

Strengthening of Citrus Production

Abstract

For many years the citrus industry, once an important exporting industry, has been on the decline and is now on the brink of not being able to cover local demand. This is unnecessary as Surinam has ample potential to produce a wide variety of citrus species. This project aims at raising citrus yields (output 2) and spreading the supply of citrus production more evenly throughout the year (output 3). Yields will be improved by working on a better supply of good quality planting material (output 1), by validating improved production techniques (output 4), and by informing and training farmers in appropriate production management techniques (outputs 5 and 6).

Introduction

After bananas, citrus fruit is the most important category of fruits grown in the country, with an area under production of 1649 ha producing 22,069 ton of output in 2014. The value of that output at farm gate price was SRD 98.3 million.¹ Of the area under citrus production, 65.6% is oranges, 7.6% pomelo, 4.9% grapefruit, 1.5% tangelo, 1.1% tangerine, 1.1% lime and the remainder 18.3% other citrus fruits, including lemon, mandarin, and cumquat.

Export of oranges (mainly to the Netherlands) peaked in 1977 (i.e., 40% of the production in that year), but rapidly declined thereafter to negligible quantities after 1990. The area under citrus production, however, peaked a lot later namely in 1994 when 2541 ha was dedicated to citrus production (FAOSTAT). Since then, the area under citrus production has declined steadily (with temporarily bouts of some recovery) to only 1649 ha in 2014. However, improvement of yield/ha has largely off-set this contraction in production area. Average citrus yields over this period went up from 7.9 ton/ha to 13.5 ton/ha (FAOSTAT). While an impressive improvement, average production/ha is still only about half the level of the three best performing countries in the region in the case of oranges and about a third in the case of grapefruit. Total volume of citrus production reached 22,069 tons in 2014, which is only 10% more than the 20,050 ton in 1994. Population grew with 33% over this period, which suggests a lower availability of citrus fruit today than 20 years ago.

During the export days, there were five 'large' citrus companies with approximately 100 ha of citrus fruit each. Of these, only one (state-owned Alliance) is still in production. Today, citrus production is primarily for the local fresh fruit market, some small-scale juice processing and, since a few years, for the Surinam Candied Fruit (SCF) company which exports succade. The company is working together with a group of 11 outgrowers, with approximately 1 ha under production each. In 2015, they produced about 95 tons of citrus medica, a citron species with a thick skin from which the succade is made. Lately, some import of fresh oranges has been reported, but that does not show up in the statistics. The drinks industry imported before the devaluation of the Surinamese dollar some modest quantities of (concentrated) citrus fruit juice (about US\$ 0.25 million a year), suggesting that there is some potential for import substitution. The state-owned Alliance company aims to setup a citrus processing plant as part of its overall strategy to strengthen the company.

Background

According to the 2008 Agricultural Census², 2841 farmers (or 28% of the total) reported to grow (some) oranges.³ Unfortunately, there is no statistical breakdown of those farms in terms of their area under orange production. However, according to staff of ODLOAV, 80% of them have less than 0.05 ha of oranges (= 15 trees) and most of their produce is for own consumption. At the other end of the distribution, there was in 2008 only one producer with 100 ha of citrus trees, namely state-owned Alliance. Most producers for which oranges is the main crop and 'produce to sell' have between 0.5-3 ha oranges. Very recently, however, the company Goliath NV has established new orange orchards at Tibiti in the district Brokopondo using the latest orange production technology from Brazil. Since 2014, some 25,000 trees (which is about 50 ha) of the Pera variety have been planted and another 25,000 are in the pipeline. In the long run, the company aims to plant some 600,000 trees, which could easily double the current supply of oranges in Surinam. The company

¹ LVV. 2016. Agricultural Production Statistics. Paramaribo: LVV.

² LVV. 2015. Eindrapport van de Vijfde Landbouwtelling 2008-2009. Paramaribo: LVV.

³ For all other types of citrus fruit the reported numbers of farms are substantially lower (200-600), but with similar percentages (80-90%) of very small producers.

aims to produce mainly for the fresh export market, but hopes that eventually a processing industry producing orange concentrate will take off as well.

