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project

Developing profitable beef business systems for previously disadvantaged farmers in South Africa

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1 Acknowledgments

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2 Executive summary

This project was developed to specifically:

1. Develop South Africa's resource-poor farmers and their networks
2. Benchmark and develop the role of cattle from emerging farmer herds and improve their performance through the South African commercial beef system
3. Increase knowledge of relationships between components of herd profitability in (sub-) tropical environments, to provide the means for ongoing genetic and non-genetic improvement of tropically adapted beef cattle.

Over the life of the “Beef Profit Partnerships” (BPP) project, outstanding progress was achieved towards all objectives, greatly exceeding the originally-planned outputs and resulting in very significant impacts on the commercialisation and profitability of the project’s emerging farmers and providing them with significant new opportunities to enter South Africa’s commercial beef markets.

Based on data recorded by the BPP farmers, the project increased revenue to the project's emerging farmers by >1.95 million Rand (R) over the period 2001-2006. The average was >R16,000 per farmer team per year. It is estimated the BPP project increased profits to the subset of farmer teams that measured gross margins by >R236,000 from 2002 to 2006, with the average being ~R7,500 per farmer team per year. If the same average improvement was achieved across all BPP farmer teams, the total improvement in gross margin would be ~R800,000 between 2002 and 2006. About 40% of the additional revenue would be expected to be retained as additional profit to the participating farmers (Madzivhandila et al., 2008).

The project also evaluated a number of tropically adapted indigenous southern African breeds and cattle from emerging farmer herds to determine their value in replacing a proportion of the several hundred thousand weaner steers or tens of thousands of tonnes of beef imported each year to satisfy South Africa’s domestic demand for beef. Results showed growth rates and feed efficiencies of steers from emerging and communal farmer herds paralleled those from commercial herds. They entered the feedlot at a lighter weight than commercial cattle, but grew as well in the feedlot and had similar feed conversion ratios, to achieve acceptable, albeit lighter carcase weights. The incidence of disease was low in all steers and was no different between commercial, emerging and communal herds. There were small or no differences between herd types or breeds in carcase and meat quality attributes. It was concluded that cattle from emerging and communal farmer herds have the ability to meet the specifications of South Africa’s commercial beef markets, indicating a genuine opportunity exists for import substitution, whereby the >5 million cattle in emerging and communal herds could be used to overcome the significant shortfall in South Africa’s domestic beef market demand.

At the end of the project, BPP networks had been expanded to 5 new South African provinces (Mpumalanga, Gauteng, Eastern Cape, Free State and Kwa-Zulu Natal) as well as the initial Limpopo and North West provinces. In South Africa, there is now very strong commitment to the Project's "Continuous Improvement and Innovation" (CI&I) process, which is used for decision-making at almost every level of the cattle industry managed by emerging farmers. Those farmers use the process to choose between new production or marketing opportunities or new technologies. The extension and technical staff use it to choose how and where to allocate their efforts for greatest impact. And the project leaders and managers use it to choose how and where to focus staff and financial resources for greatest impact. The National Department of Agriculture uses CI&I as a policy framework and has funded a number of positions to ensure more cattle farmers and more regions use the process in future.

3 Background

Since South Africa's democratisation in 1994, more emphasis on agricultural development has been directed to the previously disadvantaged communities. These communities can be divided into two main groups. The first group, referred to as small-scale farmers, run their cattle on communal grazing land. Their cattle were mostly of indigenous type but exotic breeds have been introduced. Numbers range between 4 and 3000 cattle per community group. The predominant indigenous breed is the Nguni, which has survived largely because of natural selection and adaptability to the environment. The second group, referred to as emerging farmers, own or lease land and generally have indigenous crossbred or exotic type of animals. Numbers of cattle in this sector vary between 10 and 1000 cattle per group. The majority of small-scale and emerging farmers are found in the former homelands of the Limpopo, Mpumalanga, North-West, Kwa-zulu Natal, Free State and Eastern Cape Provinces. The total number of cattle controlled by small-scale and emerging farmers is estimated at around 5 million head. Both groups include many cattle farmers who are desperately attempting to become more commercially (market) oriented.

Over the last two decades, the South African beef market has changed radically. In the past, emerging farmers could sell their cattle as steers or old cows for a reasonable price. But the advent of a large feedlot sector in South Africa has meant the commercial market now requires animals that are earlier maturing, efficient converters of high quality feed and possess superior carcase attributes. Markets generally available to emerging farmers include local butchers or meat required for local festivities. Those markets are both unpredictable and unreliable. To improve profitability, small scale and emerging farmers need to enter the well defined commercial markets, where attributes such as feed efficiency, growth and superior carcase attributes attract premium prices.

Very little was known about the cattle raised by emerging farmers. Hence, buyers from the commercial sector were reluctant to purchase these animals. Preliminary research had shown that indigenous Sanga breeds are comparable to those used by commercial farmers for traits such as reproduction and meat characteristics (tenderness and flavour for example), but this work was limited. Designed breeding programs had not been practiced in the small-scale sector. In the past, direct selection of indigenous breeds was for attributes of cultural significance such as coat colour. Indirect selection would have favoured adaptation to tropical environments and fertility (through the need for lactating females) but is unlikely to have changed carcase and beef quality attributes. It was hypothesised that if it could be demonstrated that animals bred by the emerging farmers were able to compete on these traits, opportunities would be created for these farmers to tap into the premium beef markets and, therefore, to substantially increase their profitability. It would also ensure development of a seedstock market for lines and breeds of cattle that are superior for carcase and meat quality attributes.

Australian beef producers were increasingly using crossbreeding as one of their management options to meet the demand for product quality and production efficiency. Breed options for Australian producers in tropical regions (who produce about 60% of the $6 billion per annum beef exports from Australia) have been limited by the poor adaptation of the European breeds most commonly used in crossbreeding programs. However, earlier results from CSIRO and the Beef CRC showed that Sanga breeds derived from Southern Africa have carcase and meat quality attributes that are of similar quality to those of British breeds. These breeds are much better adapted to the stressors of tropical environments than the European breeds and hence provide opportunities for beef producers in northern Australia to improve beef quality, whilst retaining adaptation to environmental stressors.

A potential limitation to this option is the possibility of a negative correlation between productive traits such as growth and fertility in the absence of environmental stressors, and resistance to stressors of tropical environments. At the start of this project, the Beef CRC was supporting a major program to determine whether negative genetic relationships

exist between cow reproductive efficiency and carcase and meat quality attributes and other important traits such as adaptation to environmental stressors when cattle are grazed in tropical and subtropical environments. Knowledge of these relationships will allow development of designed breeding programs targeted specifically at cattle breeders in tropical environments in Australia and South Africa.

Payne and Hodges (1997) identified five main characteristics of an effective cattle breeding strategy aimed at delivering benefits to small-scale cattle owners in developing countries. These characteristics are:

- simple organisation that can be implemented within the local resources
- objectives that match the expectations and values of the community
- a systems approach in which the genetic program is accompanied by improved management, animal health, marketing options for the products and extension support with trained local people
- improved cattle that retain adaptation to local stressors
- improved animal production that is evident as soon as possible and is meaningful to the cattle owners.

The collaborative project developed jointly by scientists in Australia and South Africa accommodates each of the characteristics identified by Payne and Hodges (1997) and was focused directly on the development of profitable beef business systems for small scale and emerging farmers in South Africa. The aim was to empower small-scale and emerging farmers to be self-sustaining by opening new markets for their beef products.

4 Objectives

The objectives of this project were to:

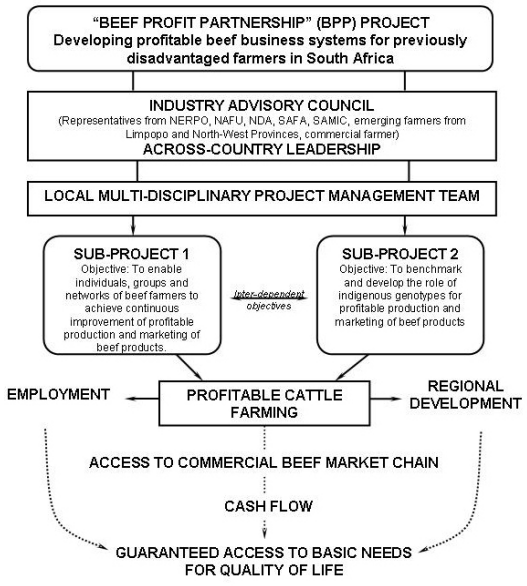
- Enable individuals, groups and networks of beef farmers to achieve continuous improvement of profitable production and marketing of beef products (i.e. to develop the resource-poor farmers and their networks)
- Benchmark and develop the role of Southern African indigenous cattle genotypes for profitable production and marketing of beef (i.e. to develop the role of the cattle and improve their performance through the South African commercial beef system)
- Increase knowledge of relationships between components of herd profitability in tropical and sub-tropical environments, to improve efficiency and product quality without unduly compromising breeder herd performance or adaptability (i.e. to provide the means for ongoing genetic and non-genetic improvement of beef cattle in the tropics and sub-tropics worldwide)
- Develop and implement an ‘exit strategy’ to preserve the gains in social infrastructure and training built up in the project and transfer the carriage of further expansion of the project to local, provincial and industry management and leadership
- Conduct an aggressive campaign to publicise the key information emanating from Objective 2 that the carcass attributes of indigenous cattle are the equal of or better than those of conventional, exotic breeds reared under conditions of high input agriculture.

5 Methodology

The project was managed in three distinct but inter-dependent sub-projects. Sub-project 1 addressed issues relating to the personal development of emerging farmers and development of their support structures in South Africa. Sub-project 2 dealt with improvement of the cattle owned by emerging farmers, using both genetic and non-genetic approaches. Sub-project 3 encompassed the Australian component of the project and addressed issues related to identification of genetically superior breeding cattle for use in harsh tropical environments, without compromising productive attributes such as carcase and beef quality and fertility. An 18-month extension to the project was designed to "institutionalise" the project's Continuous Improvement and Innovation strategy in South Africa, to ensure sustainability of the BPPs in future. A second strategy of the extension period was to widely publicise the results obtained in Sub-Project 2, to specifically provide new opportunities for emerging farmers to enter South Africa's commercial beef markets.

Figure 1 shows a diagrammatic representation of the management structure of the South African component of the project. An experienced local scientist with expertise in the relevant socio-economic or animal production discipline managed each sub-project in South Africa. Both sub-projects targeted development of profitable beef business systems for emerging beef farmers in South Africa. To clearly focus on market specifications and to ensure end-user involvement from the outset, an Industry Advisory Council was established to be an active partner with the project team to achieve the vision, mission and goals and to provide ongoing industry-relevant advice and expertise to the project. Representation on the Council was secured from NERPO (National Emergent Red Meat Producers Organisation), NAFU (National African Farmers Union), SAFA (South African Feedlotters Association), SAMIC (South African Meat Industry Council), the National Department of Agriculture, an emerging farmer from each of the Limpopo and North-West Provinces and a respected commercial farmer. Across-country leadership provided by internationally recognised scientists from Australia and South Africa was an essential component of the project to ensure the scientific standard of the project was world-class to enhance the scientific capacity of the collaborating organisations, whilst retaining direct application of project results to the priorities of small scale and emerging farmers. Project outcomes were designed to enable emerging farmers to enter the commercial beef supply chain and develop new business opportunities with the commercial sector, thereby enhancing employment and regional development on a regional scale.

Figure 1. Diagrammatic representation of the management structure of the BPP project



5.1 Sub-Project 1

Specific tested techniques for identifying appropriate farmer participants were used to build an infrastructure of effective groups and organisations to enable continuous improvement of business systems. The project initially targeted 6 teams in each of the Limpopo and North-Western Provinces, with each team comprising up to 20 farmers per team (although in some cases, the team represented an entire community of up to 400 people). Due to high demand from the farmers, the number of BPP teams expanded to 24 in total across both provinces by the end of the project.

