Economic Development Inititatives

ADOPTION OF SUPERIOR BANANA VARIETIES IN THE KAGERA REGION: accomplishments and constraints

Prepared by Joachim De Weerdt

On behalf of KCDP

E.D.I. Ltd
P.O. Box 393
Bukoba
Kagera Region
Tanzania
Tel/fax: +255 (028) 2220059
E-mail: research@edi-africa.com

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LIST OF ABBREVIATIONS

BADC	Belgian Administration for Development Co-operation
ERB	Economic Research Bureau
ITC	International Transit Centre
INIBAP	International Network for the Improvement of Banana and Plantain
KCDP	Kagera Community Development Programme
PMO	Prime Minister's Office
RCO	Regional Commissioner's Office
SBV	Superior Banana Varieties

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1 KEY FINDINGS AND RECOMMENDATIONS

The Kagera Community Development Program (KCDP) has been importing, multiplying and massively diffusing Superior Banana Varieties (SBV) in the Kagera Region of Tanzania between March 1998 and March 2003. In a sample of 177 households in seven different zones 29% of the surveyed households were found to be SBV adopters. Some zones, like the Muleba Highlands and Biharamulo East have few adopters, while the Northern Lakeside has many.

On average, the data show that non-adopters have younger household heads, less owned and rented cultivated land, less cattle and less education than adopters.

It is found that farmers in all zones, except the Karagwe Highlands, face serious banana shortages, especially in the beginning and end of the year. This suggests that SBV still have a large potential in the region.

Non-adopters are found to be primarily constrained by lack of information on the qualities of SBV, how to grow them and where to get them. Manure, land and labour constraints play a secondary role, although they can be high in certain zones, most notably in Biharamulo West and Ngara North where one quarter or more of the farmers report a lack of manure restraining them from growing SBV.

Depending on the specific zone, the key areas for future intervention identified in this report are:

- Continuing information diffusion on the qualities and husbandry of SBV.
- Guaranteeing the availability of SBV planting material in areas where indirect diffusion cannot cope with demand.
- Providing extension work on banana husbandry in general (both for SBV and local varieties).
- Assuring sustainable access to manure.
- Creating efficient markets so overproduction can be translated into income.

It is advised that research continues to be conducted, particularly to assess the impact of the programme on the food security and income situation within the region, while also gaining insights in the mechanisms of indirect diffusion (i.e. from farmer to farmer).

2 INTRODUCTION[1]

Banana[2] is a staple food crop for about 1.2 million people in the Kagera Region of North-western Tanzania and exclusively produced by smallholders. These farmers also generate cash income from the sale of banana bunches and derived products (especially the local banana brew) within and outside the region. Banana production has declined over the past decades due to pests, diseases and declining soil fertility. To offset this trend, the governments of the United Republic of Tanzania and the Kingdom of Belgium initiated a *Propagation and Diffusion of Superior Banana Plants* project in 1997/1998, which involves the introduction, testing and mass distribution of Superior Banana Varieties (SBV). These varieties are high yielding and show different levels of tolerance to most of the banana pests and diseases. This project is a component of the Kagera Community Development Programme (KCDP) being executed in the region to alleviate poverty.

In August/September 2002 a household survey was conducted in seven different villages, each one representing a different zone in the Kagera Region. This paper provides background on the impact of the project, its accomplishments and the constraints farmers still face to adoption.

Section 3 gives an overview of the Kagera Region and its banana industry. Section 4 presents the KCDP project and the SBV they have been diffusing. In Section 5 the survey set-up, its objectives and the seven survey zones are presented. Section 6 describes the general characteristics of the sample of farmers. It gives details on demographics, education, wealth and agricultural activities. Section 7 analyses adoption rates per zone, the different channels through which SBV are diffused, the husbandry practices employed by the farmers and the uses of SBV. Section 8 tries to gain insights into the different constraints that are still restraining farmers from adopting SBV. Section 9 concludes and presents recommendations for this or similar projects, for other actors and for possible follow-up surveys or other surveys similar to this one.

[1] The first three sections are largely based on Gallez, Runyoro, Van den houwe, Machiels and Swennen (2001).

[2] Bananas are divided in three classes: (i) traditional banana varieties, being the East African Highlands Bananas (AAA group); (ii) exotic banana varieties introduced in the 1960's; (iii) Superior Banana Varieties (SBV) introduced in the region by KCDP.

3 THE BANANA INDUSTRY IN THE KAGERA REGION

The Kagera Region lies in North-western Tanzania, bordering Uganda in the North, Rwanda and Burundi in the West and the Tanzanian regions of Kigoma and Shinyanga in the South. In the East, the Kagera Region shares Lake Victoria with Mwanza and Mara Regions. The region occupies about 39,168 square kilometres, of which about 27% is covered by water.

In 2001 the population of Kagera was estimated at 1.8 million distributed over 360,000 households (RCO, 2001). Its average population density is about 50 persons per square kilometre, above the national average of 35 persons per square kilometre. The population density varies significantly from one zone to the other, with some areas being uninhabited and others having a population density of up to 200 people per square kilometre. The GDP per capita in the Kagera Region for 1998 was estimated at US$ 110 per capita, far below the national average of US$ 171.

It is estimated that over 95% of the households in the Kagera Region are involved in small-scale agriculture, with banana, bean and coffee cultivation being the main agricultural activities. Most of the cultivated bananas are East African Highland Bananas (AAA subgroup), and consist of over 50 varieties that have been grown traditionally for centuries. Since the 1960's their yield started to decline due to pests (especially nematodes and weevils), diseases, adverse weather conditions and deterioration in soil fertility. It is estimated that banana yields fell from ten tons per hectare to about four tons per hectare. Farmers in the affected areas started to turn to root and cereal crops as alternative staple foods.

In the 1960's exotic banana varieties such as Gros Michel (AAA group) and Pisang Awak (ABB group) were introduced into the Kagera Region to remedy the situation. These varieties were adopted mostly around and close to the shores of Lake Victoria in the districts of Bukoba and Muleba. The exotic varieties differ much in taste and other culinary aspects from the East African Highland Bananas. In recent years, it has been demonstrated that these exotic varieties are succumbing to banana pests and diseases, especially to the Panama disease (*Fusarium Oxysporum* sp.).

4 SUPERIOR BANANA VARIETIES (SBV)

The *Propagation and Diffusion of Superior Banana Plants* project was initiated in 1997/1998 with the mandate to introduce SBV for multiplication and diffusion to farmers in the Kagera Region. These varieties had to have tolerance to one or various combinations of the major banana production constraints, which are nematodes, weevils, Panama disease, black sigatoka, low soil fertility and drought. The new bananas had also to be appealing to farmers and consumers, especially in terms of bunch weight, cycling and taste of raw fruit and derived products.

The KCDP banana project has been in operation for five years and ends in February 2003. The target of the project is to have one million suckers of SBV in the farmers' fields throughout the region at its end (PMO/BADC, 1997). By July 2001 about 71,000 *in vitro* plants from 25 different varieties had been imported to the Kagera Region. The International Transit Centre (ITC) of the International Network for the Improvement of Banana and Plantain (INIBAP) based at the Catholic University of Leuven, Belgium supplied these plants. They were shipped in small batches and hardened in a nursery near Bukoba from where they were supplied to field multiplication centres throughout the region for further multiplication. By September 2002 KCDP and its primary collaborators had distributed a total of 420,000 suckers to farmers in 344 villages representing 57% of all villages in the region. Each sucker planted is expected to produce approximately two new suckers every year, which the farmers can either plant in their own fields or diffuse further to other farmers. This process is known as indirect or farmer-to-farmer diffusion. Taking into account this multiplication effect it is fair to suggest that KCDP has more than exceeded its target of one million new suckers disbursed into the region.

5 THE SURVEY ZONES AND SET-UP

In August/September 2001 a first pilot survey was administered in seven villages in the Bugabo division of Bukoba Rural District. The findings of this survey can be found in Gallez *et al.* (2001). Later, in August/September 2002 KCDP administered a larger scale survey to represent the whole Kagera Region. The survey had the following objectives:

- To determine the degree of SBV adoption and its geographical spread in the seven socio-economic zones of the Kagera Region.
- To ascertain which categories of farmers have adopted SBV and which farmers have not.
- To disentangle the different constraints that are restraining non-adopters to grow SBV (environmental constraints, information constraints, input or capital constraints, etc...).
- To recommend strategies to improve the targeting and efficiency of this or similar projects.
- To recommend follow-up surveys and similar research and impact assessment efforts.

To sample households, the region was first divided in seven different geographical zones as identified in existing literature and from the project's own understanding of the region. One village was chosen to represent each zone. The villages were carefully selected on the basis of their characteristics:

- Villages should not lie at the periphery of a zone
- They should be easily accessible to the interviewers
- They should have had sufficient KCDP intervention.

Within each village households were sampled randomly using the route method, which involves walking a random route through the village and picking households at desired intervals. In each village five percent of the total number of households were interviewed giving a total of 177 observations across all zones. The name of the village, the number of households sampled and the characteristics of each zone are described in **Table 1**.

