Document of the Inter-American Development Bank

SURINAME

Economic Impact Assessment of the Programmatic Based Loan PBP

Cost-Benefit Analysis

Project number

(SU-L1033)

Ministry of Agriculture of Suriname,

Economic Analysis

Supported by the IDB

***October 2013***

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| This document was prepared with inputs provided by:  Dr. Rafat Soboh  TERMAC Consultancy & Research  logo8.jpg |

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**List of Acronyms**

ERR Economic Rate of Return

GOS Government of Suriname

IDB Inter- American Development Bank

IP Productivity Index

IRR Internal Rate of Return

LVV Ministry of Agriculture

NPV Net Present Value

PBP Policy Based Programmatic Loan

**Executive Summary**

The PBP has an impact on enhancing the productivity of the agricultural producers and the public expenditure on the agricultural sector. There are indirect impacts on issues such as: the economic performance of other stakeholders of the agricultural supply-chain and welfare of consumers and end users of the agricultural products. The impact on productivity has been given the highest priority, this was assessed by considering the impact of the PBL’s components on the production factors (inputs) of the standard (average farmer) within several sub-sectors. These sub-sectors cover more than 90% of the agricultural production in the country, among these sectors are:

Vegetables: Okra, Tomato, Eggplant, & Soborobo

Cereals: rice

Fruits: Oranges, West Indian Cherries, Passion-fruits, & pineapples

Livestock: Poultry (eggs & meat), Milk production, Meat (beef/cows, sheep & goats, and pigs).

We measured the economic impact using IRR & NPV incorporating the uncertainty in the figures using Monte Carlo simulation methods. The total cost of the PBL is equal to its value during the three years and is divided proportionally according to the expected (and simulated) implementation cost of each component.

# Introduction

This Report presents the Economic and financial Impact assessment of the Policy Based Programmatic Loan (PBP) (SU-L1033) that will be financed through an Inter-American Development Bank (IDB) loan to the Government of Suriname (GOS) for a total of US$ 35 million. This budget will be provided in instalment in three years (US$ 15 million, US$ 10 million and US$ 10 million, respectively). The budget will be provided to the Ministry of Finance of Suriname, while the agricultural ministry (LVV) will be the implementation side of this three-years program. The Program covers all the country of Suriname, but will focus solely on the coastal areas where most of the agricultural activities are conducted. However this structure embeds the risk of non-compliance by LVV particularly in meeting the condition of the second and third tranches. In addition to the compliance risk which will emerge in the election year (i.e. 2015) in order to meet the indicators of the third tranche. The compliance risks must be taken into account in determining the exact economic value added of the PBL to the policy reforms of Suriname.

The analysis will conduct cost- benefit analysis (CBA) based on the incremental benefits of implementing the project. Due to lack of reliable data we used Monte Carlo simulation to reduce the uncertainty of the estimation as much as the existing information allowed us. This policy loans will have several expected (incremental) benefits on the agricultural sector of Suriname. In addition to the direct impact on the productivity of the agricultural producer, an impact will be reached on the public expenditure, the performance of other stakeholders in the agricultural supply chain, the welfare of farming communities, and consumer health. This study focuses mainly on the economic benefits in terms of the productivity of the agricultural producers in Suriname. We measure the NPV & the IRR when the rate in 12%.

The following sections of this report present the economic evaluation of the Program, and the likely impact that the intervention will have on the sector. The details of the methodology employed, the main assumptions made for the estimation of the benefits, and the profitability results obtained, are given in the following sections. The “with and without Program situation” has been analysed for different components and then, incremental benefits have been estimated at economic prices. Section V presents the summary of the evaluation of the Program as a whole. Profitability indicators as the Internal Rate of Return (IRR) and the Net Present Value (NPV) have been calculated for the Program as a whole in section V. Sensitivity analysis has been performed in section VI to show how the economic performance of the Program could be affected by the changes in incremental benefits. Section VII contains a summary discussion about the fiscal impact of the Program. The evaluation of the components of the Program, IRR and NPV for each component, is presented in section VIII. Finally on section IX, the overall conclusion of the evaluation is presented.

This report aims to clarify, in an indicative way, the content and organisation of an ex ante evaluation, it builds on experiences learned from the region and other IDB projects. Many civil servants and experts of Suriname have contributed significantly to verify and consolidate the findings, particularly on the reliability and accessibility of the data. Their contribution is extremely appreciated and we sincerely provide our gratitude to them.

***General information***

Suriname is classified as an upper middle income country with an estimated population of 534,500 and has a surface area of 163820 Km2, and a population density of 3.2 per KM2 (UN-data, 2010). Suriname has an estimated GDP of 4.738 $Billion in 2012 (World Bank data).

Agricultural related activities contributes to about (5-11)% of the total GDP, much of this contribution comes from Rice, Banana, Shrimps and fish exports amounting to about (US$ 30-50 million) accounts to a range of about (8-14) % of total Suriname’s export. The Agricultural Production Index[[1]](#footnote-1) ranges between 95-137 (base year 2005), between 2000-2010. The employment in agriculture accounts to a range of 8-17% of the total work force in Suriname between 2005 and 2012.

This PBP targets to influence mainly the productivity level of the agricultural producers in the country, which will increase the value of production of the agricultural sector and have an indirect impact on the public expenditure and income.

***Objectives***

This policy loan aims at simulating the government of Suriname in its reforms of the agricultural sector in order to increase the value of production of the agricultural sector, focusing on productivity. Relative input prices, improvement of implemented technology, production efficiency, and exposing producers to high health standard are among the factors which contribute to the productivity of the agricultural sector in Suriname. The performance of some activities, such as vegetable and rice plantation, has a large impact on the productivity of agricultural sector and will increase the growth of the sector.

***The objective of the Policy Loan***

**The main objective of the Policy Based Programmatic Loan (PBP)** is to increase the value of production of the agricultural sector by improving productivity in Suriname.In addition**,** increasing the agricultural productivity is expected to have an indirect implication on other related issues such **as poverty, equality, incomes of farmers, and enhance the economic diversity**. Suriname is the least dense country the Caribbean region; less than 3.2 persons per square meter (UN Data, 2010). Thus, Suriname has a strong need for **regional cooperation and integration** particularly when it comes to **agricultural innovation**, **and animal and plant health**. The Policy loan is expected to achieve its objective by tackling several issues affecting the efficiency in the provision of most relevant agricultural services in Suriname and which are largely aligned with highlighted issues of the Surinam’s governmental strategy (white papers).

The **Program is structured as a PBP** consisting of three individual operations in support of a series of institutional and policy reforms in the agriculture sector.

The program consists of 6 main components:

(1) **Macroeconomic stability**;

(2) **Modernization of the Agricultural Statistics;**

(3) **Modernization of the Agricultural Health and Food Safety Services**;

(4) **Agricultural Innovation**;

(5) **Modernization of the Drainage and Irrigation Services;**

(6) **Policy Support for Sustainable Fisheries Management**;

**Program component 3** has been divided into three sub-components: Food safety; Animal health and Plant health. **Program component 4** will tackle two main issues: research and Extension.

This study will focus on the three components which have the most impact on the productivity of the agricultural producers and final impact on the growth of the agricultural sector: (3) **Modernization of the Agricultural Health and Food Safety Services**; (4) **Agricultural Innovation**; & (5) **Modernization of the Drainage and Irrigation Services.**

We recognize the potential impact of well-organized and well-managed fishery sector on the productivity of the fish sector. Nevertheless, to have a reasonable ex-ante economic analysis of component (6) “**Policy Support for Sustainable Fisheries Management”** a strong source of data would be required to reduce the uncertainties associated with the fishery management. Data reliability should be seriously tackled before initiating the economic analysis and performance of the Fishery sector.

The **primary beneficiaries** of PBP are the agricultural producers which are predominantly SMEs (more than 95% of the farmers are small- and medium-size in Suriname[[2]](#footnote-2)).

***Objectives of the Economic Assessment***

The objective of the consultancy is to complete the economic analysis of the proposed PBP, including the economic evaluation of overall benefit and cost streams and the corresponding sensitivity analysis for the operation.

In achieving this objective the following activities were conducted:

Reviewing studies of the structure of agriculture and food of Suriname and the situation of the rural sector. Revise consultancy reports made ​​to the preparation of the program.

Participate in missions as part of the project team or independently, if so required, providing guidance to the members of project teams and national counterparts.

Define the methodology used to evaluate the program, taking into account the nature of the benefits, and define the respective information requirements.

Perform economic evaluation using the methodology agreed once defined the basic elements based on the information collected:

i. Identify, describe, quantify and justify the incremental economic benefits (focusing on the productivity enhancement) associated with the preparation and activities of the program components.

ii. Prepare a Cost-Benefit Analysis (CBA) and calculate the respective Internal Rate of Return (IRR), including a Sensitivity analysis for key variables affecting results.

iii. Based on the economic analysis, identify measurable indicators for the program used to measure its success, and coordinate the preparation of the information needed to design the respective baseline of the policy matrix.

According to the economic evaluation, verify and set goals for performance indicators and impacts of the program.

Collaborate with the Product Support Estimate (PSE) consultant for gathering information and analysing the results.

# Assumptions & Methodology

The PBP loan has three individual loans, although these loans are linked, they are received independently. The Ministry of finance will receive the budget of this loan, however the Ministry of Agriculture (LVV) will have to provide evidence of complying with the triggering conditions of each loan, assumed to be implemented between 2013 and 2015.

***The approach to the Economic Analysis***

The economic evaluation focuses on the impact (benefits) of the policy loan on **the productivity** of the agricultural producers in Suriname. We thus evaluate the benefits (direct & indirect) and costs **of each of the components** of this policy loan **apart** and thereafter aggregate their impact as a whole (**global impact**). Our study uses the concept of the **incremental benefit**, which reflects the benefits that would occur if the loan components are implemented compared to those that would have been obtained if that course of action had not been taken.

To evaluate the economic impact of each component, we select **several agricultural sub-sectors** to analyze the impact on their **production factors**. **These sub-sectors** were selected based on their size of the total agricultural production, governmental policies and importance to the innovation strategies in Suriname.

Thereafter, the global impact is measured to reflect **the total economic value of the policy loan** of each agricultural subsector. We measure the economic value of the impact using both **IRR & NPV measures**. While measuring the NPV & IRR, we tackle the benefits on the **agricultural productivity**.

Economic costs of a PBP should account for incremental costs that result from the implementation of the proposed reforms.  The basis for the allocation of incremental costs should be based on an economy-wide stakeholder analysis.  On that basis, the main stakeholders of the proposed loan are taxpayers, whose costs are measured as incremental government expenditures, and producers, whose costs should be measured as incremental production costs necessary to achieve the purported program´s results.  As a whole, it is expected that the proposed institutional policy reforms have a potential to generate net savings to the economy.  Nonetheless, for the program´s economic analysis, the analyst has chosen to take a conservative approach and has decided to **allocate all US$ 35 million, equivalent to the total costs of the three individual operations which constitute the Policy Based Programmatic loan (PBP)**.

***The Time Frame***

The time frame for the policy loan is **3 years** (2013, 2014 & 2015), however, the impact of it implementation is measured on a period of **10 years** (to include at least two election years in Suriname (2015 & 2020)).

Since our estimations are extremely sensitive to data reliability and the potential biasness of the local experts’ views, sensitivity analysis is conducted using two scenarios (optimistic vs. pessimistic views).

