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Sustainable Smallholder Agri-Business Cocoa-Food Link Programme

Technical business services for cocoa farmers

Concepts developed and experience from in Côte d'Ivoire, Ghana and Togo

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May 2018

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1. Context and rationale

1.1. The project

The *Sustainable Smallholder Agri-Business* Programme (SSAB) is commissioned by German Federal Ministry for Economic Cooperation and Development (BMZ). The European Union co-finances the Cocoa-Food Link Programme (CFLP), an action plan of the intra-ACP[1] New Commodities Programme since end 2014. CFLP is implemented through SSAB.

The goal is to help 404,600 male and female smallholders, mainly in the cocoa growing areas of Nigeria, Cameroon, Côte d'Ivoire, Ghana and Togo, to sustainably improve their incomes and food supplies from diversified production. Across the region, the project has developed partnerships with over 50 public and civil society organizations and companies in the following areas:

- We support public and private extension services to deliver business skills training to smallholders through Farmer Business Schools (Result A/1[2])
- With our assistance, input suppliers and microfinance institutions established Business Services Centers to provide access to certified inputs, market information as well as technical and financial services (Result B/ 1+2)
- In order to intensify food production, we provide cost-effective extension services including innovative media and support platforms (Result C/3 and result D/4).
- We take stock on innovative approaches and support partners and platforms to take them up
- We advise other programmes and institutions to take up the Farmer Business School (FBS) approach in Africa for other value chains beyond the cocoa producing zones of West and Central Africa (FBS Advisory Facility, since 01/2017)

1.2. Importance of the cocoa sector and challenges

Cocoa is one of the main agricultural products and source of foreign currency in Côte d'Ivoire, Ghana, Nigeria, Togo and Cameroon. More than three million West African smallholdings produce 70% of the world cocoa supply. Additional agricultural income is derived mainly from food production. The average yields for cocoa and food crops remain far below the possibilities of recommended cultivation practices. The average incomes of smallholder families are low: 1.50 USD per day and person. High dependence on cocoa as source of income and strong fluctuating world market prices lead to impoverishment, malnutrition and social problems such as child labour.

[1] African, Caribbean, and Pacific Group of States

[2] SSAB Result A / CFLP Result 1

These are **key challenges of the cocoa sector** in West Africa:

1. **Increasing pressure to raise productivity levels:** Cocoa production competes with other crops and mining activities. The forest reserves in Ghana and Côte d'Ivoire are almost depleted. To sustain cocoa production, intensification and good soil fertility management on existing plantations are necessary.

2. **Ageing smallholders and plantations:** In Ghana, on average the cocoa smallholders are 55 years old and 23 % of the tree stock is more than 30 years old[3] (Oppong 2015: 5.). After 30 years age, the yields of cocoa trees plummet (Figure 1). Ageing farmers are often conservative, unwilling to invest into their farm or lack the manpower to do so.

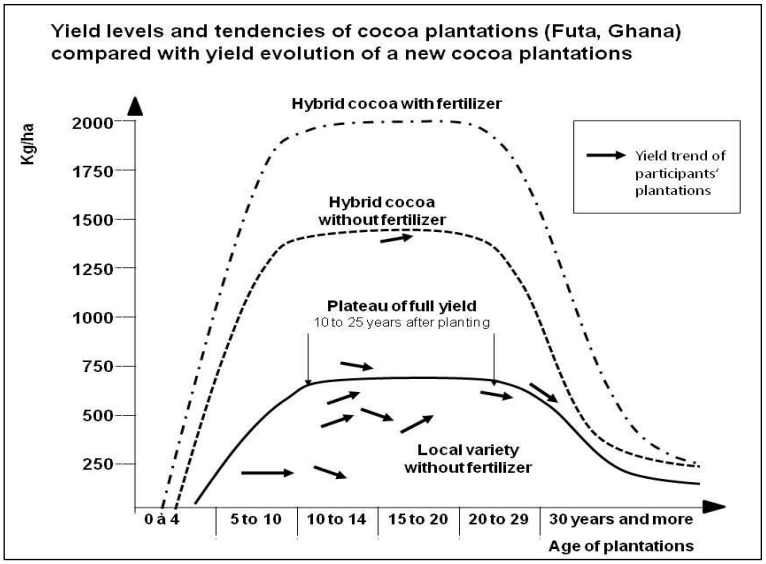

Figure 1 Productivity of cocoa trees according to tree age

Source: GIZ SSAB (2014).

3. **Lack of opportunities for youth in agriculture:** The elderly generation is still in charge of managing the farms. For young people, work in traditional agriculture is neither attractive as the work is tedious and perceived as dirty, nor does it provide sufficient income without use of Good Agricultural Practices and inputs. The lack of employment possibilities for the youth in rural areas stimulates urban migration in the expectation of better livelihood opportunities.

4. **Low quality and quantity of inputs**: Counterfeit products are widespread. In some areas, legally approved inputs are not available when needed due to a lack of transportation and distribution infrastructure. Approaches bridging the last mile to the farmers while ensuring professional application of quality inputs are lacking.

5. **Cocoa farmers' lack of technical as well as entrepreneurial knowledge, skills and mindset:** Agriculture and particularly cocoa farming are commercial activities, but most smallholders see these activities as a destiny or way of life and not as a business. Smallholders' perception of technological change focuses mainly on the additional cost without knowing the economic benefits. Most smallholders are not aware of the correct quantities, methods and timing of pesticide application.

[3] Further 17 % are infected with Cocoa Swollen Shoot Virus Disease

Consequently, cocoa farmers are not able to improve their yields and cause harm to themselves, their families and the environment when spraying pesticides. Smallholders cannot take full advantage of the opportunities of growing cocoa markets.

6. **Lack of financial services:** 64 % of Ghana's bankable population does not have accounts with commercial banks (PwC 2016: 11). In Côte d'Ivoire, only 34 % of adults in the rural areas have a formal bank account (World Bank 2017: 9). Small businesses are often perceived as weak customers with high default risk. Smallholders live far off in the remote areas, causing high transaction costs for both banks and smallholders and resulting non-banked and underbanked cocoa smallholders. Bankers often lack the knowledge on agriculture required to develop adapted financial products.

1.3. Technical business services: a solution?

As technical business services for farmers we understand any service that is provided on site by a person hired by the farmer. In the case of cocoa production, examples comprise GPS measurement of plots, motorized pruning, spraying of insecticides or fungicides, cleaning of farms, cocoa harvesting and pod breaking. This generates employment and income for the youth who act as providers. Attractiveness of these employments rise where motorized equipment is used. On top of this, the farmer clients receive services and quality inputs geared towards higher yields and higher incomes on existing farms. The intensification strategy building on technical services avoids deforestation by land expansion at low productivity levels. Embedded in businesses of agro-dealers, producer organizations and/or off-takers technical business services constitute a huge opportunity for youth employment in rural areas. Technical business services thus address some of the aforementioned challenges.

However, young rural professionals still lack the expertise, skills and financial resources to develop targeted and economically viable business services that (i) cocoa smallholders demand for and (ii) provide sufficient income throughout the year, too. For some technical services, lack of appropriate technology is also an issue.

This type of service provision to cocoa farmers and in agriculture in general is a very recent development. Together with partners SSAB-CFLP has pioneered the technical business services GPS Measurement, motorized pruning and motorized spraying. The modes of delivery are customized to the country specific needs, opportunities and capacities of partners. In the following chapters, we share our approaches and lessons learnt towards scaling-up and sustainability in the following areas:

- **Setting up business service models** that are on demand and viable for service providers
- **Operationalizing the services and related capacity development:** To this effect we refer to the following service delivery models that have been put into practice:
    - Independent service providers or employees of Business Service Centres (BSC) in Côte d'Ivoire
    - by employees of farmer-based organisations in Togo
    - by Rural Service Centres (RSC) providers of BSC in Ghana

2. Setting up viable business service models

2.1. Economic analysis: Pricing and profitability for service providers

Technical business services delivered by young professional service providers to (cocoa) smallholders in West Africa are not yet common for the following reasons:

- In some contexts, strong public extension services, cocoa buying companies and development programmes provide a variety of services either free of charge or financed by levies on cocoa exports and perceived free of charges by the beneficiaries.
- In the past, labour used to be abundant and smallholders either used to carry out these works themselves or they did not do them at all.
- There was enough fertile forest land to expand cocoa production with a sufficient yield level.

To respond to market demand while ensuring economic viability of technical business services, their profitability and the customers' willingness to pay, also against the opportunity costs by doing the work themselves or not at all, need to be carefully assessed. Services that rely on subsidies to meet willingness are not sustainable.

To assess the profitability, data on input and service prices, required labour (activity and man-days needed), equipment needs and producer prices are required. As this information is not always fully available, estimates can be used. During the validation stage, they can be verified and modified where necessary. Depending on who is involved in this activity, it may be necessary to first introduce the concept of economic analysis.

GIZ SSAB has developed standard spreadsheets for economic analysis of the following services:

- GPS measurement,
- Pruning, cutting down cocoa trees for replanting,
- Spraying.

These are the parameters needed to price and assess technical business services (Figure 2).

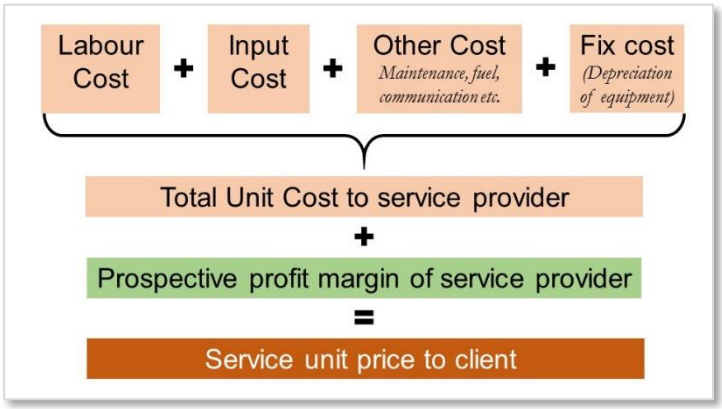

Figure 2 Parameters needed for economic analysis of services
Source: Authors.

The standard spreadsheets have the following **features:**

- Costs, including variable costs i.e. inputs, labour, fuel, communication as well as fixed costs (e.g. equipment)
- Automatic calculation and easy update of key parameters such as unit price of service, net profit for provider, gross revenue or depreciation costs

- Comparison of different techniques (e.g. motorized vs. manual) and different types of mobility (e.g. bicycle vs. motorbike)
- Simple adaptation to new services

Spreadsheets also contain overview sheets and cash flow analysis, assessment of net present value and internal rate of return. This allows for easy comparison of different technologies and to assess the benefits of the investment against other opportunities. Cash flow analysis permits quick analysis whether the service provides sufficient income over a period of time and at what point capital for investment is needed.

Simplified and modified versions of these calculations are part of trainings for the service providers.

Attention: Using the surface as a reference unit for perennial crops has its limitations for practical use. In particular in old cocoa plantations recommended planting distances are not always respected. Consequently, the actual labour (e.g. for pruning a tree) or quantity of inputs for spraying needed differ from the standard-good practice-model based on 1 hectare. For this reason, some service providers prefer to use units such as fee per tree or number of rounds needed for spraying. Farmers are also more familiar with such pricing methods. As applying the recommended quantity for inputs is crucial for the success of the application and to reduce costs for the farmers, in such cases we recommend re-calculating the parameters to the reference unit used. We sensitize service providers and farmers about the importance to know the size of the plot as well as the number of trees on it and to apply the recommended quantities.

To introduce the concept of economic analysis for a service model, we use a spraying against-mirids-service for the case of Ghana with the following elements:

- Pricing of spraying service for a 1 ha-cocoa farm, comparison use of bicycle versus motorbike (Table 1 and 2)
- How to calculate depreciation of equipment (Table 3)
- Assessing the profitability of the service and the investment: Profitability of service for a 12 months period (Table 4), cash flow analysis for life span of equipment (Table 5) and calculation of key parameters to evaluate investment made (Table 6).

Annexes 1 to 3 comprise the economic models for motorized pruning, GPS measurement by tablet and spraying against fungicides with knapsack sprayer.

