Beef case study in the flooded Palmar of Paraguay

WWF – SuLu Project (BMU / IKI)

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Credits

We would like to express our thanks to the following contributors to the report:

1. Owners and farm managers of Estancia Margarita and Estancia 19
2. Don Raúl Rivarola as experienced farm manager/owner and technical advisor
3. Producers and advisors that have actively participated in the workshops and project meetings (see annex 1 for participants list)
4. Advisors Jazmin Rivarola and Jaime Athorpe
5. The Paraguayan WWF team
6. Ernesto Reyes (field work, data collection, project management, reporting) and Lola Izquierdo (calculations)
7. Ilka Petersen from WWF Germany who gave us the opportunity to get involved in this work

1 Executive summary

Forestland conversion to grazing areas for cattle ranching is common practice in the flooded savannahs of Paraguay mainly due to short term profits (Laino et al, 2017). In recent years, this conversion has led to an increment in deforestation rates mainly because of the expansion of cattle farms (Baumann, M. et al., 2017). Cattle ranching in the flooded savannas of Paraguay are predominantly low input / low output production systems, mainly devoted to *cow-calf*[1] *only,* using the available grazing conditions based on native pastures and forages as the main source of feeding, as well as *cow-calf and beef finishing*[2] on cleared forest land. Paraguay's forest law allows for the habilitation (deforestation) of native forest for land use change throughout the Chaco region and obliges producers to maintain 25% of the total area of the property as a forest reserve and 100-meter wide windbreaks.

Cattle ranchers in the flooded savannas mainly practice low input / extensive cattle production and many ranches were developed in the second half of the last century. This early development generated a production dynamic with little variation. This translated into low production rates and in turn costs, as well as traditional cow-calf production, which had with low environmental impact and a high conservation value. For this study, a reference situation (status quo, “Baseline”) for the region was defined. Two Baselines for the production systems were identified (*cow-calf only* and *cow-calf and beef finishing*). Jointly with local experts (producers, advisors, researchers), these systems were specified and quantified in terms of land use, animal performance and economic results. A standardized questionnaire was used, which was customized to include project and site-specific aspects, capturing all particularities of the local situation. Focus groups comprising local experts are used to discuss all figures and indicators, until a consensus is reached.

The Baseline for *cow-calf only* is characterised by relatively low animal performance and productivity. The medium-term profit is around USD 13 per ha. *Cow-calf and beef finishing* (on cleared forest) shows much better results in terms of profit compared with cow-calf only (USD 54 per ha). However, this system requires a higher level of management and capital investment and often involved deforestation with all of its negative impacts. This difference could lead to a competition for land access. When comparing profit and opportunity cost for land, land opportunity costs are higher than profits per ha (return to land). It means that land prices are higher than the profit that can be generated with agriculture. Thus, factors other than agricultural land use are influencing land prices, for example expectations regarding future developments and investment decisions that are not directly motivated by agricultural production and its potential output, for example land or real estate speculations. Considering generational changes of landholders that can result in the sale of the property to new investors adds a long-term component to the issue. The traditional cow-calf production with low environmental impact can be threatened, if more profitable and appealing methods of production and management for the next generation cannot be found. The results regarding profit, opportunity costs for land, and investments required for Baseline and scenarios, have been obtained against the background of currently limiting factors of road and electricity infra-

[1] Cow-calf is the keeping of suckler-cows (beef-cows) for the purpose of raising a calf (weaner).

[2] Beef finishing (fattening) is keeping cattle for feeding and taking them to a final weight for slaughter.

structure. Those aspects may change substantially if these limiting factors can be overcome. Then, it is likely that beef production will be replaced by crop production with higher profits, especially soybean and maize production and particularly on former forestland. This is how the competition of crop-based land uses becomes relevant.

When defining and analysing the possible Better Management Practices (BMPs), the focus group discussed basic managerial changes for land, herd and water management, mainly for the cow-calf component. These include mainly the management of herd fertility, the feeding of minerals, subdivision of paddocks, improvement of water access, and dry resting areas for cows. All this in line with the implementation of advisory services. For the implementation of the BMPs, significant investments are necessary, for which access to capital and loans is a prerequisite. For organisational reasons and in order to reduce this risk, the BMPs are established gradually.

When fully established, the BMPs show improvement in animal performance (increased cow numbers, fertility, and therefore more weaned calves per year). This leads to a moderate increase of profitability (around 33 per cent), showing that implementing BMPs and allowing native ecosystem conservation can be economically viable. However, a moderate financial risk was identified (associated with the BMPs) as the profit and cash flow experienced negative values during the first two years of implementation. There is an imminent need for conservation incentives that can contribute positively to the cash flow of those producers who wish to initiate a process of production improvement that has positive impacts on environmental conservation.

This publication is one of the results of the IKI project “Land Use Change in Savannahs and Grasslands – Approaches by Policy Engagement, Land Use Planning and Best Management Practices” briefly “Sulu” (for sustainable land use). It aims at strengthening land use planning and management in the Paraguayan Pantanal and Chaco region with climate criteria, as well as with the conservation and maintenance of carbon stocks, biodiversity and hydrological regimes, and at contributing to a more sustainable agro-industrial production.

Livestock farming in flooded savannahs can be a productive activity and at the same time manage natural resources in a sustainable way. However, these systems are under threat from the expansion of crop production systems, which tend to be more profitable per hectare. Improving the profitability of the livestock by implementing of a range of practices and approaches could reduce the risk of land use change and the corresponding negative impacts on biodiversity and the environment. To show the potential of the above-mentioned practices, the following analysis was carried out in close cooperation with producers and regional experts. The results show that by implementing the proposed practices and approaches, a significant improvement in animal performance becomes evident, giving a clear opportunity to produce and preserve at the same time. This economic analysis is accompanied by other research and publications aimed at strengthening the traditional practices that have been in place in the flooded savannah region for centuries.

2 Introduction

Cattle ranching in the flooded savannas of Paraguay (mostly known as the “Palmar” ecosystem) combines low-input systems, mainly for cow-calf production, and in some cases, using forest areas (“monte alto”) for beef finishing where a more “intensive” land use management is applied (clearing forest, improved/reseeded pastures and rotation of animals, allowing higher stocking rates).

Paraguay's forest law allows for the habilitation (deforestation) of native forest for land use change throughout the Chaco region while obliging producers to maintain 25% of the total area of the property as a forest reserve and 100-meter wide windbreaks, meaning that between 45 and 55% of the total area is maintained as native forest. Savannah areas also have forests in the upper regions, and these were included in the analyses, as it is common practice to habilitate these areas for the implantation of “improved” pastures (exotic species).

These systems and their alternatives pose two major threats to land use and biodiversity: on the one hand, there is the threat of continued deforestation for the expansion of beef production (beef finishing); on the other hand, existing beef production competes with the potential introduction of crop production systems like soybean and/or rice.

