[redacted]

936-5824

PN-ABD-941
63947

Does Schooling Make a Better Farmer?: Schooling and Agricultural Productivity in Burundi

Thomas Owen Eisemon
Centre for Cognitive and Ethnographic Studies
McGill University

Robert Prouty
Adventist University of East Africa

John Schwille
College of Education
Michigan State University

Acknowledgements

The research reported in this paper was carried out with funds from USAID provided under the auspices of the BRIDGES Project administered by Harvard University.

Fieldwork was directed by the Centre de Perfectionnement et de Formation en Cours d'Emploi (CPF) in collaboration with Michigan State University. The authors wish to thank the research assistants employed by CPF and its staff, particularly Deo Kana and Francois Ukobizoba for their important contributions to this study. Yohannes Kebedde, Andrew Nyamete and Heather Usher, postgraduate students at McGill University, assisted in the data analysis.

The findings and the conclusions drawn from them do not necessarily represent the views of CPF which has prepared other reports relating to this research.

1/5/84

Abstract

This paper examines the effectiveness of educational policies in Burundi which support and require the teaching of agriculture in primary schools. Specifically, it investigates how agriculture is taught in primary schools, and how knowledge and skills acquired in school may affect the ways school leavers think about and practice agriculture. Findings are presented from studies of three primary schools and farmers living in the school catchment areas. Schooling is shown to have a modest positive impact on agricultural productivity, especially on the production of food crops, that can be strengthened by school policies and practices founded on a better understanding of the domains of agricultural work that are most influenced by formal instruction.

Introduction

The schooling of rural populations in Burundi and elsewhere in Africa has been conceived by policy makers as an opportunity to instill beliefs, knowledge and skills needed to raise agricultural productivity. There is a great deal of correlational support for the productivity increasing effects of schooling. Recent research has shown that the years of schooling a cultivator has completed is highly related to farm output in developing countries, especially when modernizing conditions are present such as access to credit, extension services and to agricultural chemicals and fertilizers. Studies summarized by Jamison and Lau (1980) correlated schooling with significant increases in the value of crop production. In eighteen developing country studies, farmers with four or more years of primary schooling produced almost 13% more crops than farmers who had not been to school when non-skill inputs affecting crop production were controlled (Jamison and Lau in Pscharopoulus and Woodhall 1985, 46). These findings can be used to argue for policies to universalize access to primary schooling, raise levels of educational attainment and to teach modern agriculture to school children. In Burundi, for instance, the reforms of the 1970s and early 1980s which guide present policies, were intended to expand access to primary schools through the introduction of double shifts, increase retention by facilitating promotion from one level of schooling to the next and, more importantly, to give schooling a rural orientation by requiring instruction in agriculture.

Efforts to teach modern agricultural practices in primary schools have a long and controversial history in Africa. They are usually regarded by educational researchers as unsuccessful. This has not discouraged countries from introducing reforms to ruralize primary schooling, however. Kenya, Nigeria and the Cameroons are among the many countries that have recently made the teaching of modern agriculture and other practical skills the subject of reforms to increase the contribution of schooling to rural development.

Below we examine how agriculture is taught in primary schools in Burundi, and how knowledge and skills acquired in school may affect the ways school leavers think about and perform agricultural tasks. We will show that schooling has a modest positive impact on agricultural productivity that can be strengthened by curricular and instructional practices founded on a better understanding of the domains of agricultural work and problem solving which are most influenced by schooling.

First, we review the efforts of colonial authorities in Burundi and elsewhere in Africa to make primary schools a focus of rural development in order to diminish demands for postprimary schooling and paid employment which thus, fostered popular resistance to agricultural and practical studies as well as to vernacular language instruction. We then discuss reforms in the independence period that have had somewhat similiar objectives and consequences but have been carried out in the context of providing universal primary education. Specific attention is given to the origins, philosophy and strategies for implementing the 1973 educational reform in Burundi. We describe the teaching of agriculture and science in primary schools, the use of school gardens for practical training, and show how enrollment expansion and selection for secondary education affect the instruction students receive.

Findings are presented from surveys of farmers and grade six students. While schooling is found to be correlated with increased output of food crops, this can not be attributed to the practical instruction farmers may have received in modern agriculture. Schooling is not highly correlated with measures of agricultural knowledge and problem solving abilities or with cultivation practices which have a larger effect on production. Classroom observations and results of a test of agricultural knowledge administered to students suggest that schooling does little more than reinforce what students learn outside school. The implications of these findings for increasing food production and achieving the objectives of the 1973 reform are discussed. A strategy for strengthening instruction in agriculture is proposed requiring: 1) linking the functions of agricultural education and extension work; 2) integrating the teaching of science, agriculture, and nutrition; 3) articulating the content of practical instruction with the skills and knowledge students acquire from social experience; 4) expanding the use of Kirundi as a medium of instruction; and, 5) increasing the attention given to agriculture and other practical subjects by ensuring that they are examined in the <u>concours national</u> given at the end of the primary cycle for admission to secondary schools.

Making Primary Schooling a Focus for Rural Development

Colonial and independent African governments have directed agricultural innovation through policies that have either obliged farmers to participate in the market economy and adopt practices intended to increase their productive capacities, or educated them for similar purposes. In countries like Burundi which were not acquired for European settlement, coercive measures focused on encouraging the production of cash crops needed to support the colonial economy, particularly coffee and cotton. The government

extension system was the principal instrument of coercion. Rene Dumont who visited Burundi in 1949-50 has provided a shocking description of the relationship between the African farmer and the colonial extension agent. "The peasant springs to attention before the agronomist," he wrote. "Those not fulfilling the directives run the risk of going to prison; eight days if they have not cleared the land, fifteen days if they have not harvested, up to a month if they have not burned the stalks after the harvest to prevent the spread of parasitic insects (Dumont 1969, 70)."

Such methods resulted in dramatic increases in the production of cash crops in the period 1945-1960 (Leurquin 1963). The government of independent Burundi has continued to emphasize cash crops, mainly coffee, which account for about 90% of the country's foreign exchange earnings (USAID 1983, 1). Farmers are currently required to plant at least one cash crop, to spend one day a week tending to cash crops and to follow the instructions given to them by extension agents who monitor their production activities.

Coercive measures have been less successful when used to increase the production of food crops. Food production in Burundi began declining on a per capita basis in the early 1970s (USAID 1983, 15). In the early 1980s (1980-1985), livestock production fell by more than 4% and the food index declined while the rural population increased by about 15% (FAO 1986, 3-15, 19, 37). The reduction in yields for cereals (7%) and beans (29%) has been particularly large in comparison, for example, to the gains in yields and in the total production of coffee (17% and 10%), and especially tea (19% and 50%). Between 1970 and 1983, per capita food consumption fell by almost 16% prompting the United Nations Development Program to describe the situation as "la crise du system vivrier" and to project steady deterioriation in food production unless measures were taken to lower population growth, conserve land and increase productivity (UNDP 1986, 4).

Teaching agriculture and other practical skills to children appeals to common sense. Most of the population of Burundi lives in rural areas; more than 95% (USAID 1983,ii). Agricultural and primary sector activities account for most national income and most employment (USAID 1983,1). Expansion of the modern employment sector (5% in 1979), while exceeding the population growth rate of more than 2% per annum, lags well behind the dramatic growth of enrolments especially at the primary level. Annual enrolment increases since 1980-81 have generally exceeded 15% (CPF 1988). Today (1988) about 85% of seven year olds are estimated to be enrolled in primary schools (Ministry of National Education, personal communication, 1988). As recently as the early 1980s, less than one fourth (23%) of the primary school age cohort was attending school (USAID 1983, 6). In brief, primary schooling will continue to be the terminal stage of schooling for most children in Burundi and what they learn in school should prepare them for a better life in rural areas. The implications of this observation are not, however, self-evident.

Colonial Strategies

The proposition that primary schooling should be a focus for rural development in Africa is articulated most persuasively in the reports of the Phelps-Stokes Commission. The Commission did not visit Rwanda and Burundi which became Belgian trust territories after the First World War, but it did collect information and wrote a section of the report on Education in East Africa about them (Jones 1924). The Commission took note of the fact that the head tax introduced during German administration and continued by the Belgians generated revenue far in excess of what colonial authorities spent on native welfare, and particularly on education. Less than 4% of children of school age were enrolled in schools in the two territories, almost all of them operated by missions such as the White Fathers which began its educational work in Burundi in 1884 (Jones 1924, 289). Expansion of primary schooling was not envisaged. Instead, the intention of Beligan colonial authorities was "to concentrate on the education of the chiefs and Batutsi notables, training from among their ranks, those who will act in all the most important phases of Native life, as civilizing agents and intermediaries between the European administration and the Native people (Jones 1924, 290)." The Commission recommended establishment of schools not only for "the training of Native leadership" but also "for the education of the masses (Jones 1924,294)." The latter, the commissioners felt, should emphasize instruction in practical subjects, including teaching of modern agricultural methods, and provide opportunities for practical experience inorder to instill respect for the dignity of work.

The impact of the Commission's recommendations relating to the centrality of agricultural education to primary schooling in African countries in Belgian, British and French colonies and territories has been commented upon elsewhere (e.g. Bude 1988; King 1971). Here it will suffice to draw attention to an important feature of the Commission's philosophy of agricultural education which is seldom recognized by scholars or policy makers, even by advocates of agricultural education. Although the purpose of agricultural instruction was to impart "the fundamentals of scientific European agriculture," the commissioners emphasized that this should be based on "a co-operative effort on the part of a man who knows and respects the Natives' work and another who is schooled in modern scientific agriculture (Jones 1924, 377)." "At present," they noted, "it would be all but impossible to write an elementary book on science for the Native without an intimate knowledge of his methods and reasons for pursuing these methods (Jones 1924, 377)" The Commission's report is best remembered for its plea for adapting African education to rural life. This did not mean imposing modern agricultural knowledge on African children but rather basing agricultural education on indigenous scientific knowledge which was to be recognized and respected. Adaptation, in other words, meant exactly what the term implies; instruction adapted to the knowledge students have acquired from social experience. Subsequent interpretations of the Commission's recommendations placed importance on the relevance of the primary

school curricula for rural development and not on the methods it proposed for imbedding modern agricultural science in the popular cultures of African countries.

Education for the "Rural Masses"

In Belgian colonies, provision for primary schooling developed rapidly in comparison to education in British or French Africa. Expansion of primary education in the Belgian Congo was especially impressive. By the mid-1950s, for example, 50% of Congolese children of school age were enrolled in primary schools (Malengreau 1955, 338). This was about twice the proportion for British Africa and three times the rate for French Africa (Stillman 1955, 58). In the Congo and in Burundi where, by comparison, much less progress was made in educating the rural population, primary schooling had three fundamental characteristics. First, vernacular languages were generally used throughout the primary cycle as the only medium of instruction in missionary schools and in many government schools until the 1950s. Second, education for the masses was, as the Phelps-Stokes Commission proposed, terminal and clearly distinguished from education for the native elite. Little provision was made for secondary or higher education on the theory that, according to one of Rene Dumont's Belgian informants,"no elite, no problems (Dumont 1969, 70)." Third, the object of education for the rural masses as stated in the reform of 1948 which applied to all of Belgium's African colonies, was "to inculcate a taste for agricultural or artisan pursuits" so as to "prevent the education received by an important percentage of the youth of school age from turning them away from agricultural occupations (Malengreau 1955, 345)."

However, Africans in rural areas, it seems, did not send their children to school to become better farmers or to learn vernacular languages and practical skills that would suit them for rural life. They wanted an education for their children which afforded them an opportunity for a much better life off the farm, preferably paid employment in a government centre. Adapted education was, as Philip Foster has forcefully observed, "precisely the kind of education that the African did not want from the schools. It combined inferior economic opportunities with the notion of tying the bulk of educated Africans to the land or, at least, it was assumed that this kind of education would have that consequence (Foster 1965,162)." The rewards to academic studies and paid employment were clearly evident to rural populations in situations in which these opportunities could be realized by ambition, hard work and good fortune.

