Research Bulletin

Economic Analysis of Castor Seed Multiplication

at

GUNEGAL RESEARCH FARM, CRIDA

C.A. Rama Rao, M. Srinivasa Rao, Y.S. Ramakrishna and Y.V.R. Reddy

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Foreword

Timely sowing and availability of quality seed material are central to achieving higher crop yields in dryland agriculture. While timely sowing is largely influenced by the onset of monsoon, farmers' access to quality seed of the preferred crop variety is constrained by availability and other market-related constraints. In spite of the best efforts of a number of government and private agencies in production and distribution of quality seed, its availability is far less than the requirement. In order to enhance the availability of quality seed material to the farmers, the ICAR and SAUs are promoting seed-village concept in addition to multiplication of quality seed material at their farms.

As with any other activity, seed multiplication has also to compete with other uses for attracting investment of public and private resources. I am glad that scientists of CRIDA have made efforts to quantify the benefits from the activity of seed multiplication in a systematic way. I believe the information contained in this bulletin will help justify the resources deployed for this important activity of making quality seed available to the farmers at affordable prices. I congratulate the authors and the scientists of CRIDA for their effort in this regard.

(I.V. Subba Rao)

Economic Analysis of Castor Seed Multiplication at Gunegal Research Farm, CRIDA

1.0 Introduction

Castor (*Ricinus communis* Linn.) is an important non-edible oilseed crop grown almost entirely in the arid and semi-arid regions in the country. The crop, an important cash crop is grown for its beans from which oil is extracted. The castor oil is mainly used in manufacture of paints, lubricants, soaps, hydraulic brake fluids, polymers, perfumery products, etc. There are several derivatives of castor oil, which are used in a variety of industries.

India is the world's largest producer of castor beans. Brazil and China are the other major producers of castor beans and castor oil in the world. The global demand for castor oil is estimated to be about 1 billion pounds worth US$ 500 million.

During the year 2000-01, the crop was grown in about 11 lakh ha in the country giving a total output of nearly 9 lakh tones of castor. The area under castor has increased from about 7 lakh ha to 11 ha during the period 1990-91 to 2000-01. Gujarat and Andhra Pradesh, Orissa and Karnataka are the major castor producing states in India. Among these, Gujarat alone accounts for more than 50 per cent of castor production. The area under castor was observed to be in creasing in Rajasthan in the recent period.

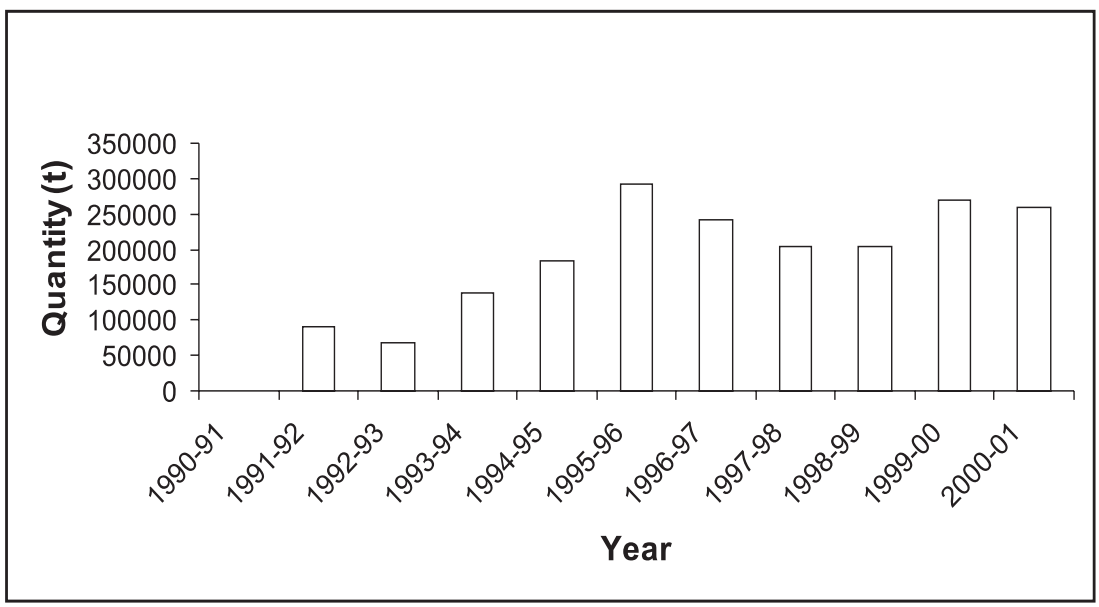

Fig. 1. Export of Castor Oil (1990-91 to 2000-01)

The cultivation of castor assumes greater importance because of its relatively low water requirement and the potential demand in the domestic and international market. India exports significant quantity of castor oil to different countries (Fig. 1.).