The region is still lacking road infrastructure and electricity, and for some parts of the year, some roads are impassable due to flooding. These features currently make the expansion of beef and crop production difficult and cause a delay.

Against this background, improving the productivity and profitability of cattle ranching by implementing Best Management Practices (BMPs), provides an opportunity to: a) reduce the need for land expansion to produce more beef and b) increase the competitive position of beef against crops. This could reduce the risk of further deforestation and its negative impacts on biodiversity and the environment.

The main objective of the study was to provide evidence about the feasibility and the extent of such interventions as well as their expected results. For this, a detailed farm-level analysis is required comprising the following:

- To obtain realistic results: a cooperation with local producers and experts to a) quantify the status quo, b) identify, define and quantify the BMPs and c) crosscheck the results obtained.
- To perform calculations and analyses: methods and tools to collect, process and present the farm-level information and results in a consistent, verifiable and understandable way.

Through the global network *agri benchmark*, the Thünen Institute of Farm Economics provides the tools and the expertise to fulfil these criteria (see details in chapter 3 of this report).

3 Activities, workflow and methods

Together with WWF staff, the project region was selected. As the SuLu project has a focus on low-input beef production in flooded savannas and their relationship with biodiversity and sustainable land use, the upper basin of the Paraguay River was selected as a study area. Two visits were carried out in the region (kick off meeting and a field visit at a later stage). The second visit comprised two field trips and one workshop.

WWF staff from Paraguay, national and regional experts and advisors and local producers participated in the visits. The following activities were scheduled:

July 24, 2017: Field visit to Estancia Margarita (Figure 1)

July 25, 2017: Field visit to Estancia 19 (Figure 2)

July 25, 2017: Discussion of Baseline (workshop with farmers from small and medium sized farms in Brazil and Paraguay, and local advisors) – Figure 3.

Figure 1 Field trip to Estancia Margarita

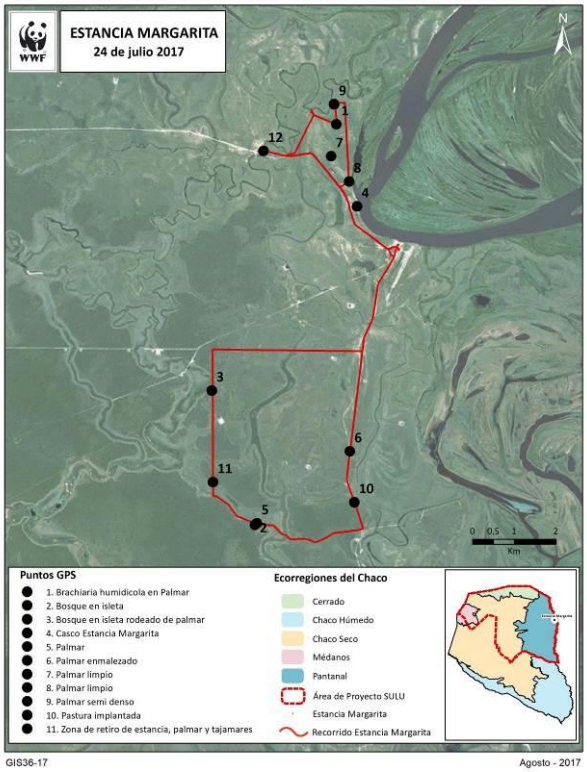
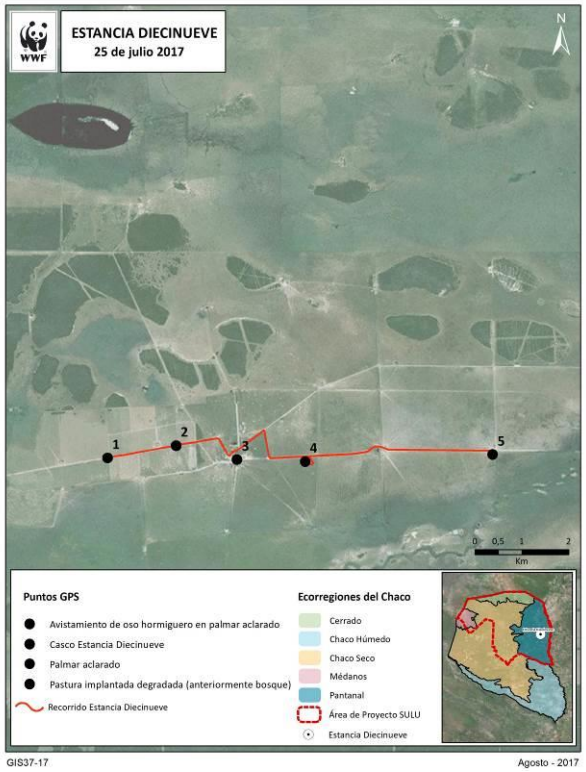


Figure 2: Field trip to Estancia 19



Source: WWF Paraguay

agri benchmark methods and tools were made available for analysing and modelling the data (see Deblitz, 2018).

Data collection

The main source of data was farm level information. The information was collected during field visits to the project region. A group of expert technicians and advisors gathered to discuss and complement the data supplied by the local producers. Regional available studies were also consulted and discussed.

Figure 3 Participants of the Palmar workshop

Source: WWF Paraguay

Data processing and analysis

The TIPI-CAL model from the *agri benchmark* Network was used to simulate the 10-year period of BMP introduction. TIPI-CAL is a production and accounting model and an assessment tool. It has a 10-year dynamic-recursive structure and produces a profit and loss account, a balance sheet, a cash flow for the whole farm and all enterprises considered for each of the 10 years of simulation. It further provides very detailed information on activity levels, performance and productivity of the enterprises such as herd size, reproductive performance, milk yields, weight of animals, feed rations, mortality, weight gains etc. For this project and in line with the standard operating procedure to define typical farms (Deblitz and Zimmer, 2018), real farms were taken as a basis and then 'typified', i.e. individual particularities were replaced by regionally typical data.

Assumptions for the calculations

With respect to data availability and quality we found several particular situations; these observations can be summarised as follows:

- When discussing main baseline components, it was a challenge to define the feeding conditions for the region and farms, due to seasonal variations, a significant number of different native species (straws, grasses, legumes, etc.) and seasonal herd movements (from wet to dry regions).
- Therefore, when modelling forage production, animal requirements were used as a basis, and the total requirements were calculated according to the number of animals in each age group.
- In the future, it is important to promote regional applied research programs that quantify forage production in terms of main species contributing to cattle diets, density distribution of these species and protein and energy content for each identified species.

