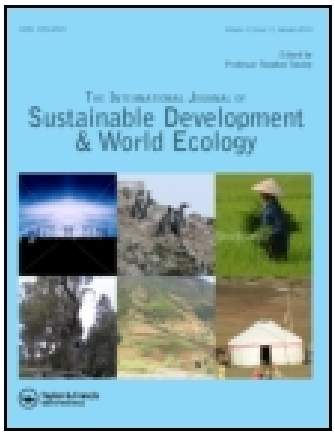

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Geographic shifts in the highland cooking banana (*Musa* spp., group AAA-EA) production in Uganda

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Key words: banana marketing, banana nematodes, banana weevil, banana yield decline, highland banana, Uganda

SUMMARY

Between 1970 and 1990 Uganda witnessed the decline of the highland cooking banana from traditional growing areas in the central region, coupled with crop expansion in the country's southwest. Apprehension that the factors leading to loss of sustainability in the central region may be replayed in extant production areas has raised concern about the future of the cooking banana in Uganda. Consequently, a multi-disciplinary study was conducted at nine central and six southwestern sites to document shifts in cooking banana production and to elucidate the causes behind these shifts.

Cooking banana production in central Uganda sites fell from 18% of total food crop and 7% of total cash crop production in the 1970s to 4% and 2%, respectively, in the 1990s. Farmers identified reduced labour availability and management, increasing pest pressure and declining soil nutrient status as the major causes of decline. On-farm verification confirmed farmers' observations: weevil levels were the highest yet found in Uganda, while foliar samples indicated deficiencies in magnesium, nitrogen, and potassium. Soil nutrient deficiencies, however, appear to be a direct outcome of reduced management rather than 'soil exhaustion' as postulated by farmers.

In southwestern Uganda, the importance of the cooking banana as a cash crop has quadrupled since 1970. Banana first penetrated the region because of its ease of production and stability of yield. High yields attracted traders and urban market demand drove further crop expansion. With current market incentives, banana management standards have been high. Under current levels of management, it is unlikely that farmers in southwestern Uganda will experience a similar process of decline as that which occurred in the central region. However, concern remains about lack of replenishment of nutrients leaving the farm in the form of fruits sold for market, a nutrient loss which may eventually lead to non-sustainability of the cropping system.

INTRODUCTION

The East Africa Great Lakes plateau has evolved as a secondary centre of *Musa* diversity (Stover and Simmonds, 1987) with at least 84 locally evolved, unique clones including cooking (*matooke*) and brewing (*mbidde*) types (Karamura, 1998). These endemic clones have been

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collectively termed the East African highland banana (*Musa* spp., group AAA-EA) (INIBAP, 1986; Karamura and Karamura, 1994; Karamura, 1998).

Highland cooking and beer bananas have been grown in central Uganda from antiquity, from the north-central shore of Lake Victoria to the west bank of the Nile. By the end of the nineteenth century, the Baganda and Basoga tribes around Lake Victoria, the Konjo and Bamba in the Rwenzori region and the Gisu near Mount Elgon were predominantly banana eaters (D. Karamura, pers. comm.). Tribes in the west and southwest were primarily pastoralists and millet growers, although banana cultivation was introduced to these regions in the early 1900s by the appointment of Baganda administrators in these areas (Langlands, 1966; Davies, 1995).

Uganda is the region's primary producer and world's leading consumer of bananas. More than 1.8 million Ugandan farmers grow cooking banana on a total of 640 000 ha of land (Uganda Ministry of Agriculture, 1992). Most production is from small plots (e.g. < 0.5 ha). Cooking banana is the most important staple food in Uganda.

Cooking banana is a key component in both the food security and agricultural sustainability of the region. An extended harvest period ensures food and income throughout the year. Well-managed banana stands may produce stable yields for > 30 years. Highland banana reduces soil erosion on steep slopes and are principal sources of mulch for maintaining and improving soil fertility (INIBAP, 1986).

Yield decline and shortened plantation life were first reported in central Uganda (Iganga, Jinja, Kamuli, Luwero, Mpigi and Mukono districts) in the 1930s (Tothill, 1940). Since the 1960s, accelerated yield decline in this region has led to the replacement of cooking banana with exotic beer bananas (Types AB and ABB) and annual crops.

Between 1970 and 1990, Kampala's indigenous population rose by 750%. Consumer preference, broad banana growing areas, limited local production of competing cereals, and the high cost of imported grain have resulted in cooking banana becoming the leading staple crop in Kampala and other urban centres, and has driven continued market growth for banana (Lynam, 1998).

As cooking banana production declined in central Uganda, high yields continued to be obtained in the country's southwest. Thus, the loss of sustainability in traditional growing areas was accompanied by a westward shift in cooking banana production. Banana cultivation gained hold in southwestern Uganda through replacement of traditional staples (e.g. finger millet) and conversion of pasture to banana plantations for purposes of food security, and in response to market demand.

As a result, cooking banana production is now concentrated in non-traditional growing zones increasingly distant from urban markets, thereby driving up transportation costs (Mugisha, 1994). Currently, 63% of the land given over to cooking banana is found in five districts in southwestern Uganda: Mbarara (20%), Bushenyi (16%), Masaka (11%), Mubende (8%) and Rakai (8%) (Uganda Ministry of Agriculture, 1992). Of these, Mbarara and Bushenyi together supplied 77% of the market in Kampala and 53% in Jinja (Mugisha, 1994). The Mbarara–Bushenyi banana growing area is 240–380 km from Kampala and 310–450 km from Jinja.

As a result, there is concern that the process of banana decline in central Uganda may extend into current production areas, thus calling into question the future of the crop. Such fears were heightened by banana weevil (*Cosmopolites sordidus* Germar) outbreaks in the mid-1980s causing up to 100% yield losses in Masaka and Rakai districts (Sengooba, 1986; Sebasigari and Stover, 1988). Additionally, evidence of early stages of yield decline in Masaka district and the appearance of new pests (*Radopholus similis*, black sigatoka, banana streak virus) further underscore questions of sustainability of the country's preferred staple food.

Since reliable data on banana production dynamics in the 1970s and 1980s do not exist, farmers remain the only source of information on the extent and causes of banana decline in central Uganda, and of crop expansion in the southwest. This study represents a multi-disciplinary effort to document banana production shifts, elucidate the causes of banana decline in the central region, and to compare management systems in central and southwestern Uganda.