Table 1: Zone Characteristics and Number of Sampled Households

Zone	Description	Name of the Sample Village	Total Number of Surveyed Households
Muleba Highlands	Mainly Haya tribe Banana is the preferred staple food High population density Intensive farming system largely dependent on bananas Local varieties are still doing well because of good banana husbandry Good marketing possibilities for bananas	Kafunjo	20
Biharamulo East	Mainly Sukuma, Subi, Rongo, Sumbwa and Waha tribes Low population density Dry area, mainly growing annual and root crops Poor banana husbandry Some marketing possibilities for bananas	Kabindi	18
Biharamulo West	Mainly Zinza and Subi tribes High population density Favourable conditions for banana growing Good banana husbandry Poor marketing possibilities for bananas	Katoke	24
Ngara South	Mainly Shubi tribe (similar to Warundi) Dry area with a farming system that does not depend much on bananas Poor banana husbandry Poor marketing possibilities for bananas	Rulenge	45
Ngara North	Mainly Hangaza tribe (similar to Wanyarwanda) Little dependence on banana growing (more than Ngara South) Poor banana husbandry Poor marketing possibilities for bananas	Mukarehe	24
Northern Lakeside	Mainly Haya tribe Banana is the preferred staple food Farming system largely dependent on bananas Severely affected by declining soil fertility and banana pests Excellent marketing possibilities for bananas	Kiilima	16
Karagwe Highlands	Mainly Nyambo tribe Banana is the preferred staple food Low population density Farming system dependent on bananas Local varieties still perform well because of excellent soil fertility Poor marketing possibilities for bananas	Mabira	30
ALL			177

6 GENERAL CHARACTERISTICS OF THE SURVEYED HOUSEHOLDS

This section looks at the general characteristics of the sample and analyses its

- demographics and education
- wealth in terms of durable goods and consumption
- land size and livestock holdings
- agricultural activities and income

6.1 Demographics and Education

Table 2 shows that households consist of between 1 and 14 individuals, with the mean lying at 5.7 individuals per household. The ages of the household heads are distributed between 22 and 90, with the mean lying at 45 years. 12 percent of the sampled households is headed by a female member.

Table 2: Demographic Characteristics of the Surveyed Households

Variable	Mean	Min.	Max.
No. of Adults (Persons Older than 15 Years) per Household	2.7	1	11
No. of Children Between 5 and 15 Years Old per household	1.8	0	7
No. of Children Under 5 Years Old per Household	1.1	0	5
Total No. of Persons per Household	5.7	1	14
Age Household Head	45	22	90

In studies on adoption of new crops, education often comes out as an important factor. Frequently the education of the head of the household is used as an indicator. However within the household, education may be a public good. For example, even if the head is not literate, a leaflet or instructions left by the extension officer can still be read to him by other household members. In general, the household is likely to be able to benefit from the education of its most educated member. Therefore it is also useful to consider the level of education of the most educated household member as an indicator.

Table 3 indicates that in the sample about one quarter of all heads cannot read, but that 86% of all households have at least one member who has completed primary education.

Table 3: Education within the Surveyed Households

Variable	Percent
Head is able to read and write	74
Some member in the household has completed primary education	86

6.2 Wealth in Terms of Durable Goods and Consumption

The survey contains questions that capture wealth in terms of daily consumption and the possession of durable goods. Not all types of durable goods and consumption have been probed for, but by attaching weights to responses on questions on meat and sugar consumption, the possession of oil lamps and means of transport and by assessing the quality of the housing it is possible to construct an index that proxies for consumption and possession of durable goods. The relevant questions, the frequency of each response and its relative weight in the index are listed in **Table 4**.

The wealth index was constructed by summing up the scores on each response. Next, the population was divided into three approximately equal[3] groups on the basis of their wealth index: the poor class (having an index of zero or one), the middle class (having an index of two or three) and the rich class (having an index higher than three).

The results based on this index should be treated with caution and two important caveats are in order when interpreting the them. First, it would have been better to get different poverty indicators for different zones, as correlates to poverty may differ across them. Second, even so the way any wealth index is constructed is quite arbitrary, as there are no rules to guide how to attach weights to the different categories. Giving different weights to the same categories, might yield different results. The final recommendations will suggest that in subsequent surveys consumption and durable goods be measured in value terms (in TZS) so that a more confident analysis can be made. For the purpose of this paper the wealth index will only be used as a very rough approximation of wealth. Other indicators of wealth that have been measured in a more reliable way in the survey are land size and livestock holdings.

[3] because of the large number of households with an index of zero or one it is impossible to construct groups of exactly equal size.

Table 4: Wealth in Terms of Durable Goods and Consumption

Question	Answer	Frequency of Response (%)								Score in Wealth Index
		Muleba High-lands	Bihara-mulo East	Bihara-mulo West	Ngara South	Ngara North	Northern Lakeside	Karagwe High-lands	ALL	
How many times did the household consume meat in the last week?	Not at all	30	19	46	41	33	93	47	43	0
	Once	35	44	38	34	46	0	33	34	1
	Twice or more	35	38	17	25	21	7	20	23	2
Did the household consume any sugar in the past week?	No	30	50	71	70	70	67	70	63	0
	Yes	70	50	29	30	30	33	30	37	2
Does the household possess and use an oil lamp?	No	50	76	88	73	83	73	53	71	0
	Yes, but cannot afford kerosene all year round	15	6	8	11	17	27	40	18	1
	Yes and can always afford kerosene all year round	35	18	4	16	0	0	7	11	2
Does the household own any means of transport?	No	53	50	71	61	83	73	63	65	0
	Bicycle	47	50	29	39	17	27	30	34	1
	Motorbike	0	0	0	0	0	0	7	1	2
Quality of housing (assessed by interviewer based on building materials used and size compared to number of inhabitants)	Not good	10	28	38	58	54	80	20	41	0
	Good	50	56	63	33	42	20	73	48	1
	Very good	40	17	0	9	4	0	7	10	2

6.3 Land Size and Livestock Holdings

Table 5 shows that there are large differences between the zones in terms of the amount of land that households own. Land is most scarce in the Northern Lakeside and most abundant in the Karagwe Highlands. In addition to livestock holdings being unequally spread between the zones, the average livestock value also differs dramatically, with values in Biharamulo East being eight times higher than that in the Northern Lakeside.

Table 5: Area of Cultivated Land and Value of Livestock Holdings

Zone	Mean Acres of Owned Cultivated Land	Mean Acres of Rented Cultivated Land	% of Households Owning Indigenous or Dairy Cows	Average Value of Livestock* Holdings (in TZS)
Muleba Highlands	1.8	0.3	30	96,540
Biharamulo East	1.9	0.2	22	278,589
Biharamulo West	2.0	0.1	8	66,892
Ngara South	2.1	0.2	24	135,053
Ngara North	1.9	0.3	8	44,530
Northern Lakeside	1.5	0.5	13	35,038
Karagwe Highlands	2.7	0.1	30	100,547
ALL	2.0	0.2	20	109,258

* all livestock, including cattle, goats, sheep, pigs, chicken, ducks, etc...

Although land and livestock holdings are good indicators of wealth in the Kagera region, means per zone may be misleading. Livestock is not only spread unequally across the zones, but also across households within each zone. For example, Biharamulo East has the highest average livestock value, but only 22% of the households own cows. Because cows constitute by far the largest share in the total livestock value, most of the wealth in terms of livestock will be shared among the 22% of households owning them. Consider too that indigenous and dairy cows are the most important source of manure, which is an important input for growing bananas. Thus in all seven zones 80% of the farmers have little to no livestock holdings and do not have direct access to manure. The higher incidence of rented land in areas such as Northern Lakeside highlight the problems of land scarcity here.

6.4 Agricultural Activities and Income

6.4.1 Agricultural Activities

The survey provided data on the most important crops grown by each household. **Table 6** shows the percentage of households growing crops in each of eight categories. It can be seen that bananas are grown by 100% of the farmers in Northern Lakeside and by 72% and 75% of the farmers in Biharamulo. Like bananas, beans and maize are grown by nearly all households across the region. Overall the table shows that beans are more widespread than bananas, with 97% of all respondents highlighting them as opposed to 88% for bananas. Coffee is grown by most farmers in the Muleba Highlands, the Karagwe Highlands and the Northern Lakeside, but by only a very small number in Ngara and Biharamulo. Tubers are grown throughout the region. They serve as an alternative staple to bananas, but note that many households in the Karagwe Highlands do not consider them to be main crops. Fruits and

vegetables are grown as main crops by 55% of the farmers of the whole sample. In the Muleba Highlands less farmers than average grow fruits and vegetables. Other cereals or pulse are grown by about half of the farmers, with Muleba and Bukoba being far below average. Except for coffee, some of the more innovative farmers also grow other non-food cash crops like vanilla or tobacco. The Northern Lakeside has a more than average percentage of farmers growing these crops.