- For modelling the alternative scenario, all investment requirements were reflected, assuming commercial credit conditions available in the region. The analysis does not include the farm owner's money requirements to cover living expenses.
- Input and output prices were taken from the year 2016, assuming average annual prices and a "normal" year (avoiding special conditions like drought, extraordinary diseases etc.).
- For modelling the adoption of BMPs a step by step approach was selected, assuming time periods (usually between 1 and 2 years) to obtain first results for each strategy.
- This first approach to measure land use in terms of production systems economics could provide the basis for future analysis. As some of the information requirements have been based on several assumptions (due to lack of information), further improvements in this regard are needed.

This case study can serve as an illustration of the potential of quite a common production system. It can show the effects of Best Management Practices on a given piece of land, which then provides the potential for other land to be freed up from production or land that is in natural vegetation to be left as it is. The study cannot provide a quantification of regional or national land use optimisation.

4 Main results

In the following, we are presenting the results for the Baseline and the Best Management Practices (BMP scenarios). We are not only showing the Baseline and the final year of BMP implementation, but also looking at how the main indicators develop over the transition from Baseline to full BMP implementation.

4.1 Baseline

The Baseline is the reference system for the BMPs. Synonyms would be 'status quo' or 'business as usual'. The Baseline is often – but not always – characterised by some deficits in the area of management, land use efficiency, animal performance, environment (mainly emissions, biodiversity, nutrient availability, water use, etc.), economics and animal welfare. These deficits are addressed when identifying, specifying, and quantifying the BMPs jointly with local producers and experts (advisors, researchers).

We have identified two Baselines, which can be seen to reflect the typical farming situation in the project region:

1. **Cow-Calf only** on flooded Palmar using the available grazing conditions based on native pastures and forages as the main source of feeding (Laino et al, 2017)
2. **Cow-Calf and Beef Finishing:** The production of weaners (cow-calf) is still done using the extensive grazing conditions in the Palmar region, whereas the beef finishing takes place on introduced pastures, specifically grown for that purpose on cleared forest.

Figures 3 and 4 give a visual impression of the two Baselines and Tables 1 and 2 provide an overview of the most important system characteristics.

Figure 3 Beef production in the Palmar region (cow-calf)

Figure 4 Beef production in the Palmar region (beef finishing)

Table 1 Production system description – Baseline Cow-Calf on natural savannas

Year of analysis	2016	
Production system	Cow-Calf only on flooded Palmar	
Land use (number of hectares)	10,000 ha (6,000 ha on Palmar and 4,000 ha on forest)	
Labour	1 Manager	
	1 Foreman	
	1 Cowboy	
	4 Cattlemen	
	1 Cook	
Financial policy	No credits	
Feeding system	Grazing on Palmar, moving herds according to grass-land seasonal availability	
Supplementation strategy	None	
Technical advisory service	Not available	
Number of cows	2,000	
Age at first calving (months)	36	
Weaning rate (No. of calves per 100 cows and year)*	60%	
Number of weaners per year	580	
Weaning age female / male (days)	250/250	
Weaning weight female / male (kg LW)	170/180	
Weaners:	*Only cow-calf*	*Cow-calf + finishing*
Males sold (%)	100%	0%
Males transfered to finishing (%)	0%	100%
Females sold (%)	0%	
Females kept (%)	100%	
Cows mortality rate (%)	2%	
Weaners mortality rate (%)	8%	

* Weaning rate is a measure of the physical productivity of the farm. It is calculated as the number of calves weaned per 100 cows and year. It summarises in one indicator pregnancy rate, birth rate and calf mortality rate.

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

- In the **Cow-Calf only** Baseline all male calves are sold to other farms for backgrounding and/or finishing after weaning. All female calves must be kept for replacement due to low productivity/weaning rates. Productivity levels are low and each cow produces slightly over half a weaned calf per year. Weaning weights are low and calf mortality rates relatively high. Cows graze on large paddocks with little supervision by staff. Feed supply is limited in terms of quantity and quality and there is a deficit of minerals such as nitrogen and potassium.
- The **Cow-Calf plus Beef Finishing** Baseline is nearly identical to the Cow-Calf only Baseline. The main difference being that all male weaners are transferred to the own finishing enterprise and additional male weaners are bought (in this Baseline, approx. 900 additional male weaners are bought in for fin-

ishing). Another important difference is that some forest areas are cleared and improved pasture species (Mombasa, Panicum and Brachiaria) are planted for finishing the weaners. This "new enterprise" (beef finishing) requires a higher level of management and a higher amount of capital.

- In the Baseline defined in the workshop (Table 2), the farm is selling 1,400 finished animals per year. The finishing takes place on pastures established on 2,250 ha of cleared forest. The finishing period is almost 2 years and reaches relatively high daily weight gains.

Table 2 Production system description – Baseline finishing on established pastures

Year of analysis	2016
Production system	Cow-Calf only and finishing on planted pastures
Land use (number of hectares)	10,000 ha (6,000 ha on Palmar, 2,250 ha pastures on forest and 1,750 ha on forest)
Labour	1 Manager
	1 Foreman
	1 Cowboy
	4 Cattlemen
	1 Cook
Financial policy	No credits
Feeding system	Grazing on improved pastures
Supplementation strategy	Mineral salt (sal protéica)
Technical advisory service	Not available
Number of weaners transferred to finishing (100% of male weaners)	580
Number of weaners bought	820
Age at start of finishing (days)	250
Age at end of finishing (months)	26
Period of finishing (months)	18
Weight at start of finishing (kg LW)	180
Weight at end of finishing (kg LW)	450
Weight gained (kg)	270
Daily weight gain (grams per day)	500

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Table 3 shows the profit and loss account of the two Baselines on the whole-farm level (USD per farm) and on a per ha basis (USD per ha).

- The profit and loss account reflect all returns and all costs except opportunity costs. Opportunity costs on these farms are land only because the owner does not work on the farm in person and all labour is hired. Thus, land costs are not included in this statement as all land is owned by the producer. The profit is the difference between the total returns and the costs stated and can be viewed as medium-term profitability.

- In economic terms, the system can be labelled 'low output – low input'. Total returns per ha are only USD 45 for the Cow-calf only Baseline and USD 147 for the Cow-calf plus Finishing Baseline, which is approx. three times more. Costs and profits are also higher for the Cow-calf plus Finishing Baseline: 2.7 and 4.2 times higher, respectively.
- The medium-term profit – calculated as total returns – expenses – depreciation – per farm is USD 129,000 and USD 542,000, respectively, in the two Baselines (USD 12.9 and 54.2 per ha, respectively). The profit margins (profit divided by returns) are 29 percent for the Cow-calf only Baseline and 37 percent for the Cow-calf plus Finishing Baselines.

For a long-term consideration of profitability, the opportunity costs for own production factors (family labour, own land and capital / equity) must be considered.