Table 1 Overview of cost elements and pricing parameters in service model

Description of parameter	Remark
Labour costs (see Table 2 for details)	
➲ *Work is calculated with Man-Days (MD). For heavy work 1 MD is 5 hours.* ➲ *In average a provider needs 1:15 hours to spray 1 ha of cocoa trees with a mist blower, hence 25 % of a Man-Day of work. Calculating with 25 GHS per MD, labour costs of spraying are 6.25 GHS.*	➲ *Work could be done by provider or hired labourers.* ➲ *Estimates on time needed for service to be obtained from the field; may vary depending on density of plantation and condition of trees*
Input costs (see Table 2 for details)	
➲ *Typically pesticides or fertilizer* ➲ *To adapt the template to new services, we use a standard unit (ml, l, g, kg etc.)* ➲ *Cocoa Research Institute of Ghana (CRIG) recommends 150ml of a specific insecticide per ha of cocoa trees, e.g. 5 bottles with 30 ml each. Total input costs for 1 ha are 37.50 GHS if 1 bottle costs 7.50 GHS.*	➲ *Customers often provide the inputs themselves or buy them in advance. We recommend that the customer shall at least source from an approved agro-dealer shop if not from the provider him/herself to ensure good quality of the products* ➲ *Actual dosage of the product depends on the density of the trees in the plantation*
Costs for depreciation (see Table 3 for details)	
➲ *Equipment is bought for several production periods. Over time the equipment loses value and needs replacement. To enable the provider to save for the future equipment, these costs are accounted for as depreciation costs.* ➲ *Depreciation is the allocation of costs along the lifespan of the equipment.* ➲ *Depreciation/reference unit= life span*days of operations per year*daily outreach [where relevant]/purchasing price* ➲ *For agric. machinery the reference unit is usually ha and for multipurpose equipment such as bicycles or motorbikes, a day.* ➲ *For the spraying service, we calculate depreciation for the bicycle, motorbike, PPE and mist blower (e.g.: depreciation of mist blower: 1700/(70*4*4)=1.52.*	➲ *The better the capacity is used per life span (determined by number of days of operations per year and outreach per day), the lower the costs of depreciation per reference unit. e.g. case of mist blower: of 1.35 GHS (outreach of 6ha/day) vs. 1.52 GHS/ha (outreach of 4ha/day) respectively* ➲ *The less the capacity is used, the higher the depreciation costs per reference unit, as the equipment also becomes weaker during non-usage (rust, influence of weather conditions etc.).* ➲ *Higher daily outreaches can be obtained by grouping visits to customers close-by, as less time is needed for moving around.*

Description of parameter	Remark
Other costs considered (see Table 2)	
➲ *Costs of maintenance of the equipment. Practically 10 % of the purchasing price are estimated, e.g. case of mistblower: 1700*0.1/280/4=0.15 GHS/ha* ➲ *Communication costs, lump sum 1 GHS* ➲ *Costs for rent of storage room, mobile phone and others where relevant:*	➲ *The more sophisticated the equipment, the higher the actual maintenance costs* ➲ *Good treatment of equipment and regular, timely servicing reduce costs for maintenance*
Total costs of the service (see Table 2)	
➲ *Are the costs of the service to the provider including all elements* ➲ *In our example service provided by bicycle: including product 50.98 GHS/ha and 13.48 GHS/ha without; by motorbike 58.43 GHS (including product) and 20.93 GHS (without product) respectively. These higher costs are mostly caused by fuel needed for the mistblower and motorbike.*	➲ *Providers often only name the costs of service without product as this sounds more attractive to customers* ➲ *Better mobility and more advanced technology are not always the better solution; the motorbike service is more expensive to the provider and consequently also for the customer*
Unit price of the service (see Table 2)	
➲ *This is the customer price. The provider needs to generate profits to sustain the service. For the service provided by bicycle we add 20 % profit margin to the total costs (20% of 13.48 =2.70 GHS), i.e. 16.17 GHS per spraying of 1 ha.* ➲ *Due to the higher costs when using motorbike, we only add a 5 % profit margin. Unit price is 21.98 GHS.*	*Unit costs of a service provide several information:* ➲ *Is my service as provider competitive compared against the services by other providers?* ➲ *Can I as customer organize the work myself at a higher or lower cost than the provider? If I can organize it myself at a lower price, the service is not interesting.*

Table 2 Pricing of spraying against mirids-service in Ghana with mist blower, use of bicycle vs. use of motorbike

Unit Price		*Country* **Ghana**		
Mistblower, bicycle		*Crop* **Cocoa**		
		Served surface area	**1** ha	
Item	**Unit**	**Quantity per ha**	**GHS per unit**	**GHS**
Work of provider	MD	0.25	25.00	6.25
Fuel for mistblower	liters	1.00	4.40	4.40
Insecticide	ml	150.00	0.25	37.50
Maintenance of mistblower	GHS/ha	1.00	0.15	0.15
Maintenance of bicycles	GHS/day	0.25	0.01	0.00
Depreciation protective clothes	GHS/day	0.25	0.47	0.12
Depreciation of mistblower	GHS/ha	1.00	1.52	1.52
Depreciation of bicycle	GHS/day	0.25	0.15	0.04
Communication & mgt. Client data	lumpsum	1.00	1.00	1.00
Total cost with product				**50.98**
Total cost without product				**13.48**
Expected profit margin per provider	GHS/ha	20%	13.48	**2.70**
Unit price of service with product	GHS/ha			**53.67**
Unit price of service without product	GHS/ha			**16.17**

Unit Price		*Country* **Ghana**		
Mistblower, motorbike		*Crop* **Cocoa**		
		Served surface area	**1** ha	
Item	**Unit**	**Quantity per ha**	**GHS per unit**	**GHS**
Work of provider	MD	0.25	25.00	6.25
Fuel for mistblower	liters	1.00	4.40	4.40
Fuel for motorbike	liters	1.50	4.40	6.60
Insecticide	ml	150.00	0.25	37.50
Maintenance of mistblower	GHS/ha	1.00	0.13	0.13
Maintenance of motorbike	GHS/day	0.25	0.39	0.10
Depreciation protective clothes	GHS/day	0.25	0.47	0.12
Depreciation of mistblower	GHS/ha	1.00	1.35	1.35
Depreciation of motorbike	GHS/day	0.25	3.93	0.98
Communication & mgt. Client data	lumpsum	1.00	1.00	1.00
Total cost with product				**58.43**
Total cost without product				**20.93**
Expected profit margin per provider	GHS/ha	5%	20.93	**1.05**
Unit price of service with product	GHS/ha			**59.48**
Unit price of service without product	GHS/ha			**21.98**

Source: GIZ SSAB (2018a).

Table 3 Costs of depreciation and maintenance of equipment- case of spraying service against mirids, Ghana

Parameter	**Unit**	**Mistblower** *4ha/day*	**PPE for spraying**	**Bicycle**	**Knapsack sprayer**	**Motorbike**	**Mistblower** *6ha/day*
Reference unit		ha	ha	day	ha	day	ha
Purchasing Price	GHS	1,700	140	200	200	5,400	1,700
Days with operations per year	days	70	150	275	140	275	70
Daily capacity	ha/day	4.00			2.00		6.00
Annual service capacity	ha/year	280			280		420
Lifecycle	year	4	2	5	3	5	3
Service capacity for entire lifecycle	see reference unit	1,120	300	1,375	840	1,375	1,260
Depreciation	per reference unit	**1.52**	**0.47**	**0.15**	**0.24**	**3.93**	**1.35**
Maintenance 10 % of purchasing price		**0.15**		**0.01**	**0.02**	**0.39**	**0.13**

Source GIZ SSAB (2018a).

Table 4 Profitability of spraying service against mirids with bicycle for 12 months, use of bicycle vs. motorbike

Profitability spraying service		*Country* **Ghana**		
Mistblower, bicycle		*Crop* **Cocoa**		
1 provider **per year** full capacity		Served surface area	**280**	ha
Item	**Unit**	**Quantity per ha**	**GHS per unit**	**GHS per year**
Work of provider	MD	70	25.00	1,750.00
Fuel for mistblower	liters	280	4.40	1,232.00
Insecticide	liters	42	250.00	10,500.00
Maintenance of mistblower	GHS/ha	280	0.15	42.50
Maintenance of bicycles	GHS/day	70	0.01	1.02
Depreciation protective clothes	GHS/day	70	0.47	32.67
Depreciation of mistblower	GHS/ha	280	1.52	425.00
Depreciation of bicycle	GHS/day	70	0.15	10.18
Communication & mgt. Client data	lumpsum	280	1.00	280.00
Total cost with product				**14,273.37**
Total cost without product				**3,773.37**
Gross revenue from service including 20% profit margin with product	GHS/yr	280.00	53.67	**15,028.04**
Gross revenue from service including 20% profit margin without product	GHS/yr	280.00	16.17	**4,528.04**
Net profit for one provider	GHS/yr			**754.67**

Profitability spraying service		*Country* **Ghana**		
Mistblower, motorbike		*Crop* **Cocoa**		
1 provider **per year** full capacity		Served surface area*	**420**	ha
Item	**Unit**	**Quantity**	**GHS per unit**	**GHS per yr**
Work of provider*	MD	105	25.00	2,625.00
Fuel for mistblower	liters	420	4.40	1,848.00
Fuel for motorbike**	liters	441	4.40	1,940.40
Insecticide	liters	63	250.00	15,750.00
Maintenance of mistblower	GHS/ha	420	0.13	56.67
Maintenance of motorbike	GHS/day	105	0.39	41.24
Depreciation protective clothes	GHS/day	105	0.47	49.00
Depreciation of mistblower	GHS/ha	420	1.35	566.67
Depreciation of motorbike	GHS/day	105	3.93	412.36
Communication & mgt. Client data	lumpsum	420	1.00	420.00
Total cost with product				**23,709.33**
Total cost without product				**7,959.33**
Gross revenue from service including 5% profit margin with product	GHS/yr	420.00	59.48	**24,980.48**
Gross revenue from service including 5% profit margin without product	GHS/yr	420.00	21.98	**9,230.48**
Net profit for one provider	GHS/yr			**1,271.15**

*More working time left for spraying, higher capacity per day (6ha) assumed, reduces also amount for depreciation for mistblower

**Economies of scale as provider sprays plantations close by

Source GIZ SSAB (2018a).

In contrast to the 1-ha-calculation in the calculation of profits over a 12 months-period (Table 4) we assume that the provider can realize economies of scale and use the motorbike to service clients that are close-by. We also assume that despite the higher usage the mist blower still lasts 4 years. This translates into the high outreach of 420 ha and 1,271 GHS net profit for the provider, compared to 280ha and 754 GHS net profit respectively.

The **cashflow analysis** (Table 5) presents the actual flows of money in and out throughout the period of the equipment with the highest lifespan- in this case the mist blower with 4 years. In Year 1 the provider has more outflows than inflows (817 GHS deficit). The outflows from Year 2 to 4 remain high due to the high costs for the insecticide. If the provider does bulk purchasing, significant savings can be realized. After 4 years of operations, the accumulated cashflows are 2,710 GHS (with deduction of labour costs) and 9,710 GHS (without deduction) respectively. Where labour costs are deducted, only the profit is considered. If labour cost is not deducted, the accumulated value is the entire remuneration for 4 years of work.

The **Net Present Value** (NPV) is the present discounted value of future cash flows, comparing the investment (here into equipment and labour) against the investment into a safe alternative (here: government bonds with 18 % annual interest).

The Internal Rate of Return (IRR) is the interest rate where the NPV of an investment is 0. In our example the IRR needs to be higher than 18 % for the investment to have a positive NPV and be hence attractive compared to an investment into a safe alternative such as bonds. In our calculation the NPV is 1,475 GHS (with deduction of labour costs) with an Internal Rate of Return of 46 % and the NPV of 6,182 GHS and 141 % respectively (Table 6). Thus, the investments into the service provision are more attractive than the safe alternative government bonds.

Calculating the **remuneration of the provider** however shows, that the provider needs another constant similar flow of incomes throughout the year to have a decent income that exceeds the daily minimum wage of 8 GHS in Ghana. Having no other source of income leads to a salary of 6.7 GHS/day (approx. 1.24 EUR/1.47 USD), which is not even sufficient for one person to live beyond the poverty threshold of 1.90 USD. If the person has similar income for the rest of the year leads to the living income of 27 GHS/day (5 EUR/5.95 USD), lifting a family of 3 beyond the poverty threshold.

In this model the provider is expected to pay for the investments into equipment upfront with own funds. Experience from the field shows that providers often don't have sufficient savings but need loans or subsidized equipment. Realistically, the provider would neither be capable to invest into government bonds nor would he/she have access to such financial product in a rural area. Thus, the analysis of NPV and IRR has its limitations for application in a rural context in a country like Ghana.

Table 5 Cashflow of spraying service against mirids with bicycle (4 years), Ghana

Cash flow of spraying service					*Country:*	**Ghana**	
Insecticide, bicycle					*Crop:*	**Cocoa**	
					Surface serviced p/yr	**280**	ha
Item	**Unit**	**Quantity**	**GHS/unit**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Work of provider	MD/yr	70.00	25.00	1750.0	1750.0	1750.0	1750.0
Fuel	liters	280.00	4.40	1232.0	1232.0	1232.0	1232.0
Insecticide	liters	42.00	250.00	10500.0	10500.0	10500.0	10500.0
Maintenance of mistblower	GHS/yr	280.00	0.15	42.5	42.5	42.5	42.5
Maintenance of bicycles	GHS/yr	70.00	0.01	1.0	1.0	1.0	1.0
Communication & mgt. Client data	GHS/yr	280.00	1.00	280.0	280.0	280.0	280.0
Equipment cost	GHS/yr			2040.0		140.0	
Total outflows	**GHS/yr**			**15,845.5**	**13,805.5**	**13,945.5**	**13,805.5**
Inflows	**GHS/yr**	**280.0**	**53.7**	**15,028.0**	**15,028.0**	**15,028.0**	**15,028.0**
Cash flow per year with deduction labour cost	**GHS/yr**			**-817.5**	**1,222.5**	**1,082.5**	**1,222.5**
Cash flow per year without deduction labour cost	**GHS/yr**			**932.5**	**2,972.5**	**2,832.5**	**2,972.5**
Cash flow accumulated with deduction labour cost	**GHS**			**-817.5**	**405.0**	**1,487.6**	**2,710.1**
Cash flow accumulated without deduction labour cost	**GHS**			**932.5**	**3,905.0**	**6,737.6**	**9,710.1**

Source GIZ SSAB (2018a).

Table 6 Net Present value, Internal Rate of Return and daily remuneration of spraying service against mirids

Parameter	Without deduction labour cost (GHS)	With deduction labour cost (GHS)
Net Present Value	6,182	1,475
Internal Rate of Return	141%	46%
Remuneration of provider 90 days	27.0	
Remuneration of provider 365 days	6.7	
Minimum daily wage GH (2016)*	8.0	

*http://www.ghana.gov.gh/index.php/media-center/news/2023-%09government-announces-increment-in-minimum-wage-salaries-for-public-workers

Source GIZ SSAB (2018a).