Criteria for identifying farmer participants were established and agreed to by the project team and essential stakeholders. The criteria included:

- Farmers must be from a previously economically disadvantaged background
- The farming enterprises must have the potential to become viable businesses
- The farmers must have an interest in improving profit and lifestyle
- Cattle owned by the farmers must be able to be validly compared with indigenous breeds
- The farmers must have an interest in meeting beef market specifications
- The farmers must have access to locally-based competent support people/staff
- The farmers must be willing to work in self-selected local group or networks
- The farmers must be committed to meet and take action every 60-90 days for 5 years
- The farmers must be willing to be a partner in a marketing group or alliance or beef improvement network
- The farmers must have a commitment to measure their cattle through membership of the Beef Performance Testing Scheme
- The farmers must have a commitment to continuous improvement of their enterprises.

Specific methods for identifying farmer participants involved:

- a clear understanding of the opportunity and its benefits and costs for individuals and teams
- a clear understanding of the process of continuous improvement and the inputs and roles and responsibilities involved over the life of the project (5 years)
- a clear decision-making process, whereby the opportunity could be compared to other opportunities available to enable individuals to make clear distinctions about the benefits versus costs
- geographically based teams (i.e. “local” and preferably, self-selected)
- face-to-face negotiations with people in local areas
- relevant community stakeholders negotiating farmer participation to achieve community support for the project
- the formation of a Farmer Network Management Team to partner the Project Management Team in important decisions about the project. The Farmer Network Management Team was representative of the targeted farmer community.

To achieve farmer commitment to full participation, a one-day (4 to 5 hour) workshop was conducted to provide the understanding necessary for commitment and to provide a structured decision-making process to give participants the confidence in their decisions.

The Continuous Innovation and Improvement (CI&I) process outlined by Clark and Timms (2000) was used to manage, implement and continuously improve the project. The goal

was to establish a sustainable beef improvement system through a Beef Improvement Network of participating farmers. All project staff were equipped with knowledge and skills in CI&I and their application in participative research and development in a 5-day workshop at the start of the project. During this workshop, each project staff member acquired skills in applying specific techniques and tools to achieve CI&I in their role in the project. They were also equipped with skills to enable farmers to practice and achieve CI&I in their beef businesses.

The CI&I process requires individuals to take focused action for impact on performance every 60 to 90 days. The focus of this practice is on the identification and implementation of those opportunities that make a real difference to performance. This focus enables individuals to become more effective and efficient in achieving real impact and desired outcomes.

A training needs assessment was undertaken, as part of this process, to design appropriate education and training programs focused on enabling farmers to take action to improve their current performance. The programs were based on Action Learning and Continuous Improvement and Innovation processes.

Self-reliance can only be achieved in the context of inter-dependency with other people and service providers. Infrastructure and service support were established by the project to enable farmers to achieve productive outcomes. Group, organisational and rural development theory was applied to achieve on-going progress in rural contexts. Farmers with interest and appropriate attributes were trained in group leadership and management to develop an organisation of beef business improvement groups with the capacity to lead and manage continuous improvement during and beyond the life of the project.

Work in Sub-Project 1 was largely coordinated by ARC staff and undertaken by technical and extension staff from the Limpopo and North Western Provincial Departments of Agriculture in herds owned by the project's farmer teams.

5.2 Sub-Project 2

Sub-project 2 used four different strategies to benchmark and develop the role of indigenous cattle genotypes. These are:

5.2.1 Database of current herd statistics

The first strategy involved collation of information from all possible sources, to compile a database of current herd statistics of cattle owned by emerging and small-scale farmers. Benchmark animal performance and farmer profitability values were established primarily by ARC research staff based at Irene. These values were used as benchmarks against which project progress was assessed throughout the life of the project.

5.2.2 Comparative performance of steers from emerging, communal and commercial herds

The second strategy sourced steers from emerging and small-scale farmer herds at weaning. The animals were not bred specifically for the project and were generally non-pedigreed, non performance-recorded animals. Representative steers were sourced from emerging and communal farmer herds in Limpopo and North Western Provinces after weaning in 2002 (Phase 1) and 2003 (Phase 2) and transferred to the ARC’s Irene campus for comparison with steers sourced from commercial herds.

Phase 1 breed (and herd) types included Brahman (emerging), Nguni (communal and emerging), non-descript crossbreds (emerging and commercial) and Bonsmara (emerging and commercial). Steers from commercial herds were used as controls to benchmark the suitability of steers from emerging and communal herds to meet specifications of commercial markets.

In Phase 2, two additional indigenous breeds from commercial farmers (Drakensberger and Tuli) and Bonsmaras from emerging farmers were included, while non-descript commercial steers were excluded.

As the Bonsmara commercial herds were relatively well characterised in South Africa (Scholtz et al., 1999), and valid comparative data were available for the Bonsmara and the Australian Belmont Red breed (Seifert et al., 1988; Corbet et al., 2000), commercial Bonsmara steers were used as the control population. The Brahman breed, although not an indigenous Sanga breed, was also used in the comparison, because about 30% of cattle controlled by small-scale and emerging farmers had some Brahman content (Mathebula and Kirsten, 2000). The Brahman and Belmont Red breeds have been well characterised for carcase and beef quality attributes through the CRC's program and hence both breeds provided a valuable international benchmark.

All animals were finished under commercial conditions, where animals were fed a grain-based diet. Intensive data collection occurred between weaning and slaughter. Measurements included growth rate, feed intake, flight time as a potential indirect indicator of meat tenderness, real-time ultrasound scans for carcase attributes and commercial carcase characteristics and incidence of disease at slaughter. In addition, full carcase and meat quality attributes were measured. The same measurements, including enzyme analyses (calpain, calpastatin and collagen parameters) were recorded in the Phase 2 steers, which were taken to three market weights including a heavy export weight, to determine the ability of these breeds to marble, a requirement for premium export markets such as those in north Asia. A full description of the experimental protocols is provided by Strydom et al. (2008).

To ensure the farmer groups were aware of the performance of their animals during the growing and finishing phases, they, and representatives of the commercial feedlotting, processing and retailing companies were invited to Irene on a regular basis to inspect progress first-hand and to hear of results as they accrued.

5.2.3 Molecular characterisation of indigenous Sanga breeds

This strategy involved a very low-key molecular characterisation of the indigenous Sanga breeds using DNA markers for beef tenderness and marbling developed by the Beef CRC to simply screen widely-used and well-characterised sires from selected indigenous breeds to determine whether the breeds or sires were carrying favourable alleles for the markers. The sires tested in this strategy were not from herds controlled by small-scale or emerging farmers because those sires were not widely used and characterised. However, if the breeds carried favourable alleles, then those results would provide an additional economic incentive to further genetically develop herds controlled by emerging and small-scale farmers through South Africa's Beef Performance Recording Scheme, to develop a national and international seedstock market for superior breeds and sire lines.

5.2.4 Industry Advisory Council

The fourth strategy was aimed at a progressive assessment of the project's impact. As part of the progressive assessment, an Industry Advisory Council was established to provide industry-relevant advice to the project and to provide and promote ongoing interaction between key industry players and emerging and small-scale farmer groups. Representation on the Industry Advisory Council was secured from NERPO (National Emergent Red Meat Producers Organisation), NAFU (National African Farmers Union), SAFA (South African Feedlotters Association), SAMIC (South African Meat Industry Council), the National Department of Agriculture, an emerging farmer from each of the Limpopo and North-West Provinces and respected commercial farmers. The Industry Advisory Council met with the project team at the beginning of the project and thereafter at least once per year to receive annual progress reports and to provide ongoing input to the project's direction. The annual reporting process involved ongoing evaluation against the benchmark performance indicators established by Strategy 5.2.1.

5.3 Sub-Project 3

Experimental progeny were generated in industry herds belonging to the Northern Pastoral Group of companies and at Belmont Research Station in Australia, using a combination of artificial insemination and single- and multiple-sire joinings between 1999 and 2001. Approximately 60 new industry sires and well-characterised link sires were selected on divergent (high/low) values for retail beef yield percentage (RBY%) and intramuscular fat percentage (IMF%). The sires were joined to approximately 3,000 cows each of the same 2 breeds as the sires (Brahman and Belmont Red/tropically adapted composites). All dams were scanned to estimate RBY% and IMF% prior to joining. Blood samples were collected from all dams and sires to extract and store DNA for genotyping. Semen was also collected from all sires and stored for possible future use. After weaning, all calves were transferred to one of several properties controlled by Beef CRC for growout and finishing (steer progeny) or for growout and subsequent joining (heifer progeny). Data collection occurred according to an agreed work-plan described in detail by Burrow et al (2003), Burrow and Bindon (2005) and Barwick et al (2008).

New and existing methods of data analysis were investigated, to better describe the biology of traits such as resistance to ticks and worms as well as to estimate genetic and phenotypic relationships between all traits of interest. Standard covariance estimation procedures were used to estimate the relationships. Early data analyses focused on estimating phenotypic relationships that provided breeders with management options to improve productivity of their herds. As project data accrued, the analyses estimated genetic relationships between the key traits of interest to the project.

Genotypes for all experimental progeny were derived using gene markers identified by the CRC. These genotypes were subsequently analysed jointly with the phenotypic data to determine the magnitude and direction of effects of gene markers on performance attributes, to demonstrate the use of genetic markers to select commercial cattle for carcase and beef quality attributes and adaptability.

5.4 Project Extension (July 2006 - March 2007)

Following an independent review of the project in May 2006, the South African component of the project was extended initially for a further 18 months, and then ultimately for a further three months to allow establishment of a 1-year small project in South Africa.

Between July 2006 and December 2007, the project team undertook activities aimed at "institutionalising" the project's Continuous Improvement and Innovation processes and achieving widespread dissemination of the project's steer experiment results to emerging farmers and commercial and government stakeholders across South Africa. This was achieved by a combination of:

- Establishing a beef industry improvement and innovation "Hub" to develop, lead and manage strategies for sustainable improvement and innovation of emerging beef businesses in South Africa
- Designing and delivering accredited courses and non-accredited short (1-day and 3-day) courses for specific target audiences in South Africa
- Developing a national communication strategy with clear target audiences to promote the project's outcomes across South Africa
- Implementing the national communication strategy.