Colonial governments usually sought to make a distinction between an academic education for a small comprador elite and a practical agricultural education for everyone else. This generally failed to prevent the spread of primary education oriented to preparing youth for wage employment. But colonial authorities in Burundi showed more resolve in resisting popular pressures for better educational and economic opportunities. Voluntary organizations were responsible for almost all mass education. In 1951, only 1,140 pupils were enrolled in government schools in Rwanda and Burundi compared to 467,751 registered in missionary schools

(Hailey 1956, 1208). Less than one third (30%) of the children attending missionary schools in 1951 were enrolled in assisted schools (Hailey 1956, 1208), and the education provided in these and in the other unassisted schools led to no further education of any kind apart from preparation for religious orders. Government primary schooling provided access to a few technical schools. The only collegiate institution established in the colonial period was an agricultural school founded in 1955 in Bujumbura (Hailey 1956, 1211). The colonial government did not permit missionary groups to create a system of secondary education nor until end of the colonial period did the government do this itself.

Reforming Primary Schooling After Independence

In the decade of independence in the 1960s, African governments moved quickly to eradicate many colonial educational legacies and fulfill popular expectations for more access to schooling and paid employment (Abernethy 1969). Racial restrictions on schooling were abolished where such restrictions existed. Governments took responsibility for primary education, operating most mission schools, severely restricting missionary activities and reducing governmental financial assistance to such schools. Metropolitan languages, English and French, were introduced as the medium of instruction in the upper primary cycle and retained for use at the secondary and higher levels. Few countries followed Tanzania's example of using a vernacular language at the primary and secondary levels for purposes of national integration. Most endorsed the 1962 Addis Ababa declaration and set out to make primary education free and universal by 1980 with varying degrees of success. And in countries like Kenya, compulsory instruction in agriculture was quietly dispensed with in favour of academic studies confering greater opportunities for secondary education and for social advancement (Government of Kenya 1964).

Tanzania was an exception in this respect as well. It is difficult in 1988 to imagine the enthusiasm which greeted the publication of Julius Nyerere's influential essay on Education for Self-Reliance (Nyerere 1968). It had an enormous impact on the thinking of educational researchers and educational policy makers in and outside Africa who generally gave the doctrine of education for self-reliance uncritical approval. Part of the reason for this was that the Catholic mission educated Nyerere seemed to be restating the colonial doctrine of curricular adaptation. What was novel and, therefore, welcome was that education for self-reliant rural development was being advocated by an African. Nyerere recognized that educational expenditures accounted for a disproportionate share of the national development budget and, in addition, that it was impossible for a poor country like Tanzania to support expansion of secondary education. Primary education would for the forseeable future, continue to be the terminal stage of education for most Tanzanian children. "Having decided that," he said, "we have to look at the relevance of the existing structure and content of Tanzanian education for the task it has to do (Nyerere 1968, 271)." That task was preparing rural youth for agricultural work organized in the "African" spirit of collectivism.

The school farm was the locus of Nyerere's plan to make the primary school a community institution. "The school community," he emphasized, "should consist of people who are both teachers and farmers, and pupils and farmers...the farm would be an integral part of the school-and the welfare of the pupils would depend on its output, just as the welfare of a farmer depends on the output of his land. (Nyerere 1968, 283)." Efforts to put these principles of agricultural education into practice led to a few highly publicized successes in model schools and widespread failure when implementation was carried out on a national basis (Moris 1976, 58; Bude 1985). Nevertheless, Nyerere's proposals had a profound influence on other African countries which saw in them a possible solution to the school leaver unemployment problem (Moris 1976, 56).

Although agriculture had been taught in some East African primary schools for at least forty years and school gardens or farms were familiar to most African children, the modalities for implementing Nyerere's innovations were poorly worked out. A review of the case study literature on agricultural education in East Africa in the 1960s and early 1970s will reveal a lengthy list of curricular constraints that were held to be responsible for failures. They include lack of teacher training in agriculture, inadequate textbooks, lack of space for cultivation, lack of fertilizers and other modern inputs to teach modern agriculture, poor co-ordination between rural schools and extension services, rigidity in the syllabus for agriculture and related topics preventing adaptation of instruction to local conditions, lack of attention to topics important to peasant agriculture such as credit and co-operative marketing, and so on.

However, lack of agreement about what should be taught was perhaps the fundamental constraint. While governments and missionary groups had experimented with agricultural education for many years, educational practice had not produced a set of workable principles for organizing agricultural instruction. It produced, instead, a disjointed compendium of worthwhile, seemingly achievable objectives; agricultural education in primary schools should foster respect for agricultural work, it should impart skills that can be practiced at school and taken home and put to use on the family farm, etc. Strategies for implementing these objectives were very unclear. For example, while the objective of integrating instruction in academic and practical subjects was well accepted, what did this mean for the teaching of science? Should it be taught as a separate subject with emphasis on agricultural applications of instruction in biology, or should a program of integrated life science instruction be developed? Should a metropolitan language be used to teach science at the upper primary level? What core scientific concepts should be taught?

Curriculum development projects supported by USAID, Unesco and Unicef and other donors in Tanzania and Zambia in the early 1970s provided many (and often contradictory) answers to these questions. It was not that educational policy makers lacked

imaginative suggestions as to how to improve agricultural education in primary schools. What was lacking were theories to guide curricular decision making based on an understanding of what basic skills are required for the introduction of modern agricultural practices by small holders, what concepts are fundamental to modern agricultural technologies and production methods, and what skills can be transferred from schools to households. Consequently, in most East African countries, Jon Moris noted,"the general tendency has been to confine innovation to the issuance of central directives and to the addition of school garden to existing science instruction. (Moris 1976, 57)."

The complexity of agricultural education is seldom recognized by innovators. This is the source of many problems arising from the custom of treating it like any academic subject and prescribing practices for teachers to follow and material for students to learn. Moris has drawn attention to the "astonishing diversity of farming systems (in East Africa that) the learner must comprehend." "Natural environments," he writes, "range from the fully tropical to the alpine and allow enormous variability in the type of farming system adopted. In addition, the student will find subsistence plots, large farms, estates and ranches, monocropping, dual cropping, and even triple cropping; state farms, private farms, cooperatives...;crops including coconuts, cashews, cotton, tobacco, tea, coffee, sisal and pyrethrum, each with its own form of processing; dry farms, irrigation and shifting cultivation. Moris 1976,85)." The task of designing instructional programs that will be of practical importance to students and local communities is enormously difficult even under the most homogeneous of circumstances.

It is hardly surprising that there has been so much variability in the success of agricultural education programs in East Africa. Many researchers have attributed failures to lack of relevance to local agricultural conditions combined with uncritical advocacy of modern methods for essentially ideological reasons (e.g. Schonmeier 1977). Even where agricultural instruction is judged to be relevant, schooling is not seen as a locus of innovation. According to Udo Bude (1985), "the school rather than rendering extension or demonstration services in the community (merely) reflects the development stage of its agricultural environment...It is the schools which derive advantage in rural science education from the stage of agricultural development already attained in the community (Bude 1985, 216)."

The Unfinished Task of Implementing the 1973 Educational Reform

At independence in 1962, Burundi had two unarticulated systems of primary schooling; one consisting mainly of residential schools operated by the government, highly selective, and offering academic studies in French leading to entry into post-primary technical schools, and another managed by religious groups, partly supported by the state, emphasizing practical and religious studies of variable content and indeterminant length. In the early 1960s, less than one third (29%) of the school age population attended school. A similiar proportion (28%) of those who began school actually completed six years (Ministry of National Education 1988, 5 and 6). Standards of instruction were judged to be low, facilities poor and most teachers untrained. The ideas which guided the development of colonial schools, both government and religious, were elitist and alienating

> L'ecole est insulaire au sens physique du terme, on l'a parfois compare a un bois sacre ou n'entraient qu'un certain nombre d'inities charges d'operer des rites esoteriques echappant a tout le monde. Meme sans cloture, on sent qu'il y a une enceinte invisible qui eloigne les profanes...Le materiel de construction est souvent insolite par rapport a l'habitat local. C'est le temple du savoir accessible seulement aux neophytes...L'enfant, des qu'il franchit les portes de l'ecole est considere par les siens comme promis a un monde a part qui de plus en plus doit s'eloigner du terrain au sens propre du terme. (Kizerbo in Ministry of National Education 1988, 6).

Steps were taken to create a national system in 1967 and 1969 when legislation was introduced to standardize the length of primary schooling at six years, establish examinations to terminate the primary cycle and identify talented students for further education, raise standards of teacher training, and prescribe a common curricula for primary schools. More importantly, this legislation was used to nationalize religious schools and to restrict the rights of religious groups to open new primary schools. The churches retained the right to organize religious instruction at the community level through pastoral institutions which gave the Roman Catholic Church an opportunity to re-establish religious schools. Because they were not eligible for assistance, they were even less subject to secular influence than the religious schools established in the colonial period.

The Yagamukama church literacy schools provide basic education to children and adults in many rural areas (Ndaruzaniye 1978). Almost all Roman Catholics receive some instruction from Yagamukama schools, usually the course of instruction required for communion and Christian marriage. Exactly how many children attend Yagamukama schools can not be estimated with any precision. In 1983, about 45% of the six to eleven age group were thought to be Yagamukama schools (USAID 1983, 7). An undetermined but probably a large number of adults also attended

Yagamukama schools. Yagamukama schools teach Kirundi literacy (for Biblical studies and religious participation), and some teach agriculture, health and nutrition as well. Shortly after independence, the government, having begun nationalizing many religious schools, established a section of the Ministry of National Education ostensibly to improve the secular education provided by religious groups in the institutions remaining under their control. Increasing conflict between the government and the Roman Catholic church eventually led to the closing of Yagamukama schools in 1986. They were re-opened a year later after a change in government.

In 1969, the government of Burundi set about to reform the educational system, though implementation was begun only in 1973. The rhetoric and implementing strategies were strikingly similiar to Nyerere's imaginative proposals for Education for Self-Reliance. Kirundization (Kirundisation) of instruction and ruralization (ruralisation) of the primary school curricula were the twin pedagogical objectives of the 1973 reform. Burundi's major ethnic groups, the Hutu and Tutsi, speak a common language, Kirundi, which was generally used for instruction in colonial missionary schools. Its use in government schools was intended to reduce alienation and the social distance between the schooled elite and the unschooled rural masses (Ministry of National Education 1988; Nyambirigi 1983). However, French is still used for instruction in the final two years of the primary cycle in academic and practical subjects. And it is the language of the concours national given at the end of the sixth year to select students for secondary schooling.

A decision to require use of Kirundi in grades 5 and 6 in the 1989 school year has been postponed indefinitely although the necessary teaching materials have been translated. Governmental hesitance to implement this important feature of the 1973 educational reform is probably best understood interms of the contradictions inherent in a policy of promoting instruction in a language that in the colonial period was associated with mass education while increasing access to what was formerly defined as quality primary schooling chiefly on the basis of the use of French and the resulting opportunities for paid employment. To put it another way, in deciding to make elite education available to the masses, the government had little choice but to continue the use of French despite its desire to expand instruction in Kirundi. Tanzania escaped this problem by discarding the colonial equation of quality schooling with instruction in English and by policies making Kiswahili the language of government and the modern sector, generally.

In the 1973 reform, the content of primary schooling is to reflect the fact that it will be the terminal stage of schooling for most children who will live in the rural milieu. They must be taught vocational skills, respect for the dignity of agricultural labour, and what is necessary to increase their contribution to national development. Instruction is to facilitate the

> ...introduction des techniques agricoles, pastorales et artisanales modernes permettant le passage a une

> economie de marche fondee sur l'intensification et la diversification des productions agricoles. (Ministry of National Education 1988, 24)

Each school located in a rural area is to have a garden attached to it where students can practice theories of modern agriculture taught as an academic subject. The school garden will utilize the teaching resources of the community, parents and extension agents, and will operate like a collective. Students will have a role in production decisions, and income earned from the sale of commodities produced on the school farm will support operating expenses of the school. Students will, thus, acquire an understanding of the principles of modern farm management.

In ruralizing primary schooling, the government was inspired by the success of a pilot school farm project supported by Unesco and UNDP in Gitega and a related project to introduce agricultural education in primary teacher training in Rusengo in the late 1960s and early 1970s (Ministry of National Education 1988, 19 and 20). Both agencies were actively propagating the Tanzanian model of education for self-reliance throughout Africa at this time. Agriculture was made a compulsory subject from the fourth grade, agricultural topics were introduced into the <u>etude du milieu</u> syllabus, and practical experience in the school garden was incorporated into the timetable of instruction. In many respects, this simply strengthened and universalized the practical orientation of missionary schooling in the colonial period, making agricultural education and rural development the responsibility of the government.