The economic analysis of costing and pricing the spraying service against mirids in Ghana and comparing different mobility options has revealed the following:

- Despite a positive investment assessment, the provision of exclusively one service only generates enough income if there is another source of similar income throughout the rest of the year.
- Depreciation needs to be included as cost element to enable the provider to renew his equipment after its life span, as providers often struggle to provide the initial investment. Leasing options would make the cash flow steadier and allow more providers to start a service.
- Higher mobility and faster performance by the providers are not necessarily more profitable for the provider and cheaper for the customer. The fuel needed to get to the farm and to operate the mist blower is costly. Thus, grouping customers close-by reduces costs for mobility.
- The higher the use of the capacity of the equipment, the lower the depreciation costs and the higher the profits. After crossing the threshold from fix depreciation to variable depreciation, the lifespan of the equipment is reduced.
- Maintaining equipment well and servicing it regularly reduces maintenance costs.
- Bulk purchases of inputs reduce the total costs significantly.

This chapter has focused on the profitability mostly from the provider's point of view. As the service also needs to add value for the customer to trigger market demand, the Chapter 2 will focus on the customer's perspective.

2.2. Added value for the user of the service

The costing of spraying service in chapter 2.1 with different mobility options shows that the profitability of a service for the provider alone is not sufficient for the success of a technical service. The service needs to generate additional profit for the user as well. The profit may be derived from better yields from professional treatments, saved labour time or from non-financial benefits, for example plant protection is ensured with properly applied products that do not harm the environment.

Based on the service model from Chapter 2.1, we have assessed the costs for the cocoa smallholder based on 3 options (Table 7):

a. Spraying the farm him/herself with mist blower purchased exclusively for his/her farm- motorized and fast, thorough, but with costly equipment

b. Spraying the farm him/herself with knap sack sprayer purchased exclusively for his/her farm- manual and much slower, hence labour intensive, but with lower initial investment costs

c. Using the service

Table 7 Costs for smallholder for spraying against mirids by doing spraying him/herself or using provider, 1 vs. 3ha farm, 2 rounds of spraying

Item	Unit	Units	GHS/unit	Total GHS 1 ha 2 rounds	Total GHS 3 ha
Customer mistblower					
Insecticide	ml	300.00	0.25	75.00	225.00
Labour spraying*	MD	0.75	20.00	15.00	45.00
Fuel	liters	2.00	4.40	8.80	26.40
Depreciation of equipment	lumpsum	1.00	537.50	537.50	537.50
Total costs				**636.30**	**833.90**
Customer knapsack sprayer					
Insecticide	ml	300.00	0.25	75.00	225.00
Labour spraying*	MD	6.00	20.00	120.00	360.00
Depreciation of equipment	lumpsum	1.00	143.33	143.33	143.33
Total costs				**338.33**	**728.33**
Service by provider					
Service fee	lumpsum/ha	2.00	53.67	107.34	322.03
Total costs				**107.34**	**322.03**
*Assumption: Smallholder is not used to spraying and slower					

Source: Calculation by authors based on GIZ SSAB (2018a).

We assume that for the entire agricultural production cycle, the farm needs to be sprayed twice[4] to keep the mirids under the economic threshold. Due to the high costs for depreciation when using an own mist blower and the labour costs for manual spraying, with 107.34 GHS/ha, the service would by far be the cheapest for the smallholder, followed by use of own knapsack sprayer (costs of 338.33 GHS) and 636.30 GHS respectively. We assume a higher daily rage for the service provider (25 GHS) as he/she is more qualified than the cocoa farmer. We have compared this for the case of a smallholder with a typical farm size of 3 ha: The depreciation weighs less, but the ranking remains the same.

Generally, whether investments into cocoa production generate additional profits for the smallholder depends not only on efforts by the smallholder, but also on external factors, mostly weather/climatic conditions influencing yields and fluctuating prices. For this reason, in the next step we have established best and worst-case scenarios for prices and additional yields for the 1ha and 3ha-cocoa farm (Table 8) for all 3 options. In this scenario additional yields from proper pest control vary between 30kg/ha and 150 kg/ha and prices are 5 GHS/kg of cocoa (worst case) and 10 GHS (best case).

Table 8 Additional net profits for cocoa smallholders of best/worst case scenarios for prices and yields

Customer mistblower	Additional yield (kg)	Cocoa price (GHS/kg)	Additional labor costs (post-) harvest* (GHS)	Additional profit (GHS, 1 ha)	Additional Profit (GHS, 3 ha)
Better yield - higher price	150.00	10.00	140.00	**723.70**	**3246.10**
Better yield - lower price	150.00	5.00	140.00	**-26.30**	**996.10**
Moderate yield increase - better price	30.00	10.00	50.00	**-386.30**	**-83.90**
Moderate yield increase - lower price	30.00	5.00	50.00	**-536.30**	**-533.90**
Customer knapsack					
Better yield - higher price	150.00	10.00	140.00	**1021.67**	**3351.67**
Better yield - lower price	150.00	5.00	140.00	**271.67**	**1101.67**
Moderate yield increase - better price	30.00	10.00	50.00	**-88.33**	**21.67**
Moderate yield increase - lower price	30.00	5.00	50.00	**-238.33**	**-428.33**
Service by provider					
Better yield - higher price	150.00	10.00	140.00	**1252.66**	**3757.97**
Better yield - lower price	150.00	5.00	140.00	**502.66**	**1507.97**
Moderate yield increase - better price	30.00	10.00	50.00	**142.66**	**427.97**
Moderate yield increase - lower price	30.00	5.00	50.00	**-7.34**	**-22.03**

*Cost per MD: 20 GHS, add. MD (post-) harvest operations: 2.5 for 30 kg, 7 for 150kg (economies of scale)

Source: Calculation by authors based on GIZ SSAB (2018a).

The analysis reveals the following results:

- The use of the service generates additional profits in all scenarios or is only slightly negative (worst-worst).
- Specifically, despite the widely spread recommendation by extension services, industry programmes and research institutes, investing into the farm by proper spraying does not always pay off for the farmer. The net benefits depend on the changes in prices and yields. In times of low cocoa prices- such as 2017/2018- it may rather save the cocoa farmer money if he/she does not invest into cocoa production.

[4] This is an assumption, based on specific products and the production standard (certified vs. conventional). Official recommendation by CRIG is 4 rounds of spraying against mirids August, September, October and December.

- Fluctuating yields are the most decisive factor determining whether the investment into spraying – self or against a fee by a provider- pays off. However, effects of weather conditions cannot always be foreseen during the productive season and consequently being taken into account by the smallholder. In contrast at least in Ghana and Côte d'Ivoire the price development is more predictable as the farm gate price is fixed and usually not changed during the main season.

- The bigger the farm, the more profitable it becomes to buy own equipment, but the use of the service remains the most profitable option for the farmer. Exclusive use of a knapsack sprayer or mist blower for spraying a cocoa plantation means underutilization of capacity and high depreciation per ha (see chapter 1). Depending on the type of pesticide used, it is not recommended to use the same sprayer for different pesticides and crops.

- For the sake of simplicity, we have not included the possible changes in labour needs at the farmer's level concerning disease and insect control activities. This depends on the farmer's initial situation and service. In combination with additional needs for labour for harvest, the total labour effects of the technical service may be positive or negative.

- In some areas where labour is scarce the labour costs for additional harvest and post-harvest operations may also incur high costs. In such cases it may be the best option not to invest into the cocoa production. Insufficient treatment of cocoa beans after the harvest will lead to inferior quality of the beans and implicates that either the farmer does not find off-takers or has to sell them at a lower price.

Based on the preceding analysis of a spraying service from the smallholder's perspective, we conclude the following:

- Initial thorough economic analysis of the livelihood involved, and careful assessment of the fluctuating decisive parameters are crucial. If the market environment is too volatile, we recommend to better select another livelihood or production system.

- Intensification and mechanization do not always create net profits for the smallholder client, also as increased supply/productivity may lead to lower prices. In extreme this can destabilize their livelihoods.

- Technical services are mostly innovative for the smallholder. They change their agricultural production systems, labour needs and underline the need for a functioning business environment. Subsequent innovations such as other technical innovations, innovations related to communication/ICT or business innovations are necessary to ensure the success of the initial technical innovation and need to be thought through aforehand.

- Technical services have implications for labour needs in rural areas due to changes in the smallholders' production systems and jobs created for the providers. The net employment effect depends on the production system, service offered and availability of labour in the community. The effect worst case can lead to social tensions and to the rejection of the service in the area concerned.

- We do not recommend investing into a service where the willingness to pay by smallholders is too low and which needs to be subsidized. Rather invest into an economically more viable and thus sustainable activity.

2.3. Operationalizing the technical business services

To develop viable technical services, we recommend the main steps listed below. This will later enable a high reach out based on a sound business model.

1. Developing the preliminary set up of the model (or parallel to 2.) considering the following dimensions:

➲ **Where is the service provider anchored?**

- Provider works independently with linkages to the community and other aggregators, who may take commissions for linking up customer and provider- for example see chapter 3.1
- Provider is employee of an aggregator such as a cooperative, Business Service Centre (BSC) or agro-dealer-shop- for example see chapter 3.1 and 3.2
- Provider works on a contract basis linked to a BSC, for example see chapter 3.3

If the anchor of the provider is already clear at this stage, involve the anchor during the next steps.

➲ **How is the initial investment into equipment financed?**

- Sponsoring of start-up kit by development programme or other institutions
- Purchasing by service provider
- Leasing agreement with equipment dealer or producer (scarce in West Africa)
- Pre-financing by an aggregator (cooperative, agro-dealer etc.)
- Loan by financial institutions to aggregator (requires strong management of the model and the providers) or to the individual providers (risky for institutions)

➲ **How are the costs of the service recovered?**

- Customer fully pays for costs
- Customers are members of cooperatives and only pay part of the costs whereas the remaining share is financed via their levies towards their group
- Service is part of a loan package and will be paid after cocoa harvest
- Service is fully or partly sponsored (not recommended)

The best set up depends on opportunities and environment in the specific context.

2. Developing the first draft of economic analysis

- Based on data as far as available, where necessary use assumptions of parameters
- Compare different mobilities and conduct analysis for different services, as not all of them may pass the validation stage in step 3
- For innovative technologies such as motorized pruning, thorough field trials need to be undertaken to verify the parameters (see step 3 and example of motorized pruner below)

3. Validation in the field and revising economic analysis

➲ **Verifying the assumptions on key parameters** such as prices and labour

- This should be done per intervention region, as the locations and density of farms as well as road conditions can differ significantly; the same applies to cost elements such as input and labour prices
- The key parameters should be assessed in different communities together with farmers in focus group discussions and by interviewing extension officers
- If properly trained, later anchor institutions and independent providers can adjust the pricing elements to mirror the conditions in their environment

➲ **Assessing the smallholders' willingness to pay** for a service

- Farmers' willingness to pay varies across regions and depends on several factors: Own skills and adherence to a group, labour availability, outreach by public extension services, industry programmes and other donor interventions subsidizing these services or providing them for free, mentality of farmers, financial means of farmers conditions and ages of trees, size of plantations, other sources of income, to name a few.
- To assess farmers' willingness to pay, per region the smallholders are interviewed individually or in focus group discussions along a standardized questionnaire building on open questions. Suggestive questions should be avoided. The interviewers should be neutral for smallholders to respond authentically.
- On top, extension agents should be interviewed to share their experiences with the farmer groups.
- Government and other institutions offering services to farmers for free or at a subsidized price leads to low willingness to pay for a service. In such cases the service should not be developed, but farmers should rather be linked up to existing providers.
- In cases the actual value added by the service differs from the perceived value added when the economic benefits are not clearly known to the end user. In such cases the solution may either be to interview informed farmers or, if the number of informed farmers is too low, to train farmers on curricula such as Farmer Business School (FBS) first to create an effective market demand.

➲ **Assessing the smallholders' ability to pay**

- A very decisive factor to assess the effective demand for a service is the farmers' ability to pay for a service during the production year. Often, they don't have sufficient savings or stable income throughout the year. Depending on the context, approaches and collaborations with financial institutions towards improving the savings' culture of smallholders may solve this challenge.

4. Agree on final set up of technical service

- Latest at this stage the anchor institutions for the service need to be involved. This depends on the organization developing the service, its motivation and environment.
- Based on the results of the works done during steps 1 to 3, the stakeholders involved agree on
  I. Type of service provided
  II. Way of financing the service
  III. Anchorage of service- This involves developing contracting modalities and shall not be underestimated with regards to time needed for this

5. Developing a practical monitoring system and tools.

- Depending on the organization driving the service and the anchor a monitoring system and adapted tools need to be developed for proper service management. This will also allow reviewing the service after a trial period and adjusting it.
- Data can be registered either in simple sheets the service provider understands and which he/she regularly submits to the host institutions or through a simple app installed on the service provider's smart phone.

6. Selecting service providers

- To generate rural employment for young people, we recommend well-known and respected young men and women in the cocoa communities who are business-driven, technically skilled to operate the equipment and strong enough.
- Women shall not provide services for plant protection or conduct heavy work when they are pregnant, nursing or need to take their children along when they work. In dialogue with the female service provider there shall be a back-up plan such as allocating her working time to other activities and/ or the woman employing a labourer for the hazardous work. However, this will reduce her remuneration.
- The service providers should be endorsed by the village elderlies to ensure ownership of the communities.

7. Training the host organisations and service providers

Training of anchors and service providers needs to be done on the following modules:

a. Business models to allow for adaption of key parameters when the conditions change
b. Agronomic aspects of the technical service
c. Correct handling of the equipment
d. Monitoring requirements
e. Contracting modalities (where complex)

8. Monitoring of services and review of service after a pilot

9. Regular review of services and readjustments because the frame conditions may have changed.

Excursus: Testing of a motorized pruner in Ghana

With the idea in mind to introduce motorized pruning in Ghana, the project and partners conducted a field trial with a motorized pruner. Forehand, different scenarios had been developed with regards to productivity of labour, mobility (bicycle vs. motorbike) and special personal protective clothing (PPE) recommended by experts.