- It reflects the fact that family labour could earn a salary outside of the farm, own land can be rented out to other producers or investors and instead of investing in equipment, the money could be taken to a bank to earn interest. In the case studies analysed, opportunity costs for labour are zero (only employed, paid labour) and capital is negligible.
- Thus, the main opportunity cost for both Baselines is land. This was valued by the producer and expert groups with a rental price of USD 37.5 and 56.3 per ha for each one of the baselines (Cow-calf only and Cow-calf plus finishing respectively – price differences are due to the introduced pastures used for beef finishing). Multiplied by the 10,000 ha the total opportunity cost for land adds up to USD 375,000 and 563,000 in both Baselines.
- Deducting the opportunity costs from the medium-term profit results in the return to management, the return to management for the farm owner is only USD -284,000 and USD -59,000, respectively. This means that from a long-term perspective, the businesses are not profitable, but with a significantly better result for cow-calf and beef finishing.

However, in this context two aspects should be mentioned:

- The above calculations only take into account the pure economic situation. That would not be an issue if all deliverables of the system were reflected and priced-in. However, environmental and biodiversity benefits are not priced and therefore not reflected as returns to the system, thus reducing profitability.
- The long-term consideration is not usually the view of the producers and it is not an exception that the return to management can be negative. In the long-term, however, low profitability creates an incentive to change land use to a more profitable option – if available – for example soybean or rice production.[3]

[3] In any case and irrespective of these crop-specific considerations, the next generation will most likely consider and question the use of own production factors: should I work on my own land or lease it out to someone else (→ current rental price is applied as opportunity costs)? Should I work in agriculture or somewhere else (non-agricultural wage rate is applied)? Should I invest in farming or take my money to the stock market or the bank (present interest rate is applied)?

- Nevertheless, when comparing both Baselines, it is very clear that the cow-calf plus finishing Baseline is 4 times more profitable than the cow-calf only Baseline (USD 12.9 versus USD 54.2 per ha).

Table 3 Profit and Loss Account of the Baselines
(USD total values and per hectare and year 2016)

	Cow-calf only		Cow-calf and finishing	
	USD per farm	**USD per ha**	**USD per farm**	**USD per ha**
1 Total Returns				
1.1 Market receipts of the enterprises				
Cow-calf market receipts	446.500	44,7	469.464	46,9
Beef finishing market receipts			990.347	99,0
Total market receipts	446.500	44,7	1.459.811	146,0
1.2 Other returns				
Interest on savings	1.688	0,2	10.567	1,1
Sum other returns	1.688	0,2	10.567	1,1
1.3 Total farm returns	448.188	44,8	1.470.378	147,0
2 Total Input				
2.1 Total variable costs crop and forage	214.286	21,4	244.420	24,4
2.2 Cow-calf				
Animals	5.357	0,5	5.357	0,5
Purchase feed costs			61.875	6,2
Other fixed and var. costs	19.643	2,0	19.643	2,0
Total expenses cow-calf	25.000	2,5	86.875	8,7
2.3 Beef finishing				
Animals			425.000	42,5
Purchase feed costs			29.016	2,9
Other fixed and var. costs			1.866	0,2
Total expenses beef finishing			455.882	45,6
2.4 Total fixed expenses	21.107	2,1	26.643	2,7
2.5 Total labour expenses	48.061	4,8	58.418	5,8
2.6 Total interest on liabilities	1.614	0,2		
2.7 Depreciation				
Machinery econ. accounting	6.357	0,6	6.429	0,6
Buildings econ. accounting	2.976	0,3	49.762	5,0
Total farm depreciation	9.333	0,9	56.190	5,6
2.8 Total farm input	319.401	31,9	928.428	92,8
3 Farm profit	128.787	12,9	541.950	54,2

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

4.2 Best Management Practices (BMPs)

The term 'Best Management Practices' was chosen to illustrate the more sustainable scenario(s) compared to the Baseline(s).

- BMPs are not necessarily limited to changes in management but can also include investments, inputs, genetics, grass varieties, etc.
- The BMPs are not a result of some theoretical model approach, but have been identified, specified, quantified and validated jointly between local producers and experts as well as *agri benchmark* staff.

Table 4 shows a list of the elements identified for the BMP strategy. The main BMP-interventions to the Baseline address are of relatively 'low-invasive' character and comprise the following elements:

- the establishment of regular technical advisory services,
- the management of herd fertility in terms of grouping animals according to their physiological condition (pregnant, empty cows, heifers, etc.) and applying different feeding strategies to these groups,
- the introduction of feeding minerals,
- the introduction of paddock subdivision and a rotational grazing system as well as improved access to water, in accordance with the subdivided paddocks, and
- the introduction of dry resting areas for cows ("dormideros").

Table 4 shows that the elements are introduced step by step and not all in one go. The reasons for this are a) capacity limits of the management, b) restrictions on capital and loan availability and c) not all elements are required immediately and at the same time.

Table 4 Elements of the 10-year BMP strategy

Strategy	2017	2018	2019	2020	2021	2022	2023	2024	2025
Information management system	X	X	X	X	X	X	X	X	X
Herd fertility management program	X	XX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Technical advisory service + (information system, herd fertility and health programs, grassland management)	XXX	XXX	XX	XX	XX	XX	XX		
Formulated mineral salt	X	X	X	X	X	X	X	X	X
Implementing rotational grazing programs plus paddock subdivision	X	X	XX	XX	XX	XXX	XXX	XXX	XXX
Implementing dry resting areas for cows (dormideros)		X	XX	XX	XX	XXX	XXX	XXX	XXX
Water management (wells, windmills, drinking points)	X	X	XX	XX	XX	XXX	XXX	XXX	XXX

Note: The number of 'x' indicates an increasing level of the intervention
Source: Local expert groups

A total investment of approximately USD 170,000 (slightly more than USD 17 per ha) is needed mainly in the first and second year of implementation. It is financed by credits with a nominal interest rate of 7 percent. Table A.1 in the Annex shows the amounts and the timing of the required investment.

Figures 5 and 6 show some of the elements introduced.

Figure 5: BMP measures from above: Paddock subdivisions, drinking points, wells, dry resting areas

Figure 6: BMP measures: Paddock subdivisions, drinking points, wells, dry resting areas

Source for both pictures: WWF Paraguay

Tables 5 and 6 on pages 14 and 15 illustrate the changes in all performance and technical parameters from the calculations for the BMP implementation phase. Tables 7 to 10 show the economic results for the implementation period in total USD per farm and USD per ha. The change in management has multiple benefits.