The first step is to focus on the productivity indicator as included in the **results matrix** of the program**.** The **cost structure** of implementing the PBL is only the direct cost of the implementation of each component, using the loan total budget during the three year – as stated above. The division of this budget across the different components is distributed equally in the three components, considering the same implementation cost for each component. The ministry of Agriculture will meet the conditions to trigger the release of the loan and will, therefore, implement the stated components. Particularly in the proposed PBP, there is a preliminary agreement between LVV and the ministry of Finance to all resources from the PBP to complement resources needed to implement the reforms.

The impact structure which reflects the benefits of this PBP is determined by using the concept of **incremental benefits**. To isolate the benefit per subsector and of each component of the PBP, we illustrate the potential impact (benefit) of each component on the input of the production process of plant and livestock subsectors. **Our main focus is at the direct benefit on the productivity level of the agricultural producers in Suriname,** however, we will briefly analyse the indirect effect on the **public budget**, consumers and other stakeholders of the agricultural supply-chain in the country.

***Area (No major changes on cultivated areas is assumed)***

Productivity enhancement can result from either an increase of total output from the currently cultivated areas (no change in area), a stable level of output (no change of output level) from reduced cultivated areas, or from a relatively higher increase in the output to a relatively lower increase in the area cultivated. In Suriname, the general trend is that the cultivated area has been in average declining in the past 5 years by 1% according to official statistics. Also to increase the size of the currently cultivated area seems to be associated with a higher transaction and preparation costs. Thus, an increase in the currently cultivated areas seems to be harder to achieve, and we think it is reasonable to assume for the purpose of this economic analysis that **no major changes in the cultivated area per standard farmer**.

***Methodological Framework***

This policy loan will have several expected (incremental) benefits on the agricultural sector of Suriname. In addition to the direct impact on the productivity of the agricultural producer, an impact will be reached on the public expenditure, the performance of other stakeholders in the agricultural supply chain, the welfare of farming communities, and consumer health.

This study focuses mainly on the economic benefits on the productivity of the agricultural producers in Suriname. Doing that, a focus will be established on the agricultural subsectors which represent the largest number of agricultural producers and reflects the baseline level of the agricultural producers in Suriname. Knowing the diversity of the characteristics of the agricultural producers and the diversity of the productivity levels, we thus propose to establish a view of what we called “*the standard producer*” of the represented sectors of the agricultural subsectors. The standard producer is referred in terms of the input use and size of production. A simulation model was performed to provide an estimated level of the average input use and output per selected subsector. This simulated model aims at incorporating the uncertainties associated with the lack of reliable data. To implement the simulation model we need to have both a value for the estimated average and a value for the estimated uncertainties (minimum & maximum estimated value).

To estimate the without project scenario we used the growth of the past 6 years, and used that information of the increase in value of production in selected products to obtain a simulated forecast for the potential growth in terms of value of production in the coming 10 years.

To estimate the “with- project” scenario, we isolated the impact of each component (and sub-components) on the inputs and output of each subsector. Thereafter, we forecasted the impact of each component on productivity, and then on the estimated incremental benefits per year for the coming ten years. We use Monte Carlo simulation to determine expected value of random variables as the growth rates of incremental benefits**.** The simulated estimations of the incremental are then discounted and used in the estimation of the Net Present Value (NPV) and Internal Rate of Return (IRR).

The discount rate in this study is 12%.

The following steps summarize **the methodology:**

1. To measure the **baseline productivity** level of the **agricultural producers in Suriname**:
   1. Using data found in the **agricultural statistics bulletins** provided by the LVV, we select the important sub**sectors** which represent the **agricultural production in Suriname.** We take into account the sub-sectors which have been identified as the sub-sectors with the **largest** number of **producers** and also identified as sector of attention by the policy makers in the country..
   2. Identify the acceptable **level of input use and output production** of the agricultural producers in Suriname. Using all sources of information available and the opinion of a number of field experts who have a daily contact with agricultural producers. Appendix I summarized this information.
   3. From (b) we obtain simulated values of the **standard farmer** in each subsector selected in (a). The input use is simulated per farmer in each sub-sector. To conduct the simulation we use the **average, the minimum and the maximum estimation of the input use and output production**. These data are validated relevant experts in the country and by using theoretical values. The simulated value of each input is calculated using Montecarlo methodology.
   4. We then provide an estimation of **the productivity** of the so called **standard farmer** of each sector. We give  **weight** for each input depending on the prices and total cost of production within the production process. We calculate an aggregate input and output index for each product.
   5. We then determine **the multifactor productivity** for each commodity and for all agricultural producers in Suriname. The total factor productivity is calculated by aggregating multifactor productivity of each product. We employ a **relative weight** to aggregate subsector indexes. Our **productivity level** (output index/input index) is a randomized variable depending on the simulated input used in each subsector . The relative weight of each sector was measured based on the relative average production of each sector of the past 5 years. Using data provided by LVV in the agricultural statistics bulletins. A snapshot of the simulated productivity level is presented in Appendix II.
2. To measure the **simulation** of the **without project scenario** we:
   1. Estimated the forecasted **growth/decline** of the productivity of the standard producer in each sector obtained in (A) above.
   2. We obtained the data to measure the **forecasted growth** values from the LVV Agricultural Statistics bulletins between 2006 & 2011.
   3. We forecast the estimated values in the coming 10 years.
3. To measure the simulation of the with-project scenario we need:
   1. The simulated impact of each component on the incremental benefit
   2. The summation of the impacts of every component
   3. Measure the NPV & IRR in 10 years.

Our methodological framework is based on evaluating the Net Present Value (NPV) and the Internal Rate of Return (IRR). We use Monte Carlo simulation method to reduce the uncertainty in measuring the division of costs and the incremental benefits.

To measure the NPV we determined the incremental benefits and costs. To implement the Monte Carlo simulation, we also need a growth rate of the incremental benefits allowing addressing uncertainties during the **10 years**.

For each component the following information is needed:

* Expected cash flow ( ) per year (t) from 2013 till 2023 [10 years], which requires to determine:
  + For this we need to determine &
* Evaluation of average growth rate (g) and its standard deviation during the 10 years
* Interest rate (R) which is pre-set to be 12%

NPV =

To estimate the potential benefits of the policy loan, experts were consulted to provide a different view point on the impact on the inputs and output of production process.

**Sensitive analysis**

The sensitivity analysis is based on key variables that could affect net benefits as well as on the benefits themselves. One of the key variables is the impact of the components of the program on productivity. In particular, our assumption is that the simulated average growth of main subsectors is increasing by the impact of the three components on productivity, 6.66%, which is the average impact of the three components. We consider a higher or lower impact (+/-10%; +/-20% and +/-30%).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Average growth of TFP impact | Change | |  | | --- | | **NPV** | | |  | | --- | | **IRR** | | **PI** |
| 6.66 | -10% (6%) | |  | | --- | | **38404.48** | | **36.53%** | **3.56** |
| 6.66 | +10% (7.33) | |  | | --- | | **48133.79** | | **42.07%** | **4.21** |
| 6.66 | -20% (5.33) | |  | | --- | | **28943.91** | | **31.32%** | **2.93** |
| 6.66 | +20% (8) | |  | | --- | | **60270.72** | | **48.57%** | **5.02** |
| 6.66 | -30% (4.66) | |  | | --- | | **20960.34** | | **27.64%** | |  | | --- | | **2.40** | |
| 6.66 | +30% (8.66) | |  | | --- | | **67427.25** | | **50.66%** | |  | | --- | | **5.50** | |

The logic behind the sensitivity analysis depends second on the uncertainties of the estimated benefits per year in which we implement the estimation for minimum, maximum and average values. We analyse the impact on production factors (each input and thus output), assuming the impact on the incremental benefit: -15%, -5%, 5%, 15%, and 20% vs 50% reduction of incremental benefits due to some exogenous factors as the impact of election years (2015 &2020). Some of the factors that could contribute to increase benefits are those that expand productivity, at a higher rate, among others those factors could be: (i) higher level of losses avoidance (or costs saved to the Government and to the farmers) by stepping up the prevention and control of high impact of pest and animal diseases, (ii) higher impact of reduction in the probability of trade disruptions due to plant and animal diseases; (iii) higher level of expansion of the export markets and increased food exports through lower rejections of Suriname’s products by main trading partners and elimination of barriers that arise from the country’s inability to ensure international quality standards and food safety; (iv) higher impact of increase technology adoption through extension and technology transfer; and (v) higher reduction in losses due to wasted resources and cost of infrastructure.

**Selected Agricultural sub-sector**

The selected subsectors account for about 80% of the total agricultural production in Suriname (excluding fisheries), and are those which received the high level of attention in the white papers (long and medium-term policy papers for the Suriname s’ government)

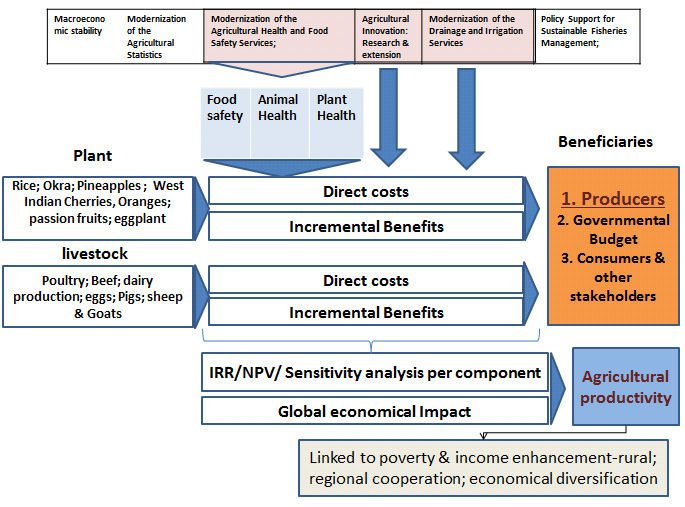
**Plants:**

Rice; Okra; Pineapples (Annanas); West Indian Cherries, Oranges; passion fruits; eggplant;

**Livestock:**

Poultry; Beef; dairy production; eggs; Pigs; sheep & Goat

Figure1: Methodological framework



# Incremental Costs

**Economic costs of a Policy Based Loan** should account for incremental costs that result from the implementation of the proposed reforms.  The basis for the allocation of incremental costs should be based on an economy wide stakeholder analysis, as indicated before.  On that basis, the main stakeholders of the proposed loan are taxpayers, whose costs are measured as incremental government expenditures, and producers, whose costs should be measured as incremental production costs necessary to achieve the purported program´s results.  Taxpayers will have incremental costs in the implementation of the reforms proposed in components 2, 3, 4 and 6; while the reforms to be implemented in component 5 will generate savings to tax payers, as the reforms aim to lead to better coordination and planning of government expenditures in irrigation and drainage.  On the other hand, the most important impact on producer´s costs will come about from the implementation of reforms in component 5, as progressively the maintenance and operation costs of I&D systems will be transferred to producers.  As a whole, however it is expected that the proposed institutional policy reforms have a potential to generate net savings to the economy, as the lion share of government expenditures in the sector take place in irrigation and drainage.  Nonetheless, for the program´s economic analysis, the we have chosen to take a conservative approach and have decided to allocate all US$ 35 million, equivalent to the total costs of the three individual operations which constitute the PBP.

To measure the incremental costs of the policy loan, we estimate the costs per component separately.