1.1 Temporal Changes in Castor Production in India

The area under castor increased from about 4 lakh ha in 1970 to 5 lakh ha in 1980 and to about 8 lakh ha in 1990. Thus, the area under castor expanded at a faster rate during the 1980s. The area, production and productivity of castor in India showed long term growth rates of 2.3, 6.8 and 4.4 percent, respectively. The crop gained area at faster rates during the mid 1980s when the oil seed crops in general enjoyed policy support under the Technology Mission on Oilseeds launched to achieve self-sufficiency in oil seed production. The oil seed prices received price support under the programme and as a result there was a steep rise in the procurement prices. Such a favorable price attracted farmers to grow oil seeds and in the process oil seeds replaced coarse cereals and pulses in many areas of the country (Gulati and Kelley, 2001).

1.2 Recent Trends

However, there was deceleration in area and production of castor during the 1990. In fact, the fluctuations in area and production were so wide that no significant trend could be

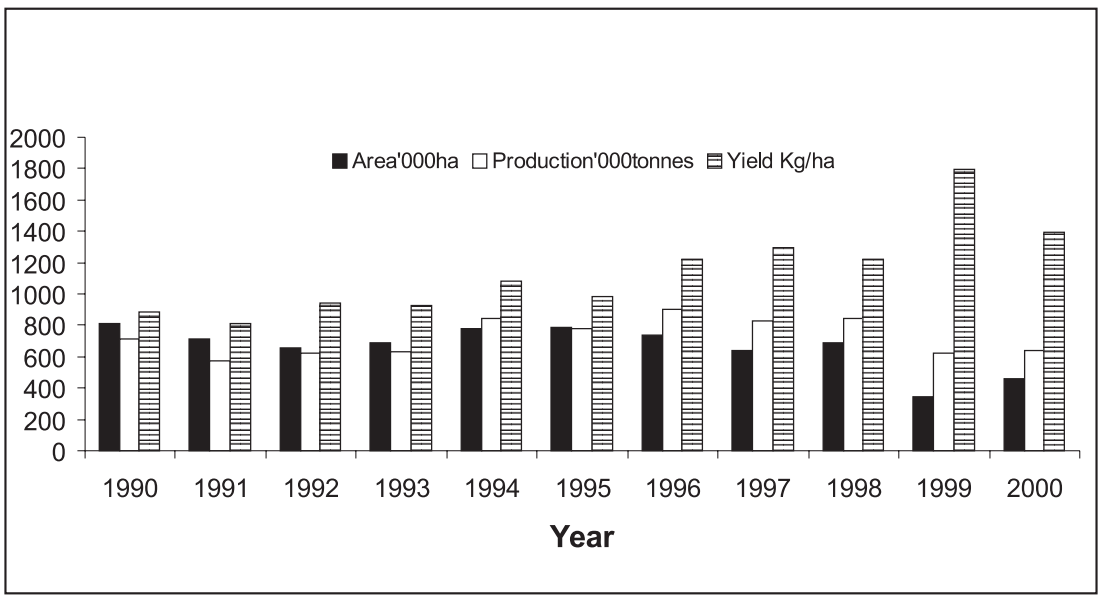

Fig. 2. Area, Production and Yield of Castor in India

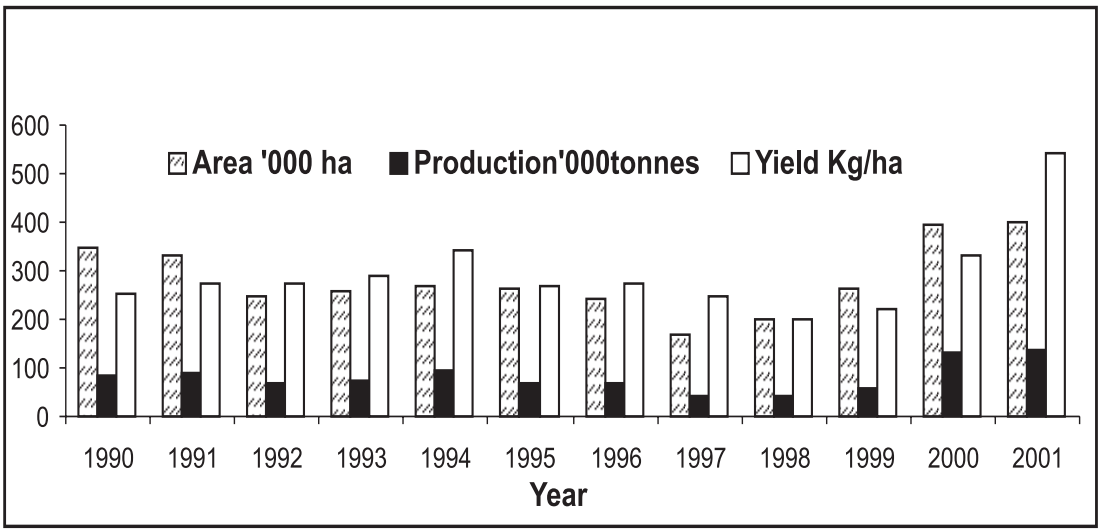

Fig. 3. Area, Production and Yield of Castor in Andhra Pradesh

observed for the period 1990-2000 (Fig. 2 and 3). The area sown to castor largely depends on the area sown to its competing crops such as cotton, sunflower, sorghum, pigeonpea, etc which are also grown under rainfed conditions. The crop faced competition from cotton in particular, in the Telangana region of Andhra Pradesh (Rama Rao, 2000). Because of the high profitability of cotton, farmers replaced castor with cotton in their cropping mix. Cotton is an investment-intensive crop as it is highly prone to a number of pests, diseases and other problems. The price situation of cotton is also volatile and depends on the government's policy with regard to exports and imports. The high risk associated with cotton caused farmers again to switch back to castor. In addition, the other important factors that determine the area under castor include the relative prices of castor vis-a-vis the competing crops, date of onset of monsoon and rainfall conditions. The area under castor tends to increase especially when the onset of monsoon is delayed because the yield of castor is not as much sensitive to the sowing time, as that of other crops such as sorghum. It is observed that castor productivity in Rangareddy district did not fall considerably during the drought of 2002-03 when most other rainfed crops suffered badly in terms of productivity losses. Further, the crop is also grown in rotation with sorghum and other rainfed cereal crops.