MATERIALS AND METHODS

A multi-disciplinary Rapid Rural Appraisal was conducted in 15 villages in areas believed to be undergoing banana production shifts in southern Uganda. Activities included key informant and group interviews, transect drives and on-farm verification of production constraints. Villages were visited between April and July 1995.

Site selection

To document banana production decline in central Uganda, nine villages were selected at random from Iganga, Kamuli, Mukono and Luwero districts using a grid map produced for diagnostic surveys of banana-based cropping systems (Jagtap, 1993; Gold *et al.*, 1994a). Stratification in the area of interest was based on rainfall and market access (Table 1, Figure 1). At least 3 days were spent in each village.

Six sites were selected in Mbarara and Bushenyi districts to elucidate the dynamics of introduction or expansion of cooking banana production in southwestern Uganda. These sites were selected from traditional pasture or millet production areas (Table 1, Figure 1) (cf. National Environment Management Authority, 1996). Four sites had good access to main roads and markets, while 2 sites were remote and inaccessible during the rainy season. Two days were spent in each village.

Key informant interviews

District Agricultural Officers were interviewed about historical trends in crop production within their districts, underlying dynamics and the current status of banana production. Within each village, the local parish council member (LCI) and at least one village elder were interviewed on banana production trends and dynamics.

Group interviews

Group interviews consisted of 25 to 60 respondents representing a cross section of farmers in the village. Informal check lists were used to guide discussions. It was hypothesized that the causes of banana decline in central Uganda included socio-economic factors (labour, market availability and government policies), pests (weevils and nematodes) and declining soil fertility. Banana expansion in the southwest was hypothesized to be market driven.

Table 1 Sites selected for a Rapid Rural Appraisal to document shifts in banana production in Uganda (May–July 1995)

Site	*District*	*Rainy months > 75 mm*	*Market access*
	Central region		
Busembatya	Iganga	6–8	fair
Namugongo	Kamuli	6–8	poor
Bulyangada	Iganga	6–8	fair
Naminage	Kamuli	6–8	poor
Kabanda	Mukono	>8	poor
Busagazi	Mukono	>8	good
Mpoma	Mukono	>8	good
Nakawomero	Luwero	>8	poor
Nakasajja	Mukono	>8	good

Site	*District*	*Traditional land usage*	*Market access*
	Southwestern region		
Biharwe	Mbarara	pasture	very good
Katoma	Bushenyi	millet	good
Buhweju	Bushenyi	millet	poor
Kashaka	Mbarara	pasture	very good
Kagarama	Mbarara	millet	fair
Kabuyanda	Mbarara	millet	poor

Farmers were asked to list all food and cash crops grown in the 1970s (presented as the 'time of Amin') and the 1990s. One farmer then led the group in matrix ranking by allocating beans to indicate relative importance of the different crops (i.e. land area and home consumption patterns for food crops; land area and income for cash crops). The scoring was finalized by group consensus. Farmers were then asked to list and rank causes of banana decline or expansion in their respective regions.

Time lines were drawn to show the timing of shifts in banana importance from the 1950s through the 1990s using the following categories as guidelines:

very low	Banana primarily grown in kitchen gardens or small plots with less than 25 mats.
low	Banana grown in small stands with few farmers having more than 100