To estimate the relative costs of each component to the other, we consider the costs of **implementing** the policy loan (through its components) as a reflection of its implementation considering it as an investment loan. In other words, we divide the value of the Policy loan (35M$) on given equal relative weights (economic size) to each of the components. Table 1 gives the average values of the percentage of direct cost per main of the three components. .

Table 1: Direct costs per component

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| US $ Thousands (x1000) | Year 1 | Year 2 | year 3 | total | Sum | % of DC |
| **Approximation Direct costs /total program -3 years** | **15,000** | **10,000** | **10,000** |  | **35,000** |  |
| **C1: Macroeconomic stability** | 0 | 0 | 0 | 0 |  | 0 |
| **C2: Modernization of the Agricultural Statistics** | ***0*** | ***0*** | ***0*** | **0** |  | **0** |
| **C3: Modernization of the Agricultural Health and Food Safety Services** | ***5,000*** | ***3,333.33*** | ***3,333.33*** | ***11,667*** | ***11,666.7*** | **33** |
| C3.1: Food safety | *1,666.67* | *1,111.11* | *1,111.11* | ***3,889*** |  | **11** |
| C3.2:Animal Health | *1,666.67* | *1,111.11* | *1,111.11* | ***3,889*** |  | **11** |
| C3.3: Plant Health | *1,666.67* | *1,111.11* | *1,111.11* | ***3,889*** |  | **11** |
| ***C4: Agricultural Innovation*** | ***5,000*** | ***3,333.33*** | ***3,333.33*** | ***11,667*** | ***11,666.7*** | **33** |
| C4.1: Research | *2,500* | *1,666.67* | *1,666.67* | ***5,833*** |  | **17** |
| C4.2: Extension | *2,500* | *1,666.67* | *1,666.67* | ***5,833*** |  | **17** |
| ***C5: Modernization of the Drainage and Irrigation Services*** | ***5,000*** | ***3,333.33*** | ***3,333.33*** | ***11,667*** | ***11,666.7*** | **33** |
| ***C6: Policy Support for Sustainable Fisheries Management*** | ***0*** | ***0*** | ***0*** | ***0*** |  | **0** |
| Sum (x1000) | **15,000** | **10,000** | **10,000** | **35,000** |  | **100%** |

Source: own calculation

# Incremental Benefits

In general, the benefits of the PBP will have the following outcomes: **1. enhancing farmers productivity, 2. reduction of public expenditure ( or increase of public taxes return), 3. The performance of other stakeholders in the agricultural supply chain, 4. The welfare of farming communities, and 5. Consumer health.**

The above benefits are classified into:

1. **direct: 1. Enhancing farmers productivity** & 2. Impact on public expenditure
2. indirect: 3. The performance of other stakeholders, 4. The welfare of farming communities, 5. Consumer health.

**In this study our focus is the benefits on enhancing the productivity level of the agricultural producers.** This is due to the impact on the largest number of beneficiaries (small & medium size agricultural producers) of the policy loan. This is not to undermine the other direct and indirect impacts of this policy loan; however data availability and reliability is the main obstacle.

**Our approach** to the incremental benefits of the PBP is to investigate the impact (benefits) of each component in the framework of the benefits of the productivity.

1. **Benefits on farmers’ productivity, Total Factor Productivity (TFP)**

To evaluate the impact (benefits) on the farmers’ productivity, we establish the **production model (average input use to produce the average size of output)** of the **standard farmer in Suriname of the above mentioned sectors**. In Suriname, the standard farmer has the following characteristics:

1. Mixed farming activities: almost all farmers (more than 95%) in Suriname have mixed farming activities (apart from Rice), in the sense that different agricultural activities are being conducted at the same location and time (different vegetables or different vegetable sorts combined with livestock).

***Table 2: Characteristics of the rice, vegetables and fruits producers in Suriname***

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop** | **Type of activity** | | **Labour** | | | | | | | **Area (hectare)** | | |
|  | **Mixed** | **Specialised** | **Family** | **Paid labour** | | **Gender** | | **20 hour per week** | | **Min** | **average** | **Max** |
|  |  |  |  | Seasonal | Fixed | M | F | less | More |  |  |  |
| Rice | 5% | 95% | 80 % | 20% | 5% | 93% | 6% | 65% | 35% | 2 | 100 | 500 |
| Okra | 100% | 0% | 99 % | 1% |  | 75% | 25% | 75% | 25% | 0.01 | 0.7 | 1 |
| Soporobo | 100% | 0% | 99 % | 1% |  | 80% | 20% | 75% | 25% | 0.01 | 0.7 | 1 |
| Tomato | 100% | 0% | 98 % | 2% |  | 85% | 15% | 75% | 25% | 0.01 | 0.7 | 1 |
| Egg-plant | 100% | 0% | 99 % | 1% |  | 80% | 20% | 75% | 25% | 0.01 | 0.7 | 1 |
| Passion fruit | 0% | 0% | 99 % | 1% |  | 95% | 5% | 95% | 5% | 0.5 | 2 | 5 |
| Oranges | 0% | 0% | 99 % | 1% |  | 97% | 3% | 95% | 5% | 1 | 5 | 10 |
| Pineapple | 0% | 0% | 99 % | 1% |  | 95% | 5% | 95% | 5% | 4 | 10 | 20 |
| W.I. cheers | 0% | 0% | 99 % | 1% | 5% | 98% | 2% | 95% | 5% | 1 | 3 | 6 |
| Total |  |  | 97% | 3% | | 83% | 17% | 80% | 20% |  |  |  |

Source: LVV 2013

***Table 3: Characteristics of the livestock producers in Suriname***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sub-Sector** | **Product** | **Average size of farm**  **( # animal)** | **Annual  Production**  **(specify units)** | **Farm gate**  **Price**  **(SRD per kg)** | **Annual Animal Feed**  **Production**  **(Kilos)** |
| Poultry | Meat | 10-49 | 11.387 ton | 9,85 | 22.978 ton |
|  | Eggs | 10-49 | 54.418.000 pieces | 0,81 piece | 8.765 ton |
| Cattle | Beef | 5-9 | 1.850 ton | 20,25 | 313 ton |
|  | Dairy | 3-4 | 6.000.000 litre | 2,50 | - |
| Sheep & Goats |  | 5-9 & 10-19 | 15,2 ton | 37,38 | - |
| Pigs |  | 5-9 | 1.851 ton | 10,54 | 451 ton |

Source: LVV 2013

To measure the productivity impact on agricultural producers (farmers) we identify what we called the standard Suriname’s famer in the following sub-sectors (See appendix I for more detailed information):

Vegetables: (1) okra; (2) Soprobo; (3) Tomato; (4) Eggplant

Cereals: (1) Rice

Fruits: (1) W.I. Cherries; (2) Oranges (3) Pineapple; (4) Passion fruit

Livestock (animal production): (1) Poultry; (2) Milk production; (3) Meat (cows/ beef/ goat/ sheep); (5) Meat (Pigs)

***Impact matrices***

These matrices reflect the expected impact on the productivity of the agricultural producers in Suriname.

The signal (+) represents a positive impact of this intervention on the factor of production or the production level, included in the Total Factor Productivity measure. Expected average impact on Yield identified is supported with the literature on the effectiveness of similar interventions. For **Component 4: Agricultural Innovation** Multiple studies have shown the importance of proper planning, monitoring and evaluation system for improved agricultural productivity (Gijsbergs et al, 2001, and World Bank, 2008). In Suriname there is a lack of critical mass of researchers in the system. As consequence, the research and extension activities and results are very much undermined. Less than 20% of the farmers receive extension services and there are no records of recent publicly funded widespread transfer of anyone technology (LVV, 2009).. Studies examining the worldwide context of research and agricultural extension have concluded that improved human resources and infrastructure capacities foster sector’s productivity (Pardey, P. et al, 2008).

For **Component 3: Modernization of the Agricultural Health and Food Safety Services,** a compilation of studies analyzing the impact of different programs of agricultural health financed by the Bank in Peru, Ecuador, Uruguay and Belize presents positive evidence of the impact that this kind of intervention has (OVE, 2009). In the case of Peru, the assessments conducted suggest that these interventions significantly reduced the prevalence of zoo sanitary diseases (for llamas) and reduced the presence of Fruit Flies. In the latter case, the improvements translated into higher prices and better yields of agricultural products (GRADE, 2008a). Furthermore, the improvement in Peru’s sanitary status improved its bargaining power with respect to other countries, creating opportunities for commercialization in international markets (GRADE, 2008b).

For **Component 5: Modernization of the Drainage and Irrigation Services,** having a healthy and dynamic irrigated agricultural sector has been associated with improvements in rural productivity, food security and households' income. Agricultural water management boosts total farm output. Increased output may arise from improved yields, reduced crop loss, improved cropping intensity, and increased cultivated area. Reliable access to water enhances the use of complementary inputs such as high-yielding varieties and agrochemicals, which also increases output levels (Smith 2004; Bhattarai and Narayanamoorthy 2003; Hasnip and others 2001; Hussain and Hanjra 2003, 2004; Huang and others 2006). Food and Agriculture Organization (FAO 2003) data show that the major sources of growth in crop production for all developing countries during 1961–99 were yield increase (71%), area expansion (23%), and cropping intensity (6%). Irrigation contributes to agricultural growth by raising the productivity of land and labour (and complementary inputs such as improved seed and fertilizer). Benefits have linkages within the rural economy can also spread the gains more widely. Increased productivity irrigation has a multiplier effect of on the economy has been estimated at 2.5–4 (Bhattharai, Barker, and Narayanamoorthy forthcoming; Lipton, Litchfield, and Faurès 2003; Huang and others 2006).

We have presented the total impact in terms of minimum and maximum based on the reasonable expectation of these experts on the potential impact of each component separately. Due to the importance of providing reliable statistics, we present the potential impact of the modernization of the agricultural statistics. We separate the impact matrix between the plant (Table 4) and livestock sectors (Table 5). Table 4 and 5 present the change in productivity for the innovation, agricultural health and drainage and irrigation. The information of those changes was obtained with conversations of local experts (LVV technical staff and Universities’ researchers) in each of the components. In order to validate such information, the yield change for most of the products used for the economic analysis, which is assumed that will grow steadily for 10 years, is compared to the yield gap of the best LAC country producer of the specific product. Table 6 shows most of the expected yield changes are at least 50% less than the yield gap; indicating that the assumptions of the yield change are quite conservative.

* ***Explanation of the Impact matrices***

The impact matrix was determined based on the expected impact on the production factors of each component. For instance a positive impact is expected from enhancing the research on the seeds quality & productivity, on the use of pesticide, the effectiveness of the production technology used and the use and effectiveness of the fertilizers. Although the exact impact on the inputs is not evaluated it is assumed to be equal per input. The expected impact on output, however, is estimated based on the weight of each input in the production technology. In other words, the average weight of using kilograms of seeds to produce 1 kilogram of output of the subsectors included in this study. The values were given as a range values to incorporate the uncertainties of the estimation associated with values within the production model and the views of the relevant experts involved with the farmers. Although the views of local experts are the most accurate we could get, given the weak availability of data, we have always incorporated an uncertainty factor and provided a simulation of each value.