6 Achievements against activities and outputs/milestones

Objective 1: To enable individuals, groups and networks of beef farmers to achieve continuous improvement of profitable production and marketing of beef products (i.e. to develop the resource-poor farmers and their networks)

no.	activity	outputs/ milestones	completion date	comments
1.1.1	Develop transparent criteria for the involvement of farmers	List of criteria agreed by project partners	December 2001	These criteria proved to be very effective in identifying appropriate project partners.
1.2.1	Individuals and groups understanding and owning the project mission and process	Farmers identified and participation agreed; a retrospective "stretch" KPI proved to be unsolicited requests from other emerging farmers to start their own BPP (hence the need to secure Crawford funds to support additional training)	June 2003 and thereafter	By the end of the project, the understanding and ownership of the project was very strong and had been expanded to additional provinces beyond Limpopo and North West. Adoption of the "BPP" name and logo in 2002/03 greatly assisted this process. The extent of ownership and understanding was clearly evident from the presentations by the leaders of the Farmer Teams at the BPP Forum held at Irene in May 2006.
1.2.2	Clear roles and responsibilities established for all participants	Roles and responsibilities documented as part of the 180-day reporting process	2001-2007, every 180 days	Roles and responsibilities were documented for the Farmer Support Team and each new "Beef Profit Partnership" as part of the 180-day reporting processes as new BPPs were formed.
1.2.3	Individuals and teams committed to taking on-going action to achieve continuous improvement	Documented KPIs outlining the actions of individuals and teams	2001-2007, every 90 days	Commitments of individuals and teams to take action to achieve continuous improvement were documented through the 180-day reporting processes, with reporting against agreed Key Performance Indicators (KPIs).
1.3.1	A sustainable infrastructure of effective groups/teams established	Clearly established linkages across the BPP farmer teams	2001-2007, every 90 days	Farmer Teams met each 30-90 days to focus on achieving improvement in profitability. The farmer networks were significantly strengthened over the life of the project by demonstrated improvements in profitability of individual farmers and the impacts on their communities.
1.3.2	Regular benchmarking of individual practices, performances, new thinking, ideas and innovations	Documented benchmarks reported each 90 days through routine reporting by each BPP team	2001-2007, every 90 days	Farmer and Farmer Support Teams met every 30-90 days to undertake situation and impact analyses and to design and monitor their actions. Reports against the KPIs were undertaken every 180 days and new innovation cycles synthesised. The result of this approach was clearly evident during the public BPP Forum at Irene in May 2006

1.4.1	Participants leading and managing their own groups and teams	Farmer-led activities such as on-farm auction sales and "markets" for other community-based products in conjunction with the auction sales	2005-2007	The ability of Farmer and Farmer Support Team leaders to lead and manage their own groups and teams continued to improve over the life of the project, to the extent that by the end of the project, several farmer teams were operating independently on aspects such as marketing. Quantified improvements were made in other aspects of the beef businesses such as throughput and costs and the farmers were beginning to lead and manage these aspects of the business as well.
1.4.2	Participants understand and manage critical elements of profitable production, marketing and business systems	Farmers are able to identify and progress new business opportunities and/or terminate activities that do not impact favourably on their businesses	2005-2007	BPP project farmers demonstrably improved their understanding and management of aspects of profitable production, marketing and business systems. In particular, outstanding successes were achieved in marketing aspects. This encouraged a strong focus on other aspects of beef business systems such as reducing costs and increasing throughput.

Objective 2: To benchmark and develop the role of Southern African indigenous cattle genotypes for profitable production and marketing of beef (i.e. to develop the role of the cattle and improve their performance through the South African commercial beef system)

no.	activity	outputs/ milestones	completion date	comments
2.1.1	Database of current herd statistics	Database of current practices and profitability available	June 2002, with regular updates thereafter	
2.1.2	Classify beef farmer groups into different levels of commercial success	n.a.	n.a.	This activity was deleted once agreement was reached that individual project farmers would use a gross margins approach for their own herds. Hence, improvements in profitability were assessed at the individual farmer and community level, rather than at communal or emerging farmer level, as originally anticipated by this output.
2.1.3	Baseline performance indicators for an ongoing benchmark process	Documented benchmarks against which each farmer or farmer team evaluated their performance every 90-180 days	December 2001, with regular updates thereafter	Baseline performance indicators, including gross margins for most individual farmers were used to evaluate the impacts of actions aimed at improving profitability of farmer herds.
2.2.1	Comparative data on growth, feed efficiency, carcase and beef quality attributes of contrasting commercial and indigenous genotypes	Results of Phase 1 and Phase 2 experiments reported in scientific papers and beef industry reports	March 2003 (Phase 1); June 2004 (Phase 2)	Results from Phase 1 and 2 steer comparisons were documented as scientific papers, beef industry reports and presentations for use by a wide range of end-users. Full scientific results of both phases are reported by Strydom et al. (2008).

2.2.2	Information on the potential market value of cattle from emerging farmers for all segments of the supply chain	Documented evidence of the suitability of cattle from emerging farmers for all beef industry sectors (feedlotters, processors, retailers)	December 2005	Results from Phase 1 and 2 steer comparisons clearly demonstrated that cattle from emerging farmers can meet the specifications of South Africa's domestic beef markets, although there are also actions which the farmers can take to improve the value of their cattle and their suitability for the commercial feedlot sector. These interventions were highlighted to the farmers by way of feedback through their regular 30-90 day BPP meetings.
2.3.1	A beef recording system designed for emerging farmer use	Beef recording system available for use by emerging farmers	June 2002	The beef recording system was progressively implemented by many of the project's farmers over the life of the project.
2.3.2	Local herds adopt best practice management to achieve commercial success	Changed management practices and their impacts documented every 90-180 days	2005-2007	Efforts to achieve this output are ongoing, but it will take several years beyond the life of the project to achieve this output. Perhaps the most important aspect is the recognition by most BPP farmers and farmer support team members that even with adoption of current best practice management, there will still be ways to improve those practices to achieve even greater commercial success (i.e. through the use of CI&I processes).
2.3.3	Emerging farmers better equipped to respond to market signals	Emerging farmers sell their cattle based on knowledge of commercial market specifications (e.g. weight)	December 2003	Demonstrable improvements were achieved towards this output in 2003/2004 and continued to be made over the life of the project, with evidence that several farmer teams were able to very competently handle marketing aspects of their businesses independently of the Farmer Support Teams by the end of the project.
2.3.4	Valid comparisons of cattle between farmers' herds	Documented reports outlining comparisons of cattle performance across herds	December 2004	The Phase 1 and 2 steer comparisons provided an initial evaluation of differences between emerging and communal herds and breed types. Valid comparisons of cattle across BPP farmer herds occurred in a small proportion (~10%) of individual herds where the farmers commenced recording through South Africa's commercial beef recording scheme towards the end of the project.
2.3.5	Better skilled workforce	Evidence that farmers are seeking and using information on which to base management decisions	June 2004 and thereafter	Demonstrable improvements in farmer skills were clearly evident over the life of the project, though at the end of the project there were still many areas where further improvements could be made.
2.4.1	Databases of South African sires from indigenous breeds carrying the favourable marbling and tenderness alleles	Scientific publication reporting the results	December 2003	Results were published for all sires tested and are available on breed society web-sites; results are also reported in a scientific publication by Banga and van der Westhuizen (2004).

2.5.1	Annual reporting against Performance Indicators in Output 2.1.3	Data for each of the KPIs in 2.1.3 for the previous year updated onto the database	December 2002 and thereafter	Data derived from each annual report (by calendar year) was used in the economic impact analyses that were updated annually.
2.5.2	Knowledge of the key constraints to beef improvement by emerging farmers	Lists of key constraints documented every 180 days by each BPP team	2003-2007, every 180 days	Key constraints were documented as they were identified during the 180-day reporting processes
2.5.3	Increased influence of the project Advisory Council on the direction and commercial success of the project	Documented interactions between the project team and the Advisory Council	2001-2005	The Advisory Council impacted strongly on the initial direction of the project, particularly with respect to the steer evaluation trials under commercial conditions. However, its influence on activities in the Farmer and Farmer Support Teams was minimal in the latter years of the project primarily due to their lack of familiarity with the CI&I approach used by the BPP teams
2.5.4	Progressive increase in the proportion of emerging farmers who achieve the next level of commercial success defined in Output 2.1.2	n.a.	n.a.	This output was not relevant to the project once improvements in profitability began to be measured at the individual farmer level using gross margins approaches
2.5.5	Progressive increase in the prices received and the proportion of cattle sold in higher value markets	Data recorded on the project's database demonstrate improved prices and higher value markets	2002-2007, every 180 days	These improvements were documented each 180 days as part of the project reporting processes. The results were used by Madzivhandila et al (2008) to report the project's impacts

Objective 3: To increase knowledge of relationships between components of herd profitability in tropical and sub-tropical environments, to improve efficiency and product quality without unduly compromising breeder herd performance or adaptability (i.e. to provide the means for ongoing genetic and non-genetic improvement of beef cattle in the tropics and sub-tropics worldwide)

no.	activity	outputs/ milestones	completion date	comments
3.1.1	Comparative information on the magnitude and direction of responses to selection for RBY% and IMF%	Scientific and industry-relevant publications available in the relevant literature	2002/03 and thereafter	Detailed results of these comparisons have been progressively published since 2003 (and are continuing to be published), as outlined in the list of project publications
3.1.2	Phenotypic database for all traits identified in Output 3.1.1	Database accessible online to authorised users, with data updates ongoing as new data accrue	2001 and thereafter	This web-accessible secure database is fully functional and data entry and validation is complete.
3.1.3	A matrix of heritabilities, genetic and phenotypic relationships between traits identified in Output 3.1.1	Scientific and industry-relevant publications available in the relevant literature	2005 and thereafter	These results are to be published in a series of scientific papers as an open-access Special Issue of the new Journal of Food and Animal Science in the second half of 2008. Results are being delivered directly to industry via Beef CRC's awareness and adoption projects
3.2.1	Across-country conversion factors to enable valid comparisons of Belmont Red cattle in Australia and Bonsmara cattle in South Africa	Original milestone: Summary of analyses and across-country EBVs available	June 2006	The objective as described was not achieved due to a third-party dispute outside the project's control (that meant South African and Australian data could not be combined for data analysis). Project objectives were therefore modified to provide new data analysis opportunities for South African scientists. This resulted in additional scientific publications from the project.
3.3.1	Database of gene marker profiles for industry sires based on selected markers for carcase and beef quality and adaptation	Project database updated to include genotypes for selected DNA markers associated with carcase and beef quality and adaptation (subsequently changed to screen for ~10,000 unknown markers)	June 2006	Due to very rapid advances in genomics technology, planned methods to address this objective changed substantially. DNA from all project animals was used to screen for the Affymetrix 10k marker panel to identify and/or validate DNA markers for feed efficiency, carcase and beef quality attributes, adaptability and female reproduction.

Objective 4: To develop and implement an 'exit strategy' to preserve the gains in social infrastructure and training built up in the project and transfer the carriage of further expansion of the project to local, provincial and industry management and leadership

no.	activity	outputs/ milestones	completion date	comments
4.1	Develop a Beef Industry Improvement and Innovation Hub (BIII-Hub) to provide the leadership and support required for sustainability of project activities	BIII-Hub established under local leadership with South African leaders and managers accepting responsibility for ongoing support of BPPs in Limpopo and North West (and other) South African provinces	March 2008	BIII-Hub developed under the leadership of ARC. South Africa's National Department of Agriculture provided funds to support technical officers in 6 provinces to provide ongoing capacity building and training in CI&I methods and to support the project's BPP teams.
4.2	Design accredited and non-accredited short (1- and 3-day) courses for specific target audiences and produce materials required for those courses	Description of courses and institution-based programs, resources and support available	December 2007	Materials developed and distributed to all attendees of training courses
4.3	Conduct "Train-the Trainer" courses in South Africa and provide resources and support for priority trainers	Priority trainers identified and trained; resources and course materials developed and provided to the trainers	December 2007	Three x 1-week training courses conducted in November-December 2007

Objective 5: To conduct an aggressive campaign to publicise the key information emanating from Objective 2 that the carcass attributes of indigenous cattle are the equal of or better than those of conventional, exotic breeds reared under conditions of high input agriculture.

no.	activity	outputs/ milestones	completion date	comments
5.1	Conduct an aggressive campaign to publicise the results from Objective 2 amongst emerging farmers and the commercial beef industry sectors across South Africa	National communication strategy developed with clear target audiences (government, industry and industry advisory committee) identified for Objective 2	December 2006	The communication strategy was developed in conjunction with ARC communication specialists and implemented progressively over the remaining 15 months of the project under the direction of Dan Motiang and Ephraim Matjuda
5.2	Develop material for staged press releases to print, radio and television material	Press releases available for wide range of media outlets	Jan 2006-March 2008	Material to publicise the results was distributed widely to a range of media outlets across South Africa
5.3	Handout material developed for partner, industry and research organisations	Printed material available	Jan 2006-March 2008	Printed material was distributed directly to the National and Provincial Departments of Agriculture, University and other research organisations and to industry agencies

7 Key results and discussion

Objective 1 ~ To enable individuals, groups and networks of beef farmers to achieve continuous improvement of profitable production and marketing of beef products.