The process of implemention is in 1988 still incomplete having been delayed by a period of ethnic turmoil in the early 1970s which precipitated a sharp decline in school enrolments. The number of children in primary schools did not exceed 1969-70 levels until 1981-82 (CPF 1988). Participation rates have now increased to about 85% of the school age cohort (Ministry of National Education, personal communication, 1988). Double shifts begun in 1982, have shortened the number of hours of instruction to about three and a half hours daily, and expanded class sizes to sometimes more than seventy students in the lower stage of the primary cycle. To reduce wastage, the government introduced a policy of increasing promotion rates throughout the primary cycle, decreasing repetition rates to about 15% nominally. How these measures to expand access to government schooling and raise levels of educational attainment may affect the teaching of agriculture and its impact of farm productivity is considered below.

Data Collection for Pilot Studies of Schooling in Rural Areas

Fieldwork was carried out in early 1988 in primary schools and their catchment areas in three of Burundi's eleven natural economic zones; Buragaane, Buyenzi and Kirmiro. Coffee is the most important cash crop in two of these zones and tea and coffee are grown in the third. Buyenzi and Kirimiro are among the largest and most densely populated natural economic zones in Burundi; 309 and 259 inhabitants per square kilometer,

respectively (CPF 1988, Table 5). The other, Buragaane is smaller in area and population (81 inhabitants per square kilometer). These are neither the wealthiest nor the poorest zones. In per capita food production and consumption in 1983 they ranked around the mid-point (UNDP 1986, vol. 2).

Selection of Schools

One primary school in each zone was selected for study. All were schools offering a six year program of studies, having satellite schools attached to them that provide instruction only for the first stage of the primary cycle. The three schools, Busera, Buzira and Nyaki, were chosen on the basis of enrolment in 1986-87 from among schools in the cantons scolaires in the regions selected. The schools are typical of other primary schools in terms of enrolment but vary greatly in terms of the performance of grade six students on the concours national which permits entry into secondary schools. In the most recent (1988) examination, fifty one of the one hundred and sixty five students at Nyaki obtained marks high enough to be admitted to secondary school, about three times the national pass rate of 10%. This is an usual performance for a rural school. Students at the school at Buzira did slightly better than the national average; thirteen of the eighty eight students passed the examination while only three of the one hundred and twenty five students at Busera passed (Ministry of National Education, personal communication, 1988).

Nyaki, established in the 1950s by the Roman Catholic Church, is one of the oldest of the schools studied and the largest in terms of staff and student enrolment. Approximately fourteen hundred (1443) students were attending in 1988 representing 92% of the school age population in the vicnity of the school, many of them children of army personnel. Twenty two teachers were assigned to Nyaki, three of them on a part time basis. Buzira (1938) and Busera (1980) are much smaller schools, enrolling less than six hundred students (514 and 562 students, respectively). However, the school at Buzira has a staff of 14 compared to six teachers at Busera. Repitition rates at the three schools exceed the national target of 15%. At Busera, where the performance of students on the concours national is poorest, the overall repetition rate in 1987-88 was 30%. A fourth (24%) of the students repeated the sixth grade the previous year. At Buzira, the grade six repitition rate was even higher, 74%.

Each of the schools has a school garden attached to it. Money earned from the sale of the produce of the school garden is used for capital improvements and purchase of sports equipment. The school at Buzira earned 33,850. FBU in 1987-88 from the sale of crops, about 20,000. FBU from coffee (US$1.=123 FBU). A wide variety of food and cash crops are grown at Buzira including potatoes, peanuts, corn, sorghum and bananas which are marketed at the school store operated by the school's co-operative. The other schools have smaller gardens and obtained much less from the sale of agricultural products. At Nyaki, for instance, only 4,000. FBU was earned in 1987-88 and at Busera, even less than

that. Of the 2,100. FBU Busera obtained, 1,500.FBU was from the sale of coffee.

The school garden at Busera has twenty four ares (hundredths of a hectare) of land, four of which are planted with coffee. About fifteen ares are used for food crops. The remainder is used for an orchard and a stand of eucalyptus trees. Despite the size of the school garden, the smallest of the three, the school is well equipped with agricultural tools for student use and there is sufficient land to practice a wide variety of soil conservation techniques and methods to increase soil fertility. The school is visited by an agronomist attached to the nearby Cultures Villageoises a Haute Altitude (CVHA) project who comes twice a week during harvests. Contact with agricultural extension agents at the other schools is less frequent. At Buzira, an extension agent may visit the school every three months and at Nyaki such visits had not occurred during the school year in which this study was carried out.

Data were obtained from the schools as well as from a sample of farmers living on adjacent collines (hillsides) in the school catchment areas. Information was collected for a period of about eight weeks by two research assistants at each site. The three research assistants who collected the school data were ordinarily employed to do school mapping work at the office of the Cantonal inspector. The Ministry connections of the three research assistants may have biased the interviews of some respondents even though much emphasis was placed on establishing trust and assessing confidentiality of responses. School directors and teachers in grades 3 through 6 were interviewed and fifty lessons observed in grades 4 to 6; twenty at Buzira, nineteen at Nyaki and eleven at Busera. Of these, twelve lessons were given in practical agriculture in class and/or on the school farm. Since fieldwork was carried out prior to the administration of the concours national, none were given in grade 6 as lessons in agriculture and other practical subjects were suspended to increase time for lessons in academic subjects. Several other lessons were observed which dealt with agricultural and science topics in the etude du milieu syllabus. Information was also gathered from ten randomly selected grade 6 students in each school on knowledge they acquired about modern agricultural practices.

Farmer Survey

In order to examine the effects of schooling on production practices and farm output, one hundred and twenty farmers were studied, about forty in each locality. The sampling design required equal proportions of male and female farmers with similar levels of schooling. Adult farmers in the school catchment areas were stratified into four groups on the basis of information obtained from colline administrators: (1) those who had no schooling and had not regularly or continuously attended church literacy classes, (2) those who had attended church literacy classes but had not gone to school, (3) those who had undertaken three or fewer years of formal instruction in a government school, and (4) those who had completed four or more years of primary schooling. Polygamous farmers, farmers who

rented their properties, and farmers who employed others to cultivate their lands were excluded. Except for polygamy which was prevalent in one of the areas studied, few exclusions resulted from the application of these criteria. The individuals selected were either chefs de menage (designated for administrative purposes as heads of households) or their spouses whose principal activity was farming.

The Teaching of Agriculture in Three Primary Schools

Policies of the Ministry of National Education* support and ensure the teaching of agriculture in primary schools. These policies are of three kinds, those that: 1) require the teaching of agriculture as part of the compulsory program of studies; 2) support instruction such as policies affecting teacher training, textbook distribution, and provision of equipment and allocation of land for practical training; and, 3) which address the quality of instruction including policies relating to the development and use of lesson guides, observation of classes by school directors and examinations to assess student performance. Policies and the practices that result from them should, of course, be reinforcing.

The syllabus for practical agriculture is set by the Ministry of National Education and is followed in all government schools. The subject is introduced in the third year of the primary cycle for one class period of thirty minutes per week. In the sixth grade, practical agriculture is also taught for one period a week. The weekly teaching schedule for grade six appears below.

* In 1988, a ministerial re-organization resulted in the creation of two ministeries for education; a Ministry for Primary and Secondary Education and a Ministry for Higher Education. The former name of the Ministry for Primary and Secondary Education is used throughout this paper.

Primary School Timetable

Day/Subject

Time:	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7:45 -8:30	Math	French	Math	French	Soc Std/ Science	7:45-8:15:Math 8:15-8:45:Sing -ing or drawing
8:30 -9:15	French	Math	French	Math	French	8:45-9:15 Practical domestic science*
9:15 -9:45	Practical agric.	Phys.Ed.	Kirundi	Soc Std/ Science	Phys. Ed.	
9:45-10:00	R E C R E A T I O N					
10-10:45	Kirundi	French	Math	French	Math	--
10:45 -11:30	French	Soc Std/ Science	French	Kirundi	French	--
11:30 -12	--	--	--	--	--	--

*TPEF=Travaux pratiques d'economie familiale

Note that the schedule for morning classes is described. Since the implementation of double shifts in grade six in 1987-88, this schedule has been repeated in the afternoon. Importance is given to French which is begun in the third year. It accounts for ten forty-five minute periods of instruction per week. Mathematics is the next most important subject (six periods of forty-five minutes and thirty minutes on Saturday). Science, including social studies, is taught for two and a half hours per week. Kirundi, which along with practical agriculture was a focus of the 1973 reform, is only taught for two hours. All subjects, except French, are taught in Kirundi for the first four years. French is to be used to teach agriculture, home economics and most academic subjects in the upper stage of the primary cycle.

The practical agriculture syllabus offers a menu of lessons for teachers to select from depending on local conditions, whether it is raining on the day that lessons are to be given, and the age of the children (Bureau of Rural Education 1983). Younger children are to study subjects like line planting. Older students are to be given instruction in composting, how to improve soil structure and topics that are presumed to require maturity and modern scientific knowledge. The syllabus is divided into three sections dealing with soil conservation, principles of cultivation and with the production of fruits and the main cash (cultures industrielles) and food crops (cultures vivrieres) of Burundi. Detailed lesson plans (fiches) are presented in French for sixty two subjects. About a third (17) of these lessons discuss the production of food crops. Class activities and practical work are described. Soil preparation, planting distances, crop care, identification and treatment of plant diseases and harvesting techniques are to be taught and practiced in the school garden. The lessons are to begin with a formal presentation by the teacher in class, followed by a demonstration given at the school garden, student emulation, and a recapitulation of the lesson in class that students are to transcribe into their exercise books.

School Gardening

A guide reflecting the national policy on school gardens is also distributed to teachers and school directors (Bureau of Rural Education 1983). The guide states that the school garden is to be a point of departure for the study of the rural milieu, and that is not to be viewed by school directors and teachers as a money earning enterpise which benefits from unpaid student labour. Its purpose is to impart modern agricultural skills, "d'apprendre a appliquer les bonnes techniques culturales adaptes a chaque region," and not to teach what students already know how to do (Bureau of Rural Education, 1983, 9). Students are to work in groups to learn the advantages of communal labour. The guide establishes minimum requirements for instruction for groups of forty students; twenty five hoes, two pitch forks, ten machetes, etc. Every school garden is to have a minimum of six food crops, one cash crop, a vegetable garden (at least five kinds), an orchard and a forest. Of the three schools studied, the one at Busera comes closest to following these norms, possibly because

of its proximity to the Belgian supported experimental food crop project and the fact that it was fortunate to receive a supply of tools from Unicef. At Buzira, for example no tools are provided for student use and only beans, maize and sweet potatoes are grown. There is no vegetable garden.

The introduction of double shifts and increased class sizes resulting from higher retention make it difficult for teachers to cover the program of instruction. At Buzira this year, for example, grade six students were fifteen lessons behind in maths about a month from the administration of the concours national. Some subjects are dropped from the school program to enable students to catch up in academic subjects; typically, home economics, health, and practical training (e.g.sewing). In the schools we studied, however, agriculture was taught to all students except to grade six students who were reviewing for their examinations. But since agriculture is not a subject examined in the concours national, it was not a high priority of the school directors. Although they are required to make one hundred and fifty classroom visits per year; only one felt it to be necessary to observe agricultural instruction. It is important to them mainly as a source of funding for school improvements.

Most lessons in practical agriculture that were observed at the three schools deviated from what is intended in the syllabus in one or more important respects. Kirundi was used for instruction at all grade levels, including grades 5 and 6 when the subject is to be taught in French. Usually, there was no lesson given prior to student work in the school garden, no demonstration by the teacher and no recapitulation of the lesson. Students were simply told what they would be doing, divided into groups, issued tools or given time to retrieve the ones they brought with them, sent to work, and made to put their tools away and wash their hands before going to the next class. Often different classes were combined and on one occasion a teacher combined lessons in agriculture and sewing because there were too many children to work in the school garden. Many of the lessons observed dealt with mulching or weeding or drying beans, which are mentioned in the syllabus, but are not objects of study per se. These are production techniques which students had undoubtedly mastered at home. For that reason, little instruction was considered necessary. Instead, the teacher merely supervised the students' work.