For cow-calf only

- The *additional labour* requirement is fulfilled partially by employing two additional cattlemen and another cowboy (puntero) in the year 2018.
- The improvement of the herd management gradually leads to a significant productivity increase from 60 to 68 percent weaned calves in the last year of implementation. This increase is possible through the increase of cow fertility, enhanced management, improvement of the forage quantity and quality (through subdivision and more efficient use of the grassland, introduction of dry resting areas for cows), the introduction of mineral salt and the reduction of mortalities of weaners and cows, all of which is accompanied by the technical advisory service.
- The combined effect of the above measures allows for an increase in the number of weaners produced per year from 1,200 to 1,360.
- Compared with the Baseline, the profit in the BMP scenario increases by 31% (from USD 13 to USD 17 per ha).

For cow-calf and beef finishing

- The *additional labour* requirement is fulfilled partially by employing two additional cattlemen and another cowboy (puntero) in the year 2018.
- The number of weaners transferred from the cow-calf enterprise to the beef finishing unit increases from 580 to 674 heads.
- The per ha profit increases by 20% (from USD 54 to USD 65 per ha).

Table 5 Technical results of the BMP implementation only Cow-calf (from Baseline / year 0 to year 9 of implementation)

Technical and managerial details	Only Cow-calf									
Year of analysis	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Year of implementation	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Production system					Cow-calf					
Labour										
Manager	1	1	1	1	1	1	1	1	1	1
Foreman	1	1	1	1	1	1	1	1	1	1
Cowboy	1	1	2	2	2	2	2	2	2	2
Cattlemen	4	4	6	6	6	6	6	6	6	6
Cook	1	1	1	1	1	1	1	1	1	1
Financial policy / credits										
Credit amount taken in the year	no	178.571	no	no	no	no	no	no	no	no
Feeding system	Grazing natural pasture	Rotational grazing improved pastures								
Supplementation strategy	no	Minerals								
Technical advisory service	no	yes								
Cow-calf										
Number of cows	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Age at first calving (months)	36	36	36	32	32	32	30	30	30	30
Weaning rate (No. of calves per 100 cows and year)	0,60	0,60	0,63	0,63	0,63	0,66	0,66	0,66	0,68	0,68
Number of weaners per cow and year	1.200	1.200	1.260	1.260	1.260	1.320	1.320	1.320	1.360	1.360
Weaning age female / male (days)	250/250	250/250	250/250	250/250	250/250	250/250	250/250	250/250	250/250	250/250
Weaning weight female / male (kg)	170/180	170/180	170/180	170/180	170/180	170/180	170/180	170/180	170/180	170/180
Male weaners sold (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Males transfered to backgrounding (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Females sold (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Females kept (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Cows mortality rate (%)	2%	2,0%	2,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%
Weaners mortality rate (%)	8%	8%	8%	7%	7%	7%	6%	6%	5%	5%

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Table 6 Technical results of the BMP implementation Cow-calf and Finishing (from Baseline / year 0 to year 9 of implementation)

Technical and managerial details	Cow-calf and finishing									
Year of analysis	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Year of implementation	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Production system					Cow-calf					
Labour										
Manager	1	1	1	1	1	1	1	1	1	1
Foreman	1	1	1	1	1	1	1	1	1	1
Cowboy	1	1	2	2	2	2	2	2	2	2
Cattlemen	6	6	8	8	8	8	8	8	8	8
Cook	1	1	2	2	2	2	2	2	2	2
Financial policy / credits										
Credit amount taken in the year	no	178.571	no	no	no	no	no	no	no	no
Technical advisory service	no				yes					
Cow-calf										
Feeding system	Grazing natural pasture				Rotational grazing improved pastures					
Supplementation strategy					Minerals					
Number of cows	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Age at first calving (months)	36	36	36	32	32	32	30	30	30	30
Weaning rate (No. of calves per 100 cows and year)	0,63	0,63	0,66	0,66	0,66	0,69	0,69	0,69	0,71	0,71
Number of weaners per cow and year	1.260	1.260	1.320	1.320	1.320	1.380	1.380	1.380	1.420	1.420
Weaning age female / male (days)	250/250	250/250	250/250	250/250	250/250	250/250	250/250	250/250	250/250	250/250
Weaning weight female / male (kg)	170/180	170/180	170/180	170/180	170/180	170/180	170/180	170/180	170/180	170/180
Male weaners sold (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Males transfered to backgrounding (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Females sold (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Females kept (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Cows mortality rate (%)	2%	2,0%	2,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%
Weaners mortality rate (%)	8%	8%	8%	7%	7%	7%	6%	6%	5%	5%
Finishing										
Feeding system					Grazing on planted pastures on cleared forest					
Supplementation strategy					Minerals					
Weaners transferred to finishing (No.)	580	580	580	607	614	614	642	649	649	674
Age at start of finishing (days)	250	250	250	250	250	250	250	250	250	250
Age at end of finishing (days)	780	780	780	780	780	780	780	780	780	780
Period of finishing (months)	18	18	18	18	18	18	18	18	18	18
Weight at start of finishing (kg LW)	180	180	180	180	180	180	180	180	180	180
Weight at end of finishing (kg LW)	450	450	450	450	450	450	450	450	450	450
Weight gained (kg)	270	270	270	270	270	270	270	270	270	270
Daily weight gain (grams per day)	509	509	509	509	509	509	509	509	509	509

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Table 7 Profit and Loss Account during the BMP implementation period only Cow-calf (USD total values)

Cow-calf	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 Total returns										
Cow-calf market receipts	446.500	446.500	446.500	559.464	475.571	485.750	548.893	511.607	520.714	530.214
Beef finishing market receipts										
1.3 Total farm returns	448.188	447.606	449.893	519.330	481.107	492.690	533.053	517.832	526.935	536.905
2 Total input										
2.1 Total variable costs crop and forage	214.286	235.714	207.143	178.571	178.571	128.571	128.571	157.143	128.571	128.571
2.2 Total expenses cow-calf	25.000	129.873	130.433	125.974	126.907	127.855	126.053	126.902	127.565	128.061
2.3 Total expenses beef finishing										
2.4 Total fixed expenses	21.107	21.107	21.107	21.107	21.107	21.107	21.107	21.107	21.107	21.107
2.5 Total labour expenses	48.061	48.061	64.175	64.175	64.175	64.175	64.175	64.175	64.175	64.175
2.6 Total interest on liabilities	1.614	21.429	27.705	26.310	25.068	19.462	12.642	9.004	7.348	6.549
2.7 Total farm depreciation	9.333	11.964	13.524	16.155	17.714	17.714	17.714	17.714	17.714	17.714
2.8 Total farm input	319.401	468.148	464.087	432.293	433.543	378.885	370.263	396.046	366.481	366.178
3 Farm profit	128.787	-20.542	-14.194	87.038	47.564	113.806	162.790	121.786	160.454	170.728

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Table 8 Profit and Loss Account during the BMP implementation period only Cow-calf (USD per ha)