1.3 Constraints to Productivity Growth

Significant yield gaps between the realizable and realized yields were observed (Kiresur *et al*, 1995). Bridging such yield gaps will be helpful in improving the yield levels substantially. Among various constraints that limit the productivity levels, availability of quality seed of the cultivars suited to the local conditions is the most critical constraint faced by the farmers (Reddy *et al.*, 1997). Availability of adequate soil moisture during the crop growth, incidence of pests and diseases and inadequate access to use of chemical fertilizers and pesticides are the other important factors that limit productivity of castor.

1.4 Distribution of Quality Seed in India

Various government and private agencies are involved in production and distribution of certified quality seed of castor. The distribution of quality seed in the country increased from about 1500 tonnes in 1989-90 to about 3000 tonnes in 1996-97 and then declined to 26000 tonnes in 1997-98 (Fig. 4) (Directorate of Oilseeds, 2000). The quantity of the seed distributed to the farmers is far less than the requirement even with the low replacement ratio. It is not uncommon to see long queues at the seed distribution counters of the government agencies. As a result, farmers use the seed saved from their harvest for a number of seasons. As a result the cultivar loses its genetic purity and is subject to 'run down'.

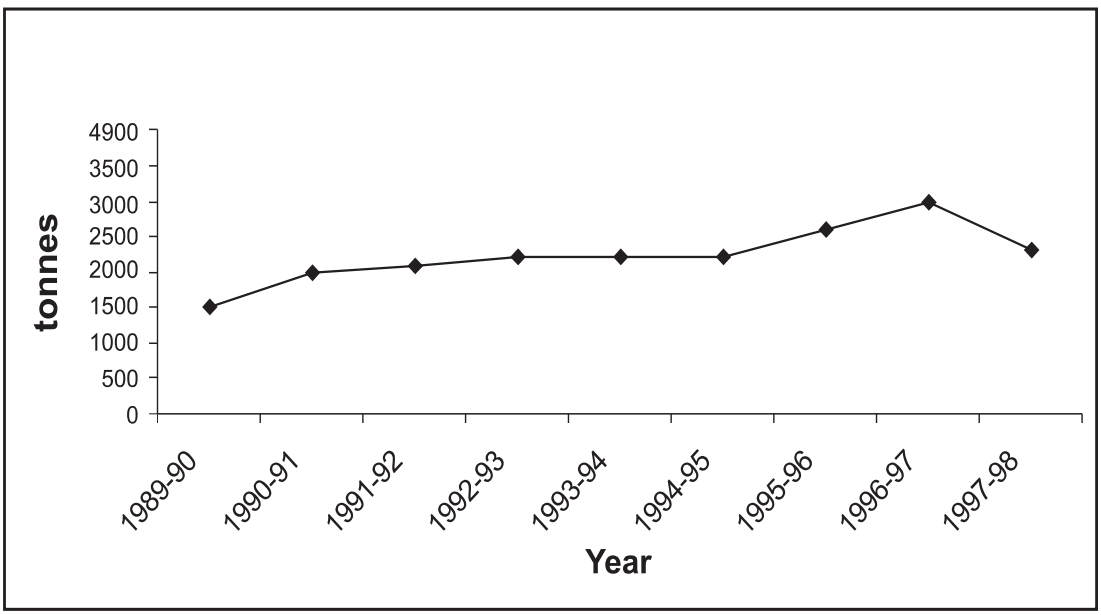

Fig. 4. Distribution of Quality Castor Seed in India

In order to enhance the availability of quality seed to the farming community, government is promoting seed production through various means. Important among them is the concept of seed village wherein the farmers are encouraged to produce the seed of various crops that are grown in the village or a cluster of villages. The aim of such an initiative is to make the village self-sufficient as far as seed is concerned. The other benefits include the faith in the seed as they see the seed being produced, less dependence on the market and protection from market-induced imperfections.