An exception is one of the lessons at Nyaki during which an agronomist, who happened to be passing by the school garden, was persuaded by the teacher to teach a lesson on how to plant sweet potatoes. The class began with the teacher giving instructions about what the students were to do in the school garden

Teacher: None murazi kurima? (Do you know how to hoe?)

Class (in chorus): Ego. (Yes)

Teacher: Mbe twababwiye ko tuyitera hehe? (Where do we hoe?)

Student: Tubitera mu murima wacu. (We hoe in our fields.)

Teacher: ...None tubanza kuhakorera iki? (Before what are we going to do before?)

Students: ...Tubanza kuharima neza. (Before we plant we are going to remember to hoe well.)

The students started weeding, collected the weeds and put them into piles for removal. At this point, the agronomist was invited to give a demonstration on the planting of sweet potatoes. He explained to the students that the seedlings must be stored in a cool place as well as how to choose and prepare them for planting

> les boutures qu'il faut prendre c.a.d celles qui terminent la tige de patate douce parce que si on plante une bouture vieille, il n'y a pas de rendement. Pour planter une bouture, il faut eviter celles qui ont les fleurs parce que c'est un signe que cette tige est vieille. Mais en cas de carrence des boutures, on se contente d'enlever les fleurs sur ces boutures. Pour planter la bouture il faut tout d'abord voir que la bouture a des bourgeons, 4 a 5...

The agronomist then demonstrated planting seedlings in mounds and the proper spacing which prompted a discussion between the agronomist and the school director who had gone to the school garden to meet him. The agronomist advised that the children plant no more than two seedlings per mound and space them about a half a meter apart between rows. The practical agriculture syllabus recommends two seedlings per mound and a meter apart. The agronomist felt that up to six seedlings could be planted per mound keeping the distance between rows a meter apart given the soil conditions in the area. The lesson is significant for what it illustrates about the potential benefits of integrating extension work with the agricultural education given in primary schools, and about the limitations of prescribing practices for a wide range of local conditions.

Science Teaching

Topics related to agriculture are incorporated into the etude du milieu syllabus which combines science with history, geography, and environmental studies. Etude du milieu is introduced in the first class. It is taught in French in the upper stage of the primary cycle, although key terminology is to be explained in Kirundi. Kirundi equivalents of French scientific and technical terms have been invented by the Bureau of Rural Education generally using Kirundi root words rather than adding Kirundi prefixes and suffixes to the French terms; for instance, parasites: ibirya ibindi bivyihishijeko (scavangers that live in the body) compared to, say, Nickel: nikeli (Bureau of Rural Education 1982). Social studies topics are prominent in the etude du milieu syllabus. In the sixth year, for example, one hundred and eight periods of history and geography are to be taught (Ministry of National Education 1984). Biology accounts for forty eight periods, and physical science for twenty eight

periods. Only ten periods are allocated for instruction in plant biology. An example of a plant biology lesson is given below. It was taught to a fifth year class and dealt with the parts of a plant.

Teacher: Quelles sont les parties d'une plante? ...

Student: Les racines.

Teacher: Quelles sont d'autres parties d'une plante?

Student: Les branches.

Teacher: Sur les branches il ya les feuilles...Quelles sont d'autres parties d'une plante? Nta bindi bihimba murabona ku bitegwa? (What are some other parts?)

Translation of the teacher's initial question into Kirundi enabled more students to respond completing the list of the parts of a plant.

Student: La fleur.

Teacher: ...Quelle est la derniere partie?

Student: Le fruit.

Teacher(at the blackboard): Les differentes parties d'une plante sont: les racines, la tige, les feuilles, les fleurs et les fruits...

According to this teacher and others we interviewed, the use of French for teaching subjects like <u>etude du milieu</u> creates many problems in covering the syllabus. French is a subject of instruction in the third year and the medium of most instruction in the last two years. Many students are simply unable to follow instruction in French, perhaps accounting for the high repetition rates in the upper stage of the primary cycle in at least two of the schools studied.

The lesson is taken from the <u>etude du milieu</u> syllabus which provides detailed guidance to teachers as to how the topic is to be taught. The teacher follows a script whose recitation may improve with practice and experience, it may be more or less complete, but it does not vary a great deal in its substance. That is intentional. The lesson guides do not provide much background information for teachers to develop in class presentations that may not be available in the student texts. There are no student texts for the <u>etude du milieu</u> and many other subjects. What teachers need to know is what they have to teach. The only texts students will study from are their exercise books in which, in this case, they have copied down the parts of plants.

The students may have to recite this information if they are asked a question about it when they take the <u>concours national</u>. The questions set for the <u>etude du milieu</u> paper are put in a multiple choice format; e.g. which of the following is not a part

of a plant? In the reviews that precede most lessons (the lesson described above began with a review of the parts of plants and then dealt with the structure of leaves), and in revisions that are taught to grade six students in the months prior to the administration of the concours national, teachers drill students on the factual information which may be tested. Interviews with school directors and grade six teachers suggest that revisions, correction of fill-in-the-missing-blank and other class exercises constructed to impart facts, and frequent mock examinations are the best strategies for increasing the likelihood of success. Because the most important papers in the concours national are given in French and the language is unfamiliar to many rural students, teachers also place much importance on developing the students' scientific and technical vocabulary. Understanding the function of roots, leaves and other parts of plants is subordinated in the syllabus to knowing the French terms. The discussion of roots and leaves, for example, is to lead to the introduction of concepts like racine secondaire, radicelles, i.e more French vocabulary. Photosynthesis is not mentioned in the guides for lessons on plants that are to be given in class five and repeated in the following year (Bureau of Rural Education 1982; Ministry of National Education 1984).

Nor does the syllabus take into account indigenous scientific knowledge that students possess from social experience. Indigenous scientific content consists of examples of local plants which in the lesson described, students were supposed to bring with them to class. Reliance on French as a language of scientific discourse, of course, seriously limits the possiblities for connecting what students are taught in school to the ways they have been taught to understand the natural world by their parents and by other members of their society. Nevertheless, the science that schooling imparts is to be modern which is to say disconnected from social experience. It is disconnected as well from the modern production methods that are covered in the practical agriculture syllabus. In implementing the 1973 reform, little thought was given to how students would integrate what they learn in French in etude du milieu about science with what they are taught in Kirundi in practical agriculture, or with what they have learned at home.

What Do Students Learn?

Instrumentation

A test was developed to measure what students learn from the instruction they receive in practical agriculture and science and administered to a small number of students at each of the three schools. The test was also designed in such a way that the questions elicited knowledge that might be obtained from social experience, especially from parents and contact with extension agents. Twenty five questions were asked dealing with the identification, treatment and prevention of crop diseases, seed selection, planting practices, soil fertility and soil conditions for growing common food crops. The questions covered three of the four sections of the practical agriculture syllabus (Conservation du sol, Operations culturales, Cultures vivrieres),

excluding only the lessons on the cultivation of cash crops. They were constructed so that answers required inferences from factual information embeded in the questions as well as from prior knowledge.

No questions were expressed in the multiple choice format used for the concours national. Instead, the questions were open ended and most measured problem solving skills. For example, students were shown a diseased plant, and asked about the cause of the disease and measures to control or prevent it. A few questions did elicit facts or, rather, rules of modern agricultural practice that are taught in school and reinforced by extension agents (and vice-versa); how many seeds of maize should be planted in a hole? The correct answer is two or three. However, these questions were generally followed by others that necessitated application and understanding of the rules; which plants should be retained after germination and how should they be selected? A correct answer to this question (mentioning colour, size, etc.) indicates that the student understands that two or three seeds are to be planted to together inorder to retain the healthiest plants. A guide for rating the correctness of responses was developed and used to score the student protocols. Scoring was carried out under the direction of individuals who were not involved in collecting data.

A second test was designed to measure functional literacy skills. This test consisted of twelve items measuring two types of text comprehension skills under different conditions: 1) recall of factual information with the text present and from memory;and, 2) inferring from propositions embeded in the text and from prior knowledge. The stimulus texts related procedural information pertinent to applying an insecticide. The product is intended for the control of stalk borers and other insect infestations of food crops and the instructions are given in Kirundi and French. Comprehension of the instructions requires literacy in both languages as the texts are not equivalent. The French text provides information on application rates that is absent in the Kirundi translation. The Kirundi text gives greater emphasis to the dangers of misuse of this product, which is highly toxic, but mentions fewer precautions.

Use of insecticides and other agricultural chemicals is mentioned in the agriculture syllabus. However, none of the schools possessed equipment for practical instruction. Agricultural chemicals are, however, widely used on cash crops and are used in school gardens to prevent coffee berry disease, for instance. On such occasions, the chemicals may be applied by or under the supervision of extension agents. Modern inputs were generally not used for food crops in the school gardens, even inorganic fertilizers where hybrid maize was introduced at one school to show the advantages of new varieties. Consequently, the prior knowledge needed to process this text comes from what may be learned outside school, although the processing skills and the technical information that must be encoded are developed through instruction in French and Kirundi and study of plant biology.

The comprehension tasks involved reading the texts aloud, summarizing the contents in the students' own words, and

answering a series of questions. Some required the student to identify the line in either one of the texts where, say, information about the kinds of insects the product controls is mentioned. Others required inferences such as a question asking when is the best time of day to apply this product? Again, responses were scored for correctness according to a rating system.

Understanding Modern Agriculture

Ten students were randomly selected at each school (N=30) from among those enrolled in the sixth grade (N=389), and then individually interviewed. About half (57%) of the students were boys. Eighteen students were fifteen or sixteen years old, the result of starting school at a late age and/or repeating classes. Three fourths (73%) had repeated grade 6. (One student repeated three times.) This is much higher than the repitition rates reported by the three schools to the Ministry of National Education which suggests either that these students are atypical or that official rates underestimate the incidence of repeating. In Burundi and many other African countries, students who obtain near passing scores on the secondary school entry examination are encouraged by their parents and teachers to retake the examination the following year.

Table 1 compares the agricultural knowledge and functional literacy scores of the students enrolled in the three schools. Responses to each item in the two tests were given a value of zero to ten and the scores aggregated. Scores for the two tests were highly ($r= -.36$, $p.<.05$) but negatively correlated; students scoring highly on measures of literacy did relatively poorly on the test of agricultural knowledge, especially on problem solving tasks. Insofar as the three schools are concerned, students

Table 1

School:	Agricultural Knowledge	Functional Literacy
	Mean=	Mean=
Busera (N=10)	133.4	107.6
Buzira (N=10	126.5	98.3
Nyaki (N=10)	120.6	104.0

at Busera obtained the highest agricultural knowledge scores and the highest scores on the literacy test. The school's proximity to the CVHA project, which has an ambitious program of agricultural extension that is directed to introducing new varieties of food crops, may partly explain these results. The school is also the best equiped for teaching agriculture. Of the three schools, though, it has the lowest proportion of students

passing the concours national. Students at Nyaki, the school with the most students gaining entry to secondary schools, had the lowest scores for the agricultural knowledge test. Generally, students did very poorly on this test which measured knowledge in a domain that is not a subject examined in the concours national. The mean score for all students (128) represents about half of the possible marks.

The transcripts of the student protocols provide some interesting insights into the knowledge students possess about agriculture and what they have retained either from school instruction or from social experience. Most students performed especially poorly on questions requiring inferential reasoning or explanations and, conversely, better on items eliciting rules of good agricultural practice. The most difficult questions on the agricultural knowledge test were those asking for causes of diseases, which maize plants to thin, criteria for selecting seeds, and what to plant to retain moisture in the soil. The easiest were the questions having to do with spacing and planting and methods of soil conservation which could be answered without understanding the reasons for rules. For example, one student asked about the number of maize seeds that should be planted in each hole, answered "deux ou trois graines sont plaques dans chaque trou." Asked why, he said "ceci fait que les plants croissent dans de bonnes conditions," making no reference to the need to select the healthiest plants to increase yields. When students understood the rules, they often could not reconcile them with knowledge acquired from social experience. Monocropping is an illustration of this. A student asked about how maize should be planted replied that "le mais est d'abord melange avec du haricot et puis on crouse des trous pour les semis" which is probably what is done at home. Asked about the principle of intercropping, he said that "le mixage n'est pas bon" and explained "une fois associe avec d'autres cultures, le mais est attaque par une maladie portant le nom de URUKARA...contrairement, le mais n'est pas atteint de la maladie s'il n'est pas associe avec d'autres cultures." This response is likely to reflect school knowledge since monocropping is taught at school and practiced in school gardens as modern agriculture.