The main citrus production areas can be found in the districts of Commewijne, Saramacca and Wanica. In 2014, average yield for oranges was 13.2 ton/ha, for grapefruit 12.7 ton/ha, for pomelo 19.4 ton/ha, for tangerine 12.8 ton/ha, for lime 18.0 ton/ha, for tangelo 18.4 ton/ha, and for other citrus fruit 9.4 ton/ha.

As noted earlier, orange yields/ha are about 50% lower than in the three best performing countries in the region, due to:

- a. Relatively old trees. Rejuvenation of orchards has been slow because of: (i) limited market prospects; (ii) rather poor quality of new planting material and poor handling, causing a high drop-out rate; and (iii) limited knowledge/information on rejuvenation of orchards.
- b. Except for the Goliath company (and this is only very recently), there has been no introduction of improved orange varieties imported from elsewhere in Surinam for the past 30 years. The planting density of improved varieties in Brazil tends to be substantially higher than in Surinam (500/ha versus 250-300/ha) and the trees are far more compact. The relatively low density of orange trees practised in Surinam is in part due to the need of ditches between the trees to drain heavy clay soils. On sandy soils such ditches are not needed.
- c. Poor pruning of trees. Proper pruning of trees can make an enormous difference in yield performance, but is labour intensive and requires skill, which is often lacking;
- d. Insufficient fertilization. LVV has issued fertilizer recommendations for citrus trees for two different soil types (sand and clay). However, many farmers do not follow these recommendations and give less fertilizer than recommended;
- e. Poor water management – no irrigation (in all cases) and drainage problems (in some cases);
- f. Pests such as aphids, rust mite, scale insects, ant bear, and termite; and
- g. Diseases such as gum disease, damping off (nursery), lichene, Thanatoporus cucumeris fungi and other fungi diseases. Fortunately, Surinam is still free from the Huang Long Bin (HLB) virus, which is causing a lot of damage in other citrus producing countries. Also the tristeza virus has been kept at bay due to the rootstock used in Surinam.

LVV maintains a collection of citrus varieties, which forms the basis for the production of new planting materials. No new varieties have been introduced over the past 30 years. Because of the HLB virus, importing new varieties can be risky if no precautionary measures are taken.

LVV currently operates 2 citrus nurseries (Houttuin in Wanica and Tamansari in Commewijne) that report to ODL and produce together some 15,000 citrus plants per year for sale to farmers and the public in general. They are sold on a weekly market at LVV's premises in Paramaribo. At the LVV market only five plants can be purchased at a time, which means it is servicing mainly small backyard production. Direct sales to farmers by the two nurseries targets mainly professional citrus producers. They have to place their orders with LVV, which has to approve them. In addition, there are three experimental gardens reporting to ODLOAV (Dirkshoop, La Poule, and Boma⁴) that together produce some 2,500 citrus plants and also sell directly to farmers. A new (since 2013) supplier of citrus planting material is the Commewijne Agricultural Development Foundation (SLOC), a state-affiliated entity, with a capacity of 10,000 citrus plants, but which would like to expand to 20,000. The price

⁴ Dirkshoop and La Poule report directly to ODLOAV, while Boma reports to the STIPRIS foundation, which is a working arm of ODLOAV.

charged by LVV for citrus planting material for the past few years has been far below cost price. Recently the price has been doubled from 6.5 SRD to 12.5 SRD, but it is unclear whether with this price actual production costs are being covered. One opinion is that the supply of new citrus plants is still too small and hence additional nursery capacity is needed. However, a rough calculation shows that with the current capacity you can replant the current area under citrus production every 18 years. This is substantially below the economic life of citrus trees, which is between 25-40 years in Surinam. In our opinion, the more urgent problem is the quality of the planting material and the poor treatment of newly planted trees (in particular wrong pruning). There is no hard data, but anecdotal evidence suggests that there is a very high dropout rate of newly planted trees.

The current supply of oranges is quite seasonal and hence as a result prices as well as consumption are also rather seasonal. In the absence of clear export opportunities in the short run, local demand will be a limiting factor in how much additional supply can be absorbed by the market. A better spread of the supply throughout the year, could help to resolve this problem to some extent as it would mobilize local demand that is currently unmet.