Table 6: Agricultural Activities per Zone: For Each Category the Percentage of Households Reporting that One of Their Main Crops is from this Category

Zone	Percent							
	Banana	Beans	Maize	Coffee	Tubers	Fruit or Vege-tables	Other Cereals or Pulse*	Other Non-food Cash Crops**
Muleba Highlands	100	100	75	80	95	25	5	5
Biharamulo East	72	100	94	33	83	50	50	6
Biharamulo West	75	96	100	13	100	63	63	4
Ngara South	82	98	80	7	93	62	60	4
Ngara North	96	100	79	8	100	79	50	0
Northern Lakeside	100	88	69	81	94	63	25	13
Karagwe Highlands	97	97	80	97	37	37	60	3
ALL	88	97	82	41	85	55	49	5

* pulse excluding beans, which because of their importance have been included as a separate category
** mainly vanilla or tobacco

The above table should be treated with care as it was left to the interpretation of the farmer to mention which six crops were most important to him. It is felt that the data for bananas, beans, maize and coffee are quite reliable as the interviewer is likely to have probed for them specifically should the farmer have left them out. Data on fruits, vegetables, tobacco and vanilla are probably less representative of the zone.

6.4.2 Agricultural Income

Table 7 shows the average income from each crop category. The averages are taken across all farmers in the zone, including the ones that do not grow the crop. Thus they give an impression of the *absolute* zone wide importance of each crop category in the generation of income. In between brackets underneath the average income it is indicated which percentage of the total income each crop category constitutes. Per row (zone) these percentages add up to one hundred. They draw a picture of the *relative* importance of each crop category to the generation of agricultural income in each zone. Absolute and relative importance may be different. For example, in Biharamulo West, banana income is not so large in absolute terms at TZS 3,946, but important in relative terms, as it constitutes 48% of total agricultural income. In

Biharamulo East, the absolute income derived from bananas is much higher in absolute terms, but lower in relative terms, compared to Biharamulo West.

Table 7: Sources of Agricultural Income in the Past Three Months (Expressed in TZS and Averaged over all Households in the Zone, i.e. Both Growers and Non-growers)

Zone	TZS Earned in the Past Three Months (Percent of Total Agricultural Income Between Brackets)								
	Banana	Beans	Maize	Coffee	Tubers	Fruit or Vege-tables	Other Cereals or Pulse*	Other Non-food cash crops*	ALL
Muleba Highlands	11,930 (47%)	0 (0%)	0 (0%)	8,427 (41%)	400 (2%)	0 (0%)	0 (0%)	0 (0%)	20,757 (100%)
Biharamulo East	8,978 (32%)	208 (1%)	556 (2%)	4,122 (15%)	350 (1%)	5,667 (20%)	2,333 (8%)	5,944 (21%)	28,158 (100%)
Biharamulo West	3,946 (48%)	67 (1%)	175 (2%)	300 (4%)	1,050 (13%)	2,288 (28%)	0 (0%)	333 (4%)	8,158 (100%)
Ngara South	636 (7%)	789 (8%)	344 (4%)	20 (0%)	3,931 (40%)	1,169 (12%)	2,893 (30%)	0 (0%)	9,782 (100%)
Ngara North	367 (12%)	563 (19%)	304 (10%)	667 (22%)	208 (7%)	0 (0%)	896 (30%)	0 (0%)	3,004 (100%)
Northern Lakeside	4,213 (40%)	0 (0%)	0 (0%)	5,874 (56%)	375 (4%)	0 (0%)	0 (0%)	0 (0%)	10,461 (100%)
Karagwe Highlands	1,873 (6%)	5,380 (17%)	1,737 (6%)	15,490 (49%)	310 (1%)	2,687 (9%)	4,100 (13%)	0 (0%)	31,577 (100%)
ALL	4,563 (29%)	1,001 (6%)	445 (3%)	4,986 (31%)	946 (6%)	1,687 (11%)	1,460 (9%)	897 (6%)	15,985 (100%)

* pulse excluding beans, which because of their importance have been included as a separate category
** mainly vanilla or tobacco

The first column of **Table 7** shows that the Muleba Highlands, the Northern Lakeside and Biharamulo derive most income from bananas, both in absolute and relative terms. In the Northern Lakeside coffee is slightly more important. It can be seen that in the Karagwe Highlands 97% of the farmers grow bananas, but it constitutes only a minor share of their agricultural income.

Care should be taken, however, when interpreting the results as only income in the three months prior the interview was probed for. This means that any seasonal fluctuations are not taken into account. Crops which mainly generate income in a period other than the three months recall period will be underrepresented. Crops with income concentrated during the recall period will be overstated. The same caveat as was mentioned concerning **Table 6** applies here also. Farmers were asked to mention their six most important crops and it is not clear how they assessed which crops were

important and which were not. It would be advisable to probe for each crop separately in future surveys.

It should be stressed again that the figures in **Table 7** are averaged across all households sampled in the zone. This is especially important when interpreting the figures for zones where only a few households grow the crop. For example in Biharamulo East only six percent of the farmers grow other non-food cash crops like tobacco (see **Table 6**). Still the zone-wide average income is TZS 5,944. This means that income must be very high for these six percent farmers to pull the zone wide average up to this number.

It can be seen that in Karagwe Highlands many households grow bananas. They are however very difficult to market in this zone, therefore they only constitute six percent of the total agricultural income. Coffee, beans, fruits, vegetables, cereals and pulse are more important in this zone. The high income from coffee in this zone is likely to be due to informal cross-border trade to Uganda. Note that both zones in Ngara also have very low average incomes derived from bananas.

6.4.3 Consumption and Income from Bananas

Table 8 gives data on consumption of and income from bananas. Farmers were asked how many meals of bananas they had out of the 14 meals a week. Responses vary from only four meals in Biharamulo to all but one meal in the Karagwe Highlands. On average across the sample half of the meals have bananas as a staple. The next column shows how many farmers derived some income from the sale of bunches and banana beer. On average, nearly half of the farmers derived some income from bananas in the three weeks prior to the interview. In Muleba 70% of farmers derive income from bananas, but in Ngara South and the Karagwe Highlands only just over one third. The last two columns of **Table 8** indicate that on average about 40% of banana income is generated from selling bunches and 60% from processing the local banana beer '*rubisi*'. These figures vary quite significantly across the seven zones. Especially in Ngara zones, nearly all banana income is generated from the sale of beer, while in Muleba Highlands and Northern Lakeside, most of it is through the sale of bunches.

Table 8: Consumption of and Income from Bananas

Zone	Average Amount of Banana Meals Eaten (Out of 14 Meals a Week)		% of Villagers who Derived Income from Bananas in the Past three Weeks	Sources of Banana Income %	
	No.	percentage		Sale of Bunches	Sale of Banana Beer
Muleba Highlands	12	86	70	84	16
Biharamulo East	4	29	50	55	45
Biharamulo West	4	29	50	40	60
Ngara South	7	50	36	14	86
Ngara North	5	36	54	8	92
Northern Lakeside	6	43	56	78	22
Karagwe Highlands	13	93	37	23	77
ALL	7	50	47	41	59

The balance between income derived from sale of bunches and sale of beer gives an idea of the marketing possibilities of bananas. Areas with good marketing possibilities will derive most of their income from the sale of bunches, while areas without marketing possibilities will produce beer to sell on the local market. Note that farmers in the Karagwe Highlands are hardly able to sell bunches. Still the abundance of bananas becomes apparent from the fact that they have nearly two banana meals every day.[4] Again, this points out the inefficiency of the marketing system in this zone.[5] The situation in the Karagwe Highlands is opposite to that in the Northern Lakeside, where banana yields have been deteriorating fastest. Still the proximity to Bukoba town gives easy access to the local market and transport across Lake Victoria to other regions. This seems to incite many farmers to sell bananas and eat cheaper staples instead. Farmers in the Muleba Highlands are able to combine both sale and consumption of bananas. Here farmers derive a sizeable income from banana production and at the same time continue eating their preferred staple every day.