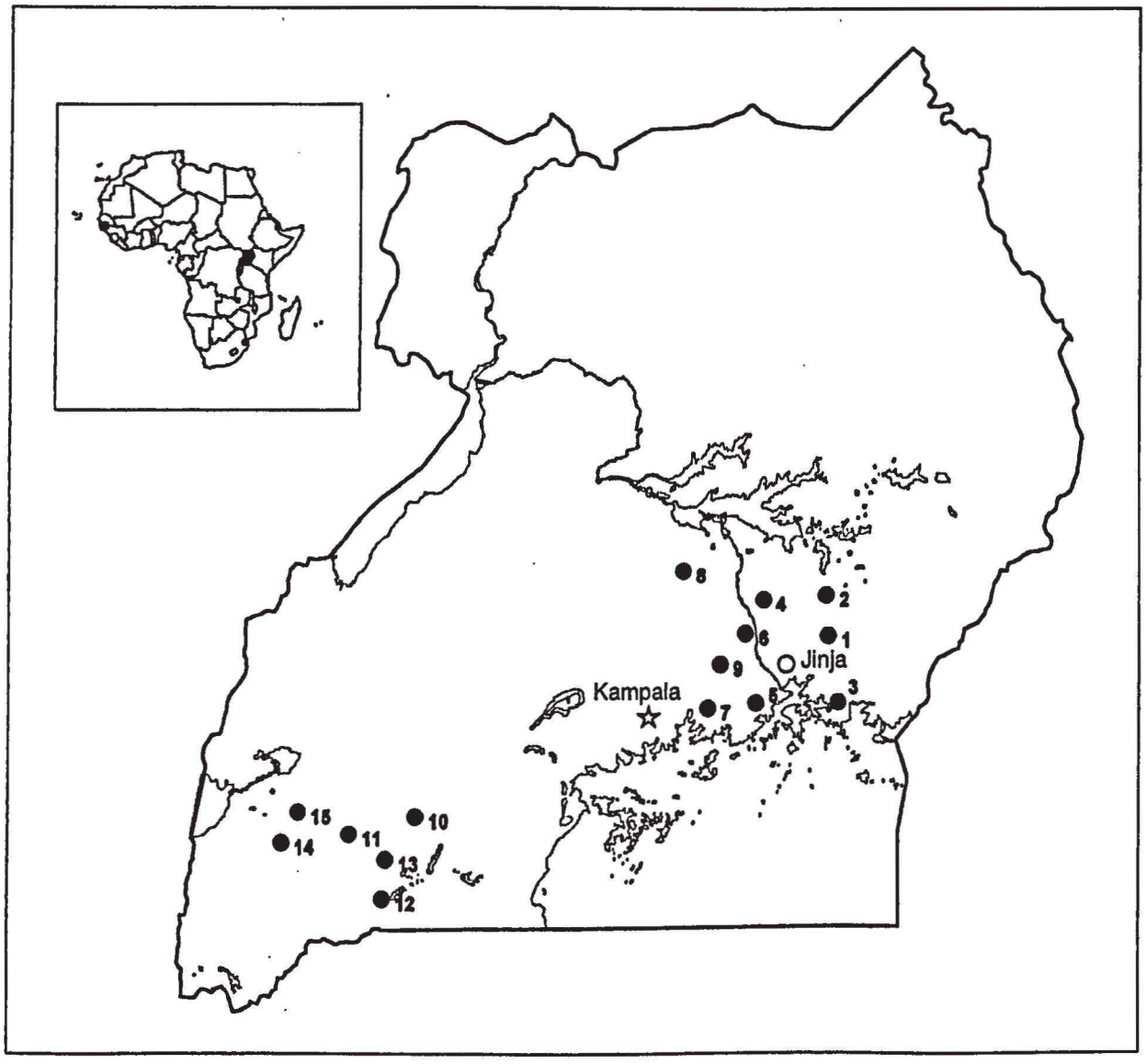

Figure 1 Village sites for studying geographic shifts in highland cooking banana production in Uganda: 1 Busembatya; 2 Namungongo; 3 Bulyangada; 4 Naminage; 5 Kabanda; 6 , Busagazi; 7 Mpoma; 8 Nakawomero; 9 Nakasajja; 10 Biharwe; 11 Katoma; 12 Buhweju; 13 Kashaka; 14 Kagarama; 15 Kabuyanda

mats, productivity low and management attention given low priority.

medium — Banana important but not dominant crop in site with 25 to 50% of farmers growing stands of more than 100 mats. Management attention variable.

high — Banana one of most important crops in village. A majority of farmers had stands of more than 100 mats and management attention given high priority.

very high — Banana the dominant crop in village with most farmers having stands of more than 100 mats and management attention given high priority.

On-farm verification

Factors identified as driving the cycle of banana production decline were verified by case studies of six randomly selected farms per site in the central region. Each farm supported a banana stand more than 2 years old and with more than 50 mats. Selected farms were at least 100 m from

the main road and a minimum of 0.75 km apart. Banana stands on these farms were 0.1 to 4.0 ha and most showed signs of declining production. Farmers estimates of bunch weights were verified by on-farm observations.

(1) *Socioeconomic factors* Farmers were interviewed on current and past size of banana stands, and shifts in resource use and availability (i.e. land, labour, capital inputs) and market access.

(2) *Weevil damage* Weevil damage was assessed for 10 randomly selected, harvested, toppled or dead plants per farm by estimating the percentage of tissue in galleries for two cross-section cuts (the collar and 10 cm below) in the inner cylinder and outer cortex following the methods of Gold *et al.* (1994a).

(3) *Root health* Root health was assessed for 10 recently flowered plants by counting all functional and dead roots in an area (20 × 20 × 20 cm) extending outward from the corm and evaluating levels of root necrosis following the methods described in Gold *et al.* (1994a). Nematodes were extracted from root subsamples for species identification and density estimates.

(4) *Nutrients* Banana foliar nutrients were evaluated on recently flowered plants distant from the homestead (to avoid kitchen garden effects), using the lamina of leaf 3 (cf. Angeles *et al.*, 1993). Samples were sent to the International Centre for Research in Agroforestry (ICRAF) soils laboratory in Machakos, Kenya and analyzed for percentage nitrogen, phosphorus, potassium and magnesium.

RESULTS AND DISCUSSION

Central Uganda – key informant and group interviews

Banana production trends

Farming systems in central Uganda were characterized by high food and cash crop diversity. Villages averaged 12 food and 11 cash crops. The relative importance of primary staples other than banana (i.e. beans, cassava, maize, millet, sweet potato) varied across sites.

Table 2 Shifts in importance of highland cooking bananas at selected sites in central Uganda between the 1970s and 1990s

	Percentage		*Rank*		
Site	*1970s*	*1990s*	*1970s*	*1990s*	*Change*
(a) Foodcrop					
Busembatya	6	2	9	10	–
Namugongo	8	2	6	11	–
Bulyangada	18	8	1	5	–
Naminage	20	4	1	7	–
Kabanda	21	4	1	6	–
Busagazi	30	4	1	6	–
Mpoma	21	4	1	8	–
Nakawomero	11	2	5	8	–
Nakasajja	27	9	1	5	–
Mean	18	4	–	–	–
(b) Cash crop					
Busembatya	4	0	8	–	–
Namugongo	5	0	5	–	–
Bulyangada	14	1	2	11	–
Kitayundwa	8	1	7	10	–
Kabanda	3	5	4	7	+
Busagazi	24	3	2	9	–
Mpoma	0	0	–	–	0
Nakawomero	5	5	8	6	0
Nakasajja	11	3	4	11	–
Mean	7	2	–	–	–

Cooking banana's importance as a staple food crop declined in all study sites between the 1970s and 1990s (Table 2). During this period, banana's share as a food crop fell from 18% to 4%. Six of the nine villages had ranked banana as their leading staple in the 1970s, while in Busembatya, banana had been the leading staple before the 1970s. In two other villages, Namugongo and Nakawomero, banana had been an important though not necessarily the dominant food crop. By the 1990s, banana ranked no higher than fifth as a food crop. In most sites, banana decline began in the 1970s and had continued through the 1990s (Figure 2). Banana production was rated as very low in five sites, low in two sites and medium in two sites.

Cooking banana had been an important cash crop at only two sites (Bulyangada and Busagazi) during the 1970s (Table 2). Overall, cooking banana represented 7% of cash crops grown in