Cow-calf	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 Total returns										
Cow-calf market receipts	45	45	45	56	48	49	55	51	52	53
Beef finishing market receipts										
1.3 Total farm returns	45	45	45	52	48	49	53	52	53	54
2 Total Input										
2.1 Total variable costs crop and forage	21	24	21	18	18	13	13	16	13	13
2.2 Total expenses cow-calf	3	13	13	13	13	13	13	13	13	13
2.3 Total expenses beef finishing										
2.4 Total fixed expenses	2	2	2	2	2	2	2	2	2	2
2.5 Total labour expenses	5	5	6	6	6	6	6	6	6	6
2.6 Total interest on liabilities	0	2	3	3	3	2	1	1	1	1
2.7 Total farm depreciation	1	1	1	2	2	2	2	2	2	2
2.8 Total farm input	32	47	46	43	43	38	37	40	37	37
3 Farm profit	13	-2	-1	9	5	11	16	12	16	17

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Table 9 Profit and Loss Account during the BMP implementation period Cow-calf and Finishing (USD total values)

Cow-calf and finishing	2.016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 Total returns										
Cow-calf market receipts	469.464	469.464	469.464	586.946	498.000	508.179	574.536	535.411	545.054	554.250
Beef finishing market receipts	990.347	990.347	990.347	990.347	990.347	990.347	990.347	990.347	990.347	990.347
1.3 Total farm returns	1.470.378	1.473.217	1.469.799	1.544.473	1.501.728	1.516.961	1.560.047	1.543.736	1.553.716	1.562.833
2 Total input										
2.1 Total variable costs crop and forage	244.420	265.848	237.277	208.705	208.705	158.705	158.705	187.277	158.705	158.705
2.2 Total expenses cow calf	86.875	132.068	132.628	127.860	128.867	129.785	127.899	128.813	129.475	129.908
2.3 Total expenses beef finishing	455.882	455.882	455.882	455.882	455.882	455.882	455.882	455.882	455.882	455.882
2.4 Total fixed expenses	26.643	26.643	26.643	26.643	26.643	26.643	26.643	26.643	26.643	26.643
2.5 Total labour expenses	58.418	58.418	77.411	77.411	77.411	77.411	77.411	77.411	77.411	77.411
2.6 Total interest on liabilities		21.429	19.412	14.286	11.001	7.143	3.571			
2.7 Total farm depreciation	56.190	58.821	60.381	63.012	64.571	64.571	64.571	64.571	64.571	64.571
2.8 Total farm Input	928.428	1.019.109	1.009.634	973.799	973.080	920.140	914.683	940.596	912.688	913.120
3 Farm profit	541.950	454.108	460.165	570.675	528.648	596.821	645.364	603.140	641.028	649.713

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Table 10 Profit and Loss Account during the BMP implementation period Cow-calf and Finishing (USD per ha)

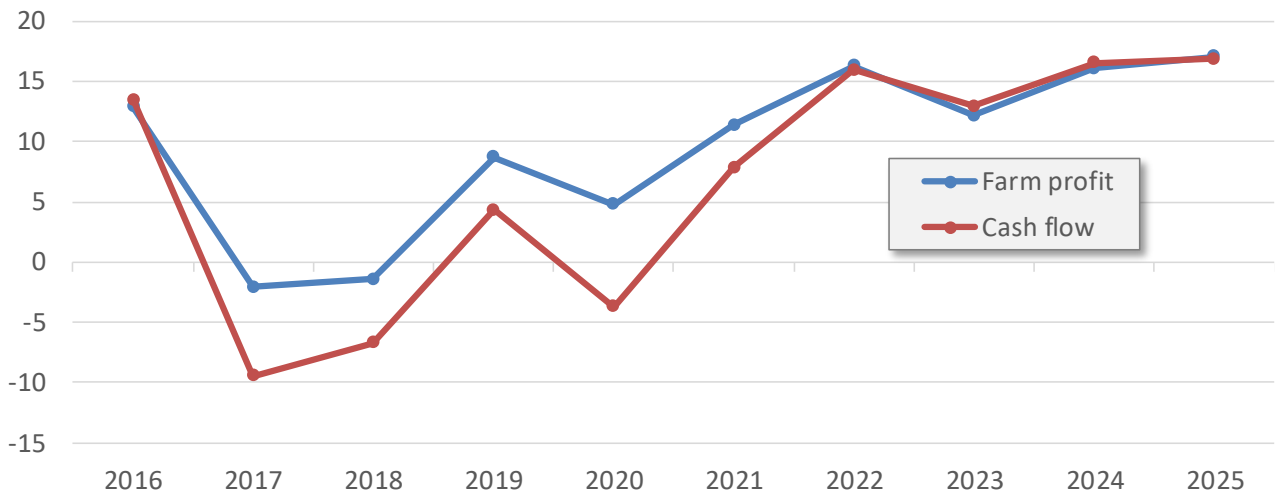
Cow-calf and finishing	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 Total returns										
Cow-calf market receipts	47	47	47	59	50	51	57	54	55	55
Beef finishing market receipts	99	99	99	99	99	99	99	99	99	99
1.3 Total farm returns	147	147	147	154	150	152	156	154	155	156
2 Total input										
2.1 Total variable costs crop and forage	24	27	24	21	21	16	16	19	16	16
2.2 Total expenses cow calf	9	13	13	13	13	13	13	13	13	13
2.3 Total expenses beef finishing	46	46	46	46	46	46	46	46	46	46
2.4 Total fixed expenses	3	3	3	3	3	3	3	3	3	3
2.5 Total labour expenses	6	6	8	8	8	8	8	8	8	8
2.6 Total interest on liabilities		2	2	1	1	1	0			
2.7 Total farm depreciation	6	6	6	6	6	6	6	6	6	6
2.8 Total farm input	93	102	101	97	97	92	91	94	91	91
3 Farm profit	54	45	46	57	53	60	65	60	64	65

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Figures 7 and 8 show the farm profit as well as the cash flow in the implementation period for both cases: Cow-calf only and Cow-calf and Finishing.