This objective focused on improving the profitability of resource-poor (emerging) farmers who own 40% of the beef cattle in South Africa but the income from their enterprises is traditionally low (Table 1). This sub-project aimed to improve profitability by at least 5% per enterprise, per year, for the life of the project (2001-2007). It also aimed to equip the project's farmers to continue improving their profitability beyond the life of the project.

Table 1. Comparison of productivity and profitability of three types of beef cattle farmers in South Africa based on a case study of herd sizes of 25 breeding cows (Tapson, 1990)

Criteria	Emerging farmers	Established farmers	Elite Farmers
Average calving percentage	40%	65%	85%
Pre-weaning mortality	50%	4%	2%
Post-weaning mortality	15%	2%	2%
Calves weaned per annum	5	16	21
Calves available for sale (after replacement)	2	16	20
Average weight of calves sold	150	180	205
Potential monetary value of sold calves	R1 050	R21 600	R33 825
Potential monthly income / farmer	R88	R1 800	R 2 818

The overall improvements in beef profitability and productivity achieved in the BPP project (Table 2) were due mainly to a very strong initial focus on marketing. Together with knowledge of results achieved in Objective 2, the project's farmers now receive about 95% of the published commercial market prices for comparable animals, whereas in 2001, their sale prices were about half those of commercial cattle prices.

The rapid increase in sale prices was achieved primarily through use of on-farm auctions, enabling farmers to join together and pre-weigh their cattle, allowing them to negotiate close-to-market rates for larger numbers of animals. Although auction sales increased the farmers' sale costs significantly, sale incomes also improved markedly, more than off-setting the increased costs and in turn improved their monthly profit by >400%.

More recently, the farmers' focuses changed to herd throughput, reflected by the improved reproduction rate, numbers of sale animals and pre-weaning mortalities in the BPP farmer herds, which in 2005 and 2006 were close to the performance for "Established Farmers" in Table 1. These figures indicate the BPP farmers are well on their way to becoming commercial farmers.

Based on data recorded by the BPP farmers, the project increased revenue to the project's emerging farmers by >1.95 million Rand (R) over the period 2001-2006. The average was >R16,000 per farmer team per year. It is estimated the BPP project increased profits to the subset of farmer teams that measured gross margins by >R236,000 from 2002 to 2006, with the average being ~R7,500 per farmer team per year. If the same average improvement was achieved across all BPP farmer teams, the total improvement in gross margin would be ~R800,000 between 2002 and 2006. About 40% of the additional revenue would be expected to be retained as additional profit to the participating farmers (Madzivhandila et al., 2008).

Table 2. The aggregate benefits of the BPP Project between 2001 and 2006 (R = Rand) (Source: Madzivhandila et al., 2008).

Item	2001	2002	2003	2004	2005	2006	Total/Av.
Number of network teams	15	15	14	13	24	28	
Number of selected farmer teams		2	8	7	5	6	
Price – actual commercial market annual average (R/kg)	6.96	8.71	7.96	7.73	9.31	13.23	8.98
Price - expected emerging farmer price (based on 2000 market situation) (R/kg)	3.48	4.36	3.98	3.87	4.66	6.62	4.49
Price – actual farmer team annual average (R/kg)	4.56	8.5	7.13	7.23	8.8	11.18	7.90
Improvement in price due to BPP (R/kg)	1.08	4.15	3.15	3.37	4.15	4.57	3.41
Growth – average weight of calves sold (kg)	150	188	210	205	194	200	200
Improvement in weight over 2000 market situation (estimate 150kg) (kg)		38	60	55	44	50	50
Throughput – number sold per year	20	23	187	219	389	322	1160
Improvement in numbers sold over 2000 market situation (estimate 1.3 per team)		3	167	199	354	280	1002
Total kg beef sold (kg)	3,000	4,324	39,270	44,895	75,466	64,400	231,355
Improvement in total kg beef sold over 2000 market situation (estimate 3000) (kg)		1,324	36,270	41,895	70,216	59,150	208,855
Income (R)	13,680	36,754	279,995	324,591	664,100	719,992	2,039,113
Improvement in income due to BPP (R)	3,240	23,689	268,055	312,996	650,135	700,132	1,958,248
Improvement in income due to BPP / farmer team (R)	216	1,579	19,147	24,077	27,088	25,005	16,185
Income - actual selected farmer team annual average (R)	12,824	34,455	57,779	150,330	102,153	67,340	70,814
Costs - actual selected farmer team annual average (R)	11,445	9,965	30,721	30,361	53,207	26,644	27,057
Gross Margin - actual selected farmer team annual average (R)	1,379	24,490	27,058	119,969	48,946	40,696	43,756
Implied total kg beef from selected farmer teams (kg)	2,812	4,054	8,104	20,793	11,608	6,023	8,899
Implied gross margin (R/kg)	0.49	6.04	3.34	5.77	4.22	6.76	4.44
Improvement in gross margin due to BPP in selected farmer teams (R)		22,502	23,084	109,771	43,253	37,742	236,352
Improvement in gross margin due to BPP / selected farmer team (R)		11,251	2,885	15,682	8,651	6,290	7,460

** Enterprises include communal herds where the number of individual beneficiaries is sometimes >300, but which are counted here as a single enterprise*

The measured project outcomes and the calculated aggregate economic benefits from the BPP project are shown in Table 2 above. In the top half of the table, the additional income generated by the BPP project is estimated for all farmer teams, while in the bottom half, the additional profit generated by the BPP project is estimated for those teams that routinely calculated gross margins. The reasoning behind the component calculations for each outcome is summarised briefly below.

7.1.1 Price per kg of calves sold

Before the BPP project commenced, Tapson (1990) estimated that emerging farmers received only about half of the price achieved by commercial producers for their cattle. Based on the average annual price received by commercial producers over the period 2001-2006 (National Department of Agriculture, 2007), the likely price received by the in the absence of the project can be estimated over this same period. That is estimated to be a price of R3.48/kg in 2001 rising to R6.62/kg in 2006, but fluctuating from year to year as market conditions changed (Figure 1). The average expected price was R4.49/kg.

However, by using the information and skills provided in the BPP project, the price the emerging farmer teams actually received increased from R4.56/kg in 2001 to R11.18/kg in 2006, also fluctuating from year to year. The average price was R7.90/kg. In the last few years, the farmer teams received more than 90 per cent of the commercial price compared to just 50 per cent before the project commenced. It is therefore estimated that the additional price due to the BPP project ranged from R1.08kg in 2001 to R4.57/kg in 2006. Across the six years, the average price enhancement was R3.41/kg.

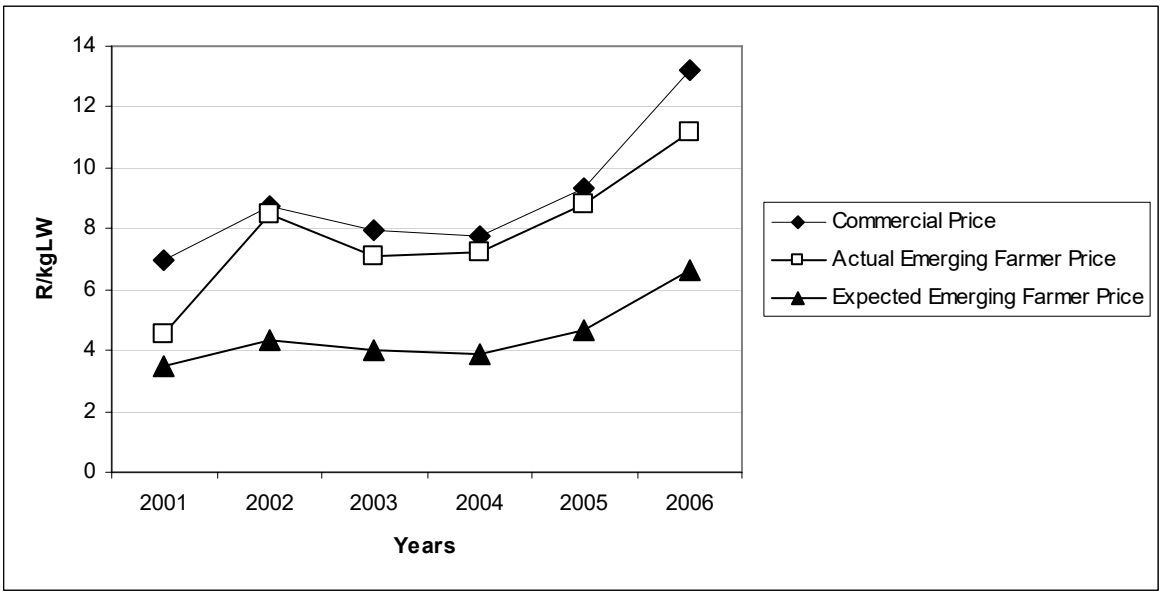


Figure 1. Prices received by commercial and emerging farmers over the BPP project

7.1.2 Carcase weight of calves sold

Before the BPP project commenced, Tapson (1990) estimated the average weight of weaner calves from emerging farmers was about 150kg, compared with at least 180kg for commercial farmers. Given actual average carcase weights achieved of between 188kg and 210kg from the farmer teams, this represents an increase in weight due to the BPP project of between 38kg and 60kg in the different years. The average increase was 50kg (Figure 2).

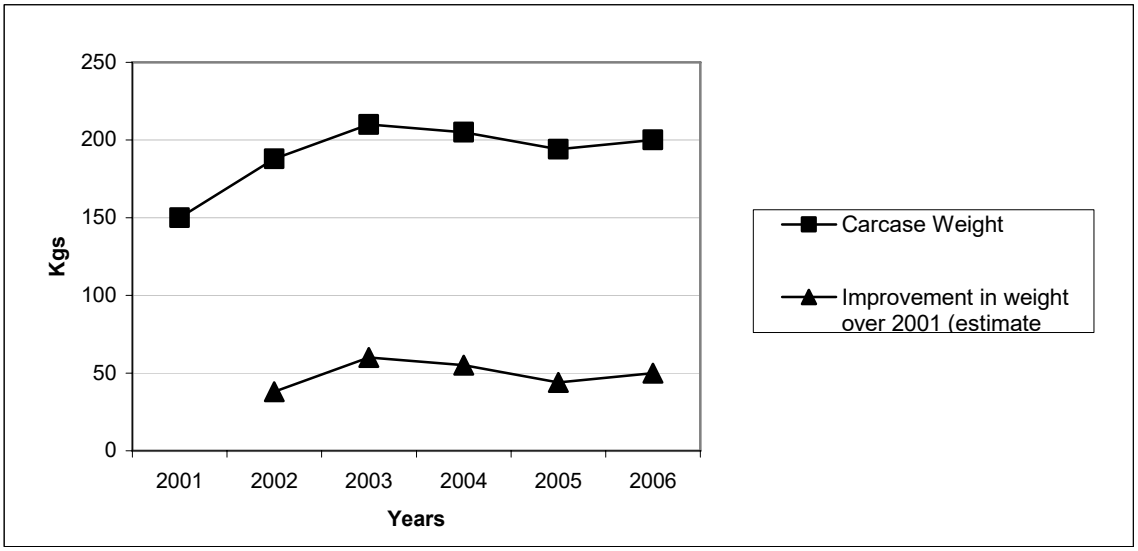


Figure 2. Average carcase weight of weaners produced by BPP farmers against national commercial herd.