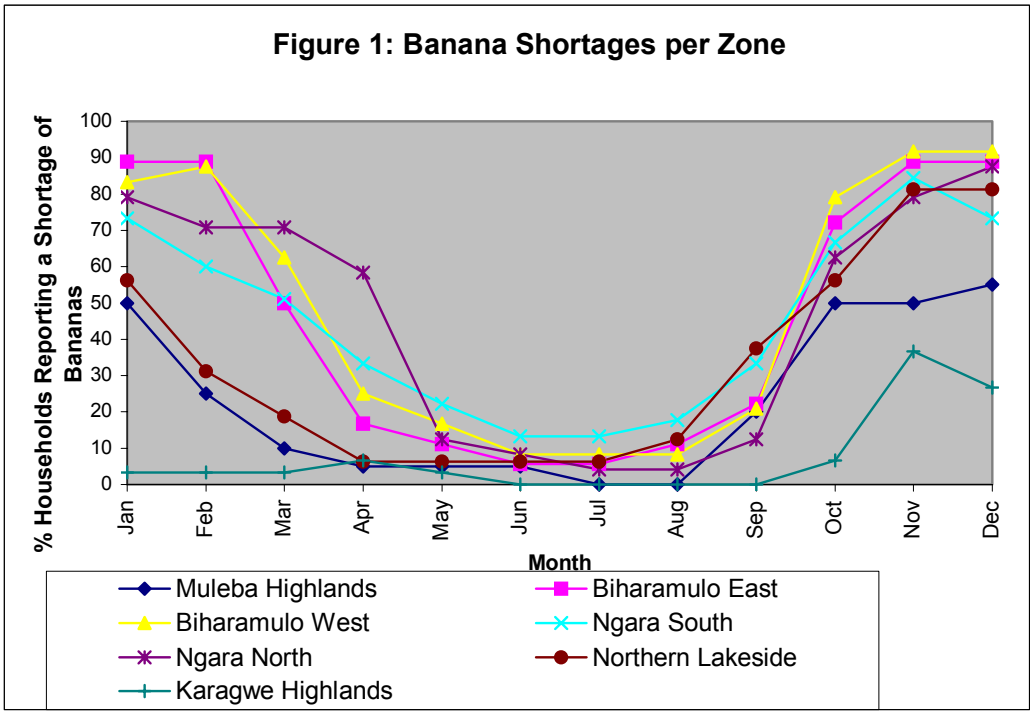
[4] For the Muleba Highlands, Karagwe Highlands and Northern Lakeside it can be assumed that the preferred staple food is banana.

[5] Research conducted in November 2002 shows that on average there is overproduction of 80% of the consumption requirements within Karagwe District (Barnett, 2002)

6.4.4 Banana Shortages

Banana yields are prone to seasonalities, which are quite similar across all zones. **Figure 1** plots the percentage of households that report a shortage of bananas for each month. Note that even though the pattern of the banana shortage is very similar across zones (all lines, have the same shape), the scale of the shortage is not (some lines lie far below others). Only Karagwe and, to a lesser extent, the Muleba Highlands remain with ample bananas during the lean season compared to other zones. In the Karagwe Highlands farmers are least affected by banana shortages.

Figure 1: Banana Shortages per Zone



7 ADOPTION, DIFFUSION, HUSBANDRY AND USES OF SBV

This section present statistics on adoption, diffusion, husbandry and final usage of SBV. The statistics are presented for all adopters per zone. For the Muleba Highlands and Biharamulo East there are only one and two adopters in the sample respectively. This is too few to come to any general conclusions about all the adopters in the zone. The figures on adoption *rates* remain valid however.

7.1 Adoption of SBV

The first column of **Table 9** describes adoption rates[6] in each zone visited. SBV are grown by 29% of the households, but adoption rates vary considerably from zone to zone, from 5% in the Muleba Highlands to 100% adoption in the Northern Lakeside. The bottom row indicates that most farmers are relatively new adopters: 75% of all the suckers were planted in 2001 and 2002, with only 18% planted during 2000.

Table 9: Adoption Rates and Timing

Zone	No. of Adopters	Annual Percentage of the Total No. of SBV Planted					
		'97	'98	'99	'00	'01	Jan-Sep '02*
Muleba Highlands	1 (5%)	0	0	0	0	100	0
Biharamulo East	2 (11%)	0	0	0	0	0	100
Biharamulo West	5 (21%)	0	0	1	8	23	68
Ngara South	11 (24%)	0	0	11	39	38	11
Ngara North	9 (38%)	0	0	0	1	36	64
Northern Lakeside	16 (100%)	4	3	7	21	59	6
Karagwe Highlands	6 (20%)	0	0	0	0	99	1
ALL	29	1	1	5	18	50	25

* note that this is before the main planting season.

There are some limitations to generalising these adoption rates. First, villages within the zone were not randomly sampled. One of the characteristics they needed to have to be eligible for inclusion was having a high degree of KCDP involvement. This is expected to bias the numbers upwards. The village in the Northern Lakeside was one of the pilot villages and it is unclear how this may have influenced adoption rates. It is, however, likely that there is not full adoption in the Northern Lakeside, although adoption rates are expected to be very high here. Third, in Biharamulo East a village was sampled with little KCDP intervention.[7] Adoption rates in this zone may in fact be higher.

SBV have a cropping cycle of 14 to 16 months. This implies that in the initial years the program had to focus primarily on obtaining the suckers and carrying out the multiplication process at their own nursery in Bukoba. The Northern Lakeside was

[6] Although the concept of 'adoption rate' may be defined in several ways, for the purpose of this report it is taken to be the percentage of farmers who have planted at least one SBV sucker in their field.

[7] Before the commencement of the survey Kabindi village was split up into two parts. One part was called Rukola village and the other part kept the original name Kabindi village. Most of the suckers that had gone to the (old) Kabindi village, had gone to the part that after the split-up became Rukola and not to the part which kept the name Kabindi. Because the KCDP diffusion file correctly stated these suckers to have gone to (old) Kabindi, the (new) Kabindi was sampled instead of Rukola.

then given first priority for receiving the suckers, as this zone was worst affected by declining banana yields. This can be seen in **Table 9**: the Northern Lakeside started adopting two years earlier than the other zones. Also the other annual percentages of SBV planted reflect when the program had started distributing on a larger scale in that zone.

Note that the average number of suckers planted in 2002 is relatively low, because the main planting season (October/November) was yet to come at the time of the survey (August/September). Had the survey been administered at the end of 2002, it is expected that this would be higher.

Table 10 gives an indication of the extent to which farmers in each zone have adopted. In absolute terms the average amount of SBV stools per adopter is highest in Ngara, the Karagwe Highlands and the Northern Lakeside. The second column shows the number of traditional and exotic stools the adopters own on average. Note the high number of stools in Muleba and Karagwe and the low number of stools in Biharamulo West and the Northern Lakeside. From the last column it can be seen that SBV represent on average only eight percent of all banana plant varieties within households who have had some level of SBV adoption. Biharamulo West has the highest extent of adoption at 17% with the Muleba Highlands close to 0%.

Table 10: Extent of Adoption

Zone	Average No. of SBV Stools per Adopter	Average No. of Traditional and Exotic Stools per Adopter	Average Share of SBV in Total No. of Banana Plants
Muleba Highlands	3	2095	0 %
Biharamulo East	11	1375	2 %
Biharamulo West	10	652	17 %
Ngara South	53	821	13 %
Ngara North	45	1280	5 %
Northern Lakeside	26	563	8 %
Karagwe Highlands	43	2122	3 %
ALL	35	1048	8 %

7.2 Diffusion of SBV

Table 11 shows from which source the farmers obtained SBV suckers. This can be either through direct diffusion from the KCDP agents or through indirect diffusion from farmer to farmer.

Table 11: Sources of SBV Suckers

Zone	Source of Suckers (As a % of all SBV Suckers Planted on the Farm)		
	KCDP	Other Farmers	Own Stools
Muleba Highlands	100	0	0
Biharamulo East	100	0	0
Biharamulo West	83	0	17
Ngara South	89	2	8
Ngara North	92	8	0
Northern Lakeside	72	16	12
Karagwe Highlands	100	0	0
ALL	85	7	8

After about one year a planted sucker will start producing other suckers that can be diffused further by the farmer. As each stool will yield an average of two suckers per year, the potential scale of farmer-to-farmer diffusion (to either a third party or to himself) grows exponentially year after year. This process has advanced most in the Northern Lakeside, where SBV have been around for the longest. Here 28% of the suckers do not come directly from KCDP any more, but have been diffused indirectly by the farmers themselves. In villages where SBV have only been recently introduced the scope for farmer-to-farmer diffusion is of course currently limited, but also here, just as in the Northern Lakeside, indirect diffusion is likely to increase over the years as more suckers become available.

7.3 Banana Husbandry

In general SBV have not been planted as an alternative to traditional and exotic banana varieties, but rather in additional to them. About half of the farmers plant SBV in between their existing banana crops, 22% opened new land and 28% substituted existing stools or other crops with SBV.

74% of the farmers say that after planting SBV the total number of banana stools (traditional, exotic and SBV) has increased, 4% say it has decreased and 22% say it has stayed the same.

In the whole sample only three farmers had stopped growing some variety of SBV, either because they had been attacked by panama disease (one farmer mentioning FHIA-02 and FHIA-03) or because the yields were not satisfactory for him (two farmers mentioning AAcv Rose, Cardaba and Pelipita).

Table 12 - Table 14 give further information about banana husbandry of SBV compared to traditional and exotic varieties. It should be noted that adopters in

Biharamulo West, Ngara North, Northern Lakeside and Karagwe Highlands use a lot more manure on their SBV compared to the traditional and exotic varieties. Differences in the use of compost and mulch are less pronounced except that farmers in the Northern Lakeside use more manure and farmers in Ngara North more mulch on SBV compared to other varieties.