After the field trip, the following changes had to be made to the model:

1. ***Mobility of service provider:*** *Since the pole of the pruner is about 2 meters long, transporting the machine by bicycle or motorbike is not possible. Alternatives are walking, which lowers outreach per day or the use of a tricycle with higher costs for mobility and more difficult to access than bicycles/ motorbike. To provide this service on a competitive basis, living at proximity to the customers (or group customers and stay temporarily in their community) is a key advantage.*


Source: GIZ SSAB (2017)

2. ***Handiness of the equipment:*** *Motorized pruners weigh 7 to 10 kg. The service provider needs to be strong and needs a shoulder strap to be able to carry the weight for a MD. The service provider does not necessarily have to swap the machine with a colleague, but it is sufficient to have an assistant who picks up the branches.*

3. ***Safety of provider and bystanders:*** *The visor of the helmet distracted the pruning worker's view and the helmet itself was considered much too warm. The pruning worker stated that he would not use a helmet in the future, even if provided for him. Instead, he would use safety glasses, ear protection, gloves and rubber or steel capped boots. The biggest danger was not to the pruning worker himself but bystanders who could be hit by falling branches or by the chainsaw blade. Involved personnel on site had to frequently duck and shout out to the pruning worker, who would swing the pruner around carelessly while switched on. The operators need to be trained on the danger of cutting bystanders or hitting them with falling branches.*

The field trial has been documented. You can view here:
https://www.youtube.com/watch?v=AODX8NmrTdo

3. Technical business services in practice

In this chapter we share our experiences made with 3 different models of technical service provision by:

- Individuals or employees of Business Service Centres (Côte d'Ivoire), chapter 3.1
- Employees of cooperatives (Togo), chapter 3.2
- Services Providers of Rural Service Centres (Ghana), chapter 3.3

3.1. Services by independent service providers or employees of BSC in Côte d'Ivoire

SSAB supports since 2011 the development of Business Service Centres (BSC) in Côte d'Ivoire. The six BSC are in the major cocoa producing areas Abengourou, Daloa, Soubré, San-Pedro and Bouaflé (see map in Figure 3). They are hosted by five input dealers and one cooperative. The hosts manage the BSC.

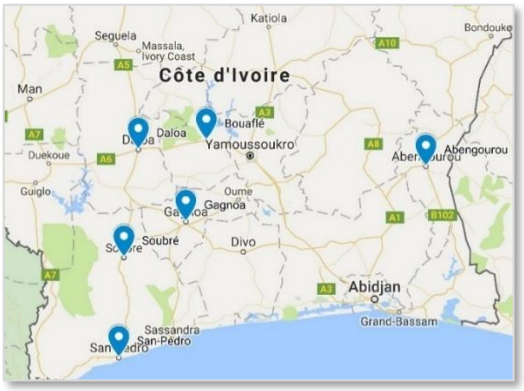

Figure 3 Locations of BSC in Côte d'Ivoire
Source: Google Maps (2017), opened on 25 Oct 2017.

On top of their core business (input sales by 5 BSC respectively bulk procurement of inputs and marketing of cocoa by 1 BSC), the BSC offer the following complementary services:

- ✓ Advising clients on Good Agricultural Practices of cocoa and food crops backed up by distribution of technical-economic producer references and demonstration plots with support of the companies YARA and LDC-CI
- ✓ Advising clients on high quality inputs and raising awareness on counterfeit products
- ✓ Link up to service providers for the technical services
    a. Cleaning of the plots, harvesting and post-harvest activities for cocoa
    b. GPS measurement of plots
    c. Spraying and fertilizer treatments (granular and foliar)
- ✓ Sensitizing on financial services (savings and credit) and linking to microfinance institutions

These complementary services add value for both clients and BSC hosts:

- **For the client:** Service provided contributes to better management of the farm, financial benefits such as saving money and higher yields as well as non-financial benefits such as environmentally less hazardous spraying of pesticides (see chapter 2.2)
- **For the BSC host:** Either in the form of income where the clients pay for the service or in the form of a stronger and growing customer base, where the services provided are part of the marketing strategy.

The support of GIZ focuses on strengthening agro-technical-economic capacities through training and information materials, support for the progressive digitalization of management, networking with microfinance institutions, monitoring of the services provided and the complementary start-up equipment of the BSC. In total more than 300 youth benefited directly from these various trainings. Since their inception in 2012, a total of 101,396 cocoa producing customers benefited from the services of the BSC. Since 2015, 91 service providers measured 4,303 hectares of cocoa plots with a GPS device and treated 16,579 ha of cocoa plots with approved pesticides. Youth brigades cleaned 4,724 hectares of cocoa plantation with cutlasses. The service providers either work as individuals or as employees of the BSC. In some cases, they are lead cocoa farmers. The youth brigades are anchored in the various communities.

Figure 4: Spraying of cocoa tree against mirids with mist blower

The pricing of the service is as follows (Table 9).

Table 9 Pricing of spraying service against mirids in Côte d'Ivoire with bicycle and annual profits per service provider

Unit cost spraying service for 1 ha		*Country:*	**Côte d'Ivoire**	
Mirids, motorized		*Crop:*	**Cacao**	
	Surface serviced		**1**	ha
Item	**Unit**	**Units/ha**	**FCFA/unit**	**FCFA/ha**
Fuel for mistblower	liters	1.50	590	885
Working time labourer	MD	0.25	3,000	750
Insecticides for 1 treatment	liters	0.50	6,500	3,250
Depreciation mistblower	FCFA/ha	1.00	178	178
Maintenance mistblower	FCFA/ha	1.00	63.00	63
Depreciation PPE	FCFA/ha	1.00	113	113
Depreciation bicycle	FCFA/day	1.00	40	40
Communication and client data	lumpsum	1.00	200	200
Total costs				**5,479**
Profit margin 20 % of total costs	FCFA/ha	0.20	5,479	**1,096**
Price of service with product	FCFA/ha			**6,574**
Service without product	FCFA/ha			**3,324**

Profitability spraying service		*Country:*	**Côte d'Ivoire**	
Mirids, motorized		*Crop:*	**Cacao**	
	Surface serviced p/yr		**280**	ha
Item	**Unit**	**Units**	**FCFA/unit**	**FCFA**
Fuel for mistblower	liters/yr	420	590	247,800
Working time labourer	MD/year	70	3,000	210,000
Insecticides for 1 treatment	liters/yr	140	6,500	910,000
Depreciation mistblower	FCFA/yr	280	178	49,875
Maintenance mistblower	lump sum	280	63	17,640
Depreciation PPE	FCFA/yr	280	113	31,500
Depreciation bicycle	FCFA/yr	280	40	11,200
Communication and client data	FCFA/yr	280	200	56,000
Total costs	FCFA/yr			**1,534,015**
Net profit of service including 20 % profit margin	FCFA/yr	280	1,096	**306,803**

Source: GIZ SSAB (2018b).

Similar to the Ghana model for spraying against mirids (chapter 2.1), the returns to investment are positive with NPV of 889,000 FCFA and the IRR of 133 % (with deduction of labour cost) and 1,634,000 FCFA and 79 % IRR (without deduction) respectively (Table 10). Nonetheless, offering this service exclusively without additional sources of income does not provide sufficient income (1,135 FCFA/day- 1.73 EUR). Assuming another source of income for the remaining year on the other side, the daily remuneration is 4,602 FCFA (7.01 EUR/8.35 USD), which can lift a family of 4 above the poverty threshold of 1.90 USD. The daily income is far beyond the minimum daily wage of 2,000 FCFA in Côte d'Ivoire (Table 10) and we can assume that it is more attractive for the service provider to stay in the rural area than migrating to a city. The additional source of income could e.g. be the income from cocoa farming, if a cocoa farmer implements the service. The cash flows for this calculation have been enclosed in Annex 4.

Table 10 NPV, IRR and remuneration of service provider - spraying against mirids service at full capacity, Côte d'Ivoire

Parameter	With deduction labour cost FCFA	Without deduction labour cost FCFA
Net Present Value*	889,940	1,634,590
Internal Rate of Return	133%	79%
Remuneration of provider 90 days		4,602
Remuneration of provider 365 days		1,135
Minimum daily wage RCI (2013)**		2,000

*280 ha per year, lifespan mistblower 4 years

**60,000 FCFA/month since 2013, http://www.lefigaro.fr/flash-eco/2013/11/20/97002-20131120FILWWW00602-cote-d-ivoire-le-salaire-minimum-gagne-60.php

Source: GIZ SSAB (2018b).

After several years of implementation in Côte d'Ivoire, these are our conclusions.

Conclusions from implementation

- Focusing on the provision of single services (such as spraying) does not create attractive livelihood options for young people nor sustainable rural employment, as the income throughout the year is not sufficient. Either the service provider has another occupation for the part of the year when the demand for the service is low (such as farming, helping out in an agro-dealer shop, other activities for a cooperative etc.) or a holistic service package is developed.
- We have realized that managing individual service providers and monitoring them is difficult, unless there is a clear contract between individuals and hosts (see chapter 3.3).
- We recommend having strong hosts for the business services, who manage the service providers, monitor their activities and ensure that they are up to date regarding agronomic knowledge, latest input recommendations and dosages
- These hosts need sound business management of their core activities and have a business mind-set. Otherwise they will not tap into the full potential of complementary business services and rely on support from outside (such as GIZ).

3.2. Services by employees of farmer-based organisations in Togo

In Togo, the programme cooperates since 2016 with the *Fédération des Unions de Producteurs de Café-Cacao du Togo* (FUPROCAT), its cooperative unions and a microfinance institution to roll out business services to cocoa producers.

The managers of the three unions of FUPROCAT are in charge of coordinating the activities of the three BSC. Monitoring of the technical business services, analysis and validation of the input credit request form, grouped inputs procurement and management of input stocks is equally done at the union level. Managers distribute inputs to grassroot cooperatives to facilitate the work of each service provider and according to the treatment schedule for the cocoa farms. They work with the FUPROCAT technical advisors to ensure that the service providers are doing the work effectively in their area. FUPROCAT organises trainings, supports the unions on management issues, purchases inputs and coordinates the activities of the unions. The unions in turn support the primary cooperatives in their activities. The start-up equipment (mist blowers etc.) in the framework of this partnership so far has been provided by GIZ so far. The micro-finance institution sensitizes the cooperative members on financial services and offers input loans to eligible members (Figure 5).

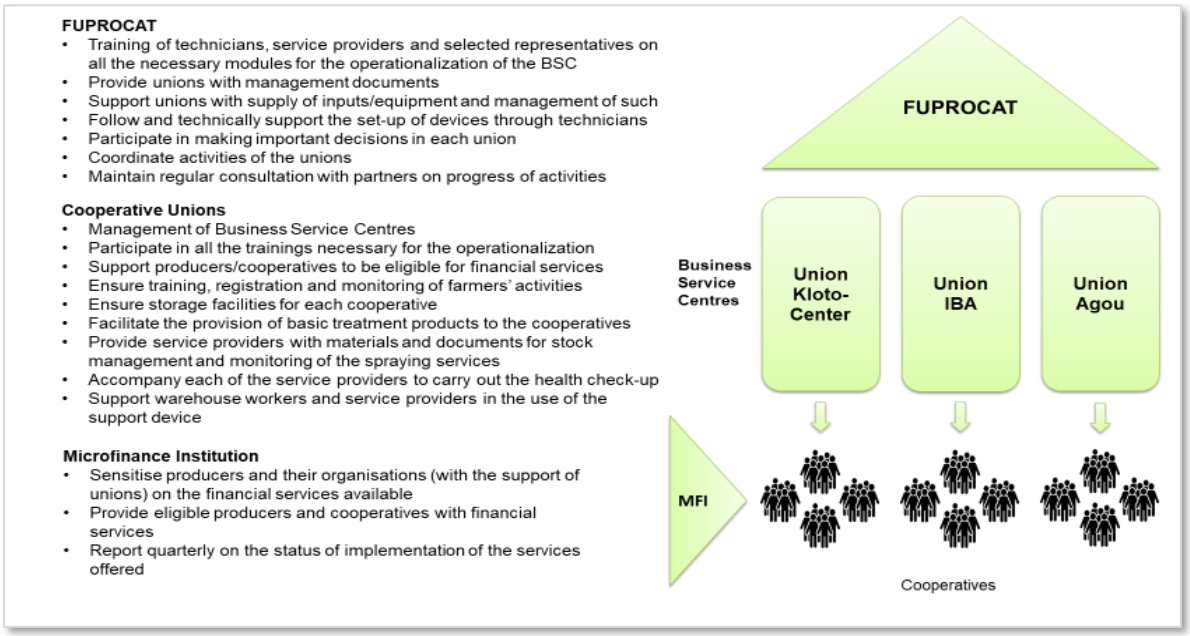

Figure 5 BSC hosted by cooperative unions in Togo - roles of FUPROCAT, unions and MFI

Source: Authors based on FUPROCRAT (2016)

Jointly these partners have set up a network of 50 service providers with priority on young farmers. Those selected are cocoa farmers themselves, able to read and write, able to carry out the spraying services. These service providers are connected to the 3 BSC hosted by the Unions Kloto-Centre, IBA (Wawa area) and Agou.

They offer the following payment-based technical business services to the members of the unions:

a. GPS measurement of cocoa farms

b. Spraying services (mainly against black pod and mirids)

In this model the providers work as part-time employees of the cooperatives for 2 services, spraying against black pod with knapsack sprayer and spraying against mirids with mist blower. The remuneration from treating 400ha annually against diseases (black pod) and insects (mirids) amounts to 640,000 CFA (975 EUR) (Table 11). The remuneration for spraying against mirids is higher than in Côte d'Ivoire (2,000 FCFA/ha vs. 750 FCFA/ha). Cooperatives receive a net profit of 215,000 CFA (327 EUR).

Similar to the case in Côte d'Ivoire, the benefits for the service provider derived only from spraying services is not sufficient to lift a family out of poverty (640,000 FCFA/year when combining 2 services, equal to 2.67 EUR or 3.18 USD). For this reason, in Togo, during the months when they are not active as spraying service providers, the service providers being cocoa farmers work on their own farms. Due to the particular small cocoa farms in Togo (1 to 2 ha), this does not constitute a bottleneck with regards to labour needed.