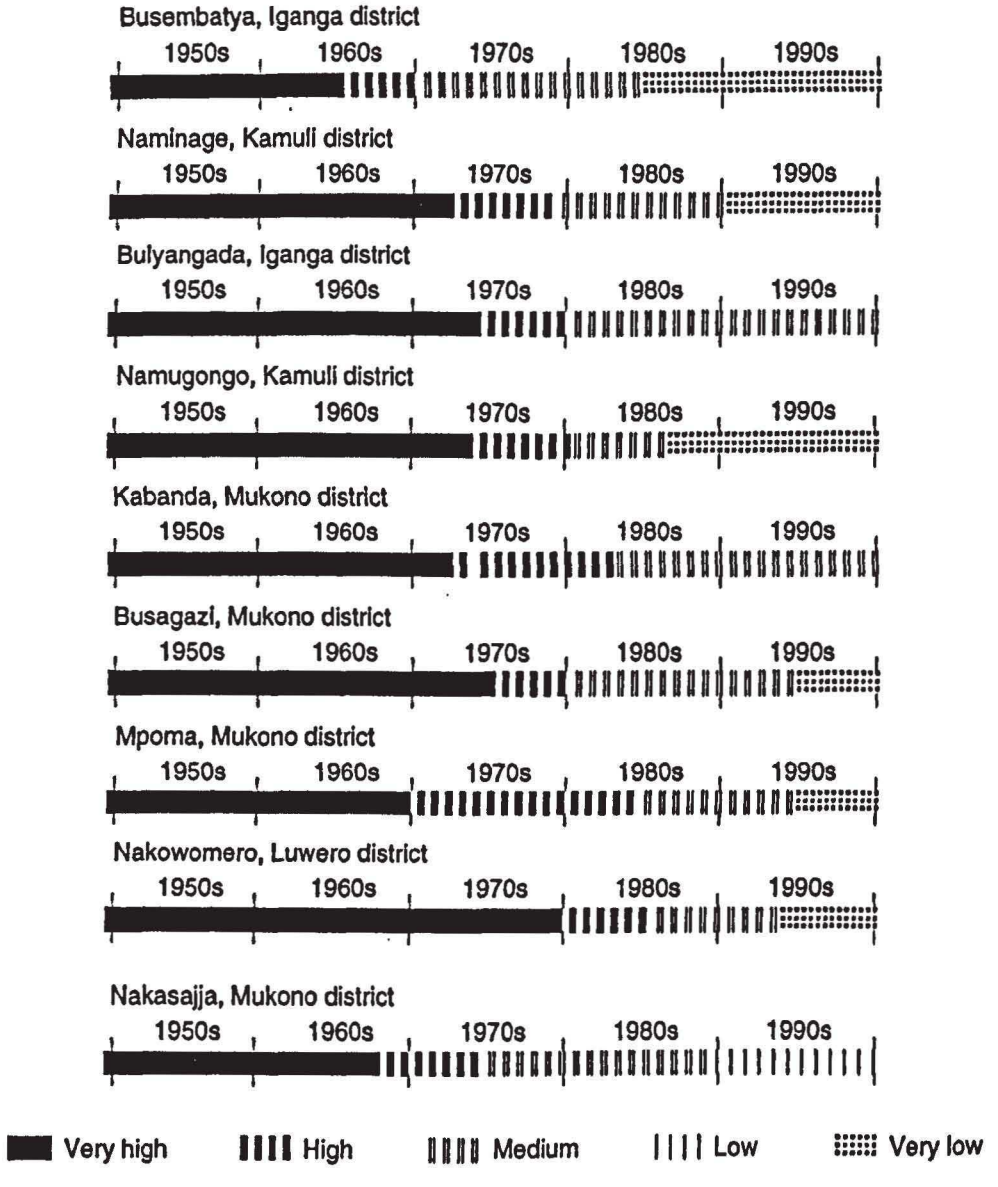

Figure 2 Time lines demonstrating production levels of highland cooking banana at selected sites in central Uganda

the region in the 1970s and only 2% in the 1990s. Unfortunately, declining yields coincided with the period of urbanization in Uganda making it impossible for banana producers in this region to compete for the growing urban market. Thus, banana marketing infrastructure remained poor because the low production could not attract traders.

Shifts in other principal staples

Throughout the region, cooking banana has been replaced by introduced AB and ABB brewing cultivars and by annual crops. For example, brewing banana's share as a cash crop rose from 1% in the 1970s to 13% in the 1990s. Staple crops which gained importance as cooking banana declined included cassava (9% in the 1970s to 15% in the 1990s), maize (10 to 16%), beans (8 to 13%) and sweet potato (10 to 14%).

In the 1990s, cassava was the most important staple crop at five sites (Bulyanganda, Kabanda, Busagazi, Mpoma and Nakasajja), maize at three sites (Busembatya, Namugongo and Naminage) and sweet potato at one site (Nakowomero). Cassava had been the leading staple at Busembatya and Nakowomero, but, in turn, failed following the arrival of African Cassava Mosaic Disease.

Causes of banana decline

Central Uganda is characterized by increasing land pressure, small farms and resource-poor farmers. At the different sites, farmers presented a list of four to nine factors contributing to banana production decline. These included increased pest pressure (listed in all villages, ranked first in seven), reduced management attention (listed in all villages, ranked first in one), declining soil fertility (listed in eight villages), unreliability of rains (listed in eight villages) and land pressure (listed in seven villages). In Mpoma, off-farm employment or trade resulted in reduced management attention for all crops and was ranked as the leading cause of banana decline.

Farmers reported increasing banana weevil pressure during the period of banana decline (although description of symptoms also suggested nematode problems). Most farmers could not offer reasons for increased pest pressure, although some suggested that weevil problems had been aggravated by lack of field sanitation (weeding, deleafing and removal of crop residues).

Reduced management attention was attributed to (1) lack of enforcement of government by-laws; (2) decreased labour availability; and (3) shifted attention to other crops or activities. Prior to the 1970s, government by-laws mandated mulching, field sanitation, rotation and fallowing. However, these by-laws went unenforced during the political turmoil of the 1970s and 1980s.

Concurrent with lax enforcement of by-laws was a worsening labour situation. Until the late 1970s, farmers in the central region had been dependent upon migrant labour from Rwanda or southwestern Uganda for the management of banana stands. At the same time, a large majority of farmers expressed an unwillingness to implement labour-intensive management activities in banana stands with family labour. As the availability of hired labour declined or became more costly, banana management suffered, leading to a continuing cycle of reduced yields, discouragement, shifted allocation of resources to more productive crops and further deterioration of banana.

Farmers further noted that banana was the crop most affected by soil fertility decline. Other (less preferred) crops such as maize, cassava, beans and sweet potato continued to perform well. Despite cooking banana's poor productivity and low market incentive to farmers, it has remained the preferred food (in terms of consumer preference) for the region. As a result, bananas were restricted to the farmers's best land, in spite of their relative low management priority.