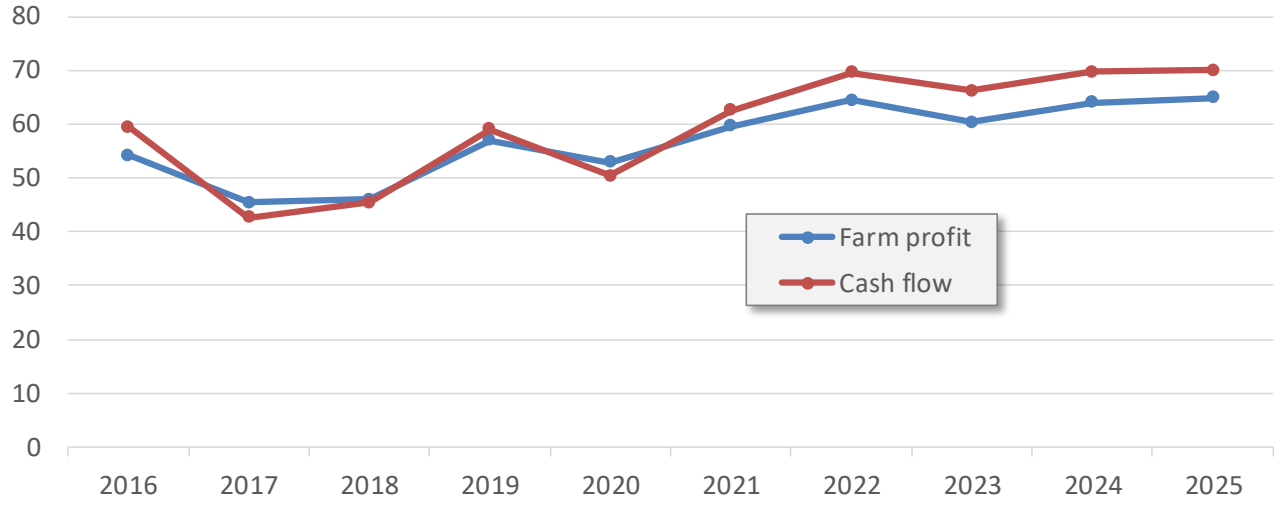
- Figure 7 (Cow-calf only) shows how the cash flow as well as the farm profit decrease abruptly in the year of implementation. This is mainly due to the BMP implementation investments. Then, both indicators experience a recovery – with a small decrease in the fourth year (due to the investments in the final subdivisions and the fact that herd productivity is still increasing) – through the increase in returns, overcompensating the increases in costs. The cost increase is mainly due to the interest payments, the purchase of animals and/or the increase of the herd and associated variable costs.
- There appears to be a certain risk involved with implementing BMPs, as both cash flow and profit show negative values during the first two years. The main reason for this is a) the relatively low profit situation in the Baseline, and b) cash needs in terms of capital requirements (mainly interest and principal payments for the loan).
- At the end of the implementation period (year 2023 onwards), the profit and cash flow show increased values when compared with the Baseline (around 33%).
- In the case of cow calf plus beef finishing (Figure 8), the cash flow and profit decrease mainly during year one and two, experiencing a continuous increment after year 2020. Final values after implementing BMPs (year 2025) are higher than the Baseline (around 20%). The risk level implied in adopting BMPs is relatively low as the cash flow and profit values do not experience negative figures. This situation is mainly due to a) a better profit for the baseline and b) a relatively low level of investments required for BMPs.

Figure 7: Profit and Loss Account and Cash Flow during the BMP implementation period Cow-Calf only (USD per ha)



Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

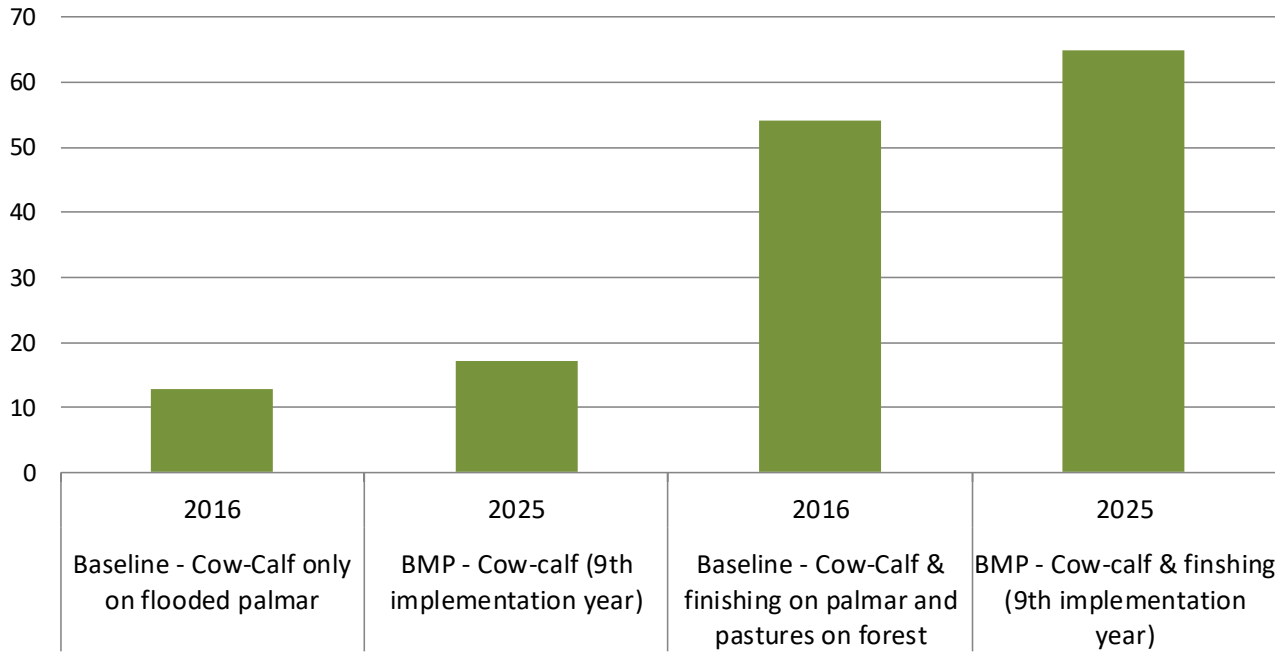
Figure 8 Profit and Loss Account and Cash Flow during the BMP implementation period, Cow-Calf and Finishing (USD per ha)



Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Figure 3 illustrates the situation in the two Baselines and the corresponding BMP, measured as farm profit per ha. The profit of the BMP for the Cow-Calf only is almost 33 percent higher than the corresponding Baseline. For the Cow-Calf plus Finishing case, although the Baseline already had a relatively high economic performance, the implementation of the BMP results in a profit increase of 20 percent.

Figure 3 Comparing Baselines and BMP profits (USD per ha)



Source Local expert focus groups and own calculations using the *agri benchmark* tools.

5 Conclusions and recommendations

The case studies provided a clear picture of the present production system and its development options. Beyond the case study level, the following remarks can be made.