Table 12: Use of Manure on SBV and Traditional/Exotic Varieties

Zone	% of Adopters Reporting Use of Manure on SBV			% of Adopters Reporting Use of Manure on Trad./Exotic Varieties		
	Yes on All	Yes on Some	Not at All	Yes on All	Yes on Some	Not at All
Muleba Highlands	0	50	50	0	50	50
Biharamulo East	0	0	100	0	0	100
Biharamulo West	20	60	20	0	60	40
Ngara South	18	36	45	18	27	55
Ngara North	44	33	22	11	11	78
Northern Lakeside	19	25	56	6	31	63
Karagwe Highlands	17	67	17	0	50	50
ALL	22	37	41	8	31	61

Table 13: Use of Compost on SBV and Traditional/Exotic Varieties

Zone	% of Adopters Reporting Use of Compost on SBV			% of Adopters Reporting Use of Compost on Trad./Exotic Varieties		
	Yes on All	Yes on Some	Not at All	Yes on All	Yes on Some	Not at All
Muleba Highlands	0	50	50	0	50	50
Biharamulo East	0	0	100	0	0	100
Biharamulo West	0	60	40	0	60	40
Ngara South	0	18	82	0	27	73
Ngara North	0	33	67	0	33	67
Northern Lakeside	19	63	19	6	56	38
Karagwe Highlands	0	33	67	0	33	67
ALL	6	41	53	2	41	57

Table 14: Use of Mulch on SBV and Traditional/Exotic Varieties

Zone	% of Adopters Reporting Use of Mulch on SBV			% of Adopters Reporting Use of Mulch on Trad./Exotic Varieties		
	Yes on All	Yes on Some	Not at All	Yes on All	Yes on Some	Not at All
Muleba Highlands	0	0	100	0	0	100
Biharamulo East	0	50	50	0	50	50
Biharamulo West	0	40	60	0	40	60
Ngara South	18	9	73	18	9	73
Ngara North	22	11	67	0	11	89
Northern Lakeside	0	50	50	0	50	50
Karagwe Highlands	0	33	67	0	33	67
ALL	8	29	63	4	29	67

It is felt that the greater use of manure for SBV compared to traditional varieties derives from Kagera farmers' observations of the need for higher intensive care for the 'new' agricultural products that have been introduced. Over the years they have seen dairy cows, laying hens, vanilla, etc... coming in to the region. All of these need extra care. Therefore it is not surprising that SBV are also cared for better. There seem to be differences across zones and it is unclear why this is the case. One possible explanation could be that the advise on SBV given by the village extension officers varies from one zone to the other.

Again, it should be kept in mind that the data on the Muleba Highlands and Biharamulo East are based on only one and two observations respectively, therefore prudence should be used in taking them as representative of the whole zone.

7.4 Uses of SBV

In the three weeks prior to their interviews, 15 adopters (i.e. 29% of the adopters or 8% of the complete sample) harvested a total of 81 bunches of SBV. This is too little to allow a split-up of SBV usage per zone.[8] Across all zones just over 50% of the SBV bunches were for home consumption, 25% were processed into the local banana beer, 12% were sold and the remainder were used as gifts or to pay wages of casual labourers. Traditional and exotic varieties were used exactly in these same proportions. These figures therefore show that across the sample there was no difference in how farmers use SBV compared to other varieties.

Although twice as many bunches are sold than are processed into banana beer, it should be mentioned that about 60% of banana income is derived from beer production and only 40% is from sale of bunches (see **Table 8**). This gives an idea of how much value a farmer can add to a bunch by processing it into beer.[9]

[8] Because of the few observations on SBV harvests, it was also necessary to exclude from the analysis some other questions from the questionnaire, which were meant to compare SBV with other varieties.
[9] Using the above figures a processed bunch would yield a 75% higher income than an unprocessed bunch.

8 CONSTRAINTS TO ADOPTION OF SBV

This section discusses the constraints that farmers in the Kagera region face for the adoption of SBV bananas. Given the data available in the survey, two approaches have been used to gain an insight in this question. First, all the 126 non-adopters in the survey were probed for the reason why they did not adopt SBV. This gives an immediate, but self-reported answer to the question. Second, the characteristics of adopters to those of non-adopters can be compared.

8.1 Self Reported Constraints

The survey probed non-adopting farmers for three different categories of constraints: information constraints, supply constraints and input constraints. Each is discussed in turn. It is clear that as there are no non-adopters in the sample from Northern Lakeside, they cannot be included in the statistics.

8.1.1 Information Constraints

Information constraints have shown to be by far the most important, as can be seen from the first part of **Table 15**. First, 20% of the non-adopters report they were held back by lack of information about how to grow SBV. These are mostly farmers who fear that SBV needs a distinct type of husbandry, different from other varieties and they do not possess these skills. Especially in the Muleba Highlands, Biharamulo East and the Karagwe Highlands this constraint is prominent. Second, 15% of all non-adopters do not know where to get SBV suckers or do not know which procedure they should follow to obtain them. This percentage ranges from zero in Biharamulo West and Ngara North to over one quarter in the Karagwe and Muleba highlands. Finally, 12% of the farmers are not aware of the existence of SBV. This percentage is particularly high in the Muleba Highlands and Ngara South. In total 47% of the reasons given relate directly to a lack of information by the farmer, with the percentages being very high in the Muleba Highlands (69%) and the Karagwe Highlands (68%) and relatively low in Biharamulo West (16%) and Ngara North (26%).

8.1.2 Supply Constraints

Supply constraints were the least self-reported constraints to adopting SBV. **Table 15** shows that supply constraints constituted 8% of the reported constraints. These were farmers who wanted to plant, but did not get any suckers or got them in a season which was not suitable for planting. The constraint did not feature in Biharamulo West and was highest in the Karagwe Highlands.

Table 15: Self-Reported Constraints to Adopting SBV (% of Non-adopters Reporting the Constraint)

Reason for not Adopting SBV	Muleba Highlands	Biharamulo East	Biharamulo West	Ngara South	Ngara North	Karagwe Highlands	ALL
INFORMATION CONSTRAINTS							
Lacks information on *how* to grow SBV: he is uncertain of whether he possesses the skills to grow them, or unacquainted with the different types of SBV.	26	39	11	6	13	32	20
Does not know *where* to get SBV suckers	26	11	0	14	0	29	15
Not aware of their existence	17	6	5	17	13	7	12
SUBTOTAL	**69**	**56**	**16**	**37**	**26**	**68**	**47**
SUPPLY CONSTRAINT							
Wanted to plant, but the suckers were unavailable or available at the wrong moment (i.e. during a non-planting season)	4	11	0	9	7	14	8
SUBTOTAL	**4**	**11**	**0**	**9**	**7**	**14**	**8**
INPUT CONSTRAINTS							
Farm yard manure constrained: household does not produce any and it is too expensive to buy	9	0	26	9	20	0	9
Lack of labour: household members are too old or too few and casual labourers are too expensive to hire	4	17	11	11	0	11	9
Land constrained: land size is too small and/or land is considered to be unsuitable	0	17	11	9	20	0	8
The suckers were too expensive to buy	4	0	0	3	0	0	1
SUBTOTAL	**17**	**34**	**48**	**32**	**40**	**11**	**27**
NOT CONSTRAINED, BUT CHOSE NOT TO PLANT							
Do not like their taste	0	0	0	0	0	0	0
Still satisfied with traditional and exotic varieties	4	0	11	6	13	7	7
SUBTOTAL	**4**	**0**	**11**	**6**	**13**	**7**	**7**
OTHERS							
Only recently got to know them and have not decided yet	0	0	21	9	0	0	5
Others (ill when diffused, afraid of potential legal consequences, new farmer concentrating on seasonal crops,...)	4	0	5	9	13	0	5
SUBTOTAL	**4**	**0**	**26**	**18**	**13**	**0**	**10**

8.1.3 Input Constraints

Input constraints are categorised by households who report having a lack of manure, labour or land to grow SBV or who found the suckers too expensive to buy. From **Table 15** it is read that on average 27% of the non-adopters reported having input constraints. Farmers in the Karagwe and Muleba Highlands reported the least input constraints, while farmers in Biharamulo West and Ngara North reported the most. Only a minority of the farmers found the suckers too expensive to buy. For the whole region the manure, labour and land constraints seem to be of equal importance, each being reported by about eight or nine percent of the farmers. There are, however, significant differences across zones. Manure is not reported as a constraint in Biharamulo East, but is a more serious constraint in Biharamulo West and Ngara North. Labour constraints are high in Biharamulo East yet zero in Ngara North. Land is not considered as a constraint by the farmers in the Muleba Highlands and the Karagwe Highlands, whereas it is particularly important in Ngara North and Biharamulo East.

8.1.4 Others

The last two parts of **Table 15** show that no farmer indicated disliking the taste as being a constraint to adoption. Seven percent does not adopt because they are still satisfied with the traditional and exotic varieties. Other reasons account for five percent of the constraints.

8.1.5 Discussion

The fact that information constraints are withholding 47% of the farmers to plant SBV is an important observation. This means that the scope for diffusion after the termination of the project is potentially very large. Information is easily diffused among the farmers themselves and as the husbandry of SBV is not different from those used for local varieties, it could be expected that information would flow quite smoothly between farmers, given time. Even so intervention would be useful for three reasons:

(i) it can speed up the information diffusion process
(ii) it can avoid wrong information being spread
(iii) when information spreads 'naturally' some farmers (e.g. the poor) will be late in receiving it, as they are badly linked in the information network. By making specific efforts to reach them the targeting of the project can be improved.