Project justification

The citrus fruit industry is a sizeable economic activity in Surinam, spread out over many farmers for which it is a small additional activity, while for 300-400 farmers it is their principal source of income. Since the mid-1990s, the area under citrus production has been on the decline. If this trend continues, Surinam could be destined to become a net importer of citrus fruit. This would be completely unnecessary (and highly undesirable) as Surinam has good conditions to grow citrus fruit. Hence this innovation project aims to give the citrus industry a boost by: (i) improving the quality of the planting material supplied by the nurseries; (ii) introducing better-performing foreign varieties; (iii) changing the composition of citrus species and varieties planted so that (potential) local demand is better met (this may also require the introduction of irrigation); and (iv) improving production practices and compliance with standards. The primary aim is to satisfy local demand.

Rather than trying to compete in the world market with oranges (which is a highly competitive market), it makes more sense trying to target specific export niche markets for the 'smaller' citrus fruits that are preferably organically grown. Succade is a good example of such a niche market.

Beneficiaries of the project will be predominantly small- to medium-sized producers or the employees of a state-owned company (Alliance).

Interventions to date

In the heydays of citrus production in Surinam in the 1970s and early 1980s, a considerable amount of citrus research has been undertaken by ODLOAV (the research department of LVV), including a citrus breeding program. At that time a lot of citrus species and varieties were acquired from abroad and several 'own' orange varieties (known under the name Kwatta) released by the program. A lot of research was also done on rootstock. As a result, ODLOAV advises the use of Cleopatra (rather than sour orange) as rootstock (especially in the coastal area) because it can tolerate wet soil conditions and is resistant against the tristeza virus. This virus has been quite damaging in other citrus producing countries in the region. Citrus research stopped somewhere in the 1980s due to the political and economic situation at that time (and the collapse of the citrus export) and the collection of citrus species and varieties kept at the experimental gardens Dirkshoop and La Poule were left unattended. As a result, a great deal of the citrus collection was lost. In 2007/8, ODLOAV decided that it should try to save what was left from the collection and establish and maintain a citrus gene bank. In this context the following actions were taken:

1. An inventory of the citrus trees that are present in the collection. For each tree the following data were collected: (i) citrus specie and variety; (ii) (estimated) age of tree; and (iii) condition of the tree.
2. Rehabilitation of citrus orchards at the two experimental gardens Dirkshoop and La Poule by: (i) training of personnel of both gardens in citrus farming practices (pruning, fertilizing, etc.); (ii) making sure that good citrus farming practices are being applied; and (iii) rejuvenation of the citrus orchards
3. The development of the citrus species collections. The conservation started with mandarin varieties at La Poule. Due to waterlogging all this was lost. So it was continued at Dirkshoop. Table 1 shows the varieties that are currently in the collection. This collection helped SCF to identify its 'succade' variety.
4. Description of the citrus species and varieties in the collection as a lot of that information has been lost. The vegetative description of the different citrus species and varieties was started in 2014. Such a description should help to easily identify and recognize the different citrus species and varieties present in Surinam. The description of fruit characteristics (such as sweetness, juice volume/fruit, etc.) was started in 2015 and is still going on. This information should help citrus growers in deciding which variety they would like to plant.

Table 1: Citrus species and varieties in LVV's citrus collection

Citrus species	Varieties
Orange	Alidjan, Kwatta 71, Kwatta 202, Kwatta 16-22, Lamb Summer, Lue gim gong, Navel, Parson brown, Pera, Valencia
Mandarin	Yellow King (pong pong), Red King, Copy mandarin, 'Curaçoise oranje', Surino, Cleopatra
Lime	Key lime, West Indian lime, Sweet lime, Tahiti lime
Lemon	Eureka, 'Sukade citroen', 'Surinaamse citroen', 'Sital citroen'
Grapefruit	Star Ruby, Thompson, Hooghart, Marsh

Project objectives

Main objective (i.e., goal): Strengthening of the citrus fruit sector in Surinam

Intermediate objectives (i.e., outcome):

1. Productivity of the citrus fruit sector improved
2. A more evenly spread, local supply of citrus fruit throughout the year

Project outputs and activities

This project proposes the following outputs to improve the productivity of the citrus sector, namely:

1. The quality of the planting material supplied by the citrus nurseries substantially improved and farmers better informed about how to plant and treat a newly planted tree. This requires training and informing staff at the nurseries about how to produce better planting material and inform farmers about how best to plant and treat a newly planted tree.
2. Better-performing citrus varieties (most likely from Brazil) identified, imported and screened. For the past 30 years, hardly any new citrus varieties have been introduced in Surinam. However, leading citrus growing countries (including neighbouring Brazil) have moved on and developed more compact, better-performing varieties. They plant more trees per hectare

than what is standard practice in Surinam (500 versus 300 per hectare), which requires different and more intensive crop management techniques (e.g., irrigation). Not all soil types in Surinam are suitable for this technology package, but on well-drained, sandy soil types it may succeed;

3. Harvest and flowering periods of citrus species and varieties identified. This activity is part of the ongoing research to describe all citrus species and varieties in the collection. It should help to identify those varieties that fruit outside the peak season of the current stock of trees planted. Irrigation may be needed in order to let these varieties produce good quality products in the dry seasons;
4. Validation of: (a) compost formula for citrus nursery; (b) irrigation to facilitate out of season production; and (c) the use of legume species to control weeds and capture nitrogen;
5. The development and promotion of a citrus production manual, integrating ICM and IPM approaches as well as information about how to comply with SPS, food safety and GAP standards. Also attention will be given to organic production; and
6. The promotion of best practices in crop and business management in the citrus industry in the form of training and demonstrations. This also includes training and demonstration of proper pruning of citrus trees.

Project outputs and activities are summarized in table 2.

Table 2: Project outputs and activities

Outputs	Activities
1. Citrus nurseries equipped and strengthened in order to produce better quality planting material	1.1 Study tour to a private Brazilian citrus nursery 1.2 Development of a protocol for the propagation of citrus planting materials to guarantee planting material of good quality 1.3 Training of nursery staff in propagation and composting techniques 1.4 Establishment of composting facilities at the nurseries in order to secure a good growing medium for plants 1.5 Production of three YouTube movies highlighting best nursery practices 1.6 Production of information brochures for the buyers of the plants 1.7 Production of YouTube movie explaining how best to plant and treat a new citrus plant. 1.8 Upgrade facilities of 6 citrus nurseries (Houttuin, Tamansari, Boma, Dirkshoop, La Poule and SLOC)
2. Better-performing citrus varieties identified, imported and screened	2.1 Study tour to Brazil in order to identify citrus varieties that could be imported; 2.2 Acquisition and importation of new varieties; 2.3 Screening of the imported varieties and description of their main characteristics; 2.4 Selected varieties made available to the nurseries for multiplication.
3. Harvest period of citrus species and varieties identified	3.1 Complete research on the seasonality of citrus species and varieties 3.2 Develop and release a seasonality chart
4. Selected recommendations validated	4.1 Validation of the compost formula for growing medium to be used by nurseries 4.2 Validation of the use of irrigation for out-of-season citrus production on experimental garden Dirkshoop 4.3 Validation of which legume species could be used in citrus orchards (other than kudzu) in order to control weeds and capture nitrogen

Outputs	Activities
5. New citrus production manual released and promoted	5.1 Survey of current production practices and problems, yields, pesticide use, and technology transfer and adoption. 5.2 Literature review 5.3 Study tour/ training to the citrus research institute of EMBRAPA in Brazil to consult with Brazilian researchers on ICM and IPM solutions in citrus production 5.4 Drafting of a citrus production manual 5.5 Production of the manual (text, layout, etc.) both in printed form as well as electronically 5.6 Promotion campaign among citrus farmers (leaflets, posters, etc.) 5.7 Production of short YouTube movies to highlight specific good practices (such as pruning of trees) 5.8 Use of social media and text messaging to reach out to farmers
6. Citrus farmers informed of and trained in best practices	6.1 Training courses for some 120 citrus farmers in the main production areas (Commewijne, Saramacca and Wanica) on 'best crop management' practices' and 'business management'. 6.2 On-farm demonstration of best practices such as pruning of trees, production and use of organic fertilizers, and weed control.

Project results

Project results are summarized in the results matrix below.