Verification: case studies and secondary sources

Village banana production

Transect drives revealed banana production to be very low in three villages (Busembatya, Namugongo, Naminage), low in four villages (Bulyangada, Kabanda, Nakawomero, Nakasajja) and medium in two villages (Busagazi, Mpoma). On study farms, mean stand size declined from 1.1 ha in the 1970s to 0.4 ha in the 1990s. Moreover, yields were poor, with mean bunch weights ranging from 5.3 to 5.6 kg in Busembatya, Namugongo and Bulyangada, and from 7.6 to 8.7 kg in the other sites. Only three study farms had mean bunch weights exceeding 10 kg, and, in general, bunches exceeding 15 kg were rare.

Socioeconomic factors and management

Decline in plantation management, productivity and stand size could be attributed to a number of socioeconomic and institutional factors, ranging from resource availability (declining farm sizes, outward labour flow, declining household incomes) to institutional breakdown (market access, road infrastructure, credit facilities and extension services) in the 1970s and 1980s.

Before the 1970s, banana was mainly produced for subsistence, while coffee and cotton were the predominant cash crops. The necessities of life for the great majority of cultivators were limited and easily met because of lack of exposure to goods and services (Anonymous, 1954a). Both group and case study interviews revealed increased wants after the 1970s as a result of greater penetration of a cash economy (purchased goods and services) into the region which changed household production objectives. The increased demand for cash and diversified income generating activities encouraged redirection of available family resources away from banana systems. Thus, farmers placed greater emphasis on annual food crops (e.g. maize, beans and

Table 3 Marketing of selected crops (metric tons) in Uganda from 1949–1952. (Source: Uganda Department of Agriculture Reports: 1949–1952

Year	*Beans*	*Soybean*	*Gnut*	*Maize*	*Cassava*	*Banana*
(a) Central (Buganda) region						
1949	4117	2584	1321	40 676	–	–
1950	4060	1620	894	21 709	–	–
1951	1657	1002	632	11 536	–	–
1952	1109	47	200	20 362	–	–
(b) Western region						
1949	106	543	1459	573	–	–
1950	250	546	2064	766	–	–
1951	256	309	1491	1386	–	–
1952	135	122	582	978	–	–

–, negligible

cassava) to generate cash, while, in some, communities, men sought higher-paying off-farm employment. At the same time, the decline in coffee prices and degeneration of the cotton marketing system further encouraged production of annual crops in the region.

In addition to providing quicker returns, some annual crops (e.g. maize), unlike banana, had their market well established prior to the 1970s (Table 3) (Anonymous 1951, 1952, 1953, 1954b). Market growth for maize had been encouraged by its industrial nature (i.e. being processed into flour or animal feeds). This was particularly true in central Uganda, which produced 42 000 of the country's 49 000 metric tons of marketed maize in 1948 (Killick, 1950). Sixty percent of this maize was exported to neighbouring countries. Food preferences of migrant labour also led to increases in local demand for maize in the central region (Killick, 1950). In contrast, there was little local demand for cooking banana (most consumers grew their own) and market growth was limited by the small African population living in the country's urban areas. Persistence of banana in the farming systems was attributed to its long established importance in the diet and culture of the Baganda (Killick, 1950).

Despite increased household expenditure, farm incomes declined in the 1970s because of poor crop prices and decreasing farm sizes. Low farm incomes made farmers reluctant to invest in higher cost/higher productivity methods, as recommended by Parish (1969) for improved banana production. Small-scale farmers are often risk aversive in conditions where crop prices are low, and where assistance with credit and inputs is absent; in such cases, farmers avoid investment in improved production techniques (Lele, 1989). This was the case for central Uganda, where farmers chose to invest in crops such as cassava, sweet potato and beans, with low labour demand (Bagamba, 1994) and short maturation periods. In contrast, banana had a long development time (18 months) and its reduced plantation life (average of 4 years) increased labour costs, making the crop uneconomical.

Throughout the region, farmers reported reduced labour availability resulting from outward migration of unskilled labour. Before the 1970s, central Uganda was the country's primary centre of production for coffee and cotton. This production attracted cheap outside labour from as far away as southwestern Uganda, Rwanda, Burundi and West Nile (Rutabajuka, 1996). Rutabajuka (1996) also attributed labour migration to central Uganda to the British colonial policy of promoting uneven development of regions, by the central region was favoured for agricultural and industrial development.

Following independence, the collapse of the colonial structure was accompanied by improvement in the economic situation in the country's southwest, making the opportunity cost of migrant labour to the central region higher. This change reversed the labour flow between the country's southwest and central regions. Urban growth at the centre also attracted more people from the farming community. With the

withdrawal of cheap labour, there was pressure put on family labour to produce both food and cash crops.

Farmers opted to reallocate labour away from banana to less labour-intensive, or more profitable, crops such as cassava and maize. Specifically, farmers reported lower levels of desuckering and deleafing (5 sites), mulching and manuring (5 sites), weeding (9 sites), sanitation (8 sites) and soil conservation (3 sites) in banana stands. This reduced cultivation led to a continuous cycle of decline, as reduced management led to even lower yields. Thus, banana production costs increased such that labour cost/output ratios of 28.2 Uganda shillings/kg and 15.8 shillings/kg for central and southwestern Uganda, respectively (Bagamba, 1994). The higher labour/output ratio for banana production in central Uganda (Bagamba 1994) suggests that farmers exhibited rational behaviour in reducing both crop area and management.

Pests

Banana weevil damage levels on study farms were the highest yet found in Uganda (Table 4): the mean level of damage at each of the nine sites exceeded that of any diagnostic survey site (Gold *et al.*, 1994b) and was nearly three times the country-wide average. Data from on-station yield loss studies suggest that the damage levels found at study sites may represent a 20% yield loss from attack in a single cycle and up to 60% yield loss if this level of attack is sustained over four cycles (Rukazambuga 1996; Rukazambuga *et al.*, 1998).

Banana weevil problems in central Uganda were probably exacerbated by reduced standards in crop management. It has been postulated that stressed bananas in poorly managed fields are most susceptible to banana weevil attack (Wallace, 1938; Ostmark, 1974; Jones, 1986). However, field surveys and on-station trials in Uganda indicate that increasing weevil pressure more likely reflected abandonment of management practices (e.g. sanitation) directly affecting the weevil, rather than to changes in host plant condition (Rukazambuga, 1996; Gold *et al.*, 1997).