Table 11 Synthesis of annual benefits for service providers and cooperatives for spraying service against back pod and mirids, 200 ha treated each

	FCFA
Annual remuneration of service provider (Black pod)	240,000
Annual remuneration of service provider (Mirids)	400,000
Total annual remuneration of service provider	***640,000***
Net profit of services incl. gross margin of 10% on total costs (Black pod)	72,208
Net profit of services incl. gross margin of 10% on total costs (Mirids)	143,625
Total net profit of cooperative (Black pod + Mirids)	***215,833***

Source : GIZ SSAB (2016).

So far, the spraying service providers have treated 3,803 ha. Across the 3 BSC, the earnings of the 50 service providers amount to 32 million FCFA (48,780 euros). The net profit drawn by the network of FUPROCAT is 10,791,650 FCFA (16,450 euros) for the 50 service providers. The GPS measurement service is still in a pilot stage with 47 ha measured to date.

Conclusions from implementation in Togo:

- Specifically, in Togo, acquisition of high quality approved inputs is challenging. For this reason, the BSC/cooperative unions need to maintain and improve their relationship with certified suppliers for the acquisition of approved inputs and scaling up of the spraying services.
- Where cocoa farmers can act as service providers, offering single services may be profitable enough, as they additionally derive their income from their cocoa farm. In this model, the labour of the farmers is not fully absorbed by farming activities- particularly relevant for small farms.
- Cooperative unions and their cooperatives are good anchors for technical services when they are strong enough in management and business minded.

3.3. Services by service providers linked to Rural Service Centres in Ghana

This case study has been prepared with Touton S.A., Ghana Office

In Ghana, the programme has partnered with the commodity trading company Touton in 2016. One of the pillars of the collaboration is the rendering of business services to cocoa smallholdings. The model chosen builds on service providers affiliated to Rural Service Centres (RSC) hosted by Touton and the licensed buying company PBC. Each service provider is affiliated to one of Touton's RSC (see Figure 6). Within a cluster of four to five communities (depending on market base), one RSC provider provides services for all farmers in the catchment area against a fee at proximity.

The RSC provider is between the age of 18 and 35 years with priority on those below 27 years old. A provider has completed at least basic education and has demonstrated aptitude for entrepreneurial skills in the community. He/she has evidence of ties to the community. Where a youth is above 27 years, he/she already has income generating activities on ground. He/she works with other youth and labourers that are interested to benefit from his or her business.

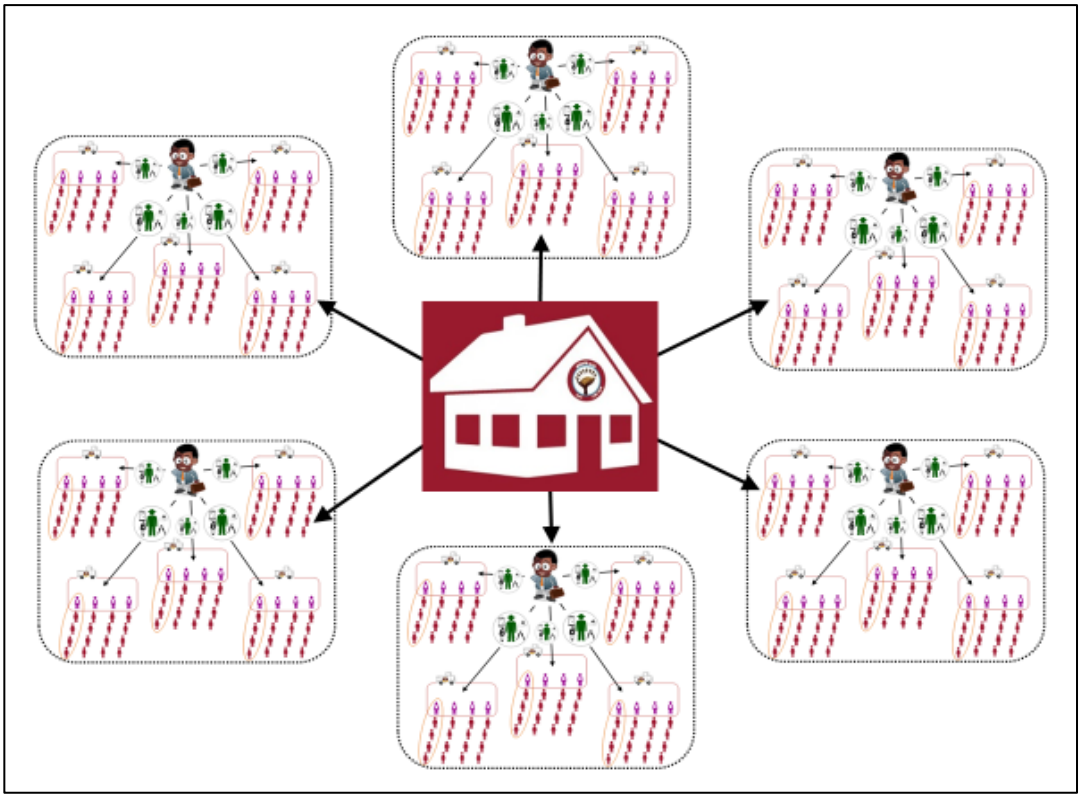

Figure 6 The Touton service provider concept in a snapshot

Source: Touton (2017).

GIZ and Touton rolled out the RSC service provider model according to the standard approach (chapter 2.3 and below) and invested several months in developing the business model as well as the contracting modalities to ensure the economic sustainability of the service provider model right from the start.

Steps to roll out the RSC provider model

1. Develop **economically viable and demand-driven business models** for input sales, spraying service, GPS measurement service, cutting down trees service and pruning service.

2. Develop the **contracting modalities for RSC providers** and linked labourers
3. Develop a **monitoring system**
4. **Select RSC providers** in consultation with the traditional village authorities, cocoa farmers and cocoa buying company
5. **Train** the RSC service providers and linked labourers (Figure 7)
6. **Manage and monitor** the RSC service providers in their daily work
7. **Revise RSC service provider model** based on first experiences

Figure 7: RSC service providers during technical training session

Besides the pricing of the individual services (see chapter 2.1 and Annex 1 to 3), the **economic analysis of the RSC service provider model** includes a cashflow analysis for the entire service package. It also contains a cashflow for a 12 months-period (Table 15) with the option to allocate the working time to different services, depending on:

a. When there is market demand according to the cropping calendar of cocoa
b. When the farm owners or their care takers are available, which varies strongly from a location to another and depends on the other crops farmers grow (such as rice)
c. Which service has the higher profitability when they are in competition with each other as they are relevant at the same period (e.g. GPS mapping and pruning)

We present the cash flow analysis for the service package spraying against mirids, spraying against black pod disease, GPS mapping and motorized pruning.

The activities follow the production calendar of cocoa (Figure 8 for example [5]) Pruning takes place until start of the raining season and stops when the growth of the tree resumes. GPS mapping can be done anytime but knowing the correct size of the plantation is more important at the beginning of the agricultural production year for purchasing of inputs and planning the financial flows. The highest pressure from peak season for diseases and insects is between Mai to October.

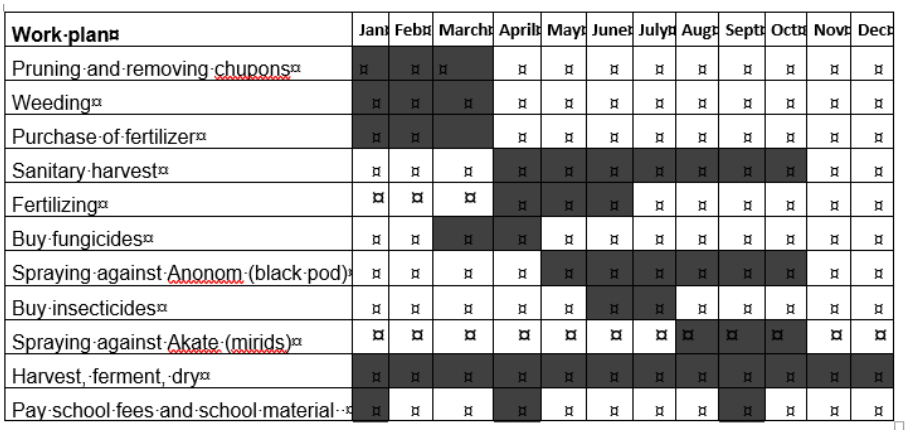

Figure 8 Cropping calendar for cocoa production in Ghana

Source: COCOBOD (2016).

We have calculated a best-case scenario with almost full use of capacity of the RSC service provider (Table 12) and a worst-case scenario with low market demand and maximum use of 70 % capacity of the RSC provider (Table 13).

Table 12 Allocation of RSC provider's working time to different services at full capacity (best scenario)

Service provided	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Motorized Pruning of cocoa		40%	80%	60%	40%							
GPS Mapping	100%	60%	20%	10%	20%							
Spraying insecticide cocoa (mistblower)								50%	50%	50%	30%	
Spraying fungicide cocoa (knapsack)				30%	40%	100%	100%	50%	50%	50%	30%	
Use of MD capacity	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**60%**	

Source: GIZ SSAB (2018a).

Table 13 Allocation of RSC provider's working time to different services at low capacity (worst scenario)

Service provided	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Motorized Pruning of cocoa		20%	20%	20%	20%							
GPS Mapping	40%	40%	20%	10%	20%							
Spraying insecticide cocoa (mistblower)								25%	25%	25%	20%	
Spraying fungicide cocoa (knapsack)				20%	30%	50%	50%	25%	25%	25%	10%	
Use of MD capacity	**40%**	**60%**	**40%**	**50%**	**70%**	**50%**	**50%**	**50%**	**50%**	**50%**	**30%**	

Source: GIZ SSAB (2018a).

[5] The cropping calendar for cocoa depends on the agro-climatic conditions in each region and in particular the rain patterns; the actual months for implementation of specific activities varies accordingly

Based on the allocation of labour force and the life time of equipment, we have calculated the Cash Flow for 4 years, NPV and IRR with 4 different options (Table 14): High or low market demand, deduction of labour cost vs. no deduction of labour cost. In Scenario 1, the RSC provider can use additional labourers to satisfy the market demand (expressed by use of capacity higher than 100 %). The labourers receive their wage and the RSC provider the net profit. In Scenario 2, the market demand is too low to work with labourers. In Scenario 3 and 4, the RSC provider works alone and receives as remuneration the net profit plus the fee for his labour.

Table 14 Presentation of different scenarios for Cash-Flow Analysis of RSC provider model

Market demand	**Deduction of labour costs**	
	Yes	No
High (Table 12)	**Scenario 1** (Annex 7)	**Scenario 3** (for cash flow 12 months Table 15, full cash-flow analysis (Annex 8)
Low (Table 13)	**Scenario 2** (Annex 9)	**Scenario 4** (Annex 10)

The NPV and IRR for Scenario 3 are the highest, which also reflects in the cash flow for 12 months (Table 15). In all 4 scenarios the investment yields positive return with a minimum NPV of 5,093 GHS and an IRR of 48 % for Scenario 2 (low demand with deduction of labour costs, see Table 16). Thus, when well managed and with sufficient market demand the combination of different technical services holds high potential to create viable business models in the rural areas that not only create economically viable attractive youth employment, but also provide an added value to cocoa farmers.

Table 15 Cash flow of RSC provider model for 12 months, without deduction working time best case scenario

	Daily capacity ha	Monthly capacity ha	Unit price ha (GHS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total costs				**3,400**	**151**	**3,351**	**112**	**111**	**113**	**113**	**1,779**	**1,779**	**1,779**	**1,067**	
Equipment costs (GHS)				**3,300**		**3,240**									
Bicycle						200									
Mist blower						1,700									
PPE mist blower						140									
Knapsack sprayer						200									
Motorized Pruner				3,200											
PPE pruner				100											
Android device						1,000									
Variable costs (GHS)				**100**	**151**	**111**	**112**	**111**	**113**	**113**	**1,779**	**1,779**	**1,779**	**1,067**	
Motorized Pruning of cocoa	1	16	7.07		90	90	68	45							
GPS Mapping	5	100	1.00	100	60	20	10	20							
Spraying insecticide cocoa (mistblower)	4	80	43.06								1,722	1,722	1,722	1,033	
Spraying fungicide cocoa (knapsack)	2	40	33.53				34	45	113	113	57	57	57	34	
Gross revenue from services (GHS)**				**730**	**868**	**1,006**	**1,311**	**1,366**	**1,976**	**1,976**	**3,135**	**3,135**	**3,135**	**1,881**	
Motorized Pruning of cocoa	1	16	67.23		430	861	645	430							
GPS Mapping	5	100	7.30	730	438	146	73	146							
Spraying insecticide cocoa (mistblower)	4	80	53.67								2,147	2,147	2,147	1,288	
Spraying fungicide cocoa (knapsack)	2	40	49.39				593	790	1,976	1,976	988	988	988	593	
Cash Flow Balance (GHS, per month)				**-2,671**	**717**	**-2,344**	**1,199**	**1,256**	**1,863**	**1,863**	**1,356**	**1,356**	**1,356**	**814**	
Cumulative (GHS)				**-2,671**	**-1,953**	**-4,297**	**-3,098**	**-1,842**	**21**	**1,883**	**3,239**	**4,595**	**5,951**	**6,764**	**6,764**

Source: GIZ SSAB (2018a).

Table 16 NPV, IRR, daily remuneration of different RSC provider model scenarios

Scenario / Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Net Present Value (GHS)	15,133	5,093	29,928	12,356
Internal Rate of Return	112%	48%	200%	95%
Remuneration of provider 365 days (GHS)			31.61	13.72

Source: GIZ SSAB (2018a).