7.1.3 Number of calves sold:

Before the BPP project commenced, Tapson (1990) estimated the average number of weaner calves sold by the emerging farmers was 2 calves for every 25 cows. No records were kept of the number of cows in each farmer team during the course of the project, but the first year of data reported in Table 1 suggests an average of 1.3 calves sold per farmer team. This estimate is applied to the number of farmer teams each year to calculate the likely number of calves sold in the absence of the BPP project.

By using the information and skills provided in the BPP project, the actual number of calves marketed by the farmer teams increased from 23 in 2002 to 322 in 2006. These represent an increase of just over 1,000 calves due to the implementation of the BPP project (Figure 3). The reason for the higher turnoff in 2005 and lower turnoff in 2006 was because of severe drought across the Limpopo and North West provinces over this time.

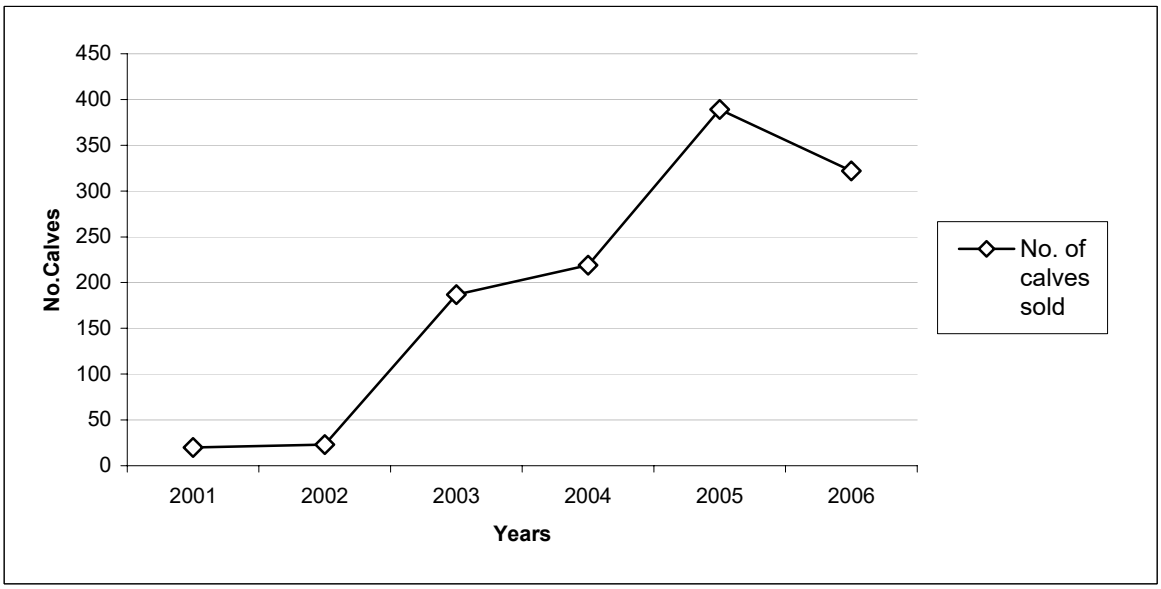


Figure 3. Throughput of calves from BPP project participants

7.1.4 Kilograms of beef sold

This is the number of calves sold by their average weight, under the two scenarios. The base case is 3,000 kg for the years 2001-2004, and 5,250 kg in 2005 and 2006. The “with-project” case is 4,324 kg in 2002 rising to 64,400 kg in 2006. The increase in beef sold due to the BPP project is almost 209,000 kg.

7.1.5 Revenue from beef sold

This is the total kilograms of beef sold (from the paragraph above) by the average price received, under the two scenarios. The “with-project” case is the kgs of beef actually sold times the price actually received. This value rises from R13,680 in 2001 to R720,000 in 2006. The sum over the five years is R2.039 million. The base case is the estimated number of kilograms sold without the BPP project times the estimated price farmers would have received without the project. This value rises from R10,440 in 2001 to R19,860 in 2006. The sum over the five years is R80,865. The difference between these two revenue streams is the aggregate gross benefit of the BPP project. These values rise from R3,240 in 2001 to R700,132 in 2006. The sum of these additional incomes is R1.958 million. The BPP project is estimated to have increased revenue to all BPP emerging farmers by more than 1.96 million Rand from 2001-2006 (Figure 4).

Based on the number of farmer teams operating in each year, these additional revenues represent between R216 per team in 2001 to R25,005 per team in 2006. The average across these six years is R16,185 per farmer team.

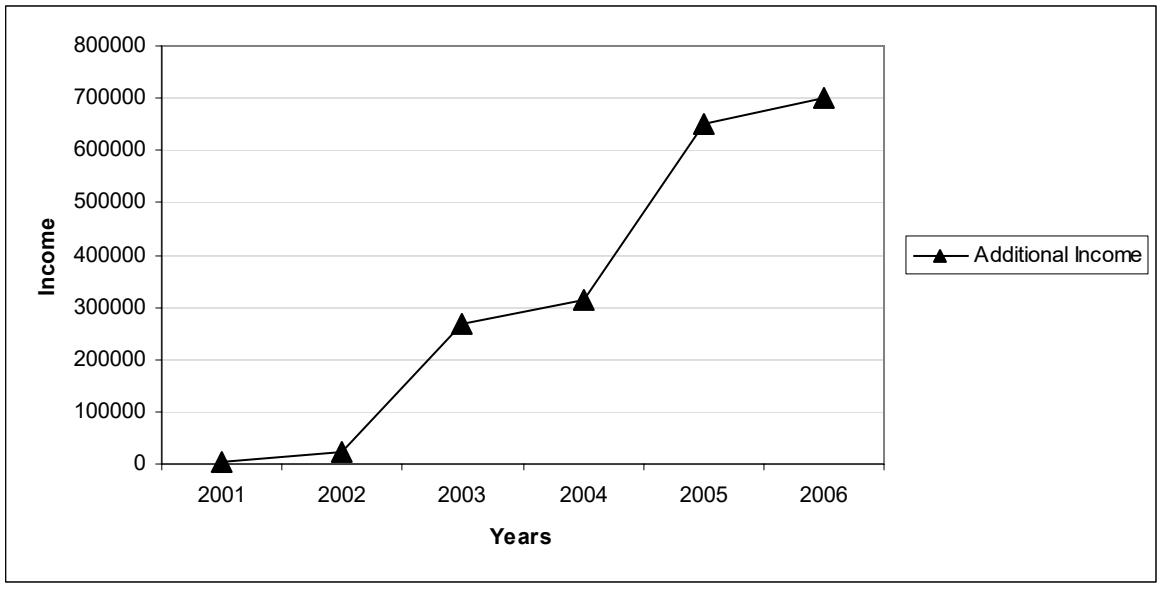


Figure 4. Additional income due to BPP project intervention.

7.1.6 Marketing costs of beef sold

These are the actual marketing costs incurred and recorded by the farmer teams, divided by the total kilograms of beef sold. While actual costs rose in aggregate, on a per kg basis they were almost constant at around R0.65/kg (Figure 5). In fact, these costs are the commissions paid to the buyers.

The other component of marketing cost is transport cost. Although there are no firm data on these costs, the project team estimates that before BPP, farmers transported a maximum of three weaners to an auction in a small utility, at an average distance of 170km. It was estimated that it cost about 3 R/km to transport these cattle in these vehicles. At the base number of cattle sold and average weights, this implies a transport cost per kg of beef produced of about R1.13 (Figure 6).

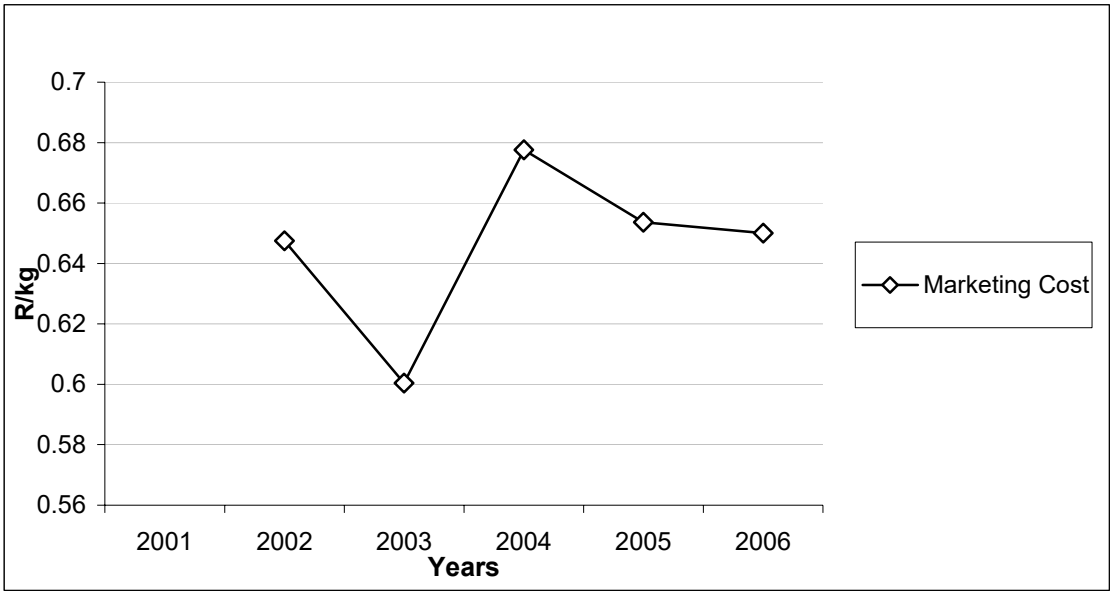


Figure 5. Estimated marketing cost per kg of beef sold.

Following the commencement of the BPP project and with the benefit of the marketing data provided by the project staff, it is estimated that farmers now coordinate transport amongst themselves and use larger trucks that can carry at least 15 weaners. They cover the same average distance of 170km, and it was estimated it cost about R5.2/km to transport these cattle in the larger trucks. Based on the actual number of cattle sold and their weights, this implies a transport cost per kg of beef produced of about R0.30 (Figure 6), suggesting the BPP project has resulted in a cost saving of around R0.80/kg.

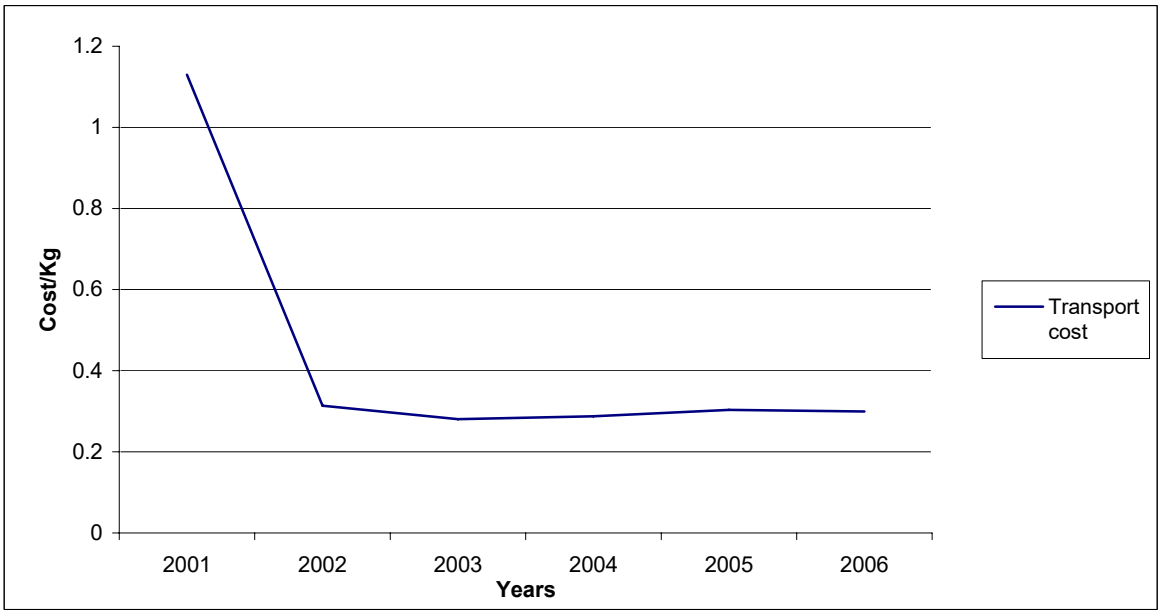


Figure 6. Estimated transport cost incurred by BPP project farmers.