Results matrix

Project objective	To strengthen the citrus fruit sector							
Outcome indicators	Base	Year 1	Year 2	Year 3	Year 4	Year 5	Target	Means of verification
<i>Increased productivity</i>								
Indicator 1: Increased yield/ha	(1)	0%	0%	5%	10%	15%	30%	1. Production statistics collected by LVV; and 2. Follow-up survey of farmers trained Comment: Some of the increase in yield will come from higher density planting on sandy soils
<i>A more evenly spread, local supply of citrus fruit throughout the year</i>								
Indicator 1: Share of low-season varieties in nursery sales increased	0%	0%	0%	0%	30%	40%	50%	1. Sales statistics of the nurseries
Output indicators	Base	Year 1	Year 2	Year 3	Year 4	Year 5	Target	Means of verification
<i>1. Citrus nurseries equipped and strengthened in order to produce better quality planting material</i>								
1.1 Study tour to commercial citrus nursery in Brazil	0	1					1	1. Study tour report
1.2 Citrus propagation manual released	0	1					1	1. Manual released
1.3: Number of staff at the different nurseries trained in citrus propagation techniques and composting	0	20	20				40	1. List of participants; 2. Evaluation forms
1.4: Improved growing medium adopted by nurseries	0%	0%	25%	50%	75%	100%	100%	1. Survey of nurseries
1.5 Three YouTube videos on good nursery practices	0		1	2			3	1. YouTube videos uploaded
1.6 Information brochure on how to plant and treat new citrus trees produced	0		1				1	1. Information brochure
1.7 YouTube video on good citrus planting practices	0		1				1	1. YouTube video uploaded
1.8 Upgraded citrus nurseries	0	6					6	1. Inspection
<i>2. Better-performing citrus varieties identified, imported and screened</i>								
2.1 Study tour to Brazil to identify potential varieties to be imported	0	1					1	1. Study tour report

2.4 Imported varieties released for multiplication	0				1		1	1. Research report
<i>3. Harvest periods of citrus species and varieties identified</i>								
3.1: Seasonality chart of citrus species and varieties published	0			1			1	1. Research report
<i>4. Selected recommendations validated</i>								
4.1 Growing medium for nurseries validated	0		1				1	1. Research report
4.2 Validation of the use of irrigation to grow out-of-season varieties	0					1	1	1. Research report
4.3 Validation of legume species to grow in citrus orchards	0			1			1	1. Research report
<i>5. New citrus production manual released and promoted</i>								
5.1 Citrus production manual released	0		1				1	1. Manual available both in printed form and electronically
5.2 Four YouTube videos highlighting specific aspects of citrus production released	0		1	1	1	1	4	1. YouTube movies uploaded
5.3 Percentage of citrus farmers that can be reached through social media, e-mail or texting	0	0	0	10	15	20	50	1. Contact database
<i>6. Citrus farmers informed of and trained in best practices</i>								
Indicator 1: Number of printed manuals distributed	0	0	400	400	200	200	2000	1. Stock figures
Indicator 2: Number of views of the 10 citrus YouTube movies	0	0	1000	1000	1000	1000	5000	1. Website statistics
Indicator 3: Number of citrus farmers trained in best practices	0		3x40	3x40	3x40		120	1. List of attendees 2. Training evaluation forms summary and analysis 3. Training materials used
Indicator 4: On-farm demonstrations of best practices	0			3	3	3	9	1. Annual progress reports specifying activities undertaken and number of farmers reached.

(1) In 2014, average yield for oranges was 13.2 ton/ha, for grapefruit 12.7 ton/ha, for pomelo 19.4 ton/ha, for tangerine 12.8 ton/ha, for lime 18.0 ton/ha, for tangelo 18.4 ton/ha, and for other citrus fruit 9.4 ton/ha.

Project implementation

The head of the fruit division of ODLOAV will be the principal executor of the project, with inputs from the other ODLOAV divisions (including three citrus nurseries operating under the auspices of ODLOAV) and from ODL staff working on extension, modern media, statistics, and citrus nurseries. The involvement of staff working at the citrus nurseries is due the fact that the project aims to substantially improve the quality of the products developed by these nurseries and at the same time inform farmers and the public in general about the different citrus varieties on offer.