The answers to many questions indicate that schooling may reinforce faith in the efficacy of agricultural chemicals as well as reliance on extension services where these are available to assist farmers in growing food crops. A student at Busera, for instance, asked how to treat an insect infestation of beans (bean fly) replied that "la maladie est traitee par des produits phyto-sanitaires livres par les agronomes du project CVHA." Several simply said "DDT," recommending its use for treating any plant disease. Few had any idea of how insecticides should be applied to increase the likelihood of success in controlling plant diseases; for example, timing application to coincide with the extent of infestation. A good answer might simply take account of the fact that "il faut mettre du produit phyto-sanitaire des la germination des jeunes plants." Even fewer students showed an awareness of more ecologically sensitive methods of disease control such as burning diseased plants.

Whatever practical knowledge students might have about using agricultural chemicals, responses to the functional literacy test suggest, is likley to be obtained at home from contacts with extension agents. Student answers to questions like the one necessitating estimation of the quantity of the insecticide to be used for each application make use of rules that are given in the Kirundi text and taught by extension agents; for example, that two or three grams is eqivalent to the quantity that can be poured into a bottle cap. The questions relating to the dangers and precautions that should be used in handling insecticides were usually answered by recalling the information presented in the printed instructions. Most students recalled no more than one or two precautions (usually, washing hands and refraining from smoking) which suggests that they had little prior knowledge of the dangers and procedures for safe handling of these products from schooling or from social experience.

Effects of Schooling on Farm Production

Characteristics of the Study Population

Farmers in the vicinity of the three schools were surveyed and data collected about their cropping practices to examine how schooling may influence the production of food and cash crops. The instrument administered to farmers through interviews also elicited information about production characteristics of households (number of individuals involved in agricultural production, size of landholdings, use of land, crops grown, use of modern agricultural technologies, etc.) as well as about crop production during the most recent growing season (late September 1987-early March 1988, varying with crop and locality). The interview schedule was prepared in French and translated into Kirundi. Although advice on translation of French technical terms was obtained from the Ministry of Agriculture, some terms had no Kirundi equivalents and explanations were offered if the farmer did not understand what information was being requested. Table 2 below summarizes some key biographic and demographic characteristics of the one hundred and twenty farmers and households studied.

Table 2

Biographic Characteristics of Farmers
N=120

1.	SEX	%
	males	52
	females	48
2.	RESIDENCE	
	Busera	35
	Buzira	31
	Nyaki	34
3.	SCHOOLING	
	none	24
	Yagamukama	29
	Primary schooling	
	three or fewer years	23
	four or more years	24
4.	AGE	
	20-29	17
	30-39	28
	40-49	23
	50+	33
5.	NO. OF CHILDREN	
	none	2
	one or two	10
	three or four	33
	five or more	56
6.	NO. OF CHILDREN IN SCHOOL	
	none	23
	one or two	26
	three or four	22
	five or more	29
7.	NO. OF CHILDREN PRESENTLY INVOLVED IN AGRICULTURE	
	none	42
	one or two	23
	three or four	24
	five or more	11

The largest number of farmers were from Busera (42 or 35%) and a slightly higher proportion of them were men (52% versus 48%). A majority of both the male and the female farmers indicated that they were responsible for most production decisions; 61% of the women, for example, said that they decided what to plant and only 13% consulted their spouses. More than half (53%) of the farmers had no schooling and/or had only attended church literacy classes. Of the farmers who had been to primary school (47%), half had completed three or fewer years of schooling. The roughly equal representation of farmers by sex, locality and educational level reflects the way in which they were selected.

46% of the farmers were below the age of forty. Most of the older farmers either had no education or attended Yagamukama schools; 75% of those fifty years or older. Families in the three localities are large, the majority (56%) of farmers having five or more children, a significant proportion of whom (42%) are involved in agriculture. Three fourths (77%) of the farmers had children in school. Almost two thirds (62%) of them were paying school fees for their children or the children of relatives. Most of those paying school fees spent less than FBU 1,000. per year for this purpose but 21% spent more than FBU 10,000. Only 13% bought exercise books and 6% paid for private tutoring. Purchasing school uniforms is the largest educational expense for parents. About half (50%) of the farmers spent between FBU 1,000.-6,000. for clothing. As a proportion of household expenditures, clothing and other school related expenses rank well below food and health care but above expenditures for tools, fertilizers, agricultural chemicals and other farm inputs.

The farmers studied are mixed producers cultivating small plots of land. The size of landholdings was approximated from information given by the farmers, most of whom calculated the size of their fields in <u>ares</u>, and converted into hectares. This was, therefore, a likely source of measurement error. Those in Busera had the smallest land holdings; twice as many cultivate plots of one hectare although 10% have plots of ten or more hectares (See Table 3). Since the average landholding in Burundi is estimated to be a little more than one hectare, these farmers are atypical in this important respect (FAO 1986, 3 & 19). There is much local variation in the production, especially of food crops. While nearly all farmers grow beans, cassava and maize are more important crops in Buzira and Nyaki than in Busera. Conversely, 81% of the farmers in Busera grow cereals compared to 8% in Buzira and 15% in Nyaki. Vegetables are grown mainly in Nyaki (by 77% of the farmers). Insofar as cash crops are concerned, most farmers produce coffee (93% in Busera, 89% in Buzira and 80% in Nyaki) Tea is mainly grown in Busera (67%). Most farmers sell some food crops. A majority of farmers in Busera who produce sorghum and sweet potatoes sell these products (50% and 63%, respectively). In Buzira and Nyaki, beans and maize are more likely to be sold. Most also keep livestock and poultry. More than three fourths of the farmers in Busera (81%) and Buzira (84%) keep cattle, though less than half (37%) of those in Nyaki do so. Sheep and goats are more common in Buzira than in the other locations.

Table 3

Production Characteristics of Farmers By Location

	Busera N=42 %	Buzira N=37 %	Nyaki N=41 %
1. Size of plots (total)			
one hectare	28	14	14
two	21	34	20
three to five	21	48	49
six to nine	21	3	14
ten or more	10	0	3
2. Proportion Growing			
beans	83	100	98
cassava	45	92	95
potatoes	67	89	98
maize	48	84	93
sorghum	50	70	41
sweet potatoes	71	22	46
wheat	81	8	15
soy beans	19	35	21
peanuts	5	22	54
vegetables	52	54	77
coffee	93	89	80
tea	67	3	-
3. If grown, proportion selling			
beans	10	44	42
potatoes	28	17	9
maize	8	22	29
sorghum	50	38	27
sweet potatoes	63	8	7
4. Proportion having live stock and poultry			
cows	81	84	37
goats	57	73	56
sheep	76	97	73
hens	67	84	39

New varieties of food crops have been introduced in one or more of these locations. New varieties of potatoes and maize have been made available to farmers in Busera which is the site of the CVHA project experimental farm. But neither are being promoted at Buzira where farmers are being encouraged to use new insect resistant varieties of beans. Agricultural extension work is very localized and food production projects, often supported by foreign donors such as the Belgian project at Busera, have different crop emphases. Farmers, of course, plant many food crops so that the impact of successful projects to introduce new varieties can often be difficult to discern in terms of increased food production. The narrow foci of agricultural research and extension work poorly correspond to the holistic pattern of food production of farmers.

Moreover, efforts to introduce new varieties are not necessarily supported by programs to distribute needed inputs to farmers. For instance, while hybrid maize is used by a majority of the maize producers studied in Busera (58%) and Nyaki (50%), few of the farmers in these locations buy fertilizers whose distribution is controlled by the state. Repeated use of hybrid maize generally requires inorganic fertilizers to maintain soil fertility and high levels of output. Less than 6% of the farmers in Busera or Nyaki obtained and used inorganic fertilizers for any crop. Some farmers in Buzira and Nyaki did purchase agricultural chemicals, usually pesticides for use on food crops (37% and 25% of each group). Still, the level of use of these or any other technological inputs for food production is very low. Of those farmers who applied inorganic fertilizers or agricultural chemicals on food crops, none mentioned receiving information about using them in school and only half said they had been given instruction by extension agents.

Production of cash crops, on the other hand, is technology intensive. Agricultural chemicals are distributed to farmers to control coffee berry disease, for example, and their use is obligatory. Two thirds (69%) of the tea producers in Busera received fertilizers.

Table 4

Use of Technology and New Varieties by Location

	Busera N=42 %	Buzira N=37 %	Nyaki N=41 %
1. If grown proportion planting new varieties of			
maize	58	-	50
beans	3	28	38
sweet potatoes	92	-	-
2. If grown, proportion using inorganic fertilizers or agricultural chemicals			
maize	5	-	3
beans	4	14	3
sorghum	-	-	33
potatoes	7	-	13
coffee	93	97	86
3. In 1987/88, proportion purchasing			
fertilizers	6	1	9
agricultural chemicals	8	37	25

Determinants of Farmer Efficiency

Schooling and Agricultural Productivity

Reference has been made to the many studies that have correlated farmer education with farm productivity. The findings of these studies are difficult to reconcile with the pessimistic view of agricultural education and primary schooling that has been presented in the preceding sections. One way is to account for the impact of schooling is to describe it as having an accelerator effect on agricultural productivity when supporting conditions exist, i.e. as an intervening variable having little independent effect on farm output. Supporting conditions may comprise high prices for agricultural products, low cost inputs, efficient marketing organizations and rural transportation systems, etc. Other accelerators of agricultural productivity include access to credit, land, and labour; education being seen as one of the factors of production (Mosher 1971; 1978).

Another way is to assume that schooling has a general impact on changes in agricultural practices that are associated with higher productivity; that "to cope with new imputs and ways of combining them, usually men (and, presumably, women) need schooling; the extension services cannot substitute for the people-changing effect of schools at this fundamental level (Bowman 1975;48)." The effect of schooling is not attributed to agricultural instruction or practical experience on the school farm but rather to the cognitive changes which literacy, numeracy and academic studies bring about. Risto Harma has proposed a model accounting for the productivity increasing effects of schooling. On the basis of interviews with extension officers and observations of farmer "entrepeneurs" in Latin America, Harma identified four stages of agricultural productivity and the knowledge and skill requirements associated with each stages. At the first level, traditional farming involving use of local varieties and technologies, some numeracy is necessary (Heyneman in Habte et al 1983,16). At the highest level of agricultural technology which is associated with the use of high yielding varieties, fertilizer, tubewells and irrigation, reading comprehension and written communication are necessary as is a knowledge of elementary chemistry, biology, physics and as well, the ability to make use of new information.

Tests of Harma's model have produced discouraging results. A recent study of the effects of farmer education on farm efficiency in Nepal, for example, concludes with the observation that neither literacy nor measures of agricultural knowledge are highly associated with technological adoption or agricultural output (Jamison and Moock 1984). Numeracy was found to have a positive effect on productivity but only for the use of fertilizer and the production of wheat. An earlier review of research on the contribution of school acquired literacy to agricultural innovation in India and Brazil indicated that their direct and indirect effects were negligible in comparison to size of land holdings and income (Villaume 1977). Non-formal learning, involvement in agricultural extension programs, for instance, had more impact than school literacy. Similiar

findings are reported by Kalirajan and Shand in their study of rice farmers in Tamil Nadu, India. They conclude that schooling is not a major factor in efficient farm performance; "an illiterate farmer without the training to read and write," according to these investigators, "can understand a modern production technology as well as his educated counterpart (Kalirajan and Shand 1985, 233)."