As a result of all contributing factors, over all farmer teams over all years 2002-2006, the average price received by the BPP farmers rose by about R3.40/kg, while the average marketing cost (commission plus transport) fell by about R0.80/kg. This implies an increase in gross margin of some R4.20/kg, before consideration of any additional production costs that might have been incurred. These additional production costs were recorded by only a select few farmer teams and not by all farmer teams.

Objective 2 ~ To benchmark and develop the role of indigenous genotypes for profitable production and marketing of beef products

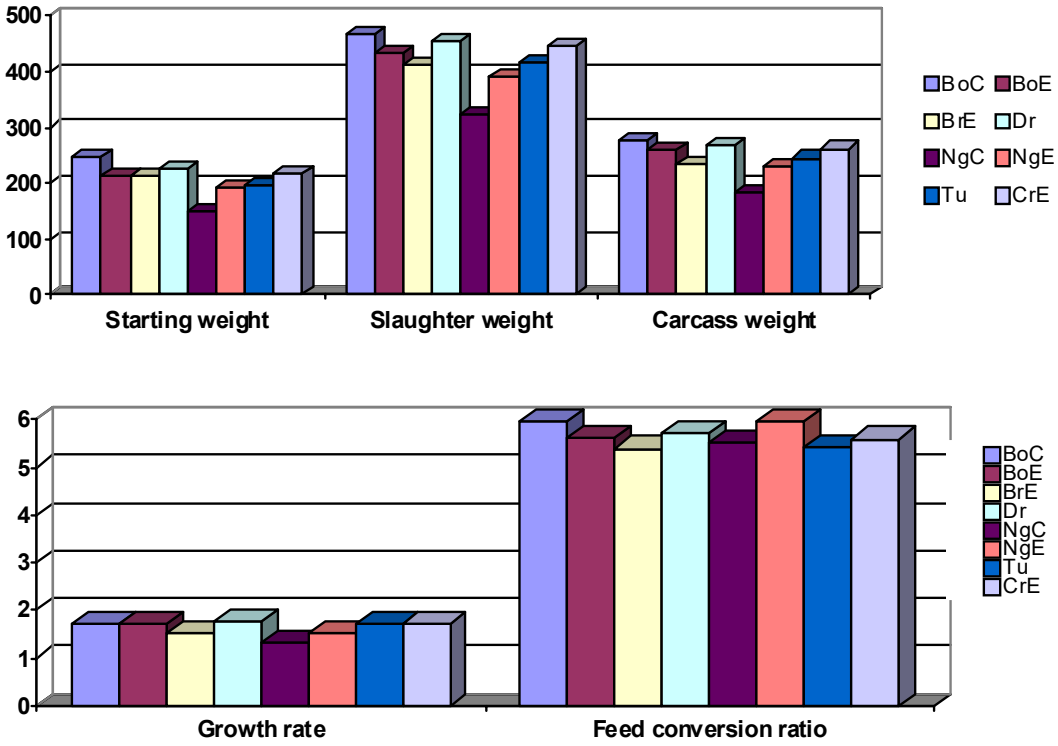
This objective evaluated a number of tropically adapted indigenous southern African breeds and cattle from BPP farmer herds to determine their value in replacing a proportion of the several hundred thousand weaner steers or tens of thousands of tonnes of beef imported each year to satisfy South Africa's domestic demand for beef. As part of the project, representative steers were sourced from emerging and communal farmer herds after weaning in two years and transferred to the ARC's Irene campus for comparison with steers sourced from commercial herds. Phase 1 breed (and herd) types included Brahman (emerging), Nguni (communal and emerging), non-descript crossbreds (emerging and commercial) and Bonsmara (emerging and commercial). Steers from commercial herds were used as controls to benchmark the suitability of steers from emerging and communal herds to meet specifications of commercial markets. In Phase 2, two additional indigenous breeds from commercial farmers (Drakensberger and Tuli) and Bonsmaras from emerging farmers were included, while non-descript commercial steers were excluded.

All animals were finished under commercial conditions, where animals were fed a grain-based diet. Intensive data collection occurred between weaning and slaughter. Measurements included growth rate, feed intake, flight time as a potential indirect indicator of meat tenderness, real-time ultrasound scans for carcase attributes and commercial carcase characteristics and incidence of disease at slaughter. In addition, full carcase and meat quality attributes were measured. The same measurements, including enzyme analyses (calpain, calpastatin and collagen parameters) were recorded in the Phase 2 steers, which were taken to three market weights including a heavy export weight, to determine the ability of these breeds to marble, a requirement for premium export markets such as those in north Asia.

Results from both phases showed growth rates and feed efficiencies of steers from emerging and communal farmer herds paralleled those from commercial herds. They entered the feedlot at a lighter weight than commercial cattle, but during the feedlot period they grew as well and had similar feed conversion ratios, to achieve acceptable, albeit lighter carcase weights. The incidence of disease was low in all experimental steers and was no different between commercial, emerging and communal herds. Meat quality analyses indicate small or no differences between herd types or breeds in carcase and meat quality attributes.

Results from Phase 2 of the study are shown in Figures 7a and b. Based on dentition, cattle from the emerging and communal herds were slightly older at slaughter than cattle from commercial herds.

Figure 7a) Average live weights of steers at feedlot entry and pre-slaughter and carcass weights 7b) average growth rates and feed conversion ratios of steers within breed groupings in Phase 2 of the BPP feedlot study (BoC–Bonsmara Commercial; BoE–Bonsmara Emerging; BrE–Brahman Emerging; Dr–Commercial Drakensberger; NgC–Nguni Communal; NgE–Nguni Emerging; Tu–Tuli Commercial; CrE–Crossbred Emerging).



It was concluded that cattle from emerging and commercial farmer herds have the ability to meet the specifications of South Africa's commercial beef markets, indicating a genuine opportunity exists for import substitution, whereby the >5 million cattle in emerging and communal herds could be used to overcome the significant shortfall in South Africa's domestic beef market demand.

In addition to the steer experiment, three ARC technicians were trained to collect real-time ultrasound beef quality records and have collected data from Phase C bulls (primarily Angus, Bonsmara and Charolais).

Moreover, three groups of widely used South African sires (~300 in total) were tested using patented DNA tests developed in Australia. Sires were identified by ARC researchers and their identities coded so only the South African scientists know the breeds of the animals. The tests are known as GeneSTAR™ Marbling and Tenderness and provide information about genes associated with those important traits. The first two sire groups were tested only for the TG5 (Marbling) and Calpastatin (Tenderness) genes. The third batch was also tested for the Calpain (Tenderness 2) gene. These DNA tests measure whether the animal has favourable or unfavourable forms of the respective marbling or tenderness genes.

Results show that Southern African breeds have a high frequency of the favourable form of the Calpastatin (tenderness) gene, with 98% of sires tested having at least one copy of the favourable gene. They have a lower frequency of the Calpain (Tenderness 2) gene, with only 38% of sires tested having one or two copies of the favourable form of that gene. The breeds also have a very low frequency of the favourable form of the TG5 Marbling gene, even though some of these breeds have been tested in Australia and USA as being high marbling breeds. This suggests that genes other than TG5 are involved in expression of high marbling in these breeds, perhaps offering an opportunity to increase marbling

through introgression of favourable TG5 genes from the British breeds and other genes associated with marbling (yet to be identified) from the African breeds in environments that are suited to African breeds of cattle. Sires tested in the project were not from BPP resource-poor herds because sires in those herds were not widely used and characterized. However, the results provide additional evidence and an economic incentive to further genetically develop herds controlled by resource-poor farmers to develop a national and international seedstock market for these breeds.

GeneSTAR Tenderness

Gene →	**Calpastatin**				**Calpain**			
Breed ↓	0-star	1-star	2-star	Overall	0-star	1-star	2-star	Overall
Afrikaner	0	2 (7%)	25 (93%)	27	9 (75%)	3 (25%)	0	12
Bonsmara	1 (1%)	5 (7%)	72 (92%)	78	32 (74%)	9 (21%)	2 (5%)	43
Boran	0	9 (75%)	3 (25%)	12	0	0	0	0
Brahman	0	1 (14%)	6 (86%)	7	4 (100%)	0	0	4
Drakensberger	0	15 (36%)	27 (64%)	42	0	0	0	0
Nguni	2 (2%)	25 (28%)	63 (70%)	90	24 (41%)	27 (47%)	7 (12%)	58
Senepol	0	1 (50%)	1 (50%)	2	1 (100%)	0	0	1
Tuli	4 (17%)	5 (22%)	14 (61%)	23	9 (100%)	0	0	9
Overall	7 (2%)	63 (23%)	211 (75%)	281	79 (62%)	39 (31%)	9 (7%)	127

GeneSTAR Marbling

	0-star	**1-star**	**2-star**	**Overall**
Afrikaner	25 (96%)	1 (4%)	0	26
Bonsmara	65 (84%)	12 (15%)	1 (1%)	78
Boran	11 (92%)	0	1 (8%)	12
Brahman	7 (100%)	0	0	7
Drakensberger	37 (88%)	5 (12%)	0	42
Nguni	79 (96%)	3 (4%)	0	82
Senepol	1 (50%)	1 (50%)	0	2
Tuli	22 (96%)	1 (4%)	0	23
Overall	247 (91%)	23 (8%)	2 (1%)	272

Objective 3 ~ To increase knowledge of relationships between components of herd profitability in tropical and sub-tropical environments, to improve efficiency and product quality without unduly compromising breeder herd performance or adaptability

In Australia, this sub-project targeted a pivotal beef genetic improvement dilemma relevant to cattle breeders in the tropics and sub-tropics worldwide: Can we change carcass and beef quality attributes of beef cattle without unduly compromising key fitness traits like reproductive performance and adaptation to harsh environmental stressors?

Industry outcomes targeted multiple traits and multi-faceted strategies including carcass and beef quality, feed efficiency, female fertility and tropical adaptation using a range of tools such as EBVs, DNA tests, ultrasound scanning and meat processing and cattle management strategies planned to impact on most sectors of the beef industry. Project results are globally unique. In the short to medium term, they will allow beef producers in tropical and sub-tropical environments globally to precisely target the specifications of premium beef markets, whilst simultaneously maintaining or improving female reproductive performance, without compromising adaptation to harsh environmental conditions.

The impacts of selecting for carcass and beef quality attributes, feed efficiency, adaptation to tropical environments and female reproduction were determined and reported as

estimates of genetic parameters for all traits. Results were delivered directly to co-operating breeders and key stakeholders, particularly those based in northern Australia and South Africa. However, widespread communication of the results to the cattle industry in general is only now starting to occur, now the full extent of trade-offs from selection (arising from the direction and magnitude of relationships between the various groups of traits) is starting to be understood. Some research is still ongoing, to determine associations with lifetime reproductive performance, but most results to date are to be published in a Special Edition of the new Australian Journal of Food and Animal Science in late 2008.

Full economic analyses of all project traits (additional to project milestones) are now underway, to enable practical recommendations to be made about how beef producers in the tropics and sub-tropics can utilise the full complement of project results to maximise herd profitability in their own environments.