*Table 4: Productivity (TFP) Impact Matrix (plant: vegetables & fruits)*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Component 4: Agricultural Innovation** | | **Component 3: Modernization of the Agricultural Health and Food Safety Services** | | | **Component 5: Modernization of the Drainage and Irrigation Services** |
| Research | Extension | Plant Health | Animal Health | Food safety |
| Input | | | | | | |
| Seeds | + | + |  |  |  |  |
| Pesticides | + | + | + |  | + |  |
| Labor-capacity |  | + |  |  |  |  |
| Water (irrigation & drainage) |  |  |  |  |  | + |
| Machines (equipment) |  | + |  |  |  |  |
| Technology (effectiveness & implementation) | + | + |  |  |  | + |
| Fertilizers | + | + | + |  | + | + |
| Output (productivity) | | | | | | |
| Average impact on Yield | +(1-4)% | +(5-11) % | +(3- 6)% |  | + (1-2)% | + (6- 10)% |

Table 5 provides the results of the impact on the livestock sectors included in our study.

*Table 5: Productivity (TFP) -Impact matrix Livestock*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Component 4: Agricultural Innovation** | | **Component 3: Modernization of the Agricultural Health and Food Safety Services** | | | **Component 5: Modernization of the Drainage and Irrigation Services** |
| Research | Extension | Plant Health | Animal Health | Food safety |
| Input | | | | | | |
| Number of healthy animal | + | + |  | + | + |  |
| Labor-capacity |  | + |  |  |  |  |
| Veterinary services | + | + |  | + | + |  |
| Technology (effectiveness and implementation) |  | + |  |  |  | + |
| Feed | + | + | + | + |  | + |
|  | | | | | | |
| Average impact on Yield | +(0-1)% | +(2-6)% | +(0-1)% | +(2-4)% | +(1-3)% | +(0-1)% |

Source: The percentages are based on the input from highly local and relevant experts

|  |  |  |  |
| --- | --- | --- | --- |
| *Table 6. Comparing Yield Gap versus Yield Growth* | |  |  |
| Product | Yield Gap Best Country in LAC |  | Yield Growth in 10 years (%) |
|  |  |  |  |
| Rice, paddy | 102.8 |  | 65.0 |
| Cabbages and other brassicas | 125.1 |  | 35.2 |
| Grapefruit | 111.0 |  | 35.2 |
| Oranges | 119.3 |  | 35.2 |
| Pineapples | 348.8 |  | 35.2 |
| Tomatoes | 544.3 |  | 35.2 |
| Cattle | 102.7 |  | 45.3 |
| Cow milk, whole, fresh | 88.4 |  | 45.3 |
|  |  |  |  |
| Source: FAOSTAT 2011, Interviews an Experts in Suriname | | | |

# Economic Return

In this section, we present the results of the impact on productivity and the ERR and NPV of the three components: (3) **Modernization of the Agricultural Health and Food Safety Services**; (4) **Agricultural Innovation**; & (5) **Modernization of the Drainage and Irrigation Services.**

***Baseline productivity level***

Following our methodology, we present the baseline productivity ratio presented in Table 7 (snapshot following Montecarlo simulation).

Table 7: The average, minimum & maximum productivity ratio at the baseline.



For each of the subsector the multifactor index represent production related to total inputs expressed in quantities. An index over 1.00 is considered a good performance for the subsector.

***Without project scenario***

The productivity level in the coming year is projected based on the growth factor of the previous years. We simulated the forecasted growth in the coming years based using the following steps

Step1: we start from the simulated results of the current level of productivity. Step2: we measure a simulated value for the potential growth in the productivity per year based on the following formula: (current Productivity level) \* (1+growth)/1+ IRR => IRR is equal 12%; growth is simulated with (mean 0.1977 the average growth of the main subsectors (2006-2011) from data provided by the LVV; and standard deviation is 0.140017. see sheet average Suriname production.

Current productivity level is the average of the multifactor productivity for the 13 subsector considered in the analysis, simulated value considering Montecarlo randomized use of inputs.

*Table 8: Projection of the productivity level based on the without project scenario*



*With-project Scenario*

Starting with the impact matrices, the simulated level of growth value of the current level of productivity could be presented. The productivity increase has been simulated according to simulated growth. In table 9 below we provide a snapshot of the simulation. For this new scenario the simulated average growth of main subsectors are increasing by the impact of the three components on productivity, 6.66%, which is the average impact of the three components presented in Tables 4 and 5. Taking this snapshot table 9 shows that as a result of the PBP, the total factor productivity index of the agricultural sector will be increasing at a higher rate.

*Table 9: Projection of the productivity level based on the with-project scenario* 

***The ERR & the NPV of the Project***

## The results of the cost-benefit analysis and the profitability indicators obtained from the simulated model, considered for the whole program, are presented in Table 9, 10 and 11. The IRR and the NPV at a discount rate of 12 per cent are 22 per cent and US$ 11 million, respectively (for this snapshot).

*Table 9: Initial information of the project*

|  |  |
| --- | --- |
| Value of initial investment | 35 million $ divided on three years: 15,000; 10,000 & 10,000 |
| Current level on economic value based on the average of the past 3 years (monetary value of agricultural output) | 28,927  ‘000 US$ |
| Discount rate | 12 % |
| Simulated growth rate of the incremental benefit (standard deviation) | 20%  (0.14) |
| Estimated incremental benefit on productivity ratio in year1 | 0.17 |
| Estimated net incremental benefit (economical value \* estimated productivity impact ration) | 1,927.28  ‘000 US$ |

Table 10: Overall NPV estimation



Figure

Table 11: Overall NPV & ERR Results

|  |  |  |
| --- | --- | --- |
| **NPV** | **NPV formula** | **‘000 US $**  **26,156.35** |
| **ERR** |  | **29.88%** |
| PI | productivity index (-NPV/ initial investment) | **2.74** |

***Discussion of the ERR & NPV results***

From the above snapshot of the simulation, the results of the NPV indicated a positive value which suggests that the project- based only on the impact of three components on the productivity level of the producers- can be accepted. Also the value of the ERR indicated a larger return than the benchmark (12%) for all the 10.000 simulations. Note also that productivity index is more than 1.

This results are based only on the three components: (3) **Modernization of the Agricultural Health and Food Safety Services**;(4) **Agricultural Innovation**; & (5) **Modernization of the Drainage and Irrigation Services.** The impact only focuses on the impact on the farmers productivity. The results are based on thousands of simulations. All other impacts if analysed have positive contribution to the overall net benefit and thus even higher value of NPV and ERR.

According to the above results, the project **can be accepted.**

# Sensitivity Analysis

The sensitivity analysis is based on key variables that could affect net benefits as well as on the benefits themselves. One of the key variables is the impact of the components of the program on productivity. In particular, our assumption is that the simulated average growth of main subsectors is increasing by the impact of the three components on productivity, 6.66%, which is the average impact of the three components. We consider a higher or lower impact (+/-10%; +/-20% and +/-30%).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Average growth of TFP impact | Change | |  | | --- | | **NPV** | | |  | | --- | | **IRR** | | **PI** |
| 6.66 | -10% (6%) | |  | | --- | | **38404.48** | | **36.53%** | **3.56** |
| 6.66 | +10% (7.33) | |  | | --- | | **48133.79** | | **42.07%** | **4.21** |
| 6.66 | -20% (5.33) | |  | | --- | | **28943.91** | | **31.32%** | **2.93** |
| 6.66 | +20% (8) | |  | | --- | | **60270.72** | | **48.57%** | **5.02** |
| 6.66 | -30% (4.66) | |  | | --- | | **20960.34** | | **27.64%** | |  | | --- | | **2.40** | |
| 6.66 | +30% (8.66) | |  | | --- | | **67427.25** | | **50.66%** | |  | | --- | | **5.50** | |

The logic behind the sensitivity analysis depends second on the uncertainties of the estimated benefits per year in which we implement the estimation for minimum, maximum and average values. We analyse the impact on production factors (each input and thus output), assuming the impact on the incremental benefit: -15%, -5%, 5%, 15%, and 20% vs 50% reduction of incremental benefits due to some exogenous factors as the impact of election years (2015 &2020). As pointed in the assumptions section, some of the factors that could contribute to increase benefits are those that expand productivity at a higher rate, among others those factors could be: (i) higher level of losses avoidance (or costs saved to the Government and to the farmers) by stepping up the prevention and control of high impact of pest and animal diseases, (ii) higher impact of reduction in the probability of trade disruptions due to plant and animal diseases; (iii) higher level of expansion of the export markets and increased food exports through lower rejections of Suriname’s products by main trading partners and elimination of barriers that arise from the country’s inability to ensure international quality standards and food safety; (iv) higher impact of increase technology adoption through extension and technology transfer; and (v) higher reduction in losses due to wasted resources and cost of infrastructure. Appendix III includes a detail description of potential benefits for the component 3: Modernization of the Agricultural Health and Food Safety Services.

From the results below, the NPV remains positive for most of the cases (sensitivity levels). We have to note that at a reduction level of above 15% in the incremental benefits, still have a positive NPV value.. From our simulation results a reduction in the incremental benefits of at most 15% will always produce positive results.

Apart from that level all results suggested a positive in terms of the NPV and the values of the ERR are above 12%. Note the value of the productivity index to be above 1.

Table 12: A simulation of the Sensitivity Results (Snapshot).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | value | NPV | IRR | PI |
| sensitivity analysis |  | Chage in incremental Benefit | current | 26,156.35 | 29.88% | 2.74 |
|  |  | -15% | 19,982.90 | 26.87% | 2.33 |
|  |  | -5% | 28,668.87 | 31.58% | 2.91 |
|  |  | 0% | 26,156.35 | 29.88% | 2.74 |
|  |  | 5% | 28,214.17 | 30.78% | 2.88 |
|  |  | 15% | 32,329.81 | 32.48% | 3.16 |

# Additional Analysis

**Governmental- budget**

The impact of the PBP on the governmental budget is two folded: 1. either on a reduction of the current expenditure or 2. on the increase of taxes return and export tariffs. Table 13 gives a summary of the proportional expenditure per component of the governmental budget to agriculture. We can notice that drainage and irrigation takes the highest proportion of the public expenditure among all the components.

Table 13: proportional current budget expenditure on the different components (LVV 2012)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Component | **Component 2:**  **Modernization** **Agricultural Statistics** | **Component 3: Modernization of the Agricultural Health and Food Safety Services** | **Component 4: Agricultural Innovation** | **Component 5: Modernization of the Drainage and Irrigation Services** | **Component 6:Policy Support for Sustainable Fisheries Management** |

A reduction of the public expenditure on each component is the major benefits of the PBP to the governmental budget, however, the increase of taxes return due to increase in the farmers productivity and size of exports is considered also a benefit to the Governmental budget.