Recently, the institutes belonging to the National Agricultural Research System (NARS) have initiated more efforts to produce and distribute quality seed to the farmers. The authorities at ICAR are also more concerned about making quality seed available to the farmers. In a recent communication to all ICAR institutes, the Director General emphasized the need to make arrangements for producing quality seed material.

2.0 CRIDA's Mandate

Leading and coordinating applied and strategic research for sustainable improvement of rainfed agriculture constitutes the mandate of CRIDA. Improvement of yields of crops grown in rainfed regions is the immediate objective of CRIDA in achieving the long term goal. In this direction CRIDA is putting efforts to identify the constraints and initiate measures that seek to ameliorate those constraints. As apart of such measures, CRIDA is taking up production of castor seed in one of its research farms located at Gunegal in Rangareddy district.

2.1 Castor Seed Multiplication at Gunegal Research Farm (GRF)

Castor is an important crop in the drylands in the Telangana region of Andhra Pradesh where the farm is located. Castor is a major dryland crop in this region, generally produced in rotation with sorghum. Considering the importance of the crop and the scarcity of quality seed, CRIDA has considered multiplying quality and reliable castor seed in its research farm located at Gunegal so that the farmers in the neighbouring villages are benefited.

During the year 2002-03, the castor seed (var. *kranthi*) multiplication was taken in 10 ha of land in the farm. *Kranthi* is the preferred variety in the region.

Before presenting the results it is to be added that the seed produced and distributed by GRF is not certified seed in its strict definition. However, enough precautions and all the

measures required to produce healthy and pure seed were taken. The package of practices recommended for seed multiplication in castor was adopted. Further, seed treatment and germination tests were conducted before allowing sales to the farmers. Thus, we prefer to call this seed truthful seed or GRF seed.

3.0 Economics of Castor Seed Multiplication

As with any other investment, seed multiplication has also to compete with other uses for attracting investment of public and private resources. It is therefore attempted to make an economic analysis of castor seed multiplication from three different perspectives – *viz.,* farmers, the Institute (CRIDA) and the society. The economics of use of quality seed is examined from the farmers' perspective where as the costs incurred and revenue generated were looked into in the analysis from the CRIDA's perspective. Since CRIDA is a public-funded organization, the returns to society as a whole are examined in the economic analysis.

3.1 The Data

The data on the inputs used and output produced with the farmers' own seed and the quality seed distributed by CRIDA (GRF seed) were obtained from a survey of farmers who actually purchased and used GRF seed during the previous years. The other farm and household characteristics were also obtained from this survey.

The cost of producing the seed was arrived at by considering the actual levels of use of various inputs and services and the prices paid by CRIDA.

3.2 The Findings

3.2.1 Profile of Seed Buyers

More than 800 farmers visited GRF during the three days in May 2003 on which the seed was offered for sale. Some more farmers visited GRF even after those three days but could not get the seed as all the seed was already sold to those who came first. Many of the farmers had to return unhappy because they could not get the seed in quantities they actually required. In all farmers from seventeen different villages belonging to the districts of Rangareddy , Nalgonda and Mahabubnagar purchased castor seed. A majority of farmers however belonged to Rangareddy district because of its proximity to the farm and visibility of CRIDA through its various on-farm research activities.

A majority of farmers (65 per cent) have purchased seed from GRF during the previous year also and the remaining 35 per cent first time. It shows the faith the farmers have in the quality of GRF seed. It is to be noted that nearly 40 per cent of the seed purchasers were women. This indicates that participation of women in decision making with regard to seed choice and seed procurement.

3.2.2 Impact of GRF Seed on Crop Yield and Economics

Data on inputs and outputs of castor and other related information were collected from a minimum of 10 farmers belonging to each of the 12 different villages. The yield differences were assessed using the data so collected. The farm level differences on yield in different villages surveyed are presented in Table 1.