An accurate and validated understanding of appropriate selection emphasis on carcass and beef quality, feed efficiency, female fertility and adaptability is now available for the first time to breeders in the tropics and sub-tropics, with knowledge of relationships amongst the entire range of traits. However an examination of GxE interactions, genetic antagonisms and of differences between breeds in parameter estimates, GxE interactions and genetic antagonisms is still being investigated using project data.

This sub-project achieved all objectives outlined in the original contract, as well as many additional objectives. Many publications arising from this research are listed amongst the project's publications. The widespread release of results to the Australian and international beef industry and their integration into education and delivery packages for use by extension specialists is now underway.

Objective 4 ~ To develop and implement an 'exit strategy' to preserve the gains in social infrastructure and training built up in the project and transfer the carriage of further expansion of the project to local, provincial and industry management and leadership

The BPP project was designed from the outset to ensure both the rate and scale of improvements and innovations was sustained beyond the end of the project, having the ambitious expectation that it would be rolled-out nationally, whilst maintaining growth in Limpopo and North-West provinces. Table 3 outlines the key actions and tools used to achieve "institutionalisation" of the BPP methodology in emerging beef farmers across South Africa. Table 4 summarises the range of new leaders trained in CI&I processes as part of this objective.

Table 3. Key actions and tools used in designing and implementing the strategy for institutionalising Continuous Improvement and Innovation (CI&I) processes in South Africa.

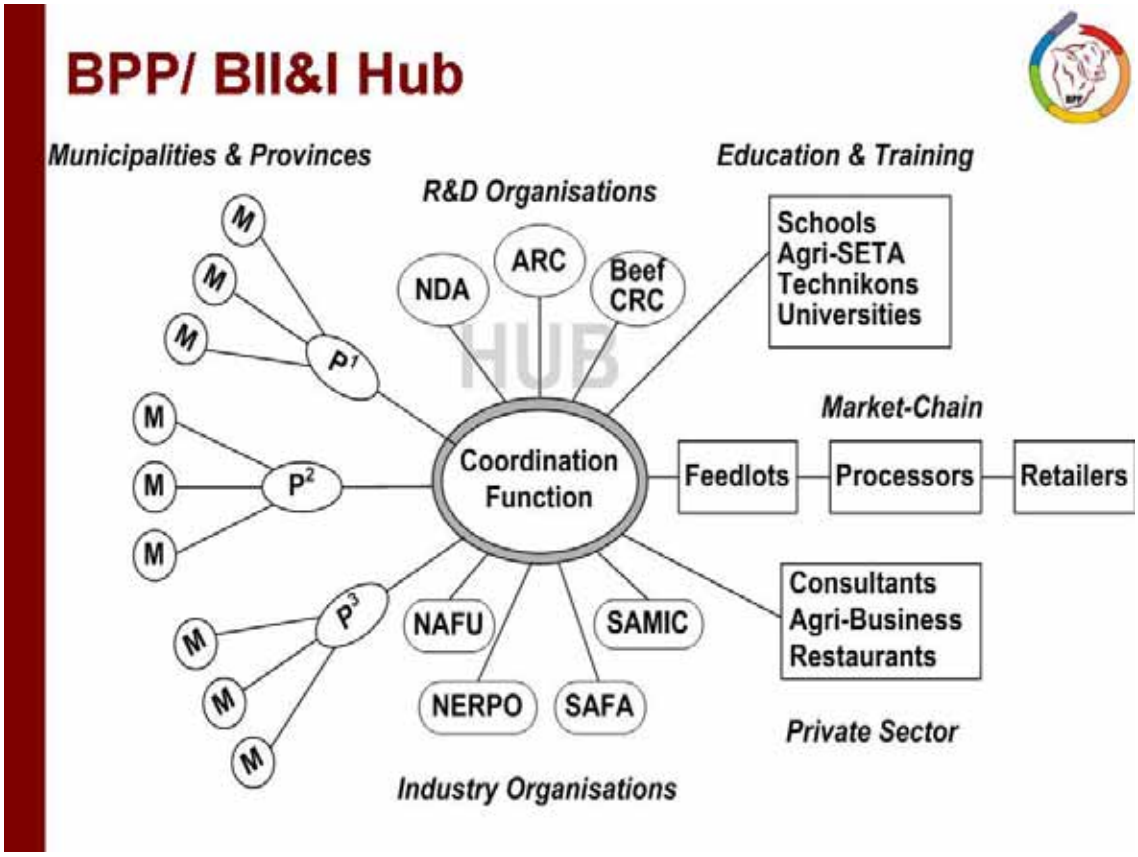
Key Actions	Key Tools
30-day leadership team meetings	CI&I strategy design and leadership tools
A critical number of industry leaders identified and trained	Critical partnership and leadership capacity criteria developed and utilised. Training design, leadership and evaluation principles and tools
Accreditation criteria developed and met	National (Agi-SETA) accreditation quality criteria obtained and fulfilled
Strategies developed to ensure the collaboration and support of relevant specialists, organisations, institutions, policy-makers	Criteria for sustainable improvement & innovation (SI&I) established and met
Measure and monitor effectiveness and efficiency	KPIs for sustainable improvement and innovation measured and monitored for SI&I

Table 4. Categories and number of industry partners with capacity from 'institutionalisation of CI&I'.

Categories	Number
Extension	42
Specialists/Expertise	22
National government	22
Provincial government	30
Local government	2
Education & training institutions	2
Research organisations	24
Management	7
Private Sector	5

One of the key activities of this strategy was formation of a BPP "Hub" under the guidance of South Africa's ARC and National Department of Agriculture, which now provides ongoing leadership and delivery of the project's Continuous Improvement and Innovation processes, as shown in Figure 8.

Figure 8. Diagram of the BPP Hub, responsible for ongoing development, delivery and sustainability of the BPP's CI&I processes.



Institutionalisation of the project's CI&I processes resulted in significant increases in the social infrastructure and partnerships created, in particular expansion to other provinces and municipalities to ensure local leadership. At the end of the project, BPP networks had been established in 7 South African provinces.

A key feature of successful institutionalisation is when a methodology becomes "the way we do things around here". In South Africa, there is now very strong commitment to CI&I as a process for decision-making at almost every level of the cattle industry managed by emerging farmers, who use the process to choose between new production or marketing opportunities or new technologies; the extension and technical staff use it to choose how and where to allocate their efforts for greatest impact; and the project leaders and

managers use it to choose how and where to focus staff and financial resources for greatest impact. The National Department of Agriculture has accepted CI&I as a policy framework and funded eight new positions to ensure more cattle farmers and more regions are included in the process. These positions are attached to the ARC.

The ARC and many provincial and municipal governments have adopted BPP/CI&I as the accepted methodology for beef industry development. The provincial and municipal governments are contributing more staff and resources to complement the National Department of Agriculture new positions and making it work in their areas themselves. The BPP/CI&I process is also being used in other animal and agricultural industries (e.g. dairy cattle, sheep, goats, pigs and horticulture).The project is now institutionalised and now about three times the size as when it started in 2001.

Objective 5 ~ To conduct an aggressive campaign to publicise the key information emanating from Objective 2 that the carcass attributes of indigenous cattle are the equal of or better than those of conventional, exotic breeds reared under conditions of high input agriculture.

As part of the project exit strategy, the main deliverable of the BPP Project during the extension period was to communicate the results of the project widely within South Africa. This was achieved with some exciting outcomes, with great support from stakeholders. This effort was part of the new focus to ensure the establishment of a CI&I “Hub” endowed as part of the sustainability strategy.

Communication activities were a mix of both pull and push efforts from the BPP Leadership. The Team made several efforts to maintain the momentum and excitement created by the BPP Forum in May 2006. After in-depth presentation of the BPP results to the Department of Agriculture (DoA), the BPP Leadership Team submitted a proposal at the request of DoA to expand BPP to other provinces. This resulted in the recruitment of eight technical officers servicing eight provinces as part of the sustainability plan. BPP has now been adopted as an anchor principle for the massive beef empowerment project at DoA, called “massification of livestock”.

Presentations were also made to the Limpopo Provincial Department of Agriculture and the Chris Hani Municipality in the Eastern Cape as part of assisting DoA to introduce the “massification project”. This resulted in a changed project design from an infrastructure-focused project to a systematic evolutionary profit-driven project. Adoption of approaches used in BPP is becoming a useful alternative to improve return on investment.

Presentations were also made to the National African Farmers Union of South Africa (NAFUSA), a key stakeholder and mouthpiece for emerging farmers in South Africa, to ensure their visible participation in the envisaged value chain beef project in the next phase of BPP. NAFUSA has used this imitative as a stepping stone towards formal collaboration agreement with the ARC.

A Further Education and Training Centre was also engaged and inducted to BPP as part of exploring mechanisms for expanding farmer training in approaches used in BPP. This is expected to lead to the accreditation of modules for farmer training and attract funding from relevant institutions.

From the pull side, the Free State has become the new player in BPP resulting in presentations being made to politicians (Member of Executive Committee /MEC), managers of the provincial department of agriculture as well as members of NAFUSA. This has aroused high levels of interest that the province has identified two municipalities for immediate implementation of the project.

8 Impacts

8.1 Scientific impacts – now and in 5 years

As outlined in Section 10.2, this project has already had a major scientific impact in South Africa through publication of the steer experimental results that clearly indicate a strong role for cattle from emerging farmer herds in South Africa's commercial beef markets. Publication of the project's Continuous Improvement and Innovation approaches has also provided entirely new benchmarks against which commercialisation of South Africa's rural poor can continue well into the future.

In Australia, the project has delivered a very wide range of scientific publications reporting entirely novel results around genetic and non-genetic effects on traits impacting on profitability of cattle herds in tropical and sub-tropical regions. They include world-first estimations of relationships between steer traits (feed efficiency; carcase and beef quality attributes) and traits in breeding females (adaptation to a range of stressors and female reproductive performance). As well, the project has provided data to discover and/or validate new DNA markers associated with a wide range of economically important traits.

Results from the project continue to be published and delivered to industry both in South Africa and Australia. The project has already achieved significant scientific impacts in both countries. Within five years, it is realistic to expect the results from both countries will be widely acclaimed by the international scientific community, whether it be for their impact on the commercialisation of South Africa's emerging farmers or for their impact on highly sophisticated commercial production systems globally.

8.2 Capacity impacts – now and in 5 years

As part of the “institutionalisation” of the BPP methodology in South Africa, extensive capacity building was undertaken in 2006 and 2007, as described in Section 7 above, using additional funds provided by ACIAR as part of the extension of the project.

In addition, two PhD students (Baldwin Nengovhela and Percy Madzivhandila) are currently being trained at the University of Queensland and University of New England, Australia respectively, as recipients of a John Allwright scholarship.

Baldwin’s PhD thesis is titled “Improving the Wellbeing of People Dependent on the Low Income Beef Industry of South Africa” and focuses on identifying factors that impact on the use of technology to improve profitability amongst emerging beef farmers in South Africa.

Percy is using BPP project and additional data derived from emerging farmers in South Africa to undertake economic impact analyses to support the roll-out of the BPP processes across South Africa.

A broad range of training materials has been developed by the project and is available in electronic and printed formats through the "Hub". These materials include:

- "Achieving Continuous Improvement and Innovation", Timms, Clark, Bond, McCartney and Stewart, February 2004
- "Leading Continuous Improvement and Innovation", Timms, Clark, Bond, McCartney and Stewart, February 2004
- "Managing Continuous Improvement and Innovation", Timms, Clark, Bond, McCartney and Stewart, February 2004
- "The Methodology of Continuous Improvement and Innovation", Clark, Timms, Bond, McCartney and Stewart, November 2004

- "BPP Training Manual", Clark and Timms, 2001.