It should be kept in mind that these are self-reported constraints and it is difficult to guess what motivated the farmer to give a particular answer. For example, a farmer who has received SBV on credit might pretend to be information constrained if he believes the project has come to request him to settle the debt under the pretence of an interview.

Eight percent of the farmers have supply constraints. It was indeed confirmed by the management of KCDP that in the last years the demand for SBV suckers has been greater than what the project was able to supply. It is obvious that supply constraints are temporary in nature. As more households have SBV stools they will multiply exponentially and farmers will distribute to one another (indirect diffusion). If supply through free indirect diffusion cannot match demand then a market in SBV suckers

will emerge and a price for them will be set accordingly. It is not uncommon in the region for suckers to be sold from farmers to farmers and casual observations have confirmed that some SBV suckers are being sold for prices up to TZS 500.

Information and supply constraints are withholding 55% of the farmers from adopting SBV. These are constraints that are expected to solve themselves given time, or that can be speeded up by relatively easy and cost efficient project interventions. The other 45% are constraints that are harder to solve. For example, 9% of the farmers do not grow SBV because they cannot get farm yard manure and 9% because they face a shortage of labour in their household. 8% is land constraint: they report having too little or unsuitable land. Some households in the survey did not own any land, but farm on rented land. They are unwilling to invest in permanent crops, because they are insecure about their future rights of farming on the same land.

These input constraints are harder to solve and would need more careful evaluation if any intervention were intended. Especially the land and labour constraints are difficult to overcome. Giving manure at the planting stage could be a short term solution to the farm yard manure constraint, as it does not guarantee the household more than a one time supply. It could be worth considering linking this project with projects introducing dairy cows, dairy goats or composting skills in the region. Households participating in these kinds of projects will probably be good candidates for adopting SBV as they now have easy access to manure and have already shown they are dynamic, innovative and willing to invest in their farming activities.

Even then, consider that the farm yard manure constraint scores relatively low compared to information constraints which are more easily dealt with. Therefore information diffusion should be first priority. Note, however, that one should not expect all the 47% information constrained farmers to start growing SBV upon acquiring the desired knowledge. Some of them might subsequently realise that they are constrained by other factors.

Another indication that the potential for expansion is very large is that only 7% of the households do not adopt SBV because they are still satisfied with the traditional and local varieties and no one reported not planting them because they dislike the taste.

8.2 Profiles of Adopters vs. Non-adopters: Two-way Analysis

The second approach to gaining insights into the constraints to adoption is to look at how the characteristics of adopters compare to those of non-adopters. Here a pooled data set of all zones has to be used, as some zones contain too few observations on adopters (Muleba Highlands and Biharamulo East) or non-adopters (Northern Lakeside). If profiles of adopters differ from those of non-adopters one has to be careful in interpreting this as a constraint to adoption. Say for example that it is found that adopters are more educated than non-adopters. There are three completely different interpretations of this result:

(i) farmers have experienced improved access to education through their participation in the KCDP program (endogeneity)
(ii) the KCDP program has targeted educated farmers (program targeting)
(iii) there exists an education constraint to adoption of SBV

Following discussions with the management of the project it seemed clear that the distribution methods of KCDP did not target specific farmers. This means that program targeting, as indicated in the second point in the list above, is unlikely to drive the results. Furthermore given that most suckers have been planted relatively recently it is doubtful whether many household characteristics (e.g. education) will have been influenced by the project already. Such an endogeneity problem would only form a problem for an analysis several years afterwards. Therefore the results of this analysis can confidently be interpreted as true constraints to adoption (the third point in the list above).

The first part of **Table 16** compares the adopters and non-adopters in terms of education. The last column gives the statistical significance of the difference between adopters and non-adopters. It should be noted that adopters have significantly more educated heads and significantly more adopter households have at least one member who has completed primary education.

Education remains a crucial ingredient in the adoption of new crops. Van den Broeck (2003) has also found it to be highly significant in another data set on Bukoba Rural District. Education catalyses the understanding of information reaching the household. Educated farmers seem to have a more open attitude to new crops and techniques.

The second part of **Table 16** shows that adopters own more land, rent more land and have more cattle than non-adopters. Note how of all the households categorised as rich or poor only 21% and 25% respectively are adopters. This is below the region wide adoption rate of 29%. Of all the households in the middle-class category 41% adopts.

It is unclear why adopters have more cattle. In fact there could be at least four reasons. First, cattle give the manure deemed necessary to grow SBV. Second, innovative farmers are likely to have cows. Three, farmers with cows are used to visiting extension officers and getting advise from outside. Four, ownership of cattle could be positively correlated with other factors positively influencing the probability to adopt (e.g. education or wealth) and it are in fact these correlates which are driving the result instead of cattle ownership.

In the third part of **Table 16** it is seen that there is no statistically significant difference between adopters and non-adopters in terms of their total household size or the number of children. The number of adults, however, is significantly higher in adopter households. The difference is small (0.2 adults), but statistically significant.

This hints at the importance of the labour constraint. Adults are the most important sources of labour. At the same time each adult is a potential source of income thus also relaxing the capital constraint of the household.

Table 16: Profiles of Adopters vs. Non-adopters

	Non-adopters	Adopters	Statistically Significant at*
Head Can Read and Write	70%	84%	7%
Some Household Member Has Completed Primary Education	82%	94%	5%
Size of Own Cultivated Land (In Acres)	1.92	2.33	7%
Size of Rented Cultivated Land (In Acres)	0.16	0.31	2%
% of Farmers Owning Cattle	16%	31%	2%
% of Poor Farmers	75%	25%	11%
% of Middle-Class Farmers	61%	39%	11%
% of Rich Farmers	79%	21%	11%
Total Household Size	5.6	5.9	21%
No. of Children Younger than 5 Yrs.	2.7	2.7	41%
No. of Children Between 5 and 15 Yrs.	1.8	1.9	44%
No. of Adults (Older than 15 Yrs.)	1.1	1.3	8%

* *t*-test or chi square test. For example 84% of the heads in adopter households can read and write, while only 70% can in non-adopter households. Because only a *sample* of farmers in Kagera was taken and not *all* of them were interviewed, this difference could be purely due to the specific farmers that were chosen. The 7% in the last column means that there is 7% chance that if another sample of farmers had been chosen, the education of adopters would not be higher than that of non-adopters.

Table 17 points out that the age of the household head also appears to play a role. The ages of the household head are spread between 22 and 90 years. There are significantly fewer adopters among the very young households, with heads under 30. The last column shows that the average number of adults in the household rises with the head's age.

It may be surprising to see that even households with very old heads, above 70, have a large percentage of adopters among them. These are likely to be households that have other younger members to take care of the bananas (as shown in the last column of the table). The data show that older heads do not restrain their households from changes in agricultural practises.

Table 17: Age of Household Head: Adopters vs. Non-adopters

Age of the Household Head	Has the Household Adopted SBV		% of Sample	Average No. of Adults in Household
	no	yes		
Older than 70	67	33	10	3.1
Between 50 and 70	68	32	25	3.1
Between 30 and 50	70	30	51	2.6
Younger than 30	84	16	14	2.0
ALL	71	29	100	2.7

The first row of **Table 18** compares the percentage of adopters among female and male headed households. Although the percentage is smaller in female headed households, the difference is not statistically significant. This is surprising, as it might be expected that female headed households would have significantly less adopters among them, given that all other odds are against them. Indeed, the

following rows of the table show that they are less literate, own less land and cattle and have fewer adult household members, all factors which were found to significantly increase the likelihood of adoption. This suggests that, for the same household characteristics, female headed households will adopt more easily.

Table 18: Female Headed Households and SBV adoption

	Female Headed Household	Male Headed Household	Statistically Significant at
% of Adopters	23%	30%	50%
Head can Read and Write	45%	78%	0%
Some Household Member has Completed Primary Education	64%	89%	0%
Size of Own Cultivated Land (in Acres)	1.5	2.1	5%
Size of Rented Cultivated Land (in Acres)	.13	.21	19%
% of Farmers Owning Cattle	5%	23%	5%
No. of Adults (Older than 15 yrs.)	2.0	2.8	1%

8.3 Profiles of Adopters vs. Non-adopters: Multivariate Analysis

Many of the variables discussed so far will be correlated with each other. Farmers with a lot of land and cattle may be expected to be rich in terms of their consumption and durable goods. Also education might be positively correlated with wealth.

In order to account for this a multivariate analysis should ideally be performed, which looks at all factors at the same time instead of tabulating each one against another. It is beyond the scope of this report to go into the details of such an analysis. Nevertheless the main findings are summarised.

The second column in **Table 19** indicates with what percentage the probability of adopting will increase given the condition stated in the first column and holding all other variables indicated in the first column constant. The third column shows at what percentage the variable is statistically significant. It is common practice to assume that a variable significant at between zero and ten percent is statistically relevant in explaining the likelihood of adoption.