Touton has designed a **hire-purchase financing scheme for motorized equipment**. All service providers involved in the programme, who have received trainings on motorized equipment handling and maintenance, are offered to acquire a set of equipment on hire-purchase terms. From the start of operations, the providers pay monthly instalments until full repayment of the lent amount. The instalments comprise cost of assets, interests to cover inflation and contribution to a guarantee fund in case of default.

Achievements within the first 6 months of implementation with only the spraying service and GPS service active yet confirm the sound design of the RSC provider model: After 6 months of implementation, the RSC providers have serviced 4,100 cocoa farmers and generated sales with 119,000 GHS value (see below). In average they have paid back 700 GHS, hence 21 % of the total amount. Thus, the providers are on track with their repayment, especially as the pruning and cutting down of trees-service have just started.

Achievements of RSC provider model in the first 6 months of implementation

- 30 RSC providers trained in two batches (2017 and 2018) on key parameters for economic analysis, the business models of the technical services, related agronomy and handling of technical equipment, certification and internal management system, basic management skills, legal rights and obligations in the framework of the RSC provider model, data collection and reporting and becoming service provider in practice
- 28 RSC providers have signed their hire-purchase agreements and started repaying to the BSC with the average repayment of 708 GHS, i.e. 21 %, after 6 months of activities
- Spraying: 3,603 customers received spraying services for 5,722 ha and generated 115,000 GHS turnover (including price for product)
- GPS Mapping: 531 farmers' biodata collected and 1,400 ha mapped, 4,000 GHS turnover
- Motorized pruning service and motorized cutting down of old plantations-service to start in April/Mai 2018

Nonetheless, the success of the RSC provider model needs to be proven. We have met the following challenges (Table 17):

Table 17 Challenges in the implementation of the RSC provider model and responses

Challenge	Response
Lower number of RSC providers than planned (28 instead of 50)	
• *Equipment was more expensive than anticipated by the partners and it was challenging to find suitable providers in the communities.*	• *Partners wanted to roll out only based on confirmed success of the pilot.* • *Having successful service providers as role models in the communities will trigger the demand of fellow youth to also be engaged.*
Clash of farmers' availability and interest with optimal allocation of working time of RSC providers	
• *Farmers demand does not always correspond to the timing of recommended GAP and availability of providers.* • *Providers could increase their income if farmers engaged them for pruning of trees from January to March, for example so that they can prioritize spraying from April on.*	• *Sensitization of farmers on recommended timing and sequencing of farming activities by RSC employees.* • *RSC providers hire qualified labourers for peak periods.*
Solution for cost-effective monitoring	
• *So far paper based; the RSC employees collect sheets once per week.* • *Close follow up in the initial state is necessary ensure the success of the model and repayment of equipment.*	• *After proven performance in the initial months of collaboration between providers and RSC, the need for monitoring becomes less.* • *An app for recording sales' data is in the pilot stage and could be rolled upon success.*
Low engagement of female providers	
• *None of the RSC providers is female due to the focus of services on those requiring hard physical labour. The only woman engaged as provider became pregnant after a while and cannot engage in hard work or spraying services for now.* • *The women themselves and other stakeholders involved were hesitant to propose women, despite Touton's attempt to get women involved.*	• *It is envisaged to bring less physically tiring services on board such as input sales and financial services which favour women better.*
Hesitance of farmers to engage providers	

Challenge	Response
• *Due to the new nature of the service; hosts for the services were not always known, some farmers were not aware of the economic benefits for them.* • *Farmers not yet engaged with PBC/Touton are hesitant to engage providers, creating the need for the providers to increase the catchment area.*	• *RSC employees engaged in strong marketing for branding of the providers as belonging to the RSC and being backed by providers of high quality inputs and equipment.* • *Providing Farmer Business School to support farmers in recognizing the economic benefits of engaging providers.* • *Farmers will notice the success of fellow farmers and develop interest in services.* • *Further sensitization of RSC employees.*
Low willingness to pay for certain services due to engagement of other actors	
• *The public extension provider Ghana Cocoa Board has decided to offer the services cutting down old cocoa plantations and motorized pruning without extra fee to the farmers.* • *Consequently, the farmers' willingness to pay for such service is reduced.*	• *Solution for the providers: Implementing service on contract basis with COCOBOD for now and adding more services such as input sales to ensure profitability of the model.* • *Solution for the smallholders: Benefit from service provision by COCOBOD without extra costs.*

Based on our pilot experience with delivering service packages by RSC service providers in Ghana, we draw the following conclusions:

Conclusions from implementation in Ghana

- Strong IT tools for economic analysis (in this case for the design of service packages) help to allocate the work force such that the income of the providers is sufficiently high
- The design of a comprehensive service package compared to single service solutions is likely to increase the income of service providers and additional labourers
- Solid leasing schemes for equipment improve take-up by service providers
- Interventions from other institutions alter the business model and create the need for other services to be added to the package
- Thorough follow-up and support of the RSC service providers by RSC employees is crucial in the beginning of the implementation phase to help them getting established in the market and to ensure regular pay-back
- RSC service providers need to be carefully selected. If the literacy level is too low or the business-mindedness of the person not existent, the model will not be successful
- Sensitization of smallholders on economic benefits of services (e.g. by Farmer Business School) and on optimal timing of agricultural activities is key
- Availability and interest of farmers to engage providers differs strongly between locations, depending on the other crops they produce and whether caretakers manage the farms or the owners themselves
- To empower women in rural areas, services need to be introduced that are not based on hard physical labour.

4. Lessons learnt

In addition to the specific lessons already presented at the end of each chapter, we share the following lessons from our experiences with technical business services:

1. The services introduced need to comprise a **number of services in a service package** based on sound economic analysis and need to provide sufficient and stable living income along the year for the service provider himself as well his family- approx. 6 members.

2. **Technical services do not necessarily create net profits for the involved smallholders.** Increased production costs may outweigh the additional profits from additional yields. Prices can drop as a consequence of increased productivity or due to volatility.

3. Introducing **technical service at large scale allows to purchase equipment and inputs in bulk,** thus reducing the costs for these items.

4. **Strong business linkages between hosts of technical business services, input suppliers as well as equipment dealers** are key to have the inputs and equipment when needed, in particular in areas where inputs are difficult to procure. The anchors need to be professional enough to do so.

5. **Subsequent innovations needed after the initial technical innovation and effects on the agro-ecological systems** need to be thought through a fore hand.

6. Technical business services have an **impact on employment in rural areas** (positive or negative) and by influencing the yields also on **prices** (negative, ceteris paribus).

7. **Solid contracting modalities** with service providers are essential, including reporting obligations; totally independent providers are difficult to manage.

8. **Thorough monitoring and support of providers by marketing/branding them** in the take off stage is useful to trigger market demand by the customers.

9. The services influence the **entire production model of the cocoa smallholder**. Unwanted side effects could for example be resorting to the use of children for breaking of cocoa pods if the yields increase significantly or rendering spraying service providers jobless if proper pruning of trees reduces the infestation with black pod disease.

We derive the following success factors for sustainability of technical business services, boosting revenues of smallholders, creating jobs for young rural people and improving food security:

Table 18 Success factors for sustainable technical business services

Profitability of service and design of packages	• Careful economic analysis for different services and mobility options as well as service packages • Design the service package flexible enough to be able to shift resources to another service when market demand for a particular service declines • Income from services needs throughout the year needs to be high enough to cater for basic needs of the service provider and his/her family and to finance equipment (taken care of by depreciation) • Service packages offered for different crops reduce dependency from specific crops and provide more stable market for demand throughout the year (where feasible)

Availability and quality of inputs and equipment	• Local structures available to high quality oil, spare parts and servicing for proper use of sophisticated equipment such as motorized pruners or chain saws • Timely availability of high quality equipment and inputs is key for service provision, working with manufacturers with a good reputation increase the market demand significantly
Modalities for financing for equipment	• Start-up costs for equipment are high; leasing agreements reduce the initial investment cost to establish technical services and facilitate scaling up
Benefits for customers and willingness to pay	• Choose crops and regions with low volatility of key prices and stable relationships to off-takers to increase likeliness of economic benefits by smallholders • Smallholders with diversified production are likely to demand service packages for different crops • Effect of increased supply on smallholders' revenue: Increased supply leads to lower prices of agricultural commodities if the market is saturated. Better quality on the other hand may attract a prime. Overall effect is not conclusive • Mid-term success strongly depends on the economic environment for the crop produced and resilience of smallholders to absorb price shocks • Where possible choose crops with low incentives for politicians, industry actors or development programmes to subsidize services- subsidized services do generate benefits for the smallholders within reach of the subsidies, but they are not sustainable
Strong, business oriented anchor companies or organizations	• Core interest to foster services (e.g. income from service and/or better services to customers) • Size of the anchor or umbrella institution to negotiate price discounts for inputs and equipment • Capacity to backstop and monitor service providers • Capacity to finance equipment or negotiate leasing agreements
Neutral or positive effect on environment	• Overuse of inputs would strain environment; correct application of inputs by professionals reduces pressure on environment. Overall effect depends on the optimal level of intensification • Increased attractiveness of agriculture may increase the use of land for agriculture at the expense of rain forest; on the other hand, intensification reduces the needs to expand the surface under production
Neutral or positive effect on rural employment	• Effect on rural employment is neutral when labour in the area is scarce and service saves the farm owners working time • Effect on rural employment is positive if there are unemployed people in rural areas, and technical service leads to creation of jobs in primary production (e.g. to harvest additional yields and process them) and for the providers themselves • Effect on rural employment is negative if services linked to mechanisation reduce the need for manual (unqualified) labour

Source: Authors.

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Annex

Annex 1 Economics of motorized pruning of cocoa trees, walking, Ghana

Unit Price		*Country*	Ghana		
Motorized, walking		*Crop*	Cocoa		
	Served surface area			1	**3**
Item	**Unit**	**Quantity per ha**	**GHS per unit**	**GHS per ha**	**GHS total**
Work of service provider	MD	1.25	25.00	31.25	93.75
Communication & mgt. Client data	lumpsum	1.00	1.00	1.00	3.00
Fuel for motorized pruner	GHS/ha	1.00	4.40	4.40	13.20
Maintenance motorized pruner	GHS/ha	1.00	1.67	1.67	5.00
Depreciation of motorized pruner	GHS/ha	1.00	16.67	16.67	50.00
Depreciation protective clothes	GHS/day	1.25	0.83	1.04	3.13
Total cost				**56.03**	**168.08**
Expected profit margin per provider	GHS/ha	20%	56.03	**11.21**	33.62
Unit price of service	GHS/ha			**67.23**	**201.69**

Parameter	**Unit**	**Motorized pruner**	**PPE for pruner**
Reference unit		ha	ha
Purchasing Price	GHS	3,200	100
Days with operations per year	days	60	60
Daily capacity	ha/day	0.80	
Annual service capacity	ha/year	48	
Lifecycle	year	4	2
Service capacity for entire lifecycle	see reference unit	192	120
Depreciation	per reference unit	**16.67**	**0.83**
Maintenance 10 % of purchasing price		**1.67**	

Profitability Pruning service		Country	Ghana	
Motorized, walking		Crop	Cocoa	
1 provider per year full capacity	Serviced surface area		48.0	ha
Item	**Unit**	**Quantity per year**	**GHS per unit**	**GHS per year**
Work of service provider	MD/yr	60.00	25.00	1500.00
Communication & mgt. Client data	GHS/yr	48.00	1.00	48.00
Fuel for motorized pruner	GHS/yr	48.00	4.40	211.20
Maintenance motorized pruner	GHS/yr	48.00	1.67	80.00
Depreciation of motorized pruner	GHS/yr	48.00	16.67	800.00
Depreciation protective clothes	GHS/yr	60.00	0.83	50.00
Total cost	GHS/yr			**2689.20**
Gross revenue from service including 20% profit margin	GHS/yr	48.0	67.23	**3227.04**
Net profit for one service provider	GHS/yr			**537.84**

Cash flow of pruning service				Country:	Ghana		
				Crop:	Cocoa		
		Surface serviced per year			48	ha	
Item	**Unit**	**Quantity**	**GHS/unit**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Work of service provider	MD/yr	60.00	25.00	1500.0	1500.0	1500.0	1500.0
Communication & mgt. Client data	GHS/yr	48.00	1.00	48.0	48.0	48.0	48.0
Fuel for motorized pruner	GHS/yr	48.00	4.40	211.2	211.2	211.2	211.2
Maintenance motorized pruner	GHS/yr	48.00	1.67	80.0	80.0	80.0	80.0
Equipment cost	GHS/yr			3300.0		100.0	
Total outflows with labour cost	**GHS/yr**			**5,139.2**	**1,839.2**	**1,939.2**	**1,839.2**
Total outflows without labour cost	**GHS/yr**			**3,639.2**	**339.2**	**439.2**	**339.2**
Inflows	**GHS/yr**	**48.0**	**67.2**	**3,227.0**	**3,227.0**	**3,227.0**	**3,227.0**
Cash flow per year with labour cost	**GHS/yr**			**-1,912.2**	**1,387.8**	**1,287.8**	**1,387.8**
Cash flow per year without labour cost	**GHS/yr**			**-412.2**	**2,887.8**	**2,787.8**	**2,887.8**
Cash flow accumulated with labour cost	**GHS**			**-1,912.2**	**-524.3**	**763.5**	**2,151.4**
Cash flow accumulated without labour cost	**GHS**			**-412.2**	**2,475.7**	**5,263.5**	**8,151.4**

	with labour cost	without labor cost
Net Present Value	**876 GHC**	**4,911 GHC**
IRR	**24%**	**78%**