Table 14: Governmental- budgetary impact Matrix ( post-project)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Component 4: Agricultural Innovation** | | **Component 3: Modernization of the Agricultural Health and Food Safety Services** | | | **Component 5: Modernization of the Drainage and Irrigation Services** | Agricultural Statistics |  |
| Research | Extension | Plant Health | Animal Health | Food safety |
| Ministries | | | | | | | |  |
| Ministry of Finance | + | + | + | + | + | + | + |  |
| Agricultural Ministry | + | + | + | + | + | + | + |  |
| Health ministry |  | + | + | + | + |  |  |  |
| Ministry of Regional development |  |  |  |  |  | + | + |  |
| Trade Ministry | + | + | + | + | + | + | + |  |
| Ministry of Public works | + | + | + | + |  | + | + |  |
| **Average impact on overall Public Budget (%)** |  |  |  |  |  |  |  |  |

Table 15: Impact on consumer and other stakeholders

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Component 4: Agricultural Innovation** | | | **Component 3: Modernization of the Agricultural Health and Food Safety Services** | | | | | **Component 5: Modernization of the Drainage and Irrigation Services** | Agricultural Statistics |  |
| Research | | Extension | Plant Health | | Animal Health | Food safety | |
|  | Stakeholder | | | | | | | | | |  |
| Consumer |  | |  |  | |  | + | |  | + |  |
| Traders (exporters) | + | |  | + | | + | + | |  | + |  |
| Processing industry (including postharvest) | **+** | **+** | | | **+** | **+** | | **+** | **+** | **+** |  |

# The ERR & NPV results of each component

Table 16: Component 3 (Montecarlo simulation Snapshot).



|  |  |
| --- | --- |
| NPV | 13,473.01 |
| IRR | 37% |
| PI | 3.69 |

Table 17: component 4 (Montecarlo simulation Snapshot).



|  |  |  |
| --- | --- | --- |
| NPV | |  | | --- | | 763.64 | |
| IRR | 14% |
| PI | 1.15 |

Table 18: NPV calculation of Component 5 (Montecarlo simulation Snapshot).



|  |  |
| --- | --- |
| NPV | 11,919.7 |
| IRR | 35% |
| PI | 3.4 |

# Conclusions

The reliability and availability of relevant data was a major concern for conducting the economic analysis of this policy loan. We have simulated all data obtained from the Suriname’s government as our attempt to address any biases in the values. Also we have obtained valuable figures from many relevant experts, secondary information and empirical international evidence, who deal on a daily basis with farmers in Suriname- simulating these inputs we obtained a value for the farmer (plant & livestock).

The project indicate a positive values in terms of the NPV and a higher value of the ERR than the 12%. Thus, our results indicate that the project can be accepted. The economic analysis has only included three components of six suggested in the initial study focusing mainly on the productivity enhancement. There are other direct and indirect impacts which all has a potential positive contribution (as indicated in tables: 14 & 15) to the results obtained in this analysis.

The sensitivity results indicated that if the incremental benefits estimated in this study is less than 15% the simulated results produce 100% positive value for the NPV. Furthermore, the fact that the other direct (Governmental budget) and indirect (i.e. consumers and other stakeholders) benefits were not included in the above analysis, the results of the overall impact will be enhanced positively.

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# Appendix I:

Level of Input use and output production

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RICE** | **Quantity** | | **Average prices (2013)** | |
| **SRD** | |
|  | **Average** | **Range** | **Average** | **Range** |
| Labor (hour per week) | 23 | 20-25 | 9 | 7-10 SRD/hour |
| Area (hectare) | 100 | [10-500 [1]](file:///D:/DATA.IDB/Suriname/Analisis%20Economico/working-file%20(only%20productivity)%204CF.xlsx#RANGE!_ftn1) |  |  |
| Seeds (Kg/hectare) | 170 | 150-180 | 18 | 15-20 SRD |
| Fertilizer (Kg/hectare) | 0.250 | 0.230-0.270 | 235 | 220-250 SRD |
| [Pesticides/chemicals[2] (Kg/hectare)](file:///D:/DATA.IDB/Suriname/Analisis%20Economico/working-file%20(only%20productivity)%204CF.xlsx#RANGE!_ftn2) | 0.650 | 0.5- 1.0 | 38 | 25-62 |
| [Water use[3] (SRD)](http://en.wikipedia.org/wiki/John_Wiley_%26_Sons#RANGE!_ftn3) | 5070 | 5050-6000 | 150 | 140-160 |
| [Machinery[4] (PK/hectare)](file:///D:/DATA.IDB/Suriname/Analisis%20Economico/working-file%20(only%20productivity)%204CF.xlsx#RANGE!_ftn4) | 5 | 3 \_ 7 | 6000 SRD | 1228-13000 |
|
| [Transportation[5] –Km](http://en.wikipedia.org/wiki/International_Standard_Book_Number#RANGE!_ftn5) | 110.8 | 100-120 | 15,000 SRD/Km | 13,000- 17800 |
|
| Output (KG/Hectare)- per season | 4800 | 4500-5700 |  |  |
|
| Price at farm gate (SRD) |  |  | 815 | 800-830 |
| Price export/market (SRD) |  |  | 1876 | 1700- 1900 |
| Specialization | 98% |  |  |  |
|
| Season per year | 2 |  |  |  |
|  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Standard vegetables farmer ( Okra ) | |  |  |  |
| **Okra** | **Quantity** | | **Average prices (2013)** | |
|  |  | | **(SRD)** | |
|  | **Average** | **Range** | **Average** | **Range** |
| Labor (hour per week) | 20 | 16-24 | 10 | 7.5-12 |
| Family labor | 95% | 93-98% |  |  |
| Area (hectare) | 0.5 | 0.3-0.8 |  |  |
| Okra density (#plants per pole) | 2 | 2\_4 |  |  |
| Soil type: 90% klei 10% sandy-soil |  |  |  |  |
| Seeds (Kg/hectare) | 90 | 80-100 | 2000 | 1864-2330 |
| [4 seeds per Pole à400 pole per ketting[6] à 2,33 ketting per hectare](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A319) |  |  |  |  |
| Fertilizer (Kg/hectare) | 0.27 | 0.220-0.336 | 1000 | 783-1174 |
| NPK 1515172 |  |  |  |  |
| 15 gram per plant (2-3 plants per pole) each three weeks  plant lives 6-9 months  8-12 times per season per plant |  |  |  |  |
| Leafs fertilizer (liter/hectare/season) | 20 | 18.6- 27.9 | 25 | 15-30 |
| 500 ml/ ketting  once each three weeks |  |  |  |  |
| Pesticides/chemicals (liter/hectare/season) | 2.9 | 2.33- 3.66 | 95.5 | 93.2-97.9 |
| [Water use[7] (Liter)](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A320) | 2097 | 1500-2500 | 62 SRD | 50- 85 SRD |
| Machinery (PK/hectare) | 2 | 1\_5 | 8000 | 7000- 9000 |
| 45% of the farmers no machinery, 5% of the farmers have advanced and expensive tractor- (6000$) about 50% of farmers have two wheels/cheap tractors |  |  |  |  |
| Energy cost | 15 | 10\_20 | 73.5 | 49.0-98.0 |
| Output (KG/Hectare)- Per season | 1865 | 1165-2330 |  |  |
| Price at farm gate (SRD) |  |  |  |  |
| Market (consumer) price (SRD) |  |  |  |  |
| Specialization | 1% | 0-2% |  |  |
| Almost all okra famers are mixed farmers (no recorded figure |  |  |  |  |
| Season per year | 1 |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Standard Eggplant farmers |  |  |  |  |
| **Item** | **Quantity** |  | **Average prices (2013)** |  |
|  |  |  | **(SRD)** |  |
|  | **Average** | **Range** | **Average** | **Range** |
| Labor (hour per week) | 20 | 16-24 | 10 | 7.5-12 |
| Family labor | 93% | 90-95% |  |  |
| Area (hectare) | 0.5 | 0.3-0.8 |  |  |
| Eggplant density (#plants per pole) | 2 | 2\_4 |  |  |
| Soil type: 50% klie 50% sandy-soil |  |  |  |  |
| Seeds (Kg/hectare) | 0.11 | 0.10-0.12 | 2000 | 1864-2330 |
| [4 seeds per Pole à400 pole per ketting[8] à 2,33 ketting per hectare](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A323) |  |  |  |  |
| Fertilizer (Kg/hectare) | 0.27 | 0.220-0.336 | 1000 | 783-1174 |
| NPK 1515172 & Urea |  |  |  |  |
| 15 gram per plant (2-3 plants per pole) each three weeks  plant lives 6-7 months  7-10 times per season per plant |  |  |  |  |
| Leafs fertilizer (liter/hectare/season) | 20 | 18.6- 27.9 | 25 | 15-30 |
| 500 ml/ ketting  once each three weeks |  |  |  |  |
| Pesticides/chemicals (liter/hectare/season) | 2.9 | 2.33- 3.66 | 95.5 | 93.2-97.9 |
| [Water use[9] (Littre/hectare / season)](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A324) | 1850 | 1300-2100 | 57 SRD | 50- 85 SRD |
| Machinery (PK/hectare) | 2 | 1\_5 | 8000 | 7000- 9000 |
| 45% of the farmers no machinery, 5% of the farmers have advanced and expensive tractor- (6000$) about 50% of farmers have two wheels/cheap tractors |  |  |  |  |
| Energy cost (transportation) | 15 | 10\_20 | 73.5 | 49.0-98.0 |
| Output (KG/Hectare)- Per season | 1400 | 1250-1680 |  |  |
| Price at farm gate (SRD) |  |  |  |  |
| Market (consumer) price (SRD) |  |  |  |  |
| Specialization | 1% | 0-2% |  |  |
| Almost all Eggplant famers are mixed farmers (no recorded figure |  |  |  |  |
| Season per year | 2 |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Standard Soporobo farmer |  |  |  |  |
| **Item** | **Quantity** |  | **Average prices (2013)** |  |
|  |  |  | **(SRD)** |  |
|  | **Average** | **Range** | **Average** | **Range** |
| Labor (hour per week) | 20 | 16-24 | 10 | 7.5-12 |
| Family labor | 96% | 93-98% |  |  |
| Area (hectare) | 0.5 | 0.3-0.8 |  |  |
| Soporopo density (#plants per m2) | 2 | 2-Apr |  |  |
| Soil type: 50% klie 50% sandy-soil |  |  |  |  |
| Seeds (Kg/hectare) | 0.9 | 0.800-1 | 2000 | 1864-2330 |
| [4 seeds per Pole à400 pole per ketting[10] à 2,33 ketting per hectare](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A329) |  |  |  |  |
| Fertilizer (Kg/hectare) | 0.25 | 0.220-0.336 | 1000 | 783-1174 |
| NPK 1515172 |  |  |  |  |
| 10 gram per plant (2-3 plants per pole) each three weeks  plant lives 5-6 months  8-12 times per season per plant |  |  |  |  |
| Leafs fertilizer (liter/hectare/season) | 20 | 18.6- 27.9 | 25 | 15-30 |
| 500 ml/ ketting  once each three weeks |  |  |  |  |
| Pesticides/chemicals (liter/hectare/season) | 2.9 | 2.33- 3.66 | 95.5 | 93.2-97.9 |
| [Water use[11] (Littre)](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A330) | 2097 | 1500-2500 | 62 SRD | 50- 85 SRD |
| Machinery (PK/hectare) | 2 | 1\_5 | 8000 | 7000- 9000 |
| 45% of the farmers no machinery, 5% of the farmers have advanced and expensive tractor- (6000$) about 50% of farmers have two wheels/cheap tractors |  |  |  |  |
| Energy cost | 15 | 10\_20 | 73.5 | 49.0-98.0 |
| Output (KG/Hectare)- Per season | 1865 | 1165-2330 |  |  |
| Price at farm gate (SRD) |  |  |  |  |
| Price export/market (SRD) |  |  | 1,876 | 1.700- 1.900 |
| Specialization(planting only soprobo) | <1% | 0-2% |  |  |
| Almost all soprobo famers are mixed farmers (no recorded figure |  |  |  |  |
| Season per year | 2 |  |  |  |
|  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Standard Tomato farmer |  |  |  |  |
| **Item** | **Quantity** |  | **Average prices (2013)** |  |
|  |  |  | **(SRD)** |  |
|  | **Average** | **Range** | **Average** | **Range** |
| Labor (hour per week) | 20 | 16-24 | 10 | 7.5-12 |
| Family labor | 93% | 90-95% |  |  |
| Area (hectare) | 0.5 | 0.3-0.8 |  |  |
| Tomato density (#plants per pole) | 2 | 2-Mar |  |  |
| Soil type: 30% clay 70% sandy-soil |  |  |  |  |
| Seeds (Kg/hectare) | 0.160 | 0.120-0.180 | 200 | 35-330 |
| [2 seeds per Pole à400-800 pole per ketting[12] à 2,33 ketting per hectare.](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A331) |  |  |  |  |
| There are different quality of tomato seeds (prices vary strongly) |  |  |  |  |
| Fertilizer (Kg/hectare) | 270 | 220-336 | 1000 | 783-1174 |
| NPK 1515172 7 nitrogen |  |  |  |  |
| 15 gram per plant (1-2 plants per pole) each three weeks  plant lives 4-5 months  8-12 times per season per plant |  |  |  |  |
| Leafs fertilizer (liter/hectare/season) | 20 | 18.6- 27.9 | 25 | 15-30 |
| 500 ml/ ketting  once each three weeks |  |  |  |  |
| Pesticides/chemicals (liter/hectare/season) | 2.9 | 2.33- 3.66 | 95.5 | 93.2-97.9 |
| [Water use[13] (Liter)](file:///D:\\DATA.IDB\\Suriname\\Analisis%20Economico\\working-file%20(only%20productivity)%204CF.xlsx" \l "RANGE!A332) | 2097 | 1500-2500 | 62 SRD | 50- 85 SRD |
| Machinery (PK/hectare) | 2 | 1\_5 | 8000 | 7000- 9000 |
| 45% of the farmers no machinery, 5% of the farmers have advanced and expensive tractor- (6000$) about 50% of farmers have two wheels/cheap tractors |  |  |  |  |
| Energy cost | 15 | 10\_20 | 73.5 | 49.0-98.0 |
| Output (KG/Hectare)- Per season | 4000 | 3000-5000 |  |  |
| Price at farm gate (SRD) |  |  |  |  |
| Price export/market (SRD) |  |  |  |  |
| Specialization | 30% | 25-35% |  |  |
| Almost all okra famers are mixed farmers (no recorded figure |  |  |  |  |
| Season per year | 3 | 2-Mar |  |  |
|  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pineapple famers |  | |  | |  | |  | |
| **Item** | **Quantity** | |  | | **Average prices (2013)** | |  | |
|  |  | |  | | **(SRD)** | |  | |
|  | **Average** | | **Range** | | **Average** | | **Range** | |
| Labor (average hour per week) | 5 | | 4\_7 | | 10 | | 7.5-12 | |
| Seasonal labour |  | |  | |  | |  | |
| Family labor | 90% | | 88-93% | |  | |  | |
| Area (hectare) | 13 | | 9\_15 | |  | |  | |
| Pineapple density (#plants per m2) | 1 | | 1 | |  | |  | |
| Soil type: 70% klie 30% sandy-soil |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
| Fertilizer (Kg/hectare) | 0.01 | | 0-0.020 | | 10 | | Aug-15 | |
|  |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
| Pesticides/chemicals (liter/hectare/season) | 0.5 | | 0.1-0.9 | | 20 | | 18-25 | |
| Water use[14] (Littre) | 0.5 | | 0.1-0.9 | | 20 SRD | | 10-50 SRD | |
| Machinery (PK/hectare) |  | |  | | 0 | | 0 | |
|  |  | |  | |  | |  | |
| Energy use (cost) | 8 | | 5\_10 | | 73.5 | | 49.0-98.0 | |
| Output (KG/Hectare)- Per season | 2300 | | 1700-2500 | |  | |  | |
| Price at farm gate (SRD) |  | |  | |  | |  | |
| Price export/market (SRD) |  | |  | |  | |  | |
| Specialization | 90% | | 80-100% | |  | |  | |
| Almost all pinaple famers are Amer-indians who cultivate their crops seasonally |  | |  | |  | |  | |
| Season per year | 1 | |  | |  | |  | |
|  |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
| oranges famers |  | |  | |  | |  | |
| **Item** | **Quantity** | |  | | **Average prices (2013)** | |  | |
|  |  | |  | | **(SRD)** | |  | |
|  | **Average** | | **Range** | | **Average** | | **Range** | |
| Labor (average hour per week) | 5 | | 4\_7 | | 10 | | 7.5-12 | |
| Seasonal labour |  | |  | |  | |  | |
| Family labor | 90% | | 88-93% | |  | |  | |
| Area (hectare) | 13 | | 9\_15 | |  | |  | |
| Pineapple density (#plants per m2) | 1 | | 1 | |  | |  | |
| Soil type: 70% klie 30% sandy-soil |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
| Fertilizer (Kg/hectare) | 0.01 | | 0-0.020 | | 10 | | Aug-15 | |
|  |  | |  | |  | |  | |
|  |  | |  | |  | |  | |
| Pesticides/chemicals (liter/hectare/season) | 0.5 | | 0.1-0.9 | | 20 | | 18-25 | |
| Water use[14] (Littre) | 0.5 | | 0.1-0.9 | | 20 SRD | | 10-50 SRD | |
| Machinery (PK/hectare) |  | |  | | 0 | | 0 | |
|  |  | |  | |  | |  | |
| Energy use (cost) | 8 | | 5\_10 | | 73.5 | | 49.0-98.0 | |
| Output (KG/Hectare)- Per season | 590 | | 510-680 | |  | |  | |
| Price at farm gate (SRD) |  | |  | |  | |  | |
| Price export/market (SRD) |  | |  | |  | |  | |
| Specialization | 90% | | 80-100% | |  | |  | |
| Almost all oranges famers cultivate their crops seasonally |  | |  | |  | |  | |
| Season per year | 1 | |  | |  | |  | |
|  |  | |  | |  | |  | |
| passion fruits famers |  |  | |  | |  | |
| **Item** | **Quantity** |  | | **Average prices (2013)** | |  | |
|  |  |  | | **(SRD)** | |  | |
|  | **Average** | **Range** | | **Average** | | **Range** | |
| Labor (average hour per week) | 5 | 4\_7 | | 10 | | 7.5-12 | |
| Seasonal labour |  |  | |  | |  | |
| Family labor | 90% | 88-93% | |  | |  | |
| Area (hectare) | 13 | 9\_15 | |  | |  | |
| Pineapple density (#plants per m2) | 1 | 1 | |  | |  | |
| Soil type: 70% klie 30% sandy-soil |  |  | |  | |  | |
|  |  |  | |  | |  | |
|  |  |  | |  | |  | |
| Fertilizer (Kg/hectare) | 0.01 | 0-0.020 | | 10 | | Aug-15 | |
|  |  |  | |  | |  | |
|  |  |  | |  | |  | |
| Pesticides/chemicals (liter/hectare/season) | 0.5 | 0.1-0.9 | | 20 | | 18-25 | |
| Water use[14] (Littre) | 0.5 | 0.1-0.9 | | 20 SRD | | 10-50 SRD | |
| Machinery (PK/hectare) |  |  | | 0 | | 0 | |
|  |  |  | |  | |  | |
| Energy use (cost) | 8 | 5\_10 | | 73.5 | | 49.0-98.0 | |
| Output (KG/Hectare)- Per season | 360 | 220-450 | |  | |  | |
| Price at farm gate (SRD) |  |  | |  | |  | |
| Price export/market (SRD) |  |  | |  | |  | |
| Specialization | 90% | 80-100% | |  | |  | |
| Almost all oranges famers cultivate their crops seasonally |  |  | |  | |  | |
| Season per year | 1 |  | |  | |  | |