The survey at the beginning of the project will help to identify the problems encountered by citrus farmers in the different resorts, related to soil, variety, cultivation and pests. Possible solutions for these problems, preferably based in ICM and IPM, will be tested and evaluated. This requires inputs from various divisions of ODLOAV and the extension service under ODL.

Table 3 provides an overview of when the different activities are scheduled to be implemented. The bulk of the activities are scheduled for early on in the project. This is also reflected in table 5 (see below), which depicts the staff time that has been budgeted for. There is a major peak in staff time needed in year 2, which coincides with the peaks in the other projects. Some rebalancing of activities may be needed in order to implement the innovation projects simultaneously.

Project partners

Local partners in the project include:

- (a) The citrus nurseries that come under LVV in various constellations – 3 under ODL (2 directly and 1 as a foundation) and 3 under ODLOAV (2 directly and 1 as a foundation);
- (b) The Alliance company;
- (c) Citrus grower associations (?);
- (d) Processing industries SCF (succade) and some local juice processors; and
- (e) IICA.

The principal international partners for the project are EMBRAPA (www.embrapa.br) with regard to new citrus varieties and improved production practices, and Citrolima Citrus Nurseries (www.citrolima.com.br) with regard to professional nursery practices.

Table 3: Activity time table

Activities	Year 1				Year 2				3	4	5
	i	ii	iii	iv	i	ii	iii	iv			
1.1 Study tour private citrus nursery in Brazil			■								
1.2 Propagation protocol	■	■	■	■	■	■	■	■			
1.3 Training nursery staff					■	■	■	■			
1.4 Building composting facilities	■	■									
1.5 Production of 3 YouTube movies on best nursery practices					■	■	■	■	■		
1.6 Production of information brochure for buyers of citrus plants					■	■	■	■			
1.7 Production of YouTube movie on how best to plant and treat					■	■	■	■			
1.8 Upgrade facilities of 6 citrus nurseries	■	■	■	■							
2.1 Study Brazil citrus varieties		■	■	■							
2.2 Acquisition and importation of new varieties		■	■	■							
2.3 Screening and description of imported varieties					■	■	■	■	■	■	
2.4 Selected varieties made available for multiplication										■	■
3.1 Research on the seasonality of citrus species and varieties	■	■	■	■	■	■	■	■	■		
3.2 Develop and release a seasonality chart									■		
4.1 Validation of the compost formula for growing medium	■	■	■	■	■	■	■	■			
4.2 Validation irrigation for out-of-season citrus production									■	■	■
4.3 Validation of legume species in citrus orchards			■	■	■	■	■	■	■	■	
5.1 Survey of current production practices and problems.		■	■	■							
5.2 Literature review		■	■	■							
5.3 Consultation with citrus specialists of EMBRAPA in Brazil		■	■	■							
5.4 Drafting of a citrus production manual					■	■					
5.5 Production of the manual in printed form and electronically							■	■			
5.6 Promotion campaign among citrus farmers							■	■			
5.7 Production of 7 YouTube movies specific good practices					■	■	■	■	■	■	■
6.1 Training courses for some 120 citrus farmers									■		
6.2 On-farm demonstration of best practices									■	■	■

Project Budget

A summary of the budget per output is provided in table 4. The general project cost budget line includes project management, stationary, equipment and vehicles that are not output specific.

Overall budget of the project is close to US\$ 616,000, of which US\$ 362,000 will be financed by the IDB loan and US\$ 254,000 by LVV (mostly salaries). Detailed budget tables are available in Excel form and will be made available as an annex.