Table 1. Yield Changes with Use of GRF Seed in different villages, 2002-03

Sno	Village	Yield with farmers' seed (q ha^{-1})	Yield with GRF seed (q ha^{-1})	Yield gain (q ha^{-1})
1	Gaddamallagudem	3.7	5.0	1.3
2	Akulamylaram	5.0	5.6	0.6
3	Gunegal	4	5.4	1.4
4	Dharmannagudem	5.1	6.6	1.5
5	Choudarypalli	4.4	5.4	1.0
6	Nandi Vanaparthi	4.2	5.0	0.8
7	Arkapally	5.2	5.4	0.2@
8	Pethulla	4.9	5.6	0.7
9	Gandlagudem	5.9	7.0	1.1
10	Ayyavarigudem	4.7	7.7	3.0
11	Medipally	4.5	6.7	2.2
12	Chintulla	5.6	7.0	1.4
	Average	**4.8**	**6.0**	**1.2**

**The differences are significant at 5 per cent level.*

@The difference is not significant.

It can be seen from the table that farmers realized higher crop yield with quality seed (GRF seed) compared to their own seed. The differences in yield advantage ranged from 0.2 q ha^{-1} to 3 q ha^{-1} with an average difference of 1.2 q ha^{-1}. The impact of yield advantage

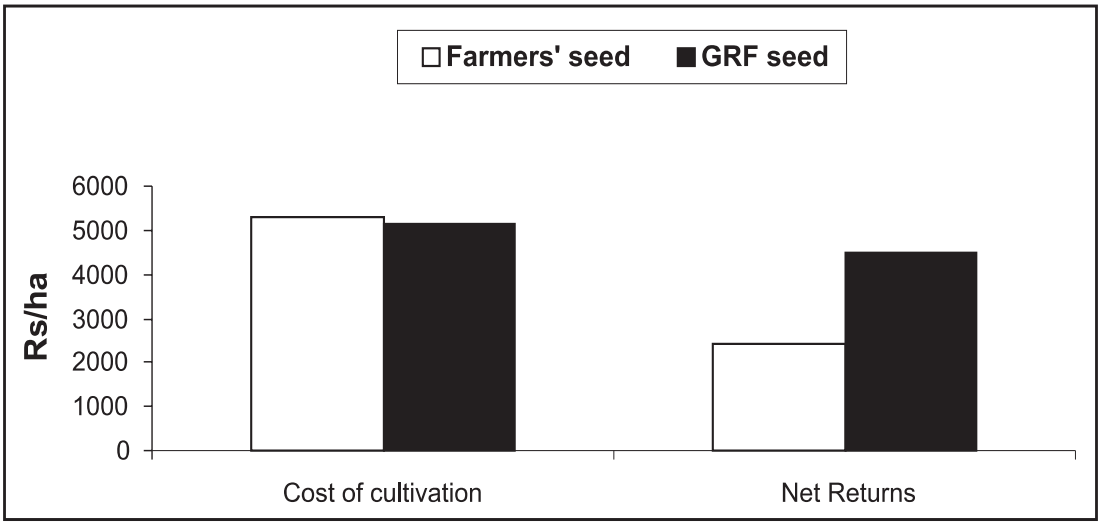

Fig. 5. Costs and Returns from Castor with Farmers' Seed and GRF Seed

on the profitability is also significant as the management practices did not differ between farmers' seed and GRF seed.

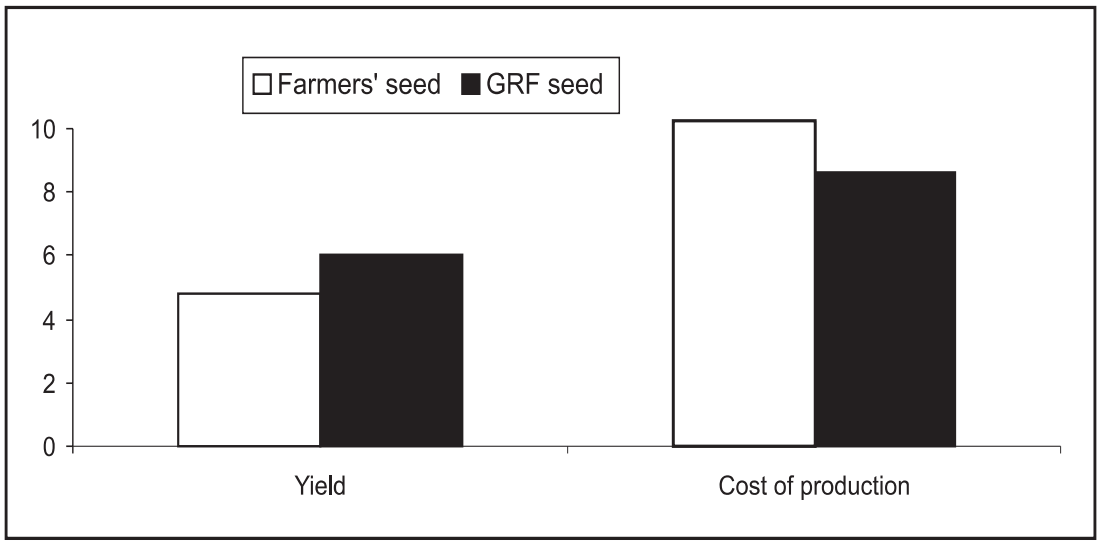

Fig. 6. Yield and Cost of Production in Castor with Farmers' Seed and GRF Seed

As can be seen from the Figures 5 and 6, the yield advantage was translated into increased net returns. The net returns increased from Rs 2395 to Rs.4470 ha^{-1} because of the use of GRF seed.

