether formal schooling and nonformal education are substitutable in these relationships or whether the two are independent of one another remains an open but researchable question.

IMPACT OF FORMAL SCHOOLING

Research on the relationship of primary and secondary education to external efficiency indicates that:

a. the link with earnings/productivity is perhaps due less to the cognitive skills gained in the classroom than to changes in the non-cognitive domain;

b. school-induced, non-cognitive correlates of productivity include self-efficacy, openness to new experiences, independence, initiative and risk-taking; such psychological dispositions characterize farmers with high allocative abilities;

c. these characteristics are an "unintended" by-product of the process of schooling, structure of the formal education system, in-class socialization, and interpersonal relationships and interactions which occur in the classroom;

d. "modern" attitudes have an incremental impact on production only when they are found in environments which support experimentation with new farming technologies and techniques.

The non-cognitive, or psychological, outcomes of formal schooling are important facilitators of technology transfer. Pupils in a learning environment have certain kinds of experiences from which they form values in response to the forces or pressures which their particular classroom experience creates.

The following conclusions summarize the research on the role of schools in producing these important psychological dispositions: [4]

1. Psychological modernity scores of children in schools are higher than those who are not enrolled;

2. The longer children have been exposed to schooling the higher are their modernity scores ($p < .001$);

3. The more modern are the structural arrangements/ process of schooling, the higher are children's modernity scores.

The correlation between agricultural success and formal schooling measures other influences on productivity that may also be correlated with schooling, such as achievement orientation, ability, social position, access to production-related resources like water etc.

Education is particularly likely to increase the output of traditional, small-scale farmers if complementary infrastructural changes and agriculture sector innovations are introduced into the local economy at the same time. Better access to markets, availability of fertilizers and new seeds, cooperatives, extension services, etc. may be conditions precedent for enabling latent, production-related capacities which are outcomes of formal schooling to become manifest. The linkages discussed above are portrayed in Figure 3.

Figure 3

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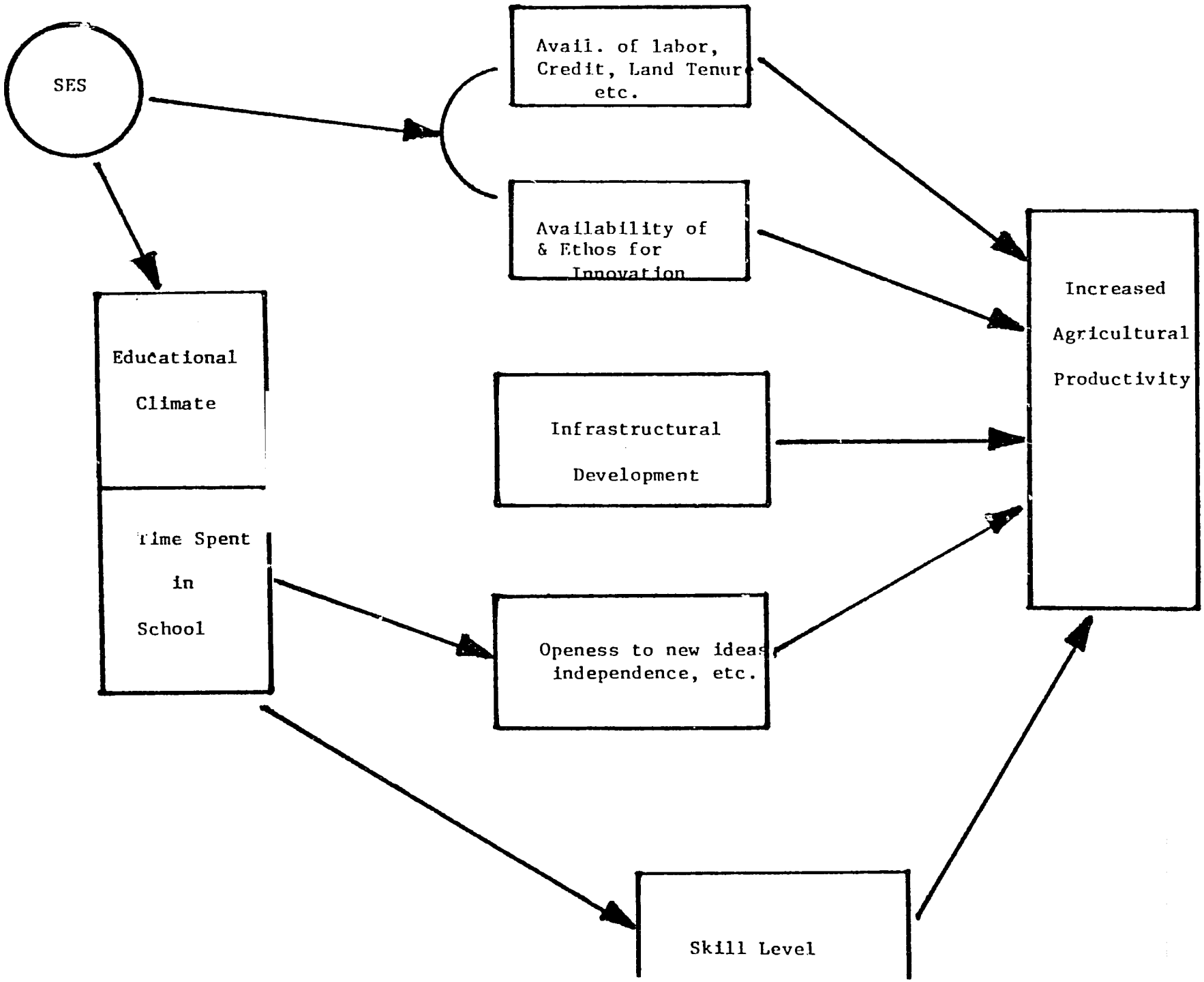
Relationship Between Primary Schooling & Agricultural Productivity