Table 4: Budget table

Outputs	Funding	Year 1	Year 2	Year 3	Year 4	Year 5	Total
		<i>(US dollars)</i>					
1. The quality of the planting material supplied by the nurseries improved	IDB	96,570	11,130	200	0	900	108,800
	LVV	2,800	6,010	2,725	0	0	11,535
2. Better-performing citrus varieties identified, imported and screened	IDB	20,470	770	770	770	0	22,780
	LVV	4,130	3,480	3,480	3,880	0	14,970
3. Harvest period of citrus species and varieties identified	IDB	2,082	832	6,232	0	0	9,146
	LVV	16,720	16,720	7,958	0	0	41,398
4. Selected recommendations validated	IDB	42,305	41,055	12,315	795	795	97,265
	LVV	25,726	25,226	25,226	12,613	12,613	101,404
5. New citrus production manual released and promoted	IDB	11,292	18,300	500	500	3,492	34,084
	LVV	6,958	9,463	1,763	1,763	5,371	25,316
6. Citrus farmers informed of and trained in best practices	IDB	0	0	7,122	1,680	1,680	10,482
	LVV	0	0	12,371	11,053	11,053	34,468
General project costs	IDB	40,000	7,500	5,000	5,000	5,000	62,500
	LVV	2,600	2,600	2,600	2,600	2,600	13,000
Subtotal	IDB	212,719	79,587	32,139	8,745	11,867	345,057
	LVV	58,934	63,499	56,122	31,909	31,637	242,090
Contingency 5%	IDB	10,636	3,979	1,607	437	593	17,253
	LVV	2,947	3,175	2,806	1,595	1,582	12,105
Total	IDB	223,355	83,566	33,746	9,182	12,460	362,310
	LVV	61,881	66,673	58,928	33,504	33,218	254,195
	All	285,236	150,240	92,674	42,686	45,679	616,505

Human resources

The human resources that have been budgeted to implement the various activities have been summarized below (see table 5). In its peak year (year 2), this project will command inputs from senior research staff, adding up to some 465 days. With the other projects coming on board at around the same time, not all this staff time may be available – some overall coordination of activities between projects may be needed.

Table 5: Human resources involved in the implementation of the project

Staff	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	<i>(days)</i>					
Research staff – HL	415	465	316	176	195	1,358
Research staff-ML	574	575	379	161	123	1,811
Research staff – LL	208	208	260	208	104	988
Extension staff – HL	2	0	0	0	2	4
Extension staff – ML	5	0	52	52	57	165
Extension staff – LL	69	0	104	104	173	450
Modern media staff – HL	5	43	43	18	18	125
Modern media staff – ML	0	15	15	5	5	40
Modern media staff – LL	0	15	15	5	5	40
Statistics – HL	3.75	0	0	0	3.75	7.5
Statistics – ML	4.25	0	0	0	4.25	8.5
Nursery staff – HL	104	104	104	52	52	416
Nursery staff – ML	208	208	208	104	104	832
Nursery staff – LL	208	208	208	104	104	832

Capital items

Table 6 summarizes the main capital items that will be purchased for the execution of the project. The single biggest investment is that into improved protective structures and composting facilities for the six citrus nurseries in order to provide citrus farmers with good quality planting material.

Table 6: Capital items that will be acquired for the project

Output	Item	Cost	Date of acquisition				
			Year 1	Year 2	Year 3	Year 4	Year 5
Overall project	Vehicle	30,000	1				
	Laptop computer	1,000	2	1			
	Desktop computer	1,500	2	1			
Output 1	Construction of a compost camp 8 X 6 m2	1,000	6				
	Concrete floor	500	6				
	Shredder	2,000	6				
	Wheel barrow	200	6				
	Greenhouse/ protective structure	10,000	6				
	Sprinkler irrigation system	3,000	6				
Output 2	Brush cutter	1,000	1				
Output 3	Brix meter, laboratory equipment	1,000	1				
Output 4	Water tank (3000 l)	1,000			1		
	Pump installation, etc.	650			1		
	Irrigation pipes	2			2,000		

Service contracts

Table 7 summarizes the services that will have to be contracted on behalf of the project.

Table 7: Service contracts

Activity	Service	Price/unit	Date of acquisition				
			Year 1	Year 2	Year 3	Year 4	Year 5
Activity 1.2	Editing services	500		1			
	Printing services	3000		1			
Activity 1.6	Editing services	250		1			
	Printing services	5000		1			
Activity 2.2	Shipping and clearance	200	2				
Activity 2.3	Land clearing and preparation	1000	1				
	Tractor lease	400	1				
Activity 3.2	Editing services	200			1		
	Printing services	5000			1		
Activity 4.1	Detailed chemical analysis	350	12	12			
Activity 4.3	Chemical analysis	350	12	12	12		
Activity 5.5	Editing services	500		1			
	Printing services	15000		1			
Activity 6.2	Soil analysis	354			3		