Notwithstanding the weak evidence of effects of measures of school knowledge and skills in raising agricultural productivity, the rates of return to investments in rural schooling for developing countries have been estimated to range from 10% to 26% depending on the prices of farm products and the time when benefits are assumed to begin (Jamison and Lau 1982, 225). The apparent contradiction may say more about the ways in which literacy, numeracy and school knowledge are usually studied than about their effects on agricultural production. For example, in the Jamison and Moock study mentioned above, literacy was determined on the basis of whether the farmer could produce a signature. Knowledge pertinent to understanding modern production technologies was measured by responses to questions eliciting awareness of extension programs. Numeracy was assessed by requiring farmers to make fourteen arithmetic computations. Such measures have no obvious relationship either to the knowledge and skills schooling is supposed to develop or, more importantly, to what may be required insofar as agricultural practices involving modern technologies are concerned. Consequently, this research is used to argue for universal schooling and higher educational attainments without specifying precisely what is to be taught and learned to increase productive capacity.

Analysis of the Farmer Survey

Information collected from the one hundred and twenty farmers was used to examine the effects of schooling and cognitive skills on the production of food and cash crops. Subsequent analysis employs the log linear form of the Cobb-Douglas production function (log y=Beta1 log X1+ Beta2 log X2...+$Beta_k$ log X_k + BjXj) where X1....Xk are continuous variables, Xj is discrete, and Betas are unknown parameters. This functional form provides an estimate of how efficiently farmers combine inputs for specific crop outputs. Four categories of inputs are assumed to influence the value of production of food and cash crops, those relating to : 1) cultivator skill; (2) land used for production; (3) labour involved in planting, cultivation and harvesting; and (4) use of modern agricultural technologies. The first comprises, for the purposes of this study, several variables measuring farm experience, schooling, agricultural knowledge, skills in comprehending instructions for using agricultural chemicals, and agricultural practices that are expected to optimize output such as fertilizing and frequency of weeding.

Age was used as a proxy for farm experience. Farmers who had gone to primary school received values gone of one to six depending on the number of years of schooling they completed. In order to compare our findings to previous studies carried out in African and Asian countries which also have well developed

systems of religious or other non-formal education, farmers with no schooling were aggregated with those only attending Yagamukama schools and both assigned a value of zero in the following analysis. That may reduce the effect of schooling on farm productivity. However, we will later consider how this might influence our results.

Agricultural knowledge and problem solving skills were measured using a shorter but similar version of the test administered to grade 6 students. The test consisted of only thirteen items, mostly those having to do with the identification, causation, prevention and control of plant diseases, soil conservation practices and the suitability of various plants for certain soils. The test of comprehension skills was also similiar to the one given to students except that it was constructed so that it could be administered to illiterates as well as literates. In the case of illiterates, i.e. farmers who could not read whether or not they had been to school, a Kirundi text was read to them. The comprehension tasks (fourteen questions) were modified so they could be answered from memory or from inferences either from the verbal or printed texts or from prior knowledge. As with the agricultural knowledge test, responses were independently rated according to an evaluation scheme according points on the basis of the correcteness of answers.

Scores on the agricultural knowledge test (Mean= 51.3) were much lower than those for the comprehension test (Mean =78.0), 39% and 56% of possible scores, respectively. The most difficult items for the agricultural knowledge test were those requiring inferential reasoning about the causes of plant diseases. Farmers were familiar with these diseases and often knew a great deal about the circumstances under which they were most likely to occur; for example, this farmer who was shown a bean plant destroyed by bean fly

Interviewer: Nikuki? (Why? What is the cause?)

Farmer: Sinzi! Mpora ndabibonai gihe c'imvura. Amababi yo hepfo atangura kubenja agahava yuma. Hanyuma hagaca haza udutobora ku mababi. (I don't know. It happens in the rainy season and the leaves are made dry, destroyed at the stem. It appears as holes on the leaves.)

They offered few hypotheses about the causes of diseases. About these matters, several farmers said that they would seek the advise of extension agents: "Ngirango hotegerezwa kuboneka umu gronome akambarira ingene nobigenza (I will ask the extension agent"). Farmers related many agricultural problems to soil fertility. The intervention strategies they relied on were applying manure and also crop rotation. In contrast to the grade six students, they rarely mentioned agricultural chemicals to control insects or inorganic fertilizers or use of any modern inputs for food crops largely, it seems, because such inputs are not widely available

Interviewer: Hariho indwara ikunda gufata ibiharage, amababi agatobagurika. Sinzi y'uko iyo ndwara uyizi.

N'imizi akaboza...(Concerning the disease that attacks beans...what is it?)

Farmer: Ivyo vyarashitse igihe kimmwe, ariko nta muti wabonetse. Kandi igiharage gifita amababi mabi kikiri gito-hariho niyindi ndwara usanga amababi ahindwka agasa n'umuhondo ukamenga igiharage kireze kandi kitaragera hanyuma kigahava cuma...(I have seen this before...but we had no product to fight it with.)

Most of the farmers had neither heard of (90%) nor used (96%) the insecticide (Folithion) which was selected for the text comprehension test. It is the first product of its kind to be manufactured in Burundi and made available for sale through the private sector. However, distribution networks in rural areas are rudimentary. Until very recently, the government controlled not only the distribution of nearly all modern inputs, including fertilizers, but their storage as well. The printed instructions for this product, for instance, advise farmers to store unused chemicals in government facilities. Farmers have not been thought capable of using such products without close supervision.

Farmers are, of course, familiar with agricultural chemicals used on cash crops. Whatever instruction they receive about applying them is given orally by extension agents. Most farmers recognized the dangers of agricultural chemicals like Folithion. Some did not. One farmer prodded by the interviewer who expressed alarm that the product was not considered to be harmful, conceded that it should not be eaten but when pressed to give precautions about using it, said only that glasses should be worn. This is not mentioned in the instructions and probably represents an inference from experience with products that are sprayed rather than dusted on crops. Answers to questions necessitating inferences revealed prior knowledge of agricultural chemical use such as those concerning the best time to apply the product (in the morning or evening when there is little wind).

An index was constructed to measure the efficiency of cultivation practices involving the production of food crops. It consisted of ten items, and dealt with planting methods (line planting or broadcasting), fertilizing and frequency of weeding of various food crops. A related index was constructed for coffee cultivation. Missing values were assigned for farmers not producing a specific crop and scores computed for those variables for which information was obtained.

Schooling was not highly correlated either with scores for the agricultural knowledge test ($r=.029$) or for the comprehension test ($r= -.066$). Nor were scores for the two tests highly correlated ($r=.029$). In other words, these are independent measures of cultivator skills. Moreover, neither of these variables were correlated with the index of cultivation practices for food crops. Farm experience did correlate with cultivation practices ($r=.443$, $p.01$) but not with agricultural knowledge ($r=.069$).

Information was elicited from farmers about how much land was used for producing food and cash crops. Estimates for food crops are, of course, biased by the prevalance of intercropping. Almost all farmers intercropped maize, beans and sorghum with one or more of these crops and with Irish and sweet potatoes. Labour estimates have a similiar bias. Information was collected about the number of days and number of people participating in preparing land for cultivation, planting, weeding and harvesting specific crops. It would have been preferable to obtain this data on an on-going basis during the period in which the activities took place, but this would have been too expensive to be feasible. Since it was difficult for farmers and field researchers to assign labour input values to particular food crops with the result that there is little variance among those that are intercropped. Thus, for this analysis, the proportion of land allocated for each food crop was multiplied by the number of person days of labour for food crops. Information about land and labour allocations to cash crops was collected more easily and disaggregated in the analysis.

An index of use of modern agricultural technologies was developed comprised of answers to ten questions concerning use of hybrid seeds, agricultural chemicals, inorganic fertilizers and whether the farmer purchased either during the preceeding year. Use of modern inputs was not positively correlated with schooling ($r= -.027$).

Crop outputs were measured by multiplying total production for each crop by the average market price received for any quantity the farmer produced during the most recent season. Values were computed for the five most common food crops (maize, beans, sorghum, Irish potatoes and sweet potatoes) as well as for coffee which is grown in all localities.

Results

Cobb-Douglas coefficients for skill, land, labour and technology inputs and crop outputs are given in Table 5 below.

Insofar as total food crop production is concerned, agricultural knowledge scores, the index of cultivation practices and comprehension skills make the largest contribution to total output. Schooling is also positively related to the production of food crops as is farm experience to a much lesser extent. Land is positively related only to the production of maize and beans. The negative value of land inputs suggests that land may be underutilized for food production due to subsistence orientations, reliance on fallowing to restore soil fertility, lack of markets or unattractive prices for many food crops. Labour makes very little positive contribution to food production, in general, and for specific crops except for sorghum and potatoes. The modern sector in Burundi is miniscule, as we have pointed out earlier. And the non-agricultural informal sector, while perhaps the most rapidly expanding employment sector, is small by comparison to other African countries although no reliable labour statistics are available. Consequently, farm production absorbs almost all labour.

Table 5

Efficiency of Food and Cash Crop Production

N=120

Crop Outputs

Inputs	Maize Beta (T-Ratio)	Beans Beta (T-Ratio)	Sorghum Beta (T-Ratio)	Potatoes Beta (T-ratio)	Sweet Potatoes Beta (T-Ratio)	All Food Beta (T-Ratio)	Coffee Beta (T-Ratio)
1. Cultivator Skill							
1.1 Farm experience	.248 (3.938***)	0.628 (11.798***)	.766 (7.711***)	-.040 (-.665)	.231 (3.428***)	.218 (4.431***)	-.433 (-2.290*)
1.2 Schooling	.055 (1.823)	-0.100 (-3.993***)	.124 (2.285*)	0.548 (17.393***)	-.028 (-.882)	.097 (3.933***)	-.613 (-2.116*)
1.3 Agricultural Knowledge	1.233 (7.439***)	-0.182 (-1.244)	.123 (.356)	0.739 (5.032***)	-.542 (-2.435*)	.774 (7.314***)	.473 (.990)
1.4 Comprehension (1.309)	.864 (.897)	0.770 (-3.251**)	.543 (2.500*)	0.207 (2.636**)	-.787	.387	2.273
1.5 Agricultural Practices	.198 (1.099)	1.128 (5.754***)	.895 (3.032**)	1.561 (7.408***)	1.101 (4.746***)	.471 (3.566***)	2.371 (2.184*)
2. Land	.245 (4.605***)	0.131 (3.098**)	-.245 (-3.140**)	-.196 (-3.977***)	-.365 (-6.870***)	-.176 (-4.519***)	-.742 (-6.414***)
3. Labour	-0.331 (-4.453***)	-.002 (-.036)	0.210 (1.972)	.140 (1.787)	.263 (3.287**)	.156 (1.810)	.503 (4.564***)
4. Technology Index	-.076 (-0.539)	-.135 (-1.419)	-.292 (-1.610)	-.584 (-3.912***)	.698 (5.391***)	.060 (.908)	2.125 (7.487***)
F=	44.0***	67.8***	27.4***	98.5***	23.3***	87.6***	30.0***

*p=<.05
**p=<.01
***p=<.001

Technology has a large impact on coffee production, however, as does scores for the test measuring skills in comprehending instructions for using agricultural chemicals. So does labour (mainly for harvesting and weed control) which has the largest contribution to output. Schooling and farm experience are negatively related to the production of coffee. The proportion of land allocated to coffee also has a negative value. The age of coffee plants probably has a greater relationship to production than the amount of land or even the number of plants.

Discussion

These results are consistent with the somewhat contradictory findings of previous research. Schooling has some effect on agricultural productivity as Jamison and Lau claimed. Nevertheless, its effect is smaller than that for measures of knowledge and experience that seem to be acquired from social experience which is what Kalirajan and Shand have found. One factor influencing our results is the aggregation of farmers with no schooling with those attending Yagamukama schools. But when Yagamukama education is treated as a dummy variable, the effect of schooling is much reduced rather than strengthened as we might expect. For example, schooling does not make a significant contribution to the a significant contribution to the total production of food crops (Beta = .068, TRatio = .503, N.S.F. = 2.87, $P<.05$). In other words, while the effects of Yagamukama education are quite different from those associated with no schooling, it does not suppress school effects in our analysis. Peasant agriculture in Burundi less technology intensive than in many other developing countries. This may, in part, explain why school effects are relatively weak inasmuch as the productively raising effects of schooling are thought to be mediated by choice and use of agricultural technologies.