Assessment of root health suggested that nematodes also contributed to yield decline at study sites. Root number was 40% lower while root necrosis was 50 to 100% higher than national means suggesting potential yield losses of 20 to 40% (Speijer pers. comm.). Moderate levels of *R. similis* (mean 1100/100 g roots) and *Heliocotylenchus multicinctus* (mean 9000/100 g roots) were present at survey sites.

Table 4 Weevil and nematode damage sites of cooking banana production decline in central Uganda (June–July 1995)

	% *Weevil damage*[1]		% *Root health*[2]		
Site	*Inner*	*Total*	*Roots*	*Dead*	*RI*
Busembatya	8	8	10.4	22	15
Namugongo	13	14	11.3	20	19
Bulyangada	12	11	10.1	21	11
Naminage	8	9	8.8	22	11
Kabanda	10	10	10.6	13	9
Busagazi	11	11	11.5	10	5
Mpoma	8	8	10.5	17	10
Nakowomero	8	9	11.7	11	6
Nakasajja	9	9	10.7	18	12
Mean	9.7	9.9	10.6	17.1	11.0

[1]Harvested plants; [2]Recently flowered plants

Soils

Critical nutrient values established for dessert bananas (*Musa* AAA) have shown wide variability, reflecting the broad range of environmental conditions under which the studies were done. Angeles *et al.* (1993) summarized the values taken from 26 such studies and used these data to determine Diagnosis and Recommendation Integrated System (DRIS) norms (Table 5a). DRIS is a method of determining critical nutrient values as a function of nutrient relationships. The DRIS norms for banana closely reflected the mean or reported critical values for all nutrients and nutrient relationships except for those involving potassium (Angeles *et al.*, 1993) More recently, Wortmann *et al.* (1994) provided DRIS values for highland banana in Tanzania (Table 5a).

DRIS analysis of foliar data collected from the nine central Uganda survey sites suggest that magnesium was deficient at all sites and was the key constraint in the region, while banana stands were deficient in potassium (6 sites) and in nitrogen (5 sites) (Table 5b). Farmers at these sites have postulated that their soils have become 'exhausted' during the last 25 years, and that this has been a primary cause of banana stand

Table 5 Banana nutrient requirements (A) and foliar nutrient levels (B) of highland cooking banana (cmol/kg) at selected levels sites in central Uganda (June–July 1995) with data for 1968 and 1995 (C)

	N	*P*	*K*	*Mg*	*Mg×K*	*DRIS deficiency*
(A) Clone						
Highland DRIS Norm (AAA-EA)[1]	3.15	0.25	3.04	0.48	1.46	
Dessert DRIS Norm (AAA)[2]	3.04	0.22	4.49	0.41	1.82	
Dessert Average (AAA)[2]	3.02	0.23	3.40	0.33	1.13	
(B) Site						
Busembatya	2.89	0.27	3.90	0.25	0.98	Mg, K
Namugongo	2.69	0.22	4.07	0.24	0.96	Mg
Bulyangada	2.60	0.17	3.61	0.32	1.28	Mg
Naminage	3.01	0.24	3.60	0.33	0.99	Mg, K
Kabanda	2.43	0.31	3.97	0.32	0.98	N, Mg, K
Busagazi	2.46	0.25	4.15	0.26	0.99	Mg, N
Mpoma	2.61	0.23	3.50	0.28	1.18	Mg, K, N
Nakowomero	2.82	0.24	3.29	0.30	0.99	Mg, K, N
Nakasajja	2.52	0.27	3.46	0.30	1.07	Mg, K, N
(C) Central Region						
1968[3]	2.88	0.21	2.77	NA	NA	
1995	2.62	0.25	3.61	0.28	1.05	

NA: not available; [1]Source: Wortmann *et al.* (1994); [2]Source: Angeles *et al.* (1993) (average represents mean value of 26 studies); [3]Source: Parish (1969)

decline. This evidence raises questions as to whether or not: (1) the soils in central Uganda are more nutrient poor than other regions in Uganda not reporting banana decline; and (2) nutrient status in Central Uganda has declined since 1970.

The country-wide soil survey completed in 1960 indicated that nutrients were well correlated with soil organic carbon and that phosphorus and potassium levels were found to be adequate for most crops (Chenery, 1960). Magnesium values were 'trace' to 4.0 cmol/kg in the central region compared to 0.6 to 7.5 cmol/kg in the west. The historical data for the sites used in the central region in this (i.e. 1995) study, magnesium levels were 0.3 to 3.4 cmol/kg with adequate base saturation at all sites. The critical value for magnesium was given as 0.5 cmol/kg. Soils were generally low in magnesium, although sufficient at most sites for crop production.

Historical data on banana foliar nutrient levels in central Uganda are limited. Parish (1969) reported yields of 20 tons/ha as common, suggesting (at reported spacing of 4.5 m and density of 3 plants/mat) bunch weights of more than 20 kg. Parish characterized many banana stands as 'well maintained on a self-mulching basis', thereby providing excellent weed and soil erosion control. He also provided foliar nutrient status for nitrogen, potassium and phosphorus from a survey of 60 farms in the 'Buganda region' of central Uganda (Table 5c). Parish described levels of nitrogen and phosphorus as 'marginally low', while potassium was 'very low' and a major constraint to yield.

Thus, foliar nutrient deficiencies appear to have been present in the central region prior to the onset of banana decline. Nevertheless, the results suggest that farmers were correct in their assessment that diminishing soil fertility (in particular, magnesium) has contributed to lower banana yields. However, the relative contribution of nutrient deficiencies and pest pressure to low yields could not be assessed in this study.

Although continuous harvesting of banana probably resulted in a net removal of nutrients from banana stands, it is unlikely that the rate of 'soil exhaustion', as described by farmers, could explain a decrease in banana bunch weights from 20 kg (20 ton/ha/yr) in 1968 to 5 to 9 kg (5.5 to 10 tons/ha/yr) in 1995 (McIntyre pers. comm.). Additionally, banana decline was also reported on farms abandoned (i.e. in fallow) during the political instability of the 1970s and mid-1980s.