Annex 2 Economics of GPS mapping service

Unit Price		Country	Ghana		
Bicycle		Crop	Cocoa		
			Served surface	**1**	**3**
Item	**Unit**	**Quantity per ha**	**GHS per unit**	**GHS per ha**	**GHS total**
Work of provider	MD	0.20	25.00	5.00	15.00
Printing of map for client	lumpsum	1.00	0.50	0.50	1.50
Maintenance of bicycles	GHS/day	0.20	0.01	0.00	0.01
Communication & electricity	lumpsum	1.00	0.50	0.50	1.50
Depreciation of bicycle	GHS/day	0.20	0.15	0.03	0.09
Depreciation of android device	GHS/day	0.20	0.24	0.05	0.15
Total cost				**6.08**	**18.24**
Expected profit margin per provider	GHS/ha	20%	6.08	**1.22**	**3.65**
Unit price of service	GHS/ha			**7.30**	**21.89**

Parameter	**Unit**	**Bicycle**	**Android device**
Reference unit		day	day
Purchasing Price	GHS	200	1,000
Days with operations per year	days	275	275
Daily capacity	ha/day		5.00
Annual service capacity	ha/year		1,375
Lifecycle	year	5	3
Service capacity for entire lifecycle	see reference unit	1,375	4,125
Depreciation	per reference unit	**0.15**	**0.24**
Maintenance 10 % of purchasing price		**0.01**	

Profitability GPS Mapping service		Country	**Ghana**	
Bicycle		Crop	Cocoa	
1 provider per year full capacity	Served surface area		**1,375**	ha
Item	**Unit**	**Quantity per year**	**GHS per unit**	**GHS per year**
Work of provider	MD/yr	275.00	25.00	6,875.00
Printing of map for client	GHS/yr	1,375.00	0.50	687.50
Maintenance of bicycles	GHS/yr	275.00	0.01	4.00
Communication & electricity	GHS/yr	1,375.00	0.50	687.50
Depreciation of bicycle	GHS/yr	275.00	0.15	40.00
Depreciation of android device	GHS/yr	275.00	0.24	66.67
Total cost				**8,360.67**
Gross revenue from service including 20% profit margin with product	GHS/yr	1,375.00	7.30	**10,032.80**
Net profit for one provider	GHS/yr			**1,672.13**

Cash flow of GPS Mapping				*Country:*	**Ghana**	
				Crop:	**Cocoa**	
			Surface serviced p/yr		**1,375**	ha
Item	**Unit**	**Quantity**	**GHS/unit**	**Year 1**	**Year 2**	**Year 3**
Work of provider	MD/yr	275.00	25.00	6875.0	6875.0	6875.0
Printing of map for client	GHS/yr	1375.00	0.50	687.5	687.5	687.5
Maintenance of bicycles	GHS/yr	275.00	0.01	4.0	4.0	4.0
Communication & electricity	GHS/yr	1375.00	0.50	687.5	687.5	687.5
Equipment cost	GHS/yr			1200.0		
Total outflows with labour cost	**GHS/yr**			**9,454.0**	**8,254.0**	**8,254.0**
Total outflows without labour cost	**GHS/yr**			**2,579.0**	**1,379.0**	**1,379.0**
Inflows	**GHS/yr**	**1,375.0**	**7.3**	**10,032.8**	**10,032.8**	**10,032.8**
Cash flow per year with labour cost	**GHS**			**578.8**	**1,778.8**	**1,778.8**
Cash flow per year without labour cost	**GHS**			**7,453.8**	**8,653.8**	**8,653.8**
Cash flow accumulated with labour cost	**GHS**			**578.8**	**2,357.6**	**4,136.4**
Cash flow accumulated without labour cost	**GHS**			**7,453.8**	**16,107.6**	**24,761.4**

	with labour cost	**without labour cost**
Net Present Value	**2,851 GHC**	**17,799 GHC**
IRR	**137%**	**720%**

Annex 3 Economics of spraying service against black pod disease, knapsack sprayer, bicycle

Unit Price			Country	Ghana		
manual, bicycle			Crop	Cocoa		
		Served surface area			1	1
Item	Unit	Quantity per ha	GHS per unit		GHS per ha	GHS served total
Work of provider	MD	0.50	25.00		12.50	12.50
Fungicide	gram	250.00	0.13		32.50	32.50
Maintenance of knapsack	GHS/ha	1.00	0.02		0.02	0.02
Maintenance of bicycles	GHS/day	0.50	0.01		0.01	0.01
Communication & mgt. Client data	lumpsum	1.00	1.00		1.00	1.00
Deperiation of knapsack	GHS/ha	1.00	0.24		0.24	0.24
Depreciation of bicycle	GHS/day	0.50	0.15		0.07	0.07
Depreciation protective clothes	GHS/day	0.50	0.47		0.23	0.23
Total cost with product					**46.58**	**46.58**
Total cost without product					**14.08**	**14.08**
Expected profit margin per provider	GHS/ha	20%	14		**2.82**	**2.82**
Unit price of service with product	GHS/ha				**49.39**	**49.39**
Unit price of service without product	GHS/ha				**16.89**	**16.89**

Parameter	Unit	PPE for spraying	Bicycle	Knapsack sprayer
Reference unit		ha	day	ha
Purchasing Price	GHS	140	200	200
Days with operations per year	days	150	275	140
Daily capacity	ha/day			2.00
Annual service capacity	ha/year			280
Lifecycle	year	2	5	3
Service capacity for entire lifecycle	see reference unit	300	1,375	840
Depreciation	per reference unit	**0.47**	**0.15**	**0.24**
Maintenance 10 % of purchasing price			**0.01**	**0.02**

Profitability spraying service			Country	Ghana	
manual, bicycle			Crop	Cocoa	
1 provider per year full capacity		Served surface area		**280**	ha
Item	Unit	Quantity per year	GHS per unit		GHS per year
Work of provider	MD/yr	140.00	25.00		3,500.00
Fungicide	kg	70.00	130.00		9,100.00
Maintenance of knapsack	GHS/yr	280.00	0.02		6.67
Maintenance of bicycles	GHS/yr	140.00	0.01		2.04
Communication & mgt. Client data	GHS/yr	280.00	1.00		280.00
Deperiation of knapsack	GHS/yr	280.00	0.24		66.67
Depreciation of bicycle	GHS/yr	140.00	0.15		20.36
Depreciation protective clothes	GHS/yr	140.00	0.47		65.33
Total cost with product					**13,041.07**
Total cost without product	GHS/yr				**3,941.07**
Gross revenue from service including 20% profit margin with product	GHS/yr	280.00	49.39		**13,829.28**
Gross revenue from service including 20% profit margin without product	GHS/yr	280.00	16.89		**4,729.28**
Net profit for one provider	GHS/yr				**788.21**

Cash flow of spraying service				*Country:*	**Ghana**	
Fungicide				*Crop:*	**Cocoa**	
				Surface serviced p/yr	**280**	ha
Item	**Unit**	**Quantity**	**GHS/unit**	**Year 1**	**Year 2**	**Year 3**
Work of provider	MD/yr	140.00	25.00	3500.0	3500.0	3500.0
Fungicide	kg	70.00	130.00	9100.0	9100.0	9100.0
Maintenance of knapsack	GHS/yr	280.00	0.02	6.7	6.7	6.7
Maintenance of bicycles	GHS/yr	140.00	0.01	2.0	2.0	2.0
Communication & mgt. Client data	GHS/yr	280.00	1.00	280.0	280.0	280.0
Equipment cost	GHS/yr			540.0		140.0
Total outflows with labour cost	**GHS/yr**			**13,428.7**	**12,888.7**	**13,028.7**
Total outflows without labour cost	**GHS/yr**			**9,928.7**	**9,388.7**	**9,528.7**
Inflows	**GHS/yr**	**280.0**	**49.4**	**13,829.3**	**13,829.3**	**13,829.3**
Cash flow per year with labour cost	**GHS/yr**			**400.6**	**940.6**	**800.6**
Cash flow per year without labour cost	**GHS/yr**			**3,900.6**	**4,440.6**	**4,300.6**
Cash flow accumulated with labour cost	**GHS**			**400.6**	**1,341.2**	**2,141.7**
Cash flow accumulated with labour cost	**GHS**			**3,900.6**	**8,341.2**	**12,641.7**

	with labour cost	**without labour cost**
Net Present Value	**1,502 GHS**	**9,112 GHS**
IRR	**162%**	**821%**

Annex 4 Cash flow of spraying service against mirids, bicycle, Côte d'Ivoire

Cash flow of spraying service	*Country:*	**Côte d'Ivoire**		
Mirids, motorized, bicycle, in FCFA	*Crop:*	**Cacao**		
	Surface serviced p/yr	**280**	ha	
Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Fuel for mistblower	247,800	247,800	247,800	247,800
Working time labourer	210,000	210,000	210,000	210,000
Insecticides	910,000	910,000	910,000	910,000
Maintenance mistblower	17,640	17,640	17,640	17,640
Communication and client data	56,000	56,000	56,000	56,000
PPE	45,000	45,000	45,000	45,000
Bicycle	100,000			
Mistblower	285,000			
Total outflows	**1,871,440**	**1,486,440**	**1,486,440**	**1,486,440**
Inflows	**1,840,818**	**1,840,818**	**1,840,818**	**1,840,818**
Cash flow per year with deduction of labour costs	**-30,622**	**354,378**	**354,378**	**354,378**
Cash flow per year without deduction of labour costs	**179,378**	**564,378**	**564,378**	**564,378**
Cash flow accumulated	**-30,622**	**323,756**	**678,134**	**1,032,512**
Cash flow accumulated without deduction labour	**179,378**	**533,756**	**888,134**	**1,242,512**

Annex 5 Economics of spraying against mirids, motorized, Togo

Unit cost spraying service for 1 ha		Country:	Togo	
Mirids, motorized		Crop:	Cacao	
	Surface serviced		1	ha
Item	**Unit**	**Units/ha**	**FCFA/unit**	**FCFA/ha**
Fuel for mistblower	liters	1.00	450	450
Working time labourer	MD	1.00	2,000	2,000
Insecticides for 1 treatment	liters	1.00	4,000	4,000
Depreciation mistblower	FCFA/ha	1.00	250	250
Maintenance mistblower	FCFA/ha	1.00	125	125
Depreciation PPE	FCFA/ha	1.00	56	56
Transport moto taxi	FCFA/ha	1.00	250	250
Communication and client data	lumpsum	1.00	50	50
Total costs				**7,181**
Profit margin 10 % of total costs	FCFA/ha	0.10	7,181	**718**
Price of service with product	FCFA/ha			**7,899**
Service without product	FCFA/ha			**3,899**

Profitability spraying service		Country:	Togo	
Mirids, motorized		Crop:	Cacao	
	Surface serviced p/yr		200	ha
Item	**Unit**	**Units**	**FCFA/unit**	**FCFA**
Fuel for mistblower	liters/yr	200	450	90,000
Working time labourer	MD/year	200	2,000	400,000
Insecticides for 1 treatment	liters/yr	200	4,000	800,000
Depreciation mistblower	FCFA/yr	200	250	50,000
Maintenance mistblower	lump sum	200	125	25,000
Depreciation PPE	FCFA/yr	200	56	11,250
Transport moto taxi	FCFA/yr	200	250	50,000
Communication and client data	FCFA/yr	200	50	10,000
Total costs	FCFA/yr			**1,436,250**
Net profit of service including 10 % profit margin	FCFA/yr	200	718	**143,625**

Depreciation of mistblower	Unit	Quantity
Service unit	ha	1
Days with operations per year	days	50
Daily capacity	ha/day	4
Purchasing price	FCFA	250,000
Life cycle	Year	5
Annual service capacity	ha/yr	200
Service capacity lifecycle	ha	1,000
Depreciation per ha	FCFA/ha	**250**
Maintenance and repairs	FCFA/ha	**125**

Depreciation protective clothes	Unit	Quantity
Service unit	ha	1
Daily capacity	ha/day	4
Purchasing price	FCFA	45,000
Days with operations per year	days	100
Life cycle	yr	2
Service capacity lifecycle	ha	800
Depreciation per ha	FCFA/ha	**56**

Annex 6 Economics of spraying against black pod disease, motorized, Togo

Unit cost spraying service for 1 ha		*Country:*	**Togo**	
Blackpod, motorized		*Crop:*	**Cacao**	
	Surface serviced		**1**	ha
Item	**Unit**	**Units/ha**	**FCFA/unit**	**FCFA/ha**
Working time labourer	MD	1.00	1,200	1,200
Fungicides for 1 treatment	sachet/ha	4.00	500	2,000
Depreciation knapsack sprayer	FCFA/ha	1.00	42	42
Maintenance knapsack sprayer	FCFA/ha	1.00	13	13
Depreciation PPE	FCFA/ha	1.00	56	56
Transport moto taxi	FCFA/ha	1.00	250	250
Communication and client data	lumpsum	1.00	50	50
Total costs				**3,610**
Profit margin 10 % of total costs	FCFA/ha	0.10	3,610	**361**
Price of service with product	FCFA/ha			**3,971**
Service without product	FCFA/ha			**1,971**

Profitability spraying service		*Country:*	**Togo**	
Blackpod, motorized		*Crop:*	**Cacao**	
	Surface serviced p/yr		**200**	ha
Item	**Unit**	**Units**	**FCFA/unit**	**FCFA**
Working time labourer	MD/year	200	1,200	240,000
Insecticides for 1 treatment	liters/yr	800	500	400,000
Depreciation mistblower	FCFA/yr	200	42	8,333
Maintenance mistblower	lump sum	200	13	2,500
Depreciation PPE	FCFA/yr	200	56	11,250
Transport moto taxi	FCFA/yr	200	250	50,000
Communication and client data	FCFA/yr	200	50	10,000
Total costs	FCFA/yr			**722,083**
Net profit of service including 10 % profit margin	FCFA/yr	200	361	**72,208**