3.2.3 Financial Analysis of Seed Production

As already mentioned castor seed production was taken up in an area of 10 ha in GRF. In addition to the actual levels of use of various inputs, the management costs were also included in arriving at the production costs. The foundation seed necessary for multiplication was obtained from the Agricultural Research Station (ANGRAU), Palem at a cost of Rs.20 kg^{-1}. The variable inputs such as chemical fertilizers and plant protection chemicals were valued at the market prices. The details of various costs incurred in production of castor seed on per hectare basis are presented in table 2 .

Table 2. Costs Incurred in Production Castor Seed at GRF

Inputs	Units	Quantity	Value (Rs)
Seed	Kg	10	200
Human Labour	Days	26	3900
Bullock Labour	Days	4	600
Tractor use	Hrs	4	1000
FYM Tons	2	500	
DAP Kg	60	504	
Urea Kg	80	288	
Plant protection chemicals	L	1	275
Others (storage, drying, seed treatment, other processing costs, etc.)			350
Total cost			7617
Output (for seed)	Kg	430	8600
Output other than for seed purpose	Kg	100	1500

Thus it can be seen from the table about Rs.16600 was spent on producing about 430 kg of castor seed from one hectare of land. The total cost incurred for 10 ha is thus about 1.67 lakhs with a seed yield of 4300 kg. Further, only the yield from primary and secondary spikes was considered for sale as seed and the yield from tertiary spikes was sold in the open market.

3.2.4 Revenue from Seed Sale

The seed produced was offered for sale to the farmers during the month of May 2003 so that they can take up sowings with the onset of monsoon. Further, only a limited quantity of seed (5 kg, which is sufficient to sow one acre of castor) was supplied to each farmer with a view to serve more number of farmers, and to discourage subsequent sale by them for profits. Considering that the previous season was a drought year and the government's obligation to make quality seed affordable, the seed was priced at Rs 20 kg^{-1} as against a market price of Rs.45 kg^{-1} in case of certified seed. All the seed produced was purchased in just three days indicating the high demand for quality seed in the area. The revenue generated from seed sale and the financial viability are given in Table 3.

Table 3. Financial Analysis of Seed Multiplication

Particulars	Value
Total seed produced (kg)	4300
Total cost incurred (Rs.)	76170
Seed sold for seed purpose (kg)	6000
Revenue from seed sale (Rs.)	86000
Seed sold in the market (kg)	1000
Revenue generated (Rs.)	15000
Total revenue (Rs.)	101000
Net financial returns (Rs.)	24830

It is observed from table 3 that the seed production activity generated a total revenue of Rs.1.01 lakhs out of which Rs. 0.86 lakh was obtained through seed sale. Considering a total cost of Rs.0.76 lakhs, the revenue exceeded the variable cost by about 0.25 lakhs.

Further the variable cost of production of truthful seed was worked out to be about Rs.18 kg^{-1}, which was much less than the market price. In order to examine whether farmers would be willing to pay more for better quality seed, we also elicited information on their willingness to pay for GRF seed. The findings are depicted in Fig. 7.

It is clear from the figure that a majority of farmers are willing to pay more than what they are paying now. More than 80 per cent of farmers were found to be willing to pay up to