# Appendix II:

Snapshotsimulation of **the increase in the agricultural total factor productivity of Surinamese producers**



# Appendix III:

# Other analysis

**Economic Evaluation of component 3: Modernization of the Agricultural Health and Food Safety Services**

The purpose of component 3 is to have an impact on the productivity of Suriname’s agriculture sector and to improve the health status of the human population through the production of safe food for local consumption and export. This component will have an indirect impact on the current public expenditure on food safety and plant and animal health.

The component’s activities will focus on (i) strengthening dialogue between competent authorities to strengthen their integrated action; (ii) strengthening of the capacity of public services in preparation, prevention and response to plant and animal diseases, including support to operational facilities at different levels (including improvement of laboratories) (iii) developing technical capacity of human resources in various topics as diagnosis, surveillance, response and extension; (iv) better access to data and dissemination of information from and to all relevant institution (v) support programs of Good Agricultural Practices (GAP) and hazard analysis and critical control points that will enable farmers to meet quality and safety requirements, and (vi) enhance regional cooperation towards supporting animal and plant health issues.

The main direct economic benefits that can be expected from the component’s activities are: (i) losses avoidance (or costs saved to Government and to farmers) by stepping up the prevention and control of high impact of pests and animal diseases, some of which pose a direct threat to human health and consequently, (ii) reduction in the probability of trade disruptions due to plant and animal diseases (iii) reduction of the losses due to a lower rejections of Suriname products by main trading partners and elimination of barriers that arise from the country’s inability to ensure international quality standards and food safety; (iv) increase the economical return due to increase the size of export.

RESULT- matrix: provides an overview of main potential benefits under each sub-component.

Most evaluations of economic benefits associated to agro-sanitary programs are based in aggregated methods close to ‘before’ and ‘after’ estimations (i.e. loss avoided, reduced losses, new exports generated). The examples examined in the evaluation of this component are based mainly on the positive impacts that the Program would have by reducing the existing pests and animal diseases prevalence and by dropping the probability of transboundary outbreaks in Suriname. However, the actual economic impact will vary depending on several factors such as the type of transboundary pest or disease. Moreover, the complexity of the effects often makes precise measurement of the economic impacts very difficult. This analysis is limited to the effects on production, with relatively little regarding subsequent impacts on prices, trade or secondary and tertiary market effects. Longer-term impacts, the dynamics of response to outbreaks and farmer or community adaptation are also lacking.

The following sub-sections of the report provide the examples analyzed for each Program sub-component’s benefits. However, the benefits estimated here should not be seen to correspond to all the potential benefits of each sub-component.

***Economic Evaluation of sub-component: Animal Health***

There is a strong commitment and enthusiasm from the LVV and other institutes to maintain the animal health status currently achieved in Suriname, and a strong commitment to improve its current plant health and food safety level. Among other things, it is estimated that the increase of emerging and re-emerging livestock disease outbreaks has cost the world more 80 billion $ in the past 15 years on (Schneider, et.al, 2007). Given the size of Suriname, its population and number of livestock, we estimate that a livestock disease outbreak could cost Suriname ranges between 200,000$ & 500,000$ average per year in a 15 years-time[[3]](#footnote-3) .