Thus, it appears that problems associated with reduced management, rather than soil exhaustion from overcropping, were primarily responsible for banana decline in central Uganda. Low levels of nitrogen and potassium have most likely resulted from reductions in mulching or organic amendments and from discontinuation of soil conservation practices. Finally, the satisfactory performance of annual crops indicates that banana is a heavy feeder, especially of nitrogen and potassium, and suggests agreement with farmers observations that it only performs well on better soils.

Southwestern Uganda – key informant and group interviews

Farming systems in southwestern Uganda were also characterized by diversified farming systems, with an average of 10 food and 9 cash crops. The importance of primary staples other than banana (i.e. beans, cassava, maize, millet and sweet potato) varied across sites.

Banana production trends

Traditionally, millet had been the leading staple crop in southwestern Uganda, with much of the grasslands kept as pasture for raising livestock. Banana, originally relegated to kitchen gardens, first gained importance in Biharwe in the 1940s, in Katoma and Kabuyanda in the 1950s, in Kashaka in the 1960s and in Buhweju and Kagarama in the 1970s.

By the 1970s, banana was the first or second most important staple crop in four of the six study sites (Table 6). Only in the two remote sites, Buhweju and Kabuyanda, was banana relatively unimportant at that time. Currently, banana is the leading staple crop in all study sites. Overall, banana's share as a food crop rose from 20% to 26%.

Marketing of banana had increased dramatically throughout the region. During the 1970s, banana was important as cash crop in a single site (Katoma) and not marketed at all in three sites (Table 6). By the 1990s, banana was the leading cash crop at all four sites with good market access, while of only moderate importance as a cash crop at the two remote sites, Buhweju and Kabuyanda. Overall, banana share as a cash crop rose from 6% to 27%.

Table 6 Shifts in importance of highland cooking bananas at selected sites in southwestern Uganda between the 1970s and 1990s

	Percentage		*Rank*	
Site	*1970s*	*1990s*	*1970s*	*1990s*
(a) Food crop				
Biharwe	20	23	2	1
Katoma	23	25	1	1
Buhweju	5	26	7	1
Kashaka	29	35	1	1
Kagarama	28	30	1	1
Kabuyanda	12	19	4	1
Mean	20	26		
(b) Cashcrop				
Biharwe	0	28	–	1
Katoma	24	25	2	1
Buhweju	0	26	–	3
Kashaka	2	35	6	1
Kagarama	0	27	–	1
Kabuyanda	7	12	7	4
Mean	6	27		

In the 1970s, Buhweju had little market for any of its agricultural production. More recently, it had developed a speciality market for peas. In contrast, Kabuyanda had access to an alternative market for beans and maize in Kabale. In both sites, infrequent and sporadic visits of traders made cooking banana a moderate risk crop. Therefore, farmers rely more on highland beer bananas for gin (*waragi*) production because of its longer shelf life. Beer bananas ranked second and third as a cash crop in Buhweju and Kabuyanda, respectively.

Time lines show banana crop expansion in southwestern Uganda during the same period that banana was declining in the central region (Figure 3) with increased production under way in five sites during the 1970s. By the 1990s, production was described as high (1 site) or very high (5 sites).

Shifts in other principal food and cash crops

Increase in banana production as a food crop began before the 1970s and was primarily at the

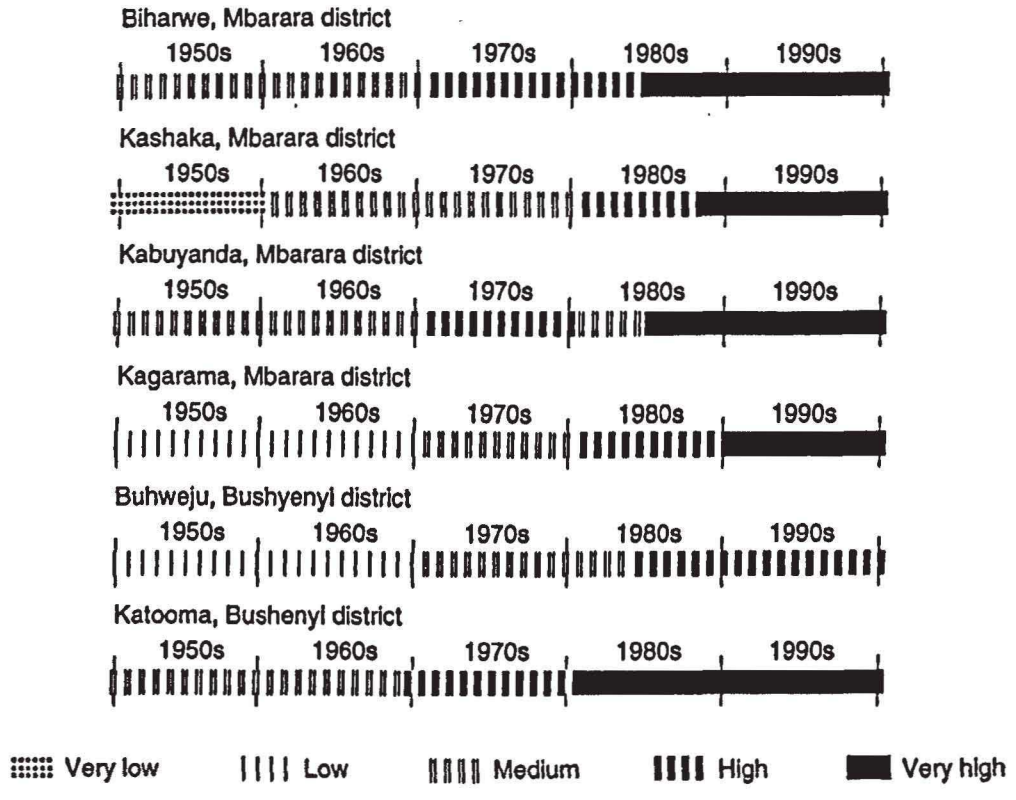

Figure 3 Time lines demonstrating production levels of highland cooking banana at selected sites in southwestern Uganda

expense of finger millet. Millet declined in importance at survey sites from 19% in the 1970s to 11% in the 1990s. There was virtually no change in beans and cassava at any site. Maize production showed a major decline at two sites (Biharwe, Buhweju) and a large increase at two other sites (Kagarama, Kabuyanda), while sweet potato production declined overall from 11% to 7%.