DISCUSSION

Conventional wisdom regarding the role of formal education in technology transfer has made a 180 degree turnabout in the past twenty years. The 1961 Conference of African Ministers of Education adopted a statement that the school must be the primary agency for implementing modern agriculture technology and practices in third world villages. With endorsement from the international research community, the ministers called for creation of a fully integrated system of agricultural education at all levels of formal schooling.

Today, planners focus on the inadequacy of resources for supporting education systems and call for greater efficiency in resource use. Because primary education costs about 1/5 of secondary school, and 1/50 of higher education (on a per student basis) donor emphasis has been placed on general primary education.

At the secondary level, vocational-technical education is often a costly mismatch between the training offered and social demand. Primary school leavers compete for places in academic secondary schools, and resort to technical schools only if they fail to gain entry into an academically streamed program. Technical schools are thus pressured to provide a more general education than was intended, but at a much higher building and operating cost.

Political and social pressures to offer "academic' curricula to primary and secondary students will likely bar inclusion of specifically agricultural content in public schools. Introducing agriculture as a subject matter in primary schools may have the following unintended results:

* exacerbate social, urban-rural differences among the student population;

* restrict mobility of students from rural areas by limiting their ability to compete with urban peers on standardized exams;

* reduce the instructional time which can be devoted to the acquisition of fundamental literacy and numeracy skills;

* create inefficiencies by offering off-the-job training in skills which could perhaps be more quickly and effectively learned in a real farming setting;

* necessitate extensive retraining of teachers;

* transfer technical information which may be obsolete; agricultural information requires frequent updating.

WHAT AID CAN DO

A. The most important contribution AID can make to promote efficient agricultural practices through primary and secondary schooling is to further develop and support efforts to improve the quality of basic education and make it more efficient. The goal of these efforts should be to develop the capacity of LDC children to continue learning upon termination of their schooling. A cognitive and affective foundation must be established in school for the subsequent acquisition and application of farming skills. This contribution rests on two assumptions:

1. a predisposition to change and an openness to experimentation is a prerequisite for successful technology transfer;

2. formal schooling is the most cost-effective way of inculcating the basic skills and psychological flexibility necessary to facilitate technological innovation.

B. AID should also support a program of research and development which focuses on the following issues:

1. the design and implementation of agricultural examples into the basic curriculum. Examples should illustrate basic concepts in literacy and numeracy and should be employed in both rural and urban areas.

2. the long-run impact of skill-transfer programs such as "school gardens" on the acquisition of basic skills and farming productivity.

3. a careful examination of the intermediate outcomes between formal education and production such as the formation of particular kinds of psychological and cognitive skills, transmission of information, etc.

4. the relationship of formal educational training to the utilization of extension services and other production-enhancing inputs.

5. the establishment of stronger linkages between education and other sectors, and exploration of ways to integrate educational objectives into a more comprehensive, rural-development strategy.

References

[1] Psacharopolous George. "Returns to Education: An Updated International Comparison," Comparative Education, Vol. 17, No.3, pp. 321-341

[2] Jamison, Dean and Lawrence J. Lau. Farmer Education and Farm Efficiency Baltimore: John Hopkins Univ. Press 1982.

[3] Jamison, Dean and Peter Mook. "Farmer Education and Farm Efficiency in Nepal: The Role of Schooling, Extension Services, and Cognitive Skills," World Development, Vol. 12, No. 1, pp. 67-86.

[4] Holsinger, Donald and Gary Theisen. "Education, Individual Modemity and National Development: A Critical Appraisal," Journal of Development Areas, Vol. 11, No. 3, April 1977, pp. 315-334.

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