The **principal benefits** from this sub-component are those derived from the prevention of the entrance of exotic diseases as:

High Pathogenic Avian Influenza (HPAI),

Foot-and-Mouth Disease (FMD) and Bovine Spongiform Encephalopathy (BSE);

Classical Swine Fever (CSF),

Bovine Brucellosis and Tuberculosis

Newcastle disease

Salmonella

E-coli

Additional benefit is to maintenance the current level of control on these diseases, which will facilitate trade, control and eradication of prevalent diseases which causes losses to the farmers; promotion for the establishment of food safety assurance programs to protect the consumers and the tourism and to facilitate trade of primary and processed agricultural products such as fruits, vegetables, meat, fish, shrimp and processed foods. The **sub-component’s activities** will focus on (i) institutional capacity building; (ii) strengthening of the permanent services of surveillance, quarantine, laboratory support, and inspection, control and registration (iii) enhancing the cooperation and readiness of the different ministries and institutions to react to any outbreaks

Four sources of benefits have been explored for this sub-component as described below. A narrative review of all relevant papers and special investigations were carried out. Concrete data and required information were provided by Mr Rozenblad (the under-director of the livestock-section within LVV), mr. Mari Fleurkens ( livestock-section van LVV)

Risk calculation:

(Estimated number of smuggled animal + estimated number of animal slaughtered outside the official slaughter-houses) / the number of slaughtered animal or Average of value of the risk in the region/ international organization

The **principal benefits** from this sub-component are those derived from the prevention of the entrance of exotic diseases as:

High Pathogenic Avian Influenza (HPAI),

foot-and-mouth disease (FMD) and Bovine Spongiform Encephalopathy (BSE);

Classical Swine Fever (CSF),

Bovine Brucellosis and Tuberculosis

Newcastle disease

Salmonella & Ecoli

Table I1: Basic Parameters Classic Swine Fever:

|  |  |
| --- | --- |
| Probability of entrance without Program | LOW risk: 10 -3 to10 -2. |
| Probability of entrance with Program | Very Low risk: 10-5 to 10-4. |
| Swine population (Heads) - 2011 | 34,327 |
| Rate of growth of swine population (per cent annual) | 2006: 28,090; 2011: 34,327; (Rate of growth of 4.4% per annum) |
| Number of slaughtered Swine[[4]](#footnote-4)– 2011 | 29.543 |
| Rate of growth of number of slaughtered swine (per cent annual) | 2006: 28,090; 2011: 34,327; (Rate of growth of4.7% per annum) |
| Mortality rate due to CSF disease in case of an outbreak (per cent) | 100 per cent (decreased to 5% with vaccination) |
| Market value of animal at farm gate (US$/Kg of slaughtered meat) - 2011 | US$ 1.9 / kg |
| Animal weight average (Kg) | 72 Kg |
| Cost per animal of slaughtering in case of disease (US$) | US$ 80/Head |

Several Suriname’s surveillance programmes are suggested (1) routine gross pathology of severely diseased pigs; (2) routine virological tests of tonsils of all pigs, submitted under 1; (3) daily clinical observation by the farmer; (4) periodic clinical inspection by a veterinarian; (5) leucocyte counts in blood samples from diseased animals on a herd where antimicrobial 'group therapy' is started.

In countries where classical swine fever is endemic, vaccines may be used to protect animals from clinical disease. Vaccines can also be used to reduce the prevalence of infections during an eradication program. Both modified live and subunit (marker) vaccines are manufactured, although availability varies with the country. Quarantines, movement bans and good surveillance are important in controlling outbreaks. Strict biosecurity on a farm can reduce the risk of infection. During an outbreak, confirmed cases and contact animals may be slaughtered. Although CSFV can be spread over long distances by animal transportation and other forms of dissemination, farms within a 500 meter radius of an infected farm have a particularly high risk of infection. Culling of all pigs in an area may be practiced, due to this ‘neighborhood effect.’ Infected premises are thoroughly cleaned and disinfected. Vaccination may be used as a tool to assist in controlling an outbreak and eradicating the disease. In countries free of classical swine fever, periodic serologic sampling is necessary to monitor for the potential reintroduction of disease.

Table I2: Basic Parameters Bovine Brucellosis

|  |  |
| --- | --- |
| Prerevalence of disease without program | > 1 per cent (last reported case 1975) This could be anticipated at 5per cent without a programme in the worst case scenario (see sensibility analysis) |
| Prevalence of disease with program | < 1 per cent |
| Dairy cows population -2010 | 23,260 |
| Rate of growth of dairy cows (vegetative) | 2006: 15,433; 2011: 23,260 - Rate of growth : -6.7 per cent –annually |
| Average productivity of milk –(2006-2011) | 2,181 Lt/cow/year |
| Loss of milk productivity due to disease (per cent) | 5 per cent |
| Average price of milk (SRD$/Lt) (2006-2011) | 1,90 SRD/Lt Max is in 2011: 2,50 SRD/Lt |
|  |  |

According to the Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the Office International des Epizooties (OIE), brucellosis is still one of the most important and widespread zoonoses in the world.

The estimated herd-level prevalence of brucellosis in Maranhão state (north East Brazil) was 11.4% (95% CI 9.2-14) and the individual animal-level prevalence was 2.5% (95% CI 1.7-3.6). Herds with more than 54 cows older than two years of age, herds that used rented pasture to feed cattle, and the presence of wetlands on the home farm increased the risk of a herd being brucellosis positive (Borba et al, 2012)

(Venzula) The official published reports of positive animals as determined with the plate agglutination test show a low rate. But results obtained with other tests of high sensitivity and specificity such as the ELISA indicate a prevalence of approximately 10.5%

(Chile) In the national study of bovine brucellosis prevalence carried out in 1991, the herd rates ranged from 23 to 38%.

In the year 2001, the rate of Milk Ring Test (MRT) positive dairies reached 19.7%, while in 1996 reached 46% (paraguay) Conversely, the number of suspects was reduced

from 32.5 to 1.4% during the same period, 1979 up to 2000. (Argentina) 20% in 1925, The individual prevalence for dairy cattle in the country was estimated between 2 and 2.5%. (Brazil) s. Herd prevalence was estimated as 2.5% [1.0–5.1%]

Table I3: Basic Parameters Bovine Tuberculosis (Suriname)

|  |  |
| --- | --- |
| Prevalence of disease without program | > 1 per cent (last reported case 1989). This could be anticipated at 5per cent without a programme in the worst case scenario (see sensibility analysis) |
| Prevalence of disease with program | <1 per cent (to be declared Free Status based on OIE guidelines) |
| Cattle population 2011 | 55245 |
| Rate of growth of cattle (vegetative) | 2006:43595; 2011: 55245; Growth:4.5 per cent/annum |
| Average weight per cow (Kg) (2006-2011) | 176 Kg -Based on slaughter data between 2006-2011 |
| Loss of weight due to disease (per cent) | 10 per cent |
| Price of meat (SRD/Kg) | 12,5 SRD/ Kg ( in 2011: 17,50 SRD/Kg) |

Newcastle disease

|  |  |
| --- | --- |
| Prerevalence of disease without program | 4.5\*10-4 per cent ( internationallly accpeted level of risk |
| Prevalence of disease with program | < 4.5\*10-4 per cent |
| Poultry population (2011) x 1000 | 5,694 |
| Rate of growth of poultry x 1000 | 2006: 3,979 ; 2011: 5,694 - Rate of growth : 7.2 per cent |
| Average weight per cow (Kg) (2006-2011) | 1,65 Kg -Based on slaughter data between 2006-2011 |
| Loss of weight due to disease (per cent) | 20 per cent ( can reach to 100% loss in caseof sever |
| Average (2006-2011) Price of chicken meat (SRD/Kg) | 8,30 SRD/ Kg ( in 2011: 10,77 SRD/Kg) |
|  |  |

Velogenic NDV is endemic in areas of Mexico, Central and South America, widely spread in Asia, the Middle East and Africa, and in double-crested wild cormorants in the US and Canada. Lentogenic strains of NDV are worldwide in their distribution while widespread mesogenic pathotypes with a special adaptation to pigeons (i.e. pigeon paramyxovirus) do not appear to infect other poultry readily.

The probability of a ND outbreak (per year) in the exporting countries was calculated based on data obtained from the national agricultural databases and the World Organization for Animal Health (OIE). The number of outbreaks per year was assumed to follow a Poisson distribution. In ND-free country, an outbreak of ND had not occurred in ostriches for 25 years (1975 to 2001), therefore the mean number of outbreaks per year (λ) was assumed to be at most 0.04. In the endemic country, there were 6 outbreaks in ostriches from 1997 to 2001 and thus it was assumed that an outbreak in ostriches occurred, on average, once a year (λ = 1). The country-level prevalence during an outbreak was assumed to be low as a result of the limited spread of ND in ostriches (Huchzermeyer 2002), which was confirmed by the data available from the endemic country. The country-level prevalence during an outbreak was assumed to be the same in both countries and followed a Pert distribution. In the endemic country, only a total of 49 cases were detected during the 6 outbreaks, which resulted in a mean country-level prevalence during an outbreak of about 4.5 x 10–6. The minimum country-level prevalence during an outbreak was 2 cases (1.1 x 10–6), and the maximum was 22 cases (1.2 x 10–5).

Table I4: E-coli

|  |  |
| --- | --- |
| Prerevalence of disease without program | < 5 per cent |
| Prevalence of disease with program | >5 per cent |
| Cattle population 2011 | 55245 |
| Rate of growth of cattle (vegetative) | 2006:43595; 2011: 55245; Growth:4.5 per cent/annum |
| Average weight per cow (Kg) (2006-2011) | 176 Kg -Based on slaughter data between 2006-2011 |
|  |  |
|  |  |

The **purpose** of the Plant Health sub-component is to update and sustainably consolidate Plant Health systems as a part of the national food safety system in Suriname. This would include the following **sub-component’ activities**: (i) strengthening the institutional and technical capacity of key participants; updating and enacting a plant health policy and legislation; (ii) updating and enhancing an efficient surveillance system for the systematic monitoring for pests of economic importance; (iii) improving pest diagnostic services to support import/export activities and plant production operations in the country; (iv) recognizing free status o major pests recognized; establishing Pest Risk Analysis Unit and (v) traceability system and consolidating extension services oriented to promote and establish GAP for selected crop.

The advent of globalization and increased trade liberalization have freed up international borders making it easier for countries to export their goods and services to anywhere in the world. But with the increase in trade comes the threat of pests being transmitted from one country to another and causing harm to agricultural production. The Program through its pest surveillance and monitoring interventions will contribute to the challenge of intercepting these pests and destroying them before they can enter the island and threaten domestic agriculture. The first line of defense is quarantining plants and monitoring imports for exotic pests.

**The departure point for the estimation of the benefits of this sub-component is the situation that is envisaged at the end of the implementation period in its logical framework. One of the indicators of the achievement of the Sub-component purpose is: “Proof of free status of**

**Mediterranean Fruit Fly (Medfly),**

**Giant African Snail (GAS)**

**Papaya Meal bug (PMB)**

White flies (the 3 most economical value)

Tomato Boarder

**maintained and recognized by the International Plant Protection Convention (IPPC) and to emphasize on the currently & locally existing pests such as: Tomato boorder, whiteflies, pink…… The Program will reduce the probability of entrance of these three main pests: i.e. Med fly, GAS, & PMB and will reduce the impact and spreading space of the currently existing pests (whiteflies & tomato Boorder) in Suriname**

**A. LOSSES AVOIDANCE PER MEDITERRANEAN FRUIT FLY**

The Mediterranean fruit fly[[5]](#footnote-5) is one of the world's most destructive fruit pests, whose larva lives and feeds in ripening fruit. It is a quarantine pest and affects to fruits and vegetables production and trade**. Suriname is free of Medfly but the probabilities of infection are very high**. Foregone production and export revenue (from USA and Japan exports) of fresh fruits hosts could happen, if an outbreak of Medfly was declared. (In 2009, Suriname earned some US$ 10 Million with the export of fresh fruit hosts: citrus, papaya, mangoes etc) and potential future earnings**. Other benefits from this Program sub-component** are as follow: (i) a reduction of losses in the production of high yield fruit caused by this pest; (ii) increased access volume and variety of fruit to foreign markets with higher selling prices to improve commercial quality of the product; (iii) reducing the costs of treatment and post-harvest handling of fruit for export at farm level and (iv) a reduced impact on the environment by reducing the use of conventional pesticides to control this pest.