Cow-Calf only

- In both the Baseline and the BMP scenarios the profit is lower (low input/low output systems) than land opportunity costs (USD 12.8 and 17.0 per ha versus land rental price of USD 37.5 and 56.3 per ha, respectively). It is quite clear that the current land value does not correspond to its production capacity and that other factors are affecting the land price (for example expectations and speculation about future developments and potential, financial depreciation models).
- Implementing BMPs provides higher profits and profit margins and could be a conservation opportunity. However, land competition with other cattle ranching activities such as beef finishing (on cleared forest) shows higher incentives in terms of profit. It can be assumed that the same applies to the introduction of crops, if that became technically feasible on the flooded land.
- Most of the measures proposed are basic managerial factors in terms of herd, water and forage management requiring a relatively low level of investment. These measures could lead to an increase in productivity, profit and cash flow.
- When implementing BMPs it is important to take into consideration that in the initial transition years profit decreases almost to zero and cash flow presents negative values. This is important when planning financial requirements.

Cow-Calf and Beef Finishing

- Cow-calf and beef finishing (on cleared forest) shows much better results in terms of profit compared to cow-calf only.
- Cow-calf and beef finishing requires higher levels of management and capital investment (clearing forest and buying additional weaners). Apparently, there are technical services available in the region for implementing these changes.
- BMPs do not seem to offer a major opportunity to improve productivity and profit as profit does not make a big difference: USD 67 (+24 percent) versus USD 54 per ha in the Baseline.
- Investments on BMPs seems to be low risk as cash flow is not significantly affected. However, for large farms, the total capital requirements could be a limiting factor in the medium and long-term.
- For the cow-calf and beef finishing on cleared forest (Baseline and BMPs scenario), the productivity analysis implemented does not reflect the improvement of soil quality over time (after a long period of monoculture using introduced pastures). The resulting effect is reflected neither in animal productivity nor in profitability. This information was not available in the project. Future studies should consider this aspect when comparing enterprises for land competition over a period.

Implementing BMPs program

- Practice change usually has long-term transition periods. The BMPs' implementation requires relatively long periods because of the significance, long-term character and interdependency of many measures. Some of the major strategies are based on improving managerial abilities and their changes usually take time.
- The long transition periods impose the perception of risk on the side of the producers. It is therefore important, especially for advisory services, to create awareness with the producers about the medium to long-term advantages of such interventions. Without advisory services, most producers are unlikely to make the change, due to the perceived risk.

Potential threats and land competition

- In general terms, when comparing profit and opportunity cost for land, it seems that there is an imbalanced situation (opportunity costs higher than profit per ha), showing that the current land use does not reflect its true value. The high level of opportunity costs can result from a) more competitive land use options and/or b) speculation on increasing land values as a result of improved infrastructure or c) on the fact that land investment takes place with motivations not directly related to agricultural production and its potential output.
- When comparing both Baselines (cow-calf and beef finishing), there is a clear difference in terms of profit and this difference could lead to a competition for land access. This competition is probably reflected in the current opportunity costs for land (greater than profit).
- The calculation of profit, opportunity costs for land, and investments required for Baseline and scenarios has taken into account the current limitations such as road and electrical infrastructure. Those aspects may change substantially if these limiting factors can be overcome. Then, it is likely that beef production will be replaced by crop production, particularly soybean and maize and especially on former forestland.
- It is important that future studies could represent longer-term profit margins, considering soil quality and its associated productivity (possible land degradation).

Conclusions on working level

This project represents the first joint piece of work between WWF Paraguay and *agri benchmark*. In the beginning, we had to create a common understanding of the work ahead of us, mainly because we were approaching the tasks from different angles – agricultural and beef production vs. nature protection. However, the project provided a great learning experience for both parties and the overall assessment of the cooperation is very positive.

For WWF, an organization dedicated to environmental conservation, the objective was to know how the current situation affects the ecosystem values of the region, to understand the drivers for development in the Chaco region and to understand the economic factors involved. The present paper and work with agri benchmark allowed for an exchange of knowledge with producers leading to a better understanding of the way they make decisions. It is these decisions that have an impact on the landscape.

References

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Annex 1

Table A.1 BMP strategy – Investments required for implementing BMP (USD Total values)

Investment and depreciation				
	Year of analysis	Year of implementation	USD	
Solar water pump 1	2017	1	5.357	
Solar water pump 2	2019	3	5.357	10.714
Drinking troughs 1	2017	1	5.714	
Drinking troughs 2	2018	2	5.714	
Drinking troughs 3	2019	3	5.714	
Drinking troughs 4	2020	4	5.714	22.857
New roads 1	2017	1	1.071	
New roads 2	2018	2	1.071	
New roads 3	2019	3	1.071	
New roads 4	2020	4	1.071	4.286
New pipes 1	2017	1	8.571	
New pipes 2	2018	2	8.571	
New pipes 3	2019	3	8.571	
New pipes 4	2020	4	8.571	34.286
Turkey nest 1	2017	1	21.429	
Turkey nest 2	2019	3	21.429	42.857
New fences (fix) 1	2017	1	8.929	
New fences (fix) 2	2018	2	8.929	
New fences (fix) 3	2019	3	8.929	
New fences (fix) 4	2020	4	8.929	35.714
Resting areas 1	2017	1	5.357	
Resting areas 2	2018	2	5.357	
Resting areas 3	2019	3	5.357	
Resting areas 4	2020	4	5.357	21.429
Total				**172.143**
Previous investments specific for the finishing activity				
3 x Water pond and water tank	2010	-6	26.786	
Cleaning and planting 2250 has	2010	-6	1.125.000	
Corral adicional	2010	-6	17.857	1.169.643
Total				**1.341.786**

Source: Local expert focus groups and own calculations using the *agri benchmark* tools.

Annex 2

Table A2 Participants list in the workshops

Name	affiliation	Participation dates			
		Jun 17	Mrz 18	Nov 18	other
Gloria Elvira Lesme de Avila	Producer				
Dario Zarate	Producer				
Tomas Vera Santander	Producer				
Erme Gimenez	Producer				
Juan Manuel Moreno	Producer				
Dario Villalba	Producer				
Domingo Benitez Balbuena	Producer				
Alcides Gonzalez Aponte	Producer				
Angel Orzuzar	Producer				
Jazmin Rivarola	Producer				
Fidelino Garcete	Producer				
Humberto Martinez Godoy	Producer				
Leonardo Chamorro	Producer				
Joaquin Avila	Producer				
Ernesto Scapinni	Producer				
Julio Hernan Avila Lesme	Producer				
Crispin Rafael Gonzalez	Producer				
Pedro Dubarry	Producer				
Samuel Chavez	Producer				
Edimar da Soureca	Producer				
Miguel Rodriguez	Producer				
Jose Dario de Alvarez	Producer				
Jaime Athorpe	Producer				
Marcelo Balmelli	Producer				
Celso Muxfeldt	Producer				
Raúl Rivarola	Producer				
Daniel Ríos	Producer				
Diego Ramírez	Producer				
Alexander Laratro	Producer				
Ricardo Mongelós	Producer				
Axel Bendlin	Producer				
Patricia del Mónico	Producer				

Source: Own compilation