One of the key outcomes from this project has been the building of significantly increased capacity of the project's farmers, extension officers, technical staff, scientists and managers, initially across two provinces in South Africa, but now over another 5 South African provinces in the final two years of the project (using additional funds provided directly by the provincial and municipal governments). Significant scientific capacity has also been built in Australia as a result of the project's research in that country.

Institutionalisation of the project's BPP/CI&I methodology in South Africa now means the processes are used for decision-making at almost every level of the cattle industry managed by emerging farmers, who use the process to choose between new production or marketing opportunities or new technologies; the extension and technical staff use it to choose how and where to allocate their efforts for greatest impact; and the project leaders and managers use it to choose how and where to focus staff and financial resources for greatest impact. The National Department of Agriculture has accepted CI&I as a policy framework and funded eight new positions to ensure more cattle farmers and more regions are included in the process.

The ARC and many provincial and municipal governments have adopted BPP/CI&I as the accepted methodology for beef industry development. The provincial and municipal governments are contributing more staff and resources to complement the National Department of Agriculture new positions and making it work in their areas themselves. The BPP/CI&I process is also being used in other animal and agricultural industries (e.g. dairy cattle, sheep, goats, pigs and horticulture). The project is now institutionalised and now about three times the size as when it started in 2001.

In five years time, it is realistic to expect that emerging farmers in South Africa will be starting to have significant impacts in South Africa's commercial beef production system as a result of their increased capacity resulting from the BPP project.

8.3 Community impacts – now and in 5 years

The greatest community impacts of the BPP project on communities in Limpopo and North West provinces (as well as the 5 additional provinces) have been via the economic impacts that have then allowed additional community impacts through enhanced educational and medical intervention opportunities for community members and providing new economic opportunities (e.g. holding community market days alongside the BPP community auctions etc). Empowering the farmers to make effective decisions about their beef businesses has also flowed on to decision-making in all areas of their lives, greatly enhancing the impact of the BPP project on their communities. In five years time, it is realistic to expect that the current and next generation of farmers will be practicing the BPP methodology to enhance all aspects of community life.

8.3.1 Economic impacts

As described in detail in Section 7.1, the project has achieved very significant economic impacts in Limpopo and North West Provinces of South Africa. It has also achieved significant economic impacts in five additional provinces in South Africa, though those impacts were not routinely recorded by the BPP project.

Based on data recorded by the BPP farmers, the project increased revenue to the project's emerging farmers by >1.95 million Rand (R) over the period 2001-2006. The average was >R16,000 per farmer team per year. It is estimated the BPP project increased profits to the subset of farmer teams that measured gross margins by >R236,000 from 2002 to 2006, with the average being ~R7,500 per farmer team per year. If the same average improvement was achieved across all BPP farmer teams, the total improvement in gross margin would be ~R800,000 between 2002 and 2006. About 40%

of the additional revenue would be expected to be retained as additional profit to the participating farmers (Madzivhandila et al., 2008).

As indicated in Section 7.4, the project in South Africa is now institutionalised and about three times as large as when it started in 2001. If the same rate of impact on industry revenue and farmer profits eventuates over the next five years, the total industry increase in revenue is anticipated to be of the order of 6 billion Rand by 2012.

The project has also achieved major economic impacts in northern Australian beef herds, with significant spin-off benefits for feedlotters, beef processors and southern Australian beef producers. Over the next 5 years, it is realistic to expect that flow on benefits will accrue to cattle breeders worldwide, with the greatest impact on those beef producers who graze their cattle in tropical and sub-tropical regions.

8.3.2 Social impacts

In addition to the “hard” measures of project success measured outputs against Key Performance Indicators (as outlined in Section 7), there were numerous “soft” measures of success that clearly demonstrate the BPP project has impacted at the national level and in the wider agricultural industries in South Africa over the past 2-3 years. As well, the project has had several unexpected “spin-off” benefits, including:

- Clear signs that the project farmers are becoming more independent in their actions and activities.
- Indications that the project’s farmers and their partners have become effective decision-makers, able to fully assess and quantify the impact of their decisions as a result of using the project’s approaches.
- One of the greatest impacts is evident in the behaviour of the project’s farmers themselves, as the CI&I approach is teaching them new ways of thinking. They are now becoming managers who can control their own lives.
- Invitations from provincial and national Members of Parliament to present details of the project at a number of different forums, to highlight the successes that the project is achieving. This in turn has resulted in greater uptake of the technology in new areas and new industries.
- Requests for assistance from ARC by the Provincial Departments of Agriculture with implementation of the BPP approaches in their provinces (with funding provided by them); this contrasts with the situation early in the project’s life, when ARC was viewed as interfering in the Provinces’ activities.
- Funding of eight new positions within the National Department of Agriculture to help support a national roll-out of the BPP methods across South Africa, with expansion of the project’s approaches to other provinces and other agricultural industries continuing.

Another unexpected benefit of the project is that the CRC for Beef Genetic Technologies has now adopted the BPP methodology developed in the BPP project in South Africa for use in the Australian and New Zealand beef industries, as one way of more effectively achieving uptake of technology and demonstrating the impact of change in their beef industries.

8.3.3 Environmental impacts

One of the most unexpected spin-off benefits from the project was a noticeable reduction in grazing pressure, with significant improvements to the resource base directly as a spin-off benefit from the increased sales of cattle at younger ages of turn-off. This benefit was not directly targeted by the project, but is clearly evident from photographic evidence of the community resources over the life of the BPP project.

8.4 Communication and dissemination activities

Over the life of the project in both South Africa and Australia, there has been a very strong effort made to communicate the project's results to achieve uptake amongst emerging and commercial farmers in both countries. Communication and dissemination activities have involved the full range of media (television, radio, print and face-to-face presentations) to large and small audiences across all sectors of stakeholders. The list of project publications in Section 10 of this report is a partial reflection of the communication activities that have occurred over the life of the project. Very importantly, the BPP farmers themselves have become key deliverers of some of the project's most crucial messages.

Figure 9. Ms Patricia Choche, farmer leader of the Thuo Boswa(Kganung) BPP team presenting her team's results at the project's BPP Forum at Irene (May 2006), in front of ~400 BPP farmers and a wide range of invited speakers and guests including the Limpopo and North West MECs for Agriculture, the ARC President and CEO and the Australian High Commissioner in South Africa.

In addition to the formal and informal communication and dissemination activities, several very important links have been established between the BPP project and current and potential activities by Beef CRC, including:

- Use of the BPP approaches developed in South Africa across Australia and New Zealand within Beef CRC's "adoption" project aimed at increasing and measuring the impact of uptake of new technologies by Australian and New Zealand beef businesses
- Ongoing use of Australian project data for DNA marker discovery, with decisions being made by Beef CRC that these markers will be placed directly into the public domain, thereby enabling South Africa's emerging and commercial beef farmers to access them immediately they become available and are shown to have economically beneficial impacts
- Development and current implementation of a small ACIAR-funded project ("Can we segment the South African market for beef palatability?") with the aim of transitioning emerging South African beef farmers to the next stage of production, potentially enabling them to join formal supply chain(s) aimed at delivering their beef products specifically to meet consumer requirements
- Potentially, there is an opportunity to test new DNA markers for female reproductive performance (developed using Australian project data) in South Africa's endangered Afrikaner cattle population (funds now being sought to support this research)

- Potentially there is also an opportunity to develop new cattle populations required to “drive” genomic selection (i.e. selection based only on DNA markers) relevant to South Africa’s production / marketing systems as part of a wider international collaboration between Beef CRC and organisations in USA, Canada and New Zealand, but also directly applicable to developing countries, with South Africa, Kenya and Brazil all being potential new partners if funding can be obtained e.g. through World Bank, Gates Foundation etc (such funding will be sought once the new international collaborative agreements are in place between Australia, NZ, USA and Canada).

9 Conclusions and recommendations

Over the life of the “Beef Profit Partnerships” (BPP) project, outstanding progress was achieved towards all objectives, greatly exceeding the originally-planned outputs and resulting in very significant impacts on the commercialisation and profitability of the project’s emerging farmers and providing them with significant new opportunities to enter South Africa’s commercial beef markets.

9.1 Conclusions

- The BPP project implemented a method known as "Continuous Improvement and Innovation" that when used effectively by the project's farmers in South Africa significantly increased the profitability of their herds, with significant flow-on benefits to community, social and environmental aspects of their businesses.
- The project's BPP / CI&I methodology has been successfully rolled out to other provinces and emerging agricultural industries in South Africa, with responsibility for ongoing delivery of the methodology now institutionalised through the BPP "Hub". This methodology is now used for decision-making at almost every level of the cattle industry managed by emerging farmers.
- The BPP project increased revenue to the project's emerging farmers by >R1.95 million over the period 2001-2006. The average was >R16,000 per farmer team per year. It is estimated the BPP project increased profits to the subset of farmer teams that measured gross margins by >R236,000 from 2002 to 2006, with the average being ~R7,500 per farmer team per year. If the same average improvement was achieved across all BPP farmer teams, the total improvement in gross margin would be ~R800,000 between 2002 and 2006. About 40% of the additional revenue would be expected to be retained as additional profit to the participating farmers.
- At the end of the project, BPP networks had been expanded to 5 new South African provinces (Mpumalanga, Gauteng, Eastern Cape, Free State and Kwa-Zulu Natal) as well as the initial Limpopo and North West provinces.
- Project results showed growth rates and feed efficiencies of steers from emerging and communal farmer herds paralleled those from commercial herds when all groups were raised under commercial conditions. Cattle from emerging and communal farmer herds have the ability to meet the specifications of South Africa’s commercial beef markets, indicating a genuine opportunity exists for import substitution, whereby the >5 million cattle in emerging and communal herds could be used to overcome the significant shortfall in South Africa’s domestic beef market demand.

- In Australia, a very wide range of entirely novel scientific results that target multiple traits and multi-faceted strategies including carcass and beef quality, feed efficiency, female fertility and tropical adaptation using a range of tools such as EBVs, DNA tests, ultrasound scanning and meat processing and cattle management strategies have been made available to the scientific and industry communities, with direct application to commercial and potentially emerging farmers in both Australia and South Africa.

9.2 Recommendations

Very strong links have been established between the BPP participants in South Africa and Beef CRC in Australia, as outlined in Section 8.4. It is recommended these links be built on over the next year, to capture the very significant new opportunities now available to enhance the productivity and profitability of South Africa's emerging beef farmers.

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10.2.3 Non-refereed conference papers and technical reports

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10.2.4 Popular press articles

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10.2.5 Project Newsletters

Issue 1 (July 2001)

Issue 2 (February 2003)

Issue 3 (October 2003)

10.2.6 Technical material

In addition to the project publications listed above, a significant amount of technical and training material has been produced, much of it translated into the local languages for the use of BPP farmers. This material has not been documented herein.

10.2.7 Workshops and forums

BPP Forum – Irene Animal Production Institute, May 2006 (included extensive TV, radio and print press coverage, with the attendance of ~400 project farmers, the Australian High Commissioner, the two Provincial MECs for Agriculture and the ARC President and Chief Executive Officer

Farmers Day and inspection of experimental steers – Irene Animal Production Institute, January 2003 (attendance of ~300 project farmers and the two Provincial MECs for Agriculture)

Official launch of the project, Polokwane, July 2001 (attendance of ~600 farmers from North West and Limpopo provinces + Australian High Commissioner and two Provincial MECs for Agriculture)

10.2.8 Current and ongoing methods of extension / outreach of results to end-users

Use of these project documents is ongoing through the continuing BPPs in South Africa and the newly-formed BPPs in Australia and the BPP management “hub” in south Africa.

10.2.9 Activities to be completed

Publication of project journal papers will continue over the next 1-2 years. As well, project data (particularly the Australian data) will continue to be used in new projects potentially over the next decade or more, both nationally and internationally.