Since 1970, banana expansion in the region was primarily as a cash crop (Table 6). In some cases, banana out-competed and replaced other cash crops. At other sites, expanding markets encouraged increases in total crop acreage, accomplished by planting in pasture lands or fallow fields. For example, Buhweju responded to improved market access by increasing production of seven cash crops.

Coffee had been the major cash crop of the region prior to the 1970s, but had largely disappeared by the 1990s because of unfavourable marketing policies. Other cash crops, including exotic beer bananas, beans, groundnut, maize, millet, onions, peas, sorghum and tomatoes, had distinct marketing patterns for each site, but no generalizations could be made.

Causes of banana expansion

Southwestern Uganda is characterized by a mixture of commercial growers and resource-poor farmers. In the 1960s, all study villages served as sources of migrant labour for banana stands in central Uganda. These workers returned with 'banana culture' which eventually gained favour over the traditional staple of millet due to ease of production and preparation and greater stability of yield. High yields coincided with the emergence of urban markets whose demand drove further crop expansion. Marketability of the crop also resulted in banana receiving greater management attention. In contrast to central Uganda, farmers in the southwest employed solely their own labour for banana management and have developed a relatively high standard of agronomic practices.

Management and constraints

At most sites, farmers reported their yields as 'better than ever'. Field observations indicated that bunch weights of 20 kg to more than 40 kg were common in all study villages. Although

management varied between farms, standards were, in general, high, and much more intensive than found in central Uganda. On almost all farms, a density of 3 or 4 plants per mat was maintained through frequent desuckering. Most farmers regularly deleafed (i.e. cut older leaves) their plants to reduce wind damage and remove adult weevils, and chopped harvested pseudostems (seen as a weevil breeding site); these materials were then spread as mulches. Additionally, many (i.e. 20 to 100%) farmers in Kabuyanda, Kagarama, Biharwe, Kashaka and Buhweju imported swamp grass for mulch, added manure and/or planted grass bunds for erosion control in banana stands.

Earlier surveys suggested that weevil levels in this region were low (less than 3% damage to the central cylinder) (Gold *et al.*, 1994b), while nematode populations were dominated by *Pratylenchus goodeyi*, a less damaging species than *R. similis* which predominated in the central zone (Kashaija *et al.*, 1993). Still, pest management practices were more consistently implemented than in the central region, in part, as a preventative measure against weevil outbreaks. A majority of farmers in Kagarama, Biharwe, Kashaka and Buhweju uprooted harvested corms (also considered breeding grounds for weevils), while 40% of the farmers in Biharwe, and nearly all farmers in Kashaka, also trapped weevils. Although most farmers in Kabuyanda and Katooma were aware of recommended cultural controls against banana weevil, few practised them.

In five sites, farmers remained enthusiastic about banana production and projected continued high levels of management, high yields and further increases in banana acreage. Here, farmers were most concerned about market saturation. Only in Katooma, was the future of banana uncertain. Farmers in this site believed that banana production would soon decline because of increasing land pressure, weevil damage, toppling and disease problems.

CONCLUSIONS

Highland cooking banana has been the primary staple food in central Uganda since antiquity. Its local name *matooke* is synonymous with food. Since the 1970s, there has been a clear geographic shift in cooking banana production from its traditional growing areas in central Uganda to the country's southwest. This shift entails higher transportation costs to satisfy the country's, growing urban market.

In addition, the central region of Uganda may be ecologically more suitable for banana production than much of the southwest. Banana does best with rainfall well distributed over the year, mean monthly temperatures of 26–30 °C, and deep, well-drained loams with high humus content (Purseglove, 1985; Stover and Simmonds, 1987). Central Uganda has annual rainfall of 1000–1500 mm/yr with ≥ 9 months with ≥ 75 mm, while the southwest averages 500–1250 mm, with 6–8 months with ≥ 75 mm (Jagtap, 1993; Hutchinson *et al.*, 1995).

Western Bushenyi contains volcanic soils which are among the most fertile in Uganda. Otherwise, the soils in the banana growing zones are mostly ferralitic/ferrasols, with those in the central zone being fertile friable clay loams, while those in the southwest are highly weathered sandy and sandy–clay loams (National Environment Management Authority, 1996). Nevertheless, under favourable conditions, high yields have been obtained in both regions.

The leading cause of cooking banana decline and disappearance in central Uganda appears to have been reduced management attention brought on, in part, by changes in labour availability. High levels of pest pressure and soil nutrient deficiencies, present in the region, were most likely associated with reductions in management.

Banana management in central Uganda was primarily dependent upon cheap outside labour. As labour became scarcer and more costly, management attention declined. The general effect was poorer crop husbandry and inability to deal with crop stresses (e.g. cultural control of pests, maintenance and restoration of soil fertility). The overall process resulted in diminished yields, non-marketable bunches, a shifting of management attention to other crops and replacement of cooking banana by exotic beer bananas and/or annual crops.

The potential to restore banana production in central Uganda is unclear. The Ugandan National Banana Research Programme has identified Luwero district as a benchmark area, with the goal

of increasing banana production in areas of severe decline. A major constraint at this site remains farmer unwillingness to commit family labour to labour-intensive management practices (e.g. mulching, weeding, crop sanitation). Nevertheless, soil and weed management (e.g. feasibility studies with fertilizers and herbicides) should be the first entry point for such an effort and the most likely area for immediate impact. Weevil and nematode management would be the second priority.

In contrast, cooking bananas gained entrance into southwestern Uganda between the 1940s and 1970s, and became widely accepted because of their ease of production and preparation. Increasing urban market demand, coupled with high productivity levels, attracted traders to the region; thus, market forces drove further intensification of production. Unlike in central Uganda, farmers give high priority to bananas, prefer to employ family labour (rather than casual workers) in banana stands, and believe that management standards are higher than ever before. Field observations confirm widespread high levels of management in study villages. Therefore, it is unlikely that the accelerated process of banana decline will reoccur in this area.

However, long-term crop sustainability in southwestern Uganda may be affected by increased population and land pressure and/or the steady erosion of nutrients leaving the farm in the form of fruits and peels. Few farmers replenish these nutrients in the form of mulches or other soil inputs. Soil depletion may eventually, in turn, influence pest levels and host plant tolerance to pest attack. Therefore, soil depletion may be the first indicator of production problems in this region. Finally, the effects of new diseases (black sigatoka, banana streak virus) on banana production remain unknown.

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