Depreciation of knapsack sprayer	**Unit**	**Quantity**
Service unit	ha	1
Days with operations per year	days	50
Daily capacity	ha/day	4
Purchasing price	FCFA	25,000
Life cycle	Year	3
Annual service capacity	ha/yr	200
Service capacity lifecycle	ha	600
Depreciation per ha	FCFA/ha	**42**
Maintenance and repairs	FCFA/ha	**13**

Depreciation protective clothes	**Unit**	**Quantity**
Service unit	ha	1
Daily capacity	ha/day	4
Purchasing price	FCFA	45,000
Days with operations per year	days	100
Life cycle	yr	2
Service capacity lifecycle	ha	800
Depreciation per ha	FCFA/ha	**56**

Annex 7 Cash flow RSC service provider model Ghana, high demand, with deduction of labour costs

Overview cash flow 12 months with deduction of labour cost (best case)														
	Daily capacity ha	Monthly capacity ha*	Unit prices ha (GHS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total costs				**3,900**	**851**	**3,851**	**612**	**611**	**613**	**613**	**2,279**	**2,279**	**2,279**	**1,367**	
Equipment costs (GHS)				**3,300**		**3,240**									
Bicycle						200									
Mist blower						1,700									
PPE mist blower						140									
Knapsack sprayer						200									
Motorized Pruner				3,200											
PPE pruner				100											
Android device						1,000									
Variable costs (GHS)				**600**	**851**	**611**	**612**	**611**	**613**	**613**	**2,279**	**2,279**	**2,279**	**1,367**	
Motorized Pruning of cocoa	1	16	38.32		490	490	368	245							
GPS Mapping	5	100	6.00	600	360	120	60	120							
Spraying insecticide cocoa (mistblower)	4	80	49.31								1,972	1,972	1,972	1,183	
Spraying fungicide cocoa (knapsack)	2	40	46.03				184	245	613	613	307	307	307	184	
Gross revenue from services (GHS)**				**730**	**868**	**1,006**	**1,311**	**1,366**	**1,976**	**1,976**	**3,135**	**3,135**	**3,135**	**1,881**	
Motorized Pruning of cocoa	1	16	67.23		430	861	645	430							
GPS Mapping	5	100	7.30	730	438	146	73	146							
Spraying insecticide cocoa (mistblower)	4	80	53.67								2,147	2,147	2,147	1,288	
Spraying fungicide cocoa (knapsack)	2	40	49.39				593	790	1,976	1,976	988	988	988	593	
Cash Flow Balance (GHS, per month)				**-3,171**	**17**	**-2,844**	**699**	**756**	**1,363**	**1,363**	**856**	**856**	**856**	**514**	
Cumulative (GHS)				**-3,171**	**-3,153**	**-5,997**	**-5,298**	**-4,542**	**-3,179**	**-1,817**	**-961**	**-105**	**751**	**1,264**	**1,264**

Overview cash flow throughout lifespan of equipment							
Item	Daily capacity ha	Monthly capacity ha*	Unit prices ha (GHS)	Year 1	Year 2	Year 3	Year 4
Total costs				**19,253**	**12,853**	**12,953**	**12,853**
Equipment costs (GHS)				6,540	140	240	140
Bicycle				200			
Mist blower				1,700			
PPE mist blower				140	140	140	140
Knapsack sprayer				200			
Motorized Pruner				3,200			
PPE pruner				100		100	
Android device				1,000			
Variable costs (GHS)				**12,713**	**12,713**	**12,713**	**12,713**
Motorized Pruning of cocoa	1	16	38.32	1,594	1,594	1,594	1,594
GPS Mapping	5	100	6.00	1,261	1,261	1,261	1,261
Spraying insecticide cocoa (mistblower)	4	80	49.31	7,100	7,100	7,100	7,100
Spraying fungicide cocoa (knapsack)	2	40	46.03	2,759	2,759	2,759	2,759
Gross revenue from services (GHS)**				**20,518**	**20,518**	**20,518**	**20,518**
Motorized Pruning of cocoa	1	16	67.23	2,366	2,366	2,366	2,366
GPS Mapping	5	100	7.30	1,532	1,532	1,532	1,532
Spraying insecticide cocoa (mistblower)	4	80	53.67	7,729	7,729	7,729	7,729
Spraying fungicide cocoa (knapsack)	2	40	49.39	8,890	8,890	8,890	8,890
Cash flow balance (GHS, per year)				**1,264**	**7,664**	**7,564**	**7,664**
Cumulative (GHS)				**1,264**	**8,929**	**16,493**	**24,157**

Net Present Value	**15,133 GHC**
IRR	**112%**

Annex 8 Cash flow RSC service provider model Ghana, high demand, without deduction of labour costs

Overview cash flow throughout lifespan of equipment							
Item	**Daily capacity ha**	**Monthly capacity ha**	**Unit price ha (GHS)**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Total costs				**13,753**	**7,353**	**7,453**	**7,353**
Equipment costs (GHS)				6,540	140	240	140
Bicycle				200			
Mist blower				1,700			
PPE mist blower				140	140	140	140
Knapsack sprayer				200			
Motorized Pruner				3,200			
PPE pruner				100		100	
Android device				1,000			
Variable costs (GHS)				**7,213**	**7,213**	**7,213**	**7,213**
Motorized Pruning of cocoa	1	16	7.07	294	294	294	294
GPS Mapping	5	100	1.00	211	211	211	211
Spraying insecticide cocoa (mistblower)	4	80	43.06	6,200	6,200	6,200	6,200
Spraying fungicide cocoa (knapsack)	2	40	33.53	509	509	509	509
Gross revenue from services (GHS)**				**20,518**	**20,518**	**20,518**	**20,518**
Motorized Pruning of cocoa	1	16	67.23	2,366	2,366	2,366	2,366
GPS Mapping	5	100	7.30	1,532	1,532	1,532	1,532
Spraying insecticide cocoa (mistblower)	4	80	53.67	7,729	7,729	7,729	7,729
Spraying fungicide cocoa (knapsack)	2	40	49.39	8,890	8,890	8,890	8,890
Cash flow balance (GHS, per year)				**6,764**	**13,164**	**13,064**	**13,164**
Cumulative (GHS)				**6,764**	**19,929**	**32,993**	**46,157**

Net Present Value	**29,928 GHC**
IRR	**200%**

Annex 9 Cash flow RSC service provider model Ghana, low demand, with deduction of labour costs

Overview cash flow 12 months with deduction of labour cost (worst case)													
	Daily capacity ha	Monthly capacity ha*	Unit prices ha (GHS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total costs				**3,540**	**363**	**3,483**	**305**	**427**	**307**	**307**	**1,139**	**1,139**	**1,139**	**850**	**0**
Equipment costs (GHS)				**3,300**	**0**	**3,240**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bicyle						200									
Mist blower						1,700									
PPE mist blower						140									
Knapsack sprayer						200									
Motorized Pruner				3,200											
PPE pruner				100											
Android device						1,000									
Variable costs (GHS)				**240**	**363**	**243**	**305**	**427**	**307**	**307**	**1,139**	**1,139**	**1,139**	**850**	**0**
Motorized Pruning of cocoa	1	16	38.32	0	123	123	123	123	0	0	0	0	0	0	0
GPS Mapping	5	100	6.00	240	240	120	60	120	0	0	0	0	0	0	0
Spraying insecticide cocoa (mistblower)	4	80	49.31	0	0	0	0	0	0	0	986	986	986	789	0
Spraying fungicide cocoa (knapsack)	2	40	46.03	0	0	0	123	184	307	307	153	153	153	61	0
Gross revenue from services (GHS)				**292**	**507**	**361**	**683**	**954**	**988**	**988**	**1,567**	**1,567**	**1,567**	**1,056**	**0**
Motorized Pruning of cocoa	1	16	67.23	0	215	215	215	215	0	0	0	0	0	0	0
GPS Mapping	5	100	7.30	292	292	146	73	146	0	0	0	0	0	0	0
Spraying insecticide cocoa (mistblower)	4	80	53.67	0	0	0	0	0	0	0	1,073	1,073	1,073	859	0
Spraying fungicide cocoa (knapsack)	2	40	49.39	0	0	0	395	593	988	988	494	494	494	198	0
Cash Flow Balance (GHS, per month)				**-3,248**	**144**	**-3,122**	**378**	**527**	**681**	**681**	**428**	**428**	**428**	**206**	**0**
Cumulative (GHS)				**-3,248**	**-3,104**	**-6,226**	**-5,848**	**-5,320**	**-4,639**	**-3,958**	**-3,530**	**-3,102**	**-2,674**	**-2,468**	**-2,468**

Overview cash flow throughout lifespan of equipment

Item	Daily capacity ha	Monthly capacity ha*	Unit prices ha (GHS)	Year 1	Year 2	Year 3	Year 4
Total costs				**12,999**	**6,599**	**6,699**	**6,599**
Equipment costs (GHS)				6,540	140	240	140
Bicyle	0	0	0	200			
Mist blower	0	0	0	1,700			
PPE mist blower	0	0	0	140	140	140	140
Knapsack sprayer	0	0	0	200			
Motorized Pruner	0	0	0	3,200			
PPE pruner	0	0	0	100		100	
Android device	0	0	0	1,000			
Variable costs (GHS)				**6,459**	**6,459**	**6,459**	**6,459**
Motorized Pruning of cocoa	1	16	38.32	490	490	490	490
GPS Mapping	5	100	6.00	780	780	780	780
Spraying insecticide cocoa (mistblower)	4	80	49.31	3,747	3,747	3,747	3,747
Spraying fungicide cocoa (knapsack)	2	40	46.03	1,441	1,441	1,441	1,441
Gross revenue from services (GHS)				**10,531**	**10,531**	**10,531**	**10,531**
Motorized Pruning of cocoa	1	16	67.23	861	861	861	861
GPS Mapping	5	100	7.30	949	949	949	949
Spraying insecticide cocoa (mistblower)	4	80	53.67	4,079	4,079	4,079	4,079
Spraying fungicide cocoa (knapsack)	2	40	49.39	4,643	4,643	4,643	4,643
Cash flow balance (GHS, per year)				**-2,468**	**3,932**	**3,832**	**3,932**
Cumulative (GHS)				**-2,468**	**1,464**	**5,296**	**9,228**

Net Present Value	**5,093 GHC**
IRR	**48%**

Annex 10 Cash flow RSC service provider model Ghana, low demand, without deduction of labour costs

	Daily capacity ha	Monthly capacity ha*	Unit prices ha (GHS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total costs				**3,340**	**63**	**3,283**	**55**	**77**	**57**	**57**	**889**	**889**	**889**	**700**	
Equipment costs (GHS)				**3,300**		**3,240**									
Bicyle						200									
Mist blower						1,700									
PPE mist blower						140									
Knapsack sprayer						200									
Motorized Pruner				3,200											
PPE pruner				100											
Android device						1,000									
Variable costs (GHS)				**40**	**63**	**43**	**55**	**77**	**57**	**57**	**889**	**889**	**889**	**700**	
Motorized Pruning of cocoa	1	16	7.07		23	23	23	23							
GPS Mapping	5	100	1.00	40	40	20	10	20							
Spraying insecticide cocoa (mistblower)	4	80	43.06								861	861	861	689	
Spraying fungicide cocoa (knapsack)	2	40	33.53				23	34	57	57	28	28	28	11	
Gross revenue from services (GHS)				**292**	**507**	**361**	**683**	**954**	**988**	**988**	**1,567**	**1,567**	**1,567**	**1,056**	
Motorized Pruning of cocoa	1	16	67.23		215	215	215	215							
GPS Mapping	5	100	7.30	292	292	146	73	146							
Spraying insecticide cocoa (mistblower)	4	80	53.67								1,073	1,073	1,073	859	
Spraying fungicide cocoa (knapsack)	2	40	49.39				395	593	988	988	494	494	494	198	
Cash Flow Balance (GHS, per month)				**-3,048**	**444**	**-2,922**	**628**	**877**	**931**	**931**	**678**	**678**	**678**	**356**	
Cumulative (GHS)				**-3,048**	**-2,604**	**-5,526**	**-4,898**	**-4,020**	**-3,089**	**-2,158**	**-1,480**	**-802**	**-124**	**232**	**232**
*Working time 20 MD/month															

Overview cash flow throughout lifespan of equipment

Item	Daily capacity ha	Monthly capacity ha*	Unit prices ha (GHS)	Year 1	Year 2	Year 3	Year 4
Total costs				**10,299**	**3,899**	**3,999**	**3,899**
Equipment costs (GHS)				6,540	140	240	140
Bicyle				200			
Mist blower				1,700			
PPE mist blower				140	140	140	140
Knapsack sprayer				200			
Motorized Pruner				3,200			
PPE pruner				100		100	
Android device				1,000			
Variable costs (GHS)				**3,759**	**3,759**	**3,759**	**3,759**
Motorized Pruning of cocoa	1	16	7.07	90	90	90	90
GPS Mapping	5	100	1.00	130	130	130	130
Spraying insecticide cocoa (mistblower)	4	80	43.06	3,272	3,272	3,272	3,272
Spraying fungicide cocoa (knapsack)	2	40	33.53	266	266	266	266
Gross revenue from services (GHS)				**10,531**	**10,531**	**10,531**	**10,531**
Motorized Pruning of cocoa	1	16	67.23	861	861	861	861
GPS Mapping	5	100	7.30	949	949	949	949
Spraying insecticide cocoa (mistblower)	4	80	53.67	4,079	4,079	4,079	4,079
Spraying fungicide cocoa (knapsack)	2	40	49.39	4,643	4,643	4,643	4,643
Cash flow balance (GHS, per year)				**232**	**6,632**	**6,532**	**6,632**
Cumulative (GHS)				**232**	**6,864**	**13,396**	**20,028**

Net Present Value	**12,356 GHC**
IRR	**95%**

Imprint

Published by the

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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As at

May 2018

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Photo credits

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On behalf of the

German Federal Ministry for Economic Cooperation and Development (BMZ)