Three findings of the preceeding analyses are particularly important. First, while schooling has a modest relationship to increased output of food crops, it is not highly correlated with agricultural knowledge, comprehension skills, use of modern technology or with agricultural practices that are supposed to be taught in school. Hence, the effects of schooling on agricultural production in Burundi can not be attributed to any practical training which students have received in school that might have increased their knowledge of the causes and prevention of plant diseases, disposed them to adopt agricultural technologies, enabled them to make more efficient use of modern inputs or made them better farmers.

Second, schooling does not make farmers better producers of cash crops. In Burundi, these crops are technology intensive and coffee production is related to both technology use and skills in comprehending instructions for using agricultural chemicals. The latter are probably learned outside school. Other studies have shown that coffee, tea and many other cash crops that are grown in East Africa have low skill requirements in comparison to what is required to increase food production with modern technology (Eisemon and Nyamete 1988). What this suggests is that schooling may have an important role to play in increasing food production

if modern inputs are made available to farmers and future farmers are taught how to use them. Conversely, teaching school children how to grow coffee and other cash crops is not likely to be very effective.

Third, the impact of schooling on food crop production in this sample of households is highly varied. It is positive for some crops and negative for others. Exactly why this is the case can not be determined. It may have something to do with the skill requirements of different crops, or with the propensity of schooled farmers to grow certain crops, or with characteristics of the three localities or with anomalies in the data. However, it is apparent that schooling is no panacea for increasing food production. Efforts to increase the impact of schooling need to take account of these variations and of the factors that may contribute to them.

It is significant that agricultural knowledge and practices have such a large effect on crop production, more than that for land, labour or technology. The potential for increasing agricultural productivity through better farmer education is very great. This is not just a matter of teaching production skills that most individuals are familiar with like weeding and fertilizing or about methods of controlling erosion and plant diseases, though these are important. Productive capacities are increased when modern agricultural knowledge and skills change the ways individuals think about and perform practical tasks, and when circumstances favour innovation.

Conclusion

Is Implementation the Problem?

The weaknesses of agricultural education in African primary schools are often attributed to poor implementation which, presumably, can be remedied by efficient management and more frequent monitoring of instruction. For instance, school inspectors in the Anglophone provinces of the Cameroon placed responsibility for the unsatisfactory situation on school farms on inadequate teacher supervision of practical work, the implication being that changes in policies affecting teacher supervision might result in improvements. Cameroonian teachers gave different explanations. They put the blame on shortages of textbooks and other teaching materials, large class sizes, student absenteeism, lack of in-service training and other factors beyond their control (Bude 1985, 217 and 260). Similar sentiments have been expressed by the teachers and school directors interviewed for this study as well as by educational policy makers in Burundi who have drawn attention to the implications of poor implementation for the attitudes students acquire about the importance of practical studies

> Le comportement de certains directeurs d'ecoles, la repugnance que manifestent bon nombre d'enseignants vis-avis du travail manuel risquent d'en compromettre l'evolution. Il est deconcertant en effet, de constater que les maitres, pourtant inities a la pratique des travaux manuels dans le but d'assurer l'encradrement du travail des eleves, se desinteressent de plus en plus de ces activites. Face a cette attitude des enseignants, les eleves risquent de croire, au moment meme ou il devrait etre rehabilite, que le travail manuel est reserve aux pauvres en incompatible avec l'education. Le risque est donc grand de voir aussi les eleves perdre definitivement leur enthousiasme de depart. (Ministry of National Education 1988, 51)

Agricultural instruction in primary schools can not be improved simply through better implementation on the assumption that present policies are correct and the ways they are being interpreted and carried out are wrong. Nor will improvements necessarily result from innovations in the syllabi for science and practical agriculture in primary schools or in primary teacher training colleges. There are, in fact, a great many imaginative proposals relating to how agriculture should be taught that may be gleaned from the extensive literature on education for rural development; from the reports of the Phelps-Stokes Commission, for example. But good ideas will not improve instruction unless policy makers, educational administrators and teachers adopt them, and students and parents value what is taught.

Policies Must Be Changed As Well

Agricultural education programs have usually been guided by pronouncements about school leaver unemployment, concerns about the exodus of youth from rural areas and the attendant social problems, about the need to deflect pressures for expansion of secondary and post-primary technical education, about the dignity of manual work and virtues of rural life, and about the importance of raising agricultural productivity. This litany has been recited in the rationale constructed for teaching agriculture to African children for at least a half a century. Unfortunately, while it may assist in creating a compelling argument in favour of agricultural education in statements of public policy, few inferences can be drawn relating to how agricultural education should be organized in ways that may facilitate rural development.

The 1973 educational reform which sought to give primary schooling in Burundi a rural orientation did not provide much practical guidance to policy makers as to what schools should be doing to make them a focus for rural development. Even if it had, economic conditions in the country have changed a great deal since then, most dramatically in regard to the decline of per capita food production. We have argued that it is in increasing capacities to grow food that schooling is likely to have the most impact. However, efforts to strengthen the contribution of schooling to food production must be reinforced by a national strategy for rural development that makes increasing food production a principal objective of development planning and allocates significant resources for this purpose. The present and former governments of Burundi recognize the importance of raising food production and this is emphasized in the third (1978-82) and fourth (1983-88) five year plans. Nevertheless, there are many structural impediments to be removed not the least of which are poor transportation networks in rural areas, lack of credit, taxes on the movement of foodstuffs to rural markets, inefficient systems for distributing modern agricultural inputs to farmers, and extension services which are oriented to increasing the production of coffee, tea and other cash crops.

The latter is of particular importance inasmuch as agricultural education in primary schools must augment and be reinforced by the work of agricultural extension agents. Many Societees Regionales de Developpement (SRDs)have initiated projects to disseminate new varieties of food crops and improve seed treatment, storage and distribution, often with the assistance of foreign donors. An example is the CVHA project in Busera. Local extension services are often closely involved in implementing these projects.

Agricultural extension and primary education are the responsibility of different ministries. The instructional programs which teachers and school directors must implement are determined at the national level though there is some scope for local variation in teaching subjects like practical agriculture. Consequently, the possibilities for co-ordinating agricultural education with agricultural extension are very limited. Such

co-ordination as does occur is usually spontaneous as in the example presented earlier of a lesson on planting sweet potatoes given by a passing agricultural extension agent. Only one of the schools in this study was visited by an agronomist (actually, his assistant) on a regular basis; and then only at harvest time. The notion that schools should become a locus of rural development assumes a much closer relationship that can only be brought about if: 1) extension and primary education are guided by national policies on food production; 2) both are subject to local control; and 3) the relationship between them is formalized in such a way that they are accountable to each other as well as to local and national levels of political authority. One way to do this may be to make agricultural education in primary schools a responsibility of the SRDs.

There are many domains in which co-operation is needed including in-service and pre-service primary teacher training, school inspection and classroom supervision, textbook preparation, syllabus adaptation, planning the school garden and marketing its produce, organizing field trials and demonstrations, distributing new varieties and modern imputs, among others. Some consultation occurs between officials of the ministries of national education and agriculture in several of these respects; in the preparation of texts for teaching practical agriculture, for instance. Nevertheless, strengthening the contribution of education to rural development will require a more formal integration of the functions of extension and primary schooling than presently exists in Burundi.

Increasing the Importance of Agriculture in the School Curricula

Attention will have to be given to the contradictions in the philosophy and implementation of the 1973 education reform. Participants at a recent (1988) workshop organized by the Ministry of National Education to begin an evaluation of the reform "n'ont pas pu voir comment l'ecole ruralisee peut a la fois preparer un bon paysan et un bon eleve susceptible de poursuivre les etudes secondaires (Ministry of National Education 1988, 27)." Instruction in the upper stage of the primary cycle is oriented to preparing students for the concours national, i.e. for possible entry into secondary schools. Agriculture is not a required paper for the concours national though questions set for the etude du milieu paper often deal with agricultural and natural science topics. The examination is given in French except for the compulsory paper in Kirundi. This seems inconsistent with the intention of promoting practical studies and the use of Kirundi, as well as with the premise of the 1973 reform and the reality that primary schooling is the terminal stage of schooling for most children (Ministry of National Education 1988, 7).

Agriculture is a required subject for the school leaving examination in some other African countries. In Kenya, for instance, it has been a compulsory paper since 1985. Questions set by the Kenya National Examinations Council cover the theory as well as the practical aspects of agricultural instruction. The practical questions may deal with soil samples and plant specimens which are provided to students to examine prior to

administration of the test. Agricultural knowledge is tested in questions like this one: "Give the reason why specimen H2 should not be used as a planting material if it originated from a hybrid plant (KNEC 1984, 2)." If the Ministry of National Education in Burundi wishes to increase the importance of agriculture for school directors, teachers and students, serious consideration might be given to making the theory and practice of modern agriculture a compulsory paper for the concours national. The paper might be given in Kirundi to reinforce the use of Kirundi as a medium of instruction for both practical agriculture and natural science topics covered in the etude du milieu syllabus. That, of course, implies production of the necessary teaching materials in Kirundi, "une condition majeure pour la reussite de la Ruralisation (Ministry of National Education 1988,27)."

The introduction of double shifts to increase school participation and efforts to raise educational attainment through discouraging repetition have undoubtably worsened conditions of instruction. It is difficult to cover the school syllabus in the time available (about three and a half hours) given average class sizes often in excess of forty students even in the upper stage of the primary cycle. In lieu of a program to accelerate school construction and teacher training, the only ways to increase instructional time for subjects like natural science and practical agriculture are: 1) to combine different shifts or classes; or 2) to reduce the scope of the school curricula. The first is, in fact, done in many schools including the three studied. Classes in different shifts are combined to increase instruction, generally in academic subjects and often prior to the administration of the concours national. In practical agriculture, classes from different grades are combined to give teachers more time for lesson preparation and marking. The second, reducing curricula, is also practiced. School directors and teachers in two of the three schools studied have either abandoned or severely reduced instruction in home economics, health and prevocational studies on the pretext that the necessary instructional materials and equipment are not available. There may be other, better reasons for this; for instance, doubts have been expressed about whether prevocational and vocational training is best carried out in schools (Eisemon, Ong'esa and Hart 1988). However, health and nutrition are domains in which school instruction has been found to have a powerful impact on household practices (Eisemon 1988; Eisemon, Patel and Ole Sena 1987).

The agriculture syllabus according to school directors and teachers is covered at least in two of the three schools we studied. It is perhaps in the majority of rural primary schools, despite the fact that instruction in the subject is not important to inspection or teacher supervision. This does not mean that agriculture is well taught or even that standards of instruction in academic subjects have been maintained through combining classes and syllablus reduction. The latter is, indeed, a serious concern to many teachers, school directors, school inspectors and to the Ministry of National Education (1988). What is lacking are policies to guide school and classroom level decisions as to how to increase instructional time and reduce the scope of the school syllabus that are in accordance with the

objectives of the 1973 reform as well as with desires to increase school participation and educational attainment. A policy of indifference will not facilitate achievement of either the practical or the academic aims of primary schooling. In brief, a fundamental decision will have to be made about purposes and content of primary schooling. A decision in favour of the teaching of agriculture and other practical subjects and expanded use of Kirundi will under the present circumstances, compromise attention to academic subjects, especially French.

This is not meant to imply that academic instruction is unrelated to farm productivity or to other practical outcomes of primary schooling. Nor is it suggested that French has no importance for rural life apart from facilitating access to secondary schooling and modern sector employment. So long as French remains a language of governance and is important as a language of scientific, technical and commercial discourse, it will be necessary to teach it. Nevertheless, rapid implementation of Kirundization (with French remaining as a subject of instruction) will probably alleviate some of the pressures produced by the introduction of double shifts assuming that it will enable teachers to cover the existing syllabus more quickly.

Improving Agricultural Instruction

Insofar as agriculture is concerned, our research raises many questions about the construction of the practical agriculture syllabus, the use of school gardens and the importance given agricultural and natural science topics in studies of the *etude du milieu*. Several principles to guide agricultural instruction emerge from the findings and analyses presented here. First, agricultural instruction in primary school is likely to be most effective when it is oriented to increasing capacities to grow food crops. The practical agriculture syllabus, described earlier, provides for instruction in many subjects, the cultivation of cash crops (*cultures industrielles*) being given relatively little importance. However, money earned from the sale of cash crops grown on the school gardens is in the three schools we studied and perhaps in many others, an important source of funds for school improvements. As a result, a significant proportion of school land and school time is used for growing crops like coffee; probably because these are labour intensive, students are already skilled in their cultivation, and it is easier to market them than to market food crops which might have to be transported considerable distances. However, this is not what is envisioned in the practical agriculture syllabus. Nor is it the purpose of the *jardin scolaire* (Bureau of Rural Education 1983).