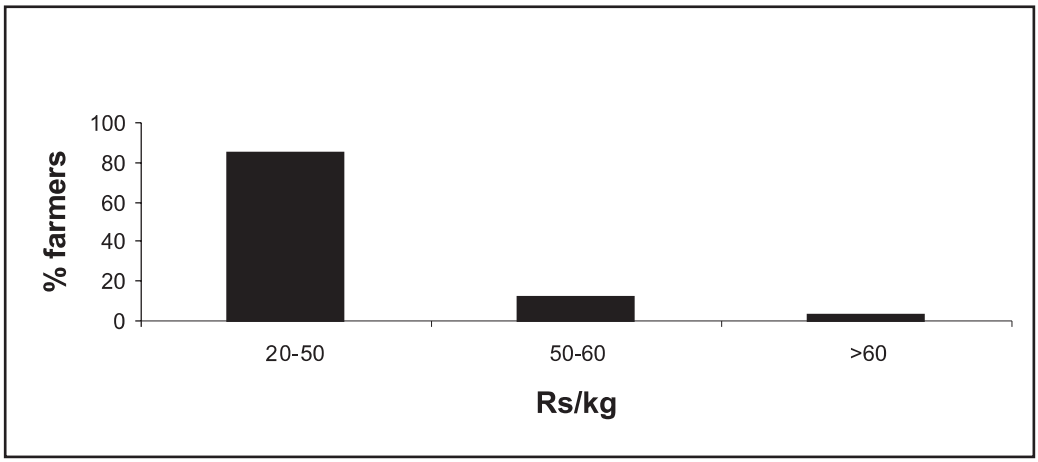

Fig. 7. Farmers' willingness to pay for GRF seed

Rs.50 kg^{-1}, which is close to the market price. Some of the farmers are even ready to invest more than the market price, as they are convinced about the yield advantage that they would get with GRF seed.

3.2.5 Economic Analysis of Seed Multiplication

Since CRIDA(ICAR) is a Government of India organization run by the tax payers' money, a financial analysis of the kind mentioned above is inadequate to capture the costs and benefits incurred by and accrued to the society as a whole. The benefits from quality seed are not enjoyed by the producers alone. Since an improvement in the yield of the crop through use of quality seed induces shifts in supply and demand, especially when the crop is produced for market rather than for home consumption, it is considered to

capture the costs and benefits to the society as whole. In order to achieve this, an attempt is made to conduct an economic analysis in an economic surplus methodology framework (Alston *et al.*, 1995).

In the economic analysis, the costs of planning and supervision were also included in addition to the paid-out variable costs considered in the financial analysis. About 10 per cent of salaries of two supervising staff and two per cent of the salary of the officer-in-charge were taken as planning and supervision costs. These proportions were arrived at based on the time spent on this activity. Further, in an economic analysis one ought to consider the actual costs the society as a whole incurs or the shadow prices of various inputs. However, estimation of shadow prices in itself requires some more data on productivity of the inputs in their alternative uses. Also the opportunity cost of land was not included. Further, the subsidy given to the chemical fertilizers was also not considered in the financial analysis. In order to make up for such omissions, the total cost was inflated by 25 per cent in the economic analysis. It was further assumed that the farmers would reuse the seed in at least 50 per cent of the area covered in the next season with same yield advantage. The following are the other assumptions made while computing the economic surplus to the society.

- Period of analysis: Two seasons 2003 and 2004
- Yield change: +25% over farmers' seed – arrived from the actual data
- Change in cost of production: -20 %
- Probability of success (that 25% yield gain will be obtained): 0.6
- Target area: Rangareddy district Andhra Pradesh
- Adoption rate: 2 per cent of area under Castor in Rangareddy in 2003 and 3 per cent in 2004
- Base Quantity: 10000 t valued at the farm harvest price (Rs.16000 per ton)
- Seed production cost: Rs.2.08 lakhs
- Discounting rate: 8 %
- Elasticity of supply: 0.30 (from literature for oil seeds)

- Elasticity of demand: 0.50 (from literature for oil seeds)

The economic surplus model as applied to a closed economy was employed to compute the economic surplus generated from the technology adoption. The procedure basically computes the consumer surplus and the producer surplus resulting from the shifts in demand and supply curves caused by the improved technology (seed). Following Alston *et al* (1995) the economic surplus was computed as follows:

Change in total economic surplus = $K_t P_0 Q_0 (1 + 0.5 Z_t h)$

Where $Z_t = K_t / (e + h)$

K = Vertical shift in supply function

e = Elasticity of supply

h = Elasticity of demand

P_0 = Output price

Q_0 = Output quantity

The total surplus generated, the costs incurred and the net economic surplus as computed by the above methodology are presented in Table 4 and Fig. 8.

Table 4. Economic Surplus Analysis of Castor Seed Production

Particulars	Value
Total seed produced (kg)	5000
Total cost incurred (Rs)	2.08 lakhs
Seed sold for seed purpose (kg)	6000
Total Economic Surplus generated (Rs)	9.9 lakhs
Net Economic Benefit (Rs)	8.02 lakhs
Benefit-cost ratio	4.05

The results of the economic surplus analysis make it amply clear that the investments made in production and distribution of castor seed generated large enough economic surplus