The two main variables which predict whether or not a household will adopt or not, controlling for all other variables, are education and the possession of cattle. If the household has at least one member who has completed primary education then the probability of it adopting SBV increases by 18.1%. This variable is significant at two percent. This means that there is only a two percent chance that this variable does not, in reality, have an effect on the decision to adopt. If two households have exactly the same characteristics, but one owns cattle and the other one does not, then the household owning cattle has a 21.0% higher probability of being an SBV adopter than a household not owning cattle. All other variables like land size, labour, consumption, wealth, sex of the household head, etc... become irrelevant. In the two-way analysis they were significant and this is most likely because they are strongly correlated with education and cattle. Once statistical controls are put in for all variables, there are only two significant ones left: education and cattle ownership.

This fits in nicely with the results of the self-reported constraints, where it was found that information is the most important constraint. Diffusing information to illiterate households takes more time and deliberate effort and is much more difficult to achieve. Also the farm yard manure constraint remains an important issue, many farmers do not adopt because they lack the necessary manure to grow SBV.

Table 19: Multivariate Probit Analysis to Explain the % Increase/Decrease in the Likelihood of Adopting.

Variable	% Increase/Decrease in the Probability of Adopting	Statistically Significant at
If at Least One Household Member Has Received Primary Education	18.1	2%
If the Age of the Household Head Goes up with One Year	0.2	31%
If The Household Is Headed By A Female	-0.6	96%
For Each Extra Adult in the Household	-1.8	51%
If the Household Owns Indigenous or Dairy Cows	21.0	5%
For Each Extra Acre of Cultivated Land Owned	1.9	41%
For Each Unit Increase of the Wealth Index	-2.3	12%

8.4 How to Measure the Impact of SBV on the Kagera Region

Given that SBV have a cycle of 14 to 16 months and that the majority of the farmers have adopted in the past two years (see **Table 9**) it is early days yet to assess the impact of the program. This survey, in design and set-up, was ideal to determine the degree of and constraints to adoption SBV. However, the expected impact, identified by the program, is to increase food security and income of the farmers in Kagera. To assess this one would need to have data over time on the same farmers (a panel data set).

Having data in only one period would be problematic. To see why a simple, one-period comparison of, for example, banana shortages of adopters vs. non-adopters would not be convincing, consider the following example. Say that it is found that adopters have more banana shortages than non-adopters. This would not mean that the project has created banana shortages and has no impact on food-security in the region. It may well be that farmers start adopting exactly when their banana productivity goes down. The causality in this example goes in the other way: banana shortages cause farmers to adopt. Say that the opposite is found, namely that adopters face less banana shortage than non-adopters. Also this might merely indicate that good, innovative farmers (facing less banana shortage) are planting SBV. Because these farmers had less banana shortages from the beginning one could wrongly attribute this to the project.

If there are data on the same farmers over time, however, the analysis could be made more robustly. It would then be possible to track how the yields of the SBV progress

compared to those the other banana varieties and whether adopters, some time after having adopted SBV, face less banana shortages than before.

Subsequent surveys, aimed at assessing the impact of the program should not only try to get an accurate picture of what the share of SBV harvest is in the total banana harvest, but also in which months this goes up and down. Ideally one would want to see SBV taking over from the traditional and exotic varieties at times when the latter fail, i.e. in the beginning and at the end of the year. Having good SBV harvests at times when the local varieties produce well can also be beneficial to the farmers, but only in zones where farmers are able to externally market their banana surplus.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions and Recommendations per Zone

This section concludes the findings for each geographical zone and provides specific zone related recommendations.

9.1.1 Muleba Highlands

Households in the Muleba Highlands cultivate an average of 1.8 acres of land (below the region wide average) and rent another 0.3 acres (above the region wide average). Just under one third of the households own cattle and thus have direct access to manure. Banana is the preferred staple in the Muleba Highlands. This zone has high population density, but through intensive farming and excellent banana husbandry households are able to produce enough bananas to eat an average of 13 banana meals a week (93% of all meals). At the same time they derive by far the largest income from sale of banana bunches.

Only five percent of the farmers in this zone have adopted SBV. The Muleba Highlands has the largest degree of information problems, with 69% of the farmers not adopting because they are information constrained. 17% of the farmers are unaware of the existence of SBV, 25% is ignorant on where to obtain suckers and 25% is unsure about the husbandry to grow SBV. Input constraints play a minor role here: most farmers have enough land, labour and manure to adopt SBV. Only four percent of the non-adopters report not planting SBV because they are still satisfied with the local varieties.

First, an intervention here should concentrate on information diffusion. Farmers need to be made aware of what SBV are, where they can obtain suckers and how they should grow them. The latter will be unproblematic in Muleba as farmers have a long tradition of growing bananas. Second, direct diffusion of SBV planting material to farmers should continue in the Muleba Highlands. Adoption rates are currently too low in this zone to form a sufficient base for indirect diffusion on a massive scale. Suggested interventions are summarised in **Table 20**.

Even though local varieties are still doing well, there still remains quite some potential for farmers to adopt SBV. First, it would be a safe strategy for them to adopt at least some SBV, should the yields of local banana varieties decline in the future. Second, given that farmers have good access to markets, any increase in their banana production can be sold off to yield extra income (contrary to e.g. a zone like the Karagwe Highlands). Third, still half the farmers report banana shortages in the beginning and at the end of the year. If SBV are able to relieve shortages during these months, farmers should be interested in adopting.

9.1.2 Biharamulo East

Biharamulo East, being a very dry area, is mainly dependent on annual and root crops for food security. Only 72% of the farmers grow bananas (the lowest in the region) and the consumption of banana is very low at 29% of the meals taken (also the lowest in the region). Husbandry is very poor, but still bananas yield a high income for those who grow them. This is due to the marketing possibilities in non-banana growing areas like Geita, Mwanza and Chato.

Most farmers are aware of the existence of SBV and know where to get them, but 39% lack the confidence to start growing them. They feel they do not have the right knowledge. Indeed, even the knowledge on growing traditional and exotic varieties is quite poor in this area. Intervention here should concentrate on basic banana husbandry skills, to improve the yields of SBV *and* traditional and exotic varieties. Market possibilities do exist in this zone, so increasing banana yields would not only improve food security but also generate extra income for the farmers in this zone. Because of low adoption rates in this zone it is advised that direct diffusion of SBV suckers to farmers continues.

Also apparent here is that 34% of the farmers is labour or land constrained. These are two constraints for which interventions are relatively more difficult. Note that no one is farm yard manure constrained in this zone. There is a lot of livestock in Biharamulo East and although much of it is concentrated in the hands of 22% of the population, the availability of manure (through sale) would be high. Indeed, no farmers in this zone reported to be constrained by lack of manure.

9.1.3 Biharamulo West

Despite Biharamulo West having favourable conditions for growing bananas, it a low average amount of stools per household. The husbandry is relatively good in this region, but farmers lack access to markets. Compared to other zones, they derive the least income from agricultural activities. Three quarters of the farmers grow bananas (the second lowest in the region) and the income they derive from this is small in absolute terms. Still, because total agricultural income is low, bananas do become important when looked at in relative terms. Banana consumption is limited with banana meals taking a share of only 29% out of all meals eaten.

Information constraints do not represent major problems in Biharamulo West, as they are the second highest informed zone after Northern Lakeside. The major constraints affecting this zone are those of inputs. Nearly a quarter of the farmers report they do not grow SBV because they lack manure to put on their land. This fits with the findings of this report that there is very little livestock in this zone, with only 8% of the farmers owning cattle.

In this zone an intervention should concentrate on relieving the input constraints. Presenting households with alternatives to manure, or linking the projects to one distributing cattle may be options. Over one fifth of the farmers report other input constraints like labour and land constraints. As noted above, these constraints are more difficult to solve.

9.1.4 Ngara South

Ngara South is a dry zone with poor banana husbandry and a limited number of traditional and exotic and stools per household. The number of cultivated acres of land per household is the highest in the region. Many households own cattle and the average value of livestock is high. Bananas are grown by 82% of the households, but consumption and sale of bananas is low. Only seven percent of the agricultural income comes from bananas and most of this is through sale of banana beer on the local market. Market opportunities for the sale of banana bunches are limited.

About a quarter of the farmers have adopted SBV and the absolute number of SBV stools per household is the highest in the region. Despite this high adoption rate, the non-adopters in this zone have both severe information and input constraints.

The introduction of SBV in this zone is expected to have a positive effect on the food security situation of the households. In order to have an impact on the food security situation of households, interventions should initially concentrate on diffusing information on SBV and introducing sound banana husbandry techniques. Later on, possibilities to creating efficient markets could be further investigated to improve the income situation. Although input constraints are high, manure constraints do not feature as a major problem.

9.1.5 Ngara North

Farmers in Ngara North have poor knowledge of banana husbandry. Although 96% of the farmers grow bananas only 12% of agricultural income is derived from them. 92% of this income is through sale of the local banana brew and only 8% through sale of bunches. This shows what little marketing possibilities there are in this zone.