Based on the information provided by the Plant Quarantine/Produce Inspection Unit of the MOAF (see Table I5), it has been estimated that the probability of pest entrance into Suriname without the Program is very high, a maximum of 90 per cent. If the pest enters, the maximum loss would be 5 per cent of the value of production of host plants, and it will take 18 months to control it. It would no be possible to eradicate it. If controlled, the losses would be less than an 0,5 per cent of the value of production of the host plants for a long time.

Table I5: Basic Parameters used for cost-benefit analysis

|  |  |
| --- | --- |
| Probability of introduction of Medfly into Suriname without program | 90 per cent |
| Probability of introduction of Medfly into Suriname with Program | 40 per cent |
| Most important hosts in Suriname impacted by Medfly | Citrus; Bell pepper; Manja |
| Rate of productivity lost due to Medfly's introduction (per cent) | 5 per cent |
| Time required to control an Medfly outbreak in Suriname | 24 months |
| Rate of production lost after the entrance of Med fly | 0.5 per cent |
| Estimated total average costs to control Medfly the year of introduction | US$ 2.5 Million |
| Estimated annually costs for monitoring & surveillance once pest in Suriname (per year) | US$ 160 Mil |

Source: Date provided by LVV- 2013 ( A. v. Sauers-Muller & M. Jagroep)

**B. LOSSES AVOIDANCE PER GIANT AFRICAN SNAIL**

The Giant African Snail (GAS) is on Suriname’s quarantine pest list and also it is nominated as among the one hundred of the ‘world’s worst top invaders’. GAS is already introduced into some Caribbean countries like Barbados and Trinidad and Tobago. The most likely pathway for entry are: on cargos, containers, used vehicle, used machinery, private yachts, fruits and vegetables, cut flowers and tourist/returning residents. Without proper inspection and strict regulations in place GAS could be easily introduced into Suriname. The Plant Quarantine/Produce Inspection Unit of LVV[[6]](#footnote-6) has estimated as high the GAS likelihood and consequences of establishment by assessing the availability of suitable host, suitability of the environment, cultural practices and cultural measures in place and also the characteristic of the pest. Once GAS is established it is very difficult to eradicate. The GAS has over 500 host plants, which can be found throughout the many regions in Suriname. The potential economic consequence was estimated to be high. The GAS would not only have a negative impact on the agricultural sector but also the human health and the environment. GAS can cause a serious damages on human nerves system and thus is considered a serious threat to the population. The GAS can also be a vector for other pest and diseases.

The Program will be instrumental to reduce the probability of introduction of GAS in Suriname. Table I6 provides the basis parameter used to estimate the losses avoided of a selected group of crops, i.e. peas and beans.

Table I6: Basic Parameters for cost-benefit analysis

|  |  |
| --- | --- |
| Probability of introduction of GAS into Suriname without Program | 65 per cent |
| Probability of introduction of GAS into Suriname with Program | 8 per cent |
| Most important hosts in Suriname impacted by GAS | tubers; vegetables; legumes and ornamentals |
| Rate of productivity lost due to GAS's introduction (per cent) | 15 per cent |
| Time required to control GAS outbreak in Suriname | >5 years |
| Estimated total average costs to control GAS the year of introduction | >US$ M 5 |
| Estimated annually costs for monitoring & surveillance once in Suriname | US$ 60 mil |

Source: Date provided by LVV, July 2013

It has been simulated that GAS enters Suriname in PY3 with or without Program. But with the Program the probability of introduction is 8 per cent, and without the Program, it is 65 per cent. It has been assumed that the pest will attack the production of major legumes, with an annual value of production of US$ 70 million (Production and value estimated in 2011). The year of the entrance, the loss of value of production amounts to 15 per cent of the above-mentioned group of crops. US$ 5 million must be spent in order to control the GAS during the first two years. For the years after the entrance, i.e. from PY3 to PY10, the rate of losses is reduced to zero. After the entrance year, the cost of US$ 60 mil must be spent annually in monitoring and surveillance. **They amount to US$ 365 mil the year of entrance and US$ 18 mil annually thereafter for the peas and beans.**

**C. LOSSES AVOIDANCE PER PAPAYA MEALY BUG**

The Papaya mealy bug[[7]](#footnote-7) is a small pest helipterum that attacks several genera of host plants, including economically important tropical fruits and ornamentals. The papaya mealy bug is native to Mexico and/or Central America. When the papaya mealy bug invaded the Caribbean region, it became a pest there; since 1994 it has been recorded in the following 14 Caribbean countries: St. Martin, Guadeloupe, St. Barthelemy, Antigua, Bahamas, British Virgin Islands, Cuba, Dominican Republic, Haiti, Puerto Rico, Montserrat, Nevis, St. Kitts, and the U.S. Virgin Islands. At Present Suriname is free from this pest. According to the information provided by Mrs. Alice van Sauers-Muller Entomology department LVV , **the entrance of Papaya Mealybug to the country poses a risk to the island.**

Economically important host plants of the papaya mealy bug include papaya, hibiscus, avocado, citrus, cotton, tomato, eggplant, peppers, beans and peas, mango, cherry, and pomegranate. It is found on leaves and fruits of host plants and infestations are typically observed as clusters of cotton-like masses on the above-ground portion of plants. Heavy infestations are capable of rendering fruit inedible due to the build up of thick white wax.

For the relevant departments of the LVV, Papaya Mealybug could potentially causes a big threat to numerous agricultural products in Suriname, if not controlled. It could be also possible that certain greenhouse crops could be at risk in areas where the LVV has been investing. Based on the experience of Caribbean countries, the specialists of the LVV consulted estimate that the probability of entrance fluctuates between 20 and 50 per cent, although it is difficult to know this could happen. If the pest enters, the maximum loss would be 5 per cent of the value of production of host plants, and will take two years to control it. If controlled, the losses would be less than 0.25 per cent of the value of production of the host plants for a long time (See Table I7).

Table I7: Basic Parameters for cost-benefit analysis

|  |  |
| --- | --- |
| Probability of introduction of PMB into Suriname without program | 50 per cent |
| Probability of introduction of PMB into Suriname with program | 5 per cent |
| Most important hosts in Suriname impacted by PMB | Papaya |
| Rate of productivity lost due to PMB introduction (per cent) | 15 per cent |
| Time required to control a PMB outbreak in Suriname | 2 year |
| Rate of productivity lost after PMB introduction | 0.25 per cent |
| Estimated total average costs to control PMB the year of introduction | US$ 60 mil |
| Estimated annually costs in monitoring and surveillance once PMB in the country | USD 5 mil |

Source: Date provided by LVV, July 2013

The Program will invest in preventing the introduction of the PMB. The benefits estimated here come, by the reduction of the probability of the Papaya Mealy Bug entrance, from 50 per cent without the Program to 5 per cent with the Program. For both cases, it was simulated the introduction of the PMB in Suriname and that the pest will attack mainly the Papaya crops, with an annual value of production not so significant.

The entrance year of the papaya mealy bug, the loss of production amounts to 15per cent, and US$ 60 mil must be spent in chemical controls. Thus, chemical controls are only partially effective and require multiple applications[[8]](#footnote-8). The rate of productivity lost is reduced to 0.25 per cent, over the same base and US$ 5 mil must be spent annually in monitoring and surveillance. **The avoided losses due to the Program are shown in Annex x Table xx. They amount US$ 82 mil the year of entrance and US$ 13.8 mil annually thereafter.**

**Tomato Boarders**

This pest already exists in Surinam for some years ( due to import), the benefit of the program will be mainly due to the reduction of infected output.

Table I8: Basic parameters for Cost-Benefit of tomato Boarder

|  |  |
| --- | --- |
| Probability of infected crops in Suriname WIth T.B. | 20 per cent |
| Probability of infected crops with T.B | < 10 per cent |
| Most important hosts in Suriname impacted by T.B | Tomato |
| Rate of productivity lost due to T.B (per cent) | 5% per cent |
| Time required to fight the pest in Suriname | >3 year |
| Estimated total average costs to control T.B. | US$ 1 Million |
| Estimated annually costs in monitoring and surveillance | US$ 10,000 Per year |
|  |  |

White flies

There are three sorts of whiteflies with economical values (2 local sorts and one is not). The local sorts of the white flies are being fought with biological parasites’, however, the imported sort (from south east Asia), has no biological parasites in Suriname. One major challenge is the regional cooperation to fight these sorts of pests.

Table I9: Basic parameters for Cost-Benefit

|  |  |
| --- | --- |
| Probability of infected fruits in Suriname WIth whiteflies | 5-10 per cent |
| Probability of infected crops with Whiteflies | < 5 per cent |
| Most important hosts in Suriname impacted by | Fruits, |
| Rate of productivity lost due to whiteflies (per cent) | 2% per cent |
| Time required to fight the pest in Suriname | >3 year |
| Estimated total average costs to control T.B. | US$ 5 Million |
| Estimated annually costs in monitoring and surveillance | US$ 50,000 Per year |
|  |  |

**IV. 3. EVALUATION OF FOOD SAFETY SUB-COMPONENT**

The **purpose** of the Food Safety Sub-component is to implement and operate an integrated, efficient and sustained Agricultural Health and Food Safety System that meets international standards and has active stakeholder participation. This sub-component will contribute to: i) guarantee the food security of the country with foods of good quality and safety; (ii) prevent outbreaks of Food borne illnesses (FBI); (iii) prevent losses to the food producers due to recalls, refusals and interceptions; (iv) increase the production of foods for the country and prevent expenses from the large importation of foods; (v) increase the availability of foods for exportation; (vi) increase the tourism industry and prevent large losses due to the presentation of FBI and (vi) coordinate and rationalize the use of the human and financial resources.

**Three sources of benefits have been analyzed for this sub-component.** The first is related to the loss avoidance or ‘costs that could be saved’ by reducing the number of FBIs in Suriname. The second refers to the losses avoidance by dropping the refusals and interceptions of Suriname exports due to higher level of contaminants. The last source of benefits analyses the potential impact on tourism expenditure that an attack rate of traveller’s diarrhea could originate.

1. The Agricultural production index: Based on the sum of price-weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner. All the indices at the country, regional and world levels are calculated by the Laspeyres formula. Production quantities of each commodity are weighted by average international commodity prices in the base period and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period. The commodities covered in the computation of indices of agricultural production are all crops and livestock products originating in each country. Practically all products are covered, with the main exception of fodder crops. (12, 1995, p. ix) [↑](#footnote-ref-1)
2. LVV (Mr. Algoe), 2013. [↑](#footnote-ref-2)
3. Calculation per capita [↑](#footnote-ref-3)
4. Slaughterd at the official slaughtering houses, this covers around the vast majority of the slaughtered Swine [↑](#footnote-ref-4)
5. Ceratitis capitata (Wiedemann) [↑](#footnote-ref-5)
6. Pest Risk Assessment Giant African Snail prepared by Kimmoia Witter, Plant Quarantine/Produce Inspection, Ministry of Agriculture and Fisheries, November 2009 [↑](#footnote-ref-6)
7. [↑](#footnote-ref-7)
8. [↑](#footnote-ref-8)