Second, much of the effect of schooling on agricultural productivity in previous research is attributed to increasing capacities to use and combine inputs, especially modern agricultural inputs and practices that require a knowledge of modern biology. Practical agriculture and natural science are separate subjects in the school curricula, and one is usually taught in Kirundi and the other in French in the last two years of the primary cycle. Might it not be desirable to integrate these subjects and teach both in the vernacular language? This

is the practice in many Anglophone African countries whose primary science programs have been influenced by the USAID Science Education Program for Africa and the British Council's Primary School Science Project, both of which emphasized integrated science, discovery learning and development of vernacular language instructional materials.

A related observation might be made concerning the integration of agricultural instruction with instruction in nutrition and home economics. Again, these are separate subjects. Nutrition and home economics seem to be, we have noted above, among the principal casualties of the introduction of double shifts and other strategies to implement the 1973 reform. The combination of nutrition and home economics with instruction in the cultivation of food crops is likely to be mutually beneficial.

Third, what students learn in school about agriculture is influenced by what they have learned at home. This has many implications. It is unnecessary for schools to teach what most students already know. For instance, weeding and the cultivation and harvesting of cash crops are generally learned outside school from parents or extension agents. Teachers should not give disproportionate attention to these subjects. Instead, practical instruction should focus on what students are unlikely to learn outside school. This might include requirements of new varieties and techniques for seed treatment and storage, use of fertilizers, properties of herbicides, insecticides and fungicides, and so on. The present practical agriculture syllabus assumes that agriculture is being taught to children in urban areas, i.e. agriculture is being learned ab ovo.

Texts

The texts used to teach practical agriculture in Burundi and in many other African countries condemn indigenous agricultural knowledge by neglect. Traditional agricultural and livestock practices are rarely mentioned and when mentioned, presented as objects of change. Food production in Burundi has been largely uninfluenced by agricultural extension, the introduction of new varieties and distribution of fertilizers and agricultural chemicals. It is the most traditional sector of agricultural production. Efforts to modernize this sector are apt to be more successful if new practices make sense to farmers and students in light of the knowledge they already possess (Eisemon 1989). This implies that what is of value in traditional practices, such as certain patterns of intercropping and effective ecologically sensitive methods of pest control, be recognized in textbooks rather than treated as something to be discarded. It also implies that the explanations of the natural world which underlie traditional beliefs be connected to modern scientific explanations whenever this is possible.

In addition, agricultural innovation whether organized through extension agents or through primary school instruction, has tended to be conceived as a hierarchial process, the source of wisdom being government officials. Historically, percolation strategies accompanied by coersion have been effective in introducing and disseminating innovations in cash crop

production. But they have not been as successful in stimulating food production largely because, our study suggests, the skill requirements are higher. Farmer education and the education of future farmers is probably most effectively carried out by farmers themselves. That is, after all, the premise although it is seldom the outcome of the contact farmer scheme which is the basis of agricultural extension. Attempts to utilize community resources to teach agriculture in primary schools in Burundi have been abandoned though this was an object of the 1973 reform. The experience of Tanzania, the Cameroons and many African countries indicates that such efforts appeal more to the imagination than to the realities of program implementation (Bude 1985). Still, community resources can be utilized in other ways; in designing instructional materials for local use, for example. Materials developed for teaching agriculture at the national level, though they may provide for local adaptation, can not adequately recognize the complexity of environmental conditions that exists even in a small country like Burundi. Consideration might be given to decentralizing the development of curriculum materials and soliciting the expertise of farmers in their preparation.

Strengthening the Teaching Agriculture

The teaching of agriculture ranks low in the priorities of school directors and teachers in the schools we studied. We do not, of course, know how widespread these views are, or the extent to which they are shared by school inspectors and other education officials. It is reasonable to suppose that agricultural instruction is generally not felt to be central to the intellectual mission of primary schools, that agriculture is something that most informed people would agree ought to be taught to children in rural areas but that probably impedes more serious studies. Evidence from some African countries, Tanzania and the Cameroons, indicates that a well thought out, well taught program of agricultural and rural science instruction not only supports academic studies but facilitates academic achievement and in doing so, enhances opportunities for secondary education (Freyhold 1979; Bude 1985, 220). That is hardly surprising. However, it may be necessary to justify the intellectual benefits of agricultural education in Burundi since this is counterintuitive for many educators.

The teaching of practical agriculture in primary schools in Burundi is oriented to completing a syllabus that is in most essential respects, repeated for three years. Presumably, age and maturity permit successively deeper treatments of already familiar subject matter. This approach is not designed to stimulate student interest, though it may accurately reflect the purposes of agricultural instruction conceived, simply, as transmission of a set of practical skills that are best mastered through repetition. Such a narrow conception of the purposes of agricultural education makes it difficult to justify its inclusion in the primary school curricula, or to identify what could be accomplished that could not be done as well or better through agricultural extension or through the kind of adult education offered in many Yagamukama schools.

Agricultural education can only be improved and its effects on agricultural production strengthened if its purposes are reconsidered and expanded. Certainly agricultural education should seek to transmit production skills. But what schools can do better than extension services and adult education programs is to transmit a basic scientific knowledge of the natural world and develop capacities to make inferences from this knowledge that enable individuals to assimilate new information and adopt new practices. While this has been recognized in Burundi and in other African countries that have made agricultural education a subject of instruction in primary schools, it has had little impact on the teaching of agriculture. Perhaps the explanation has to do with the importation of the conception and methods of extension work into the design and implementation of agricultural instruction in schools. This is a legacy of some of the recommendations of the Phelps-Stokes report which envisioned primary schooling as having extension functions and using extension methods. Whatever the explanation, a different approach is needed that takes into account the fundamental changes that are taking place in rural Africa. Chief among them are the introduction of a wide range of science based production technologies---agricultural chemicals, fertilizers and new seed varieties. In Burundi, these changes are occuring in the context of declining per capita food production. The rationale for primary schooling adapted to the changing conditions of rural life is more compelling now than in 1973 or at any time during the colonial period. What this implies remains to be carefully thought out.

References

Abernethy, D.B. The Political Dilemma of Popular Education. (Stanford: Stanford University Press, 1969).

Bowman, M.J. Rural People and Rural Economic Development. (Paris: IIEP/Unesco, 1975).

Bude, U. Primary Schools, Local Community and Development in Africa. (Baden-Baden: Nomos Verlagsgesellschaft, 1985).

Bureau of Rural Education (Bureau d'Education Rurale). Fichier du Maitre: Etude du Milieu, 5me annee. (Bujumbura: BRE, 1982).

Bureau of Rural Education (Bureau d'Education Rurale). Guide pratique d'installation et d'entretien d'un jardin scolaire. (Bujumbura: BRE, 1983).

Centre de Perfectionnement et de Formation en Cours D'Emploi (CPF). Etudes de l' ENSEIGNEMENT PRIMAIRE dans le cadre du Developpement Rural. (Bujumbura: CPF, mimeo, 1988).

Dumont, R. False Start in Africa. (New York, Praeger, 1969).

Eisemon, T.O. Benefiting from Basic Education. (Oxford: Pergamon, 1988).

Eisemon, T.O., "Schooling and Creating Capacities for Technological Change," International Review of Education, 1989 (forthcoming).

Eisemon, T.O. and A. Nyamete, "Schooling and Research Productivity in Western Kenya," Journal of East African Research and Development, 1988 (forthcoming).

Eisemon, T.O., E. Ong'esa and L. Hart, "Schooling for Self-Employment: The Acquisition of Craft Production skills in Kenya," International Journal of Educational Development, 1988 (forthcoming).

Eisemon, T.O., V.Patel and S. Ole Sena, "Use of Informal and Formal Knowledge in Comprehension of Instructions for Oral Rehydration Therapy in Kenya," Social Science and Medicine, 25 (1987), 1225-1234.

Foster, P. Education and Social Change in Ghana. (Chicago: University of Chicago, 1965).

von Freyhold, M. Universal Perimary Education and Education for Self-reliance in Tanga. (Eschborn: GTZ Bildungsreport Nr. 10, 1979.

Government of Kenya. Kenya Education Commission Report. (Nairobi: Government Printer, 1964).

Hailey, L. An African Survey. (London: Oxford University Press, 1957).

Heyneman, S.P., "Improving the Quality of Education in Developing Countries," in A. Habte et al eds. Education and Development: Views from the World Bank (Washington: World Bank, 1983). 15-18.

Jamison, D.R. and L. Lau. Farmer Education and Farm Efficiency. (Baltimore, Johns Hopkins, 1982).

Jamison, D.T. and P.R. Moock, "Farmer Education and Farm Efficiency in Nepal: The Role of Schooling, Extension Services and Cognitive Skills," World Development, 12 (1984), 67-86.

Jones, T.J.,ed. Education in East Africa. (New York: Phelps-Stokes Fund, 1924).

Kalirajan, K.P. and R.T. Shand, "Types of Education and Agricultural Productivity," Journal of Development Studies, 21 (1985), 222-243.

Kenya National Examinations Council. "Agricultural Principles and Practices." (Nairobi: KNEC, mimeo, 1984).

King, K. Pan-Africanism in Education. (London: Oxford, 1971).

Leurquin, P.P. Agriculture Change in Rwanda-Urundi 1945-1960. (Stanford: Stanford University Studies in Tropical Development, mimeo, 1963).

Malengreau, G., "Recent Developments in Belgian Africa," in C.G. Haines, ed. Africa Today (Baltimore: Johns Hopkins Press, 1955), 337-356.

Ministry of National Education (Ministere De L'Education Nationale). Fiches Techniques A L'Usage Du Maitre Pour La Preparation Des Lecons De Travaux Pratiques Agricoles. (Bujumbura: MNE, 1983).

Ministry of National Education (Ministere De L'Education Nationale). Etude du milieu: Fichier du maitre 6me. (Bujumbura: MNE, 1984).

Ministry of National Education (Ministere De L'Education Nationale). Rapport Final: Seminaire National De Reflection Sur L'Evaluation Systematique De L'Enseignement Primaire, Bujumbura, 16-21 Mai 1988. (Bujumbura: MNE, 1988).

Ministry of National Education (Ministere De L'Education Nationale). Politique Et Strategies Pour Ameliorer La Qualite De L'Education De Base. (Bujumbura: MNE, mimeo, 1988).

Moris, J.R., "Agriculture in the Schools: The East African Experience," in J.R. Sheffield, ed. Agriculture in African Secondary Schools (New York: African-American Institute, 1976), 39-114.

Mosher, A.T. To Create a Modern Agriculture. (New York: Agricultural Development Council, 1971).

Mosher, A.T. An Introduction to Agricultural Extension. (New York: Agricultural Development Council, 1978).

Ndaruzaniye, G. L'ecole communautaure et l'integration de l'enfant dans milieu. (Bujumbura: Universite de Burundi, memoire, 1978).

Nyambirigi, D. "La kirundisation a l'ecole primaire et l'enseignement du Burundi," (Bujumbura: Universite de Burundi, mimeo, 1983).

Nyerere, J.K., "Education for Self-Reliance," in Freedom and Socialism (Dar Es Salaam: Oxford University Press, 1968), 267-290.

Psacharopoulos, G. and M. Woodhall. Education for Development. (New York: Oxford University Press, 1985).

Schonmeier, H.W. Agriculture in Conflict-The Shambaa Case. (Bensheim: Kubel Foundation, 1977).

Stillman, C.W.,ed. Africa in the Modern World (Chicago: University of Chicago Press, 1955).

United Nations Development Program (PNUD). Le secteur vivrier au Burundi. (Bujumbura: PNUD, 1986).

United Nations Food and Agricultural Organization (FAO). FAO Production Yearbook 1986. (Rome: FAO, 1987).

United States Agency for International Development. Strategy Assessment: Burundi (Bujumbura: AID Field Mission, mimeo,1983?).

Villaume, J.M. Literacy and Agricultural Innovation. (Boston: Harvard University, Ph.D. dissertation, 1977).