Households are relatively well informed about SBV, but they lack inputs, especially manure. Only 8% of the households own cattle and the average livestock value is very low. Alleviating the manure constraint and introducing sound banana husbandry techniques in this area would be the key to the success of SBV and other varieties. Introduction of SBV would be mainly expected to improve the food security situation of the households, as marketing of bananas is difficult here.

9.1.6 Northern Lakeside

The Northern Lakeside has a long tradition of banana cultivation. Households have excellent access to markets due to the proximity of Bukoba town and lake access to Mwanza. Farmers, however, own little land and a quarter of the cultivated land is rented. All farmers in this zone grow bananas and they derive most of their income from the sale of bunches. Sale of banana beer is less important here. Farmers do not consume many banana meals per week, preferring to sell the crop on the market and buy cheaper staples with part of the income. By cutting down on their banana consumption and selling off a large proportion of their harvest, they are able to earn 40% of their agricultural income. Still, this situation is not ideal for them as banana is their preferred staple.

The Northern Lakeside has been worst affected by declining banana yields and most farmers had already switched from traditional to exotic varieties before the introduction of SBV. Adoption rates are very high and farmers in this zone were the earliest adopters of SBV in the region. This is mainly due to the huge benefits of growing the superior varieties and the concentrated efforts of the KCDP program in this zone. SBV have undoubtedly been permanently introduced in this zone. This can be seen from the high indirect diffusion rates. With just under a third of all suckers being diffused from farmers to other farmers or from farmers to themselves, the program should have a sustainable effect in this zone, even without further intervention.

9.1.7 Karagwe Highlands

The Karagwe Highlands are characterised by abundant land and excellent soil fertility. Even with average banana husbandry techniques farmers get high yields from traditional and exotic varieties. Nearly all farmers in this zone cultivate bananas and 20% cultivate SBV. However, the income they are able to derive from their harvests is relatively low. Only six percent of agricultural income is from the sale of bananas. The main reason for this is a serious lack of marketing opportunities for their bunches. Most bananas are processed into banana beer for sale on the local market. Only 23% of banana income is from the sale of bunches. Farmers in this area produce a lot of waste bunches, which are left to rot on the fields because markets do not function.

In Karagwe information problems are high, with 68% of the farmers reporting to be information constraint. Solving information constraints in this area is expected to have very little effect on the food security or income situation of the farmers. At present farmers have ample bananas for consumption and face hardly any banana shortages throughout the year. Farmers might plant SBV out of curiosity or as a diversification strategy, but the effect of the introduction of SBV in this zone will be limited unless the marketing of this crop is improved. Without such an improvement in the marketing system, it is suggested that SBV are not introduced into this zone.

9.1.8 Summary of Zone Interventions

Table 20 presents a summary of key interventions per zone as discussed above.

Table 20: Priority Intervention Areas per Zone

Zone	Continue with Direct Diffusion of SBV Suckers	Diffuse More Information on SBV	Diffuse Information on Banana Husbandry in General	Tackle Manure Constraint	Create Efficient Markets
Muleba Highlands	√	√			
Biharamulo East	√	√	√		
Biharamulo West	√			√	√
Ngara South	√	√	√		√
Ngara North	√		√	√	√
Northern Lakeside	√ *				
Karagwe Highlands	√ **	√ **			√

* only for certain varieties which have not yet been massively introduced

** conditional upon the improvement of the marketing system

9.2 Conclusions and Recommendations for Similar Programs

SBV have been adopted by 29% of the sampled farmers. Adoption rates were shown to be highest in the Northern Lakeside and lowest in the Muleba Highlands. In the former zone SBV have been introduced since 1997 and indirect diffusion is currently high.

Given these adoption and indirect diffusion rates, it should be safe to say that SBV have been permanently introduced in the region. It is estimated that the KCDP program has diffused over one million SBV suckers across the region and that indirect diffusion will continue to increase.

Profiles of adopters and non-adopters differ. Adopters were found to have significantly more cattle and have better educational achievements than non-adopters.

This is thought to be due to self-selection of farmers and not because of intentional targeting of the programme. If it is the belief that SBV can be successfully grown by farmers without primary education and direct access to manure, future interventions should try to encourage greater participation by those with low education levels and less cattle.

Information emerges as the key constraint to adoption, with nearly half of the non-adopters not growing SBV because they are uncertain of what exactly they are, how they should grow them or how they should go about obtaining them. 26% of the farmers report being constrained by a lack of manure, labour or land, while 8% was unable to get suckers at the time they wanted to plant.

Intervention would be advisable to speed up and control the natural process of information diffusion:

- Speed up: a relatively cost-efficient intervention could speed up the process of information diffusion.
- Control what information is spread: make sure that accurate information is spread among the farmers, i.e. correct misunderstandings
- Control who receives information: If SBVs are left to diffuse by themselves the poor are likely to be the last to benefit. A program intervention specifically aimed at targeting them could counter this.

Input constraints are harder to solve. Especially farmers who are land or labour constraint, will remain difficult to reach. Farm yard manure constraint farmers could be reached by linking the project to one distributing dairy cows, but further analysis should be done concerning this. Availability constraints are expected to be temporary as indirect diffusion increases exponentially. Still, in areas with low adoption rates continuing direct diffusion would be advisable.

9.3 Recommendations Other Actors

After the phasing out of the project, diffusing information on SBV should be the responsibility of the government through its extension workers.

Involve local, village-level actors, like village leaders, teachers, or influential farmers in the information diffusion process. This could ensure smooth information transfers to non-adopters.

The infrastructure of demonstration and multiplication fields should be taken over and put to use:

- As testing and research sites for the currently introduced SBV
- As multiplication fields for further distribution of SBV
- As necessary infrastructure for yet unidentified SBV that might want to be introduced in the future.

More extension work should be given on general banana husbandry. Adopters of SBV should be systematically followed up.

The government or local research institutes should continue monitoring the performance of all banana varieties, so early warning can be given when yields go down. They should keep close contact with organisations with knowledge of and access to SBV to smooth future introduction of new types.

Through investments in trading points, roads and other market infrastructure, markets should be made to function efficiently so that production in excess of consumption requirements can be sold.

Universal access to primary education will make farmers more open and willing to innovate. This will benefit any newly introduced technology.

9.4 Recommendations for Further Studies

The stated goal of the programme was to provide more food security and income to households in Kagera in order to decrease poverty and vulnerability. The study that was undertaken does not assess the achievement of this goal. Rather, it was designed to identify the accomplishments in terms of adoption rates and the constraints to SBV adoption. Therefore, in order to fully assess impact a new study should be initiated.

It is suggested that an on-going survey be designed comparing like for like data between adopters and non-adopters (i.e. a panel survey). Data collection for this type of survey would need to be undertaken on a monthly basis, whereby monthly yields for all the banana varieties are monitored via households along with consumption, sale and other usage of harvest, in line with other more general household and situational data. It should be considered taking a new sample of households, which strikes a balance between the inclusion of non-adopters, recent adopters and long time adopters, as well as being geographically stratisfied.

The following points are some preliminary suggestions as to the sort of data that could prove valuable to analyse in a new survey:

- An evaluation of the monthly yields of all banana types should be conducted in order to be able to conduct a more in-depth statistical impact analysis and to ascertain if there is a possibility that SBV could yield well in seasons when traditional and exotic varieties do not.
- Assessment of current and potential marketing of bananas, locally, regionally and export should be considered providing a close examination of the seasonal price differences in various markets.
- Income obtained from the sale of each variety needs to be monitored on a monthly basis in order to know the absolute and relative incomes of each variety in each season.
- Include questions relating to the performance of traditional and exotic banana varieties and other substitutes.
- When valuing consumption, durable goods, wealth etc... this should be done in monetary terms in order to conduct a more complete analysis than was possible with the data collected during this survey.
- In the crops grown section of the questionnaire probe specifically for each crop, instead of letting the respondent mention his main crops.
- In the household members section probe for health and ability to work of all adults, to get a more accurate figure for labour availability within the household.
- More detailed questions relating to the way in which farmers gained their information regarding SBV and how they diffused it further would be useful to assist in understanding the information diffusion in the region, particularly after the closure of the KCDP. Furthermore, these questions should also probe the quality and integrity of the information that was provided.

The above suggestions for an on-going survey are by no means exhaustive, but have been presented to give an indication of the direction for such a study.

A further area of potential study that could prove interesting to KCDP and other similar programmes would be to track the life and on-going diffusion of a random sample of suckers introduced by KCDP. It is understood that KCDP has kept in-depth records regarding the distribution of each sucker to each community. From this information, it would be possible to gain an understanding into the multiplication effect from one single sucker, and to track its family development.

It is also suggested that in the future, say two years from now, a similar survey to this current one, assessing adoption rates and constraints, be conducted. This would allow the evaluation of any changes to adoption constraints once KCDP has disbanded. In this instance, it would be necessary to use a different sample of respondents in order to ensure that results would not be distorted by the impact of the original survey. E.g. farmers who responded that they had not heard of SBV during the first survey, could not respond in the same way during a follow-up survey as they would by then be aware of SBV from the original interview.

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