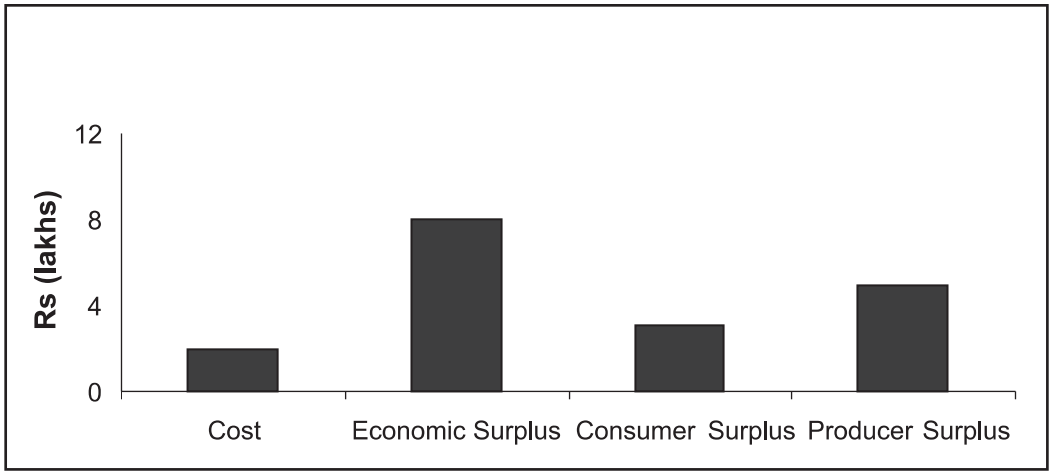

Fig. 8. Cost, quantity and distribution of economic surplus from castor seed production

to justify these investments. From an investment of about Rs. two lakhs the seed production generated a net economic surplus of about Rs.eight lakhs giving a benefit cost ratio of about 4. About 68 per cent of the surplus was shared by the producers (farmers) and 38 per cent by consumers. Thus, it can be concluded that the money on seed production is well spent from the society's point of view.

4.0 Farmers' Feed Back

The following feed back was received from the farmers about the GRF seed (Fig. 9).

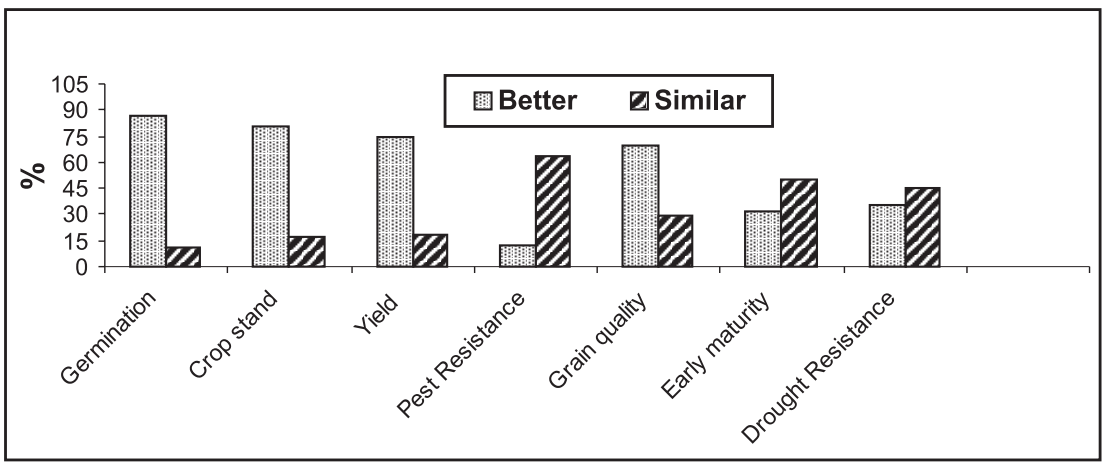

Fig. 9. Farmers' Evaluation of GRF - Seed

- The germination and crop stand were observed to be better with GRF seed compared to the farmers' own seed.
- The quality and weight of the seed are better.
- With respect to other parameters such as pest and moisture stress resistance, a majority of farmers observed that there was not much difference between GRF-seed and their own seed.
- As already described, farmers realized higher crop yield with GRF and are ready to pay more than they have actually paid now for GRF seed.
- Farmers also wanted more seed to be made available.

5.0 Conclusions

The following conclusions can be drawn from the foregoing analysis of seed production.

- There is a strong demand for quality seed of castor in the region.
- The use of truthful seed from GRF enhanced crop yield and net returns from castor, which is the driving force for the high demand for castor seed supplied by GRF. This is further reflected in the farmers' willingness to pay higher prices for the GRF-seed than they actually paid.
- CRIDA recovered more than the financial costs of multiplying and distributing quality seed.
- The economic analysis from the society's point of view justified the investment in seed multiplication as revealed by the substantial amount of net economic surplus generated.

6.0 Acknowledgments

We sincerely thank Dr. H P Singh, former Director, CRIDA for his support and encouragement. We are grateful to Dr Y Eswara Prasad, Professor and Head, Department of Agricultural Economics, ANGR Agricultural University, Hyderabad and Dr S V Ramana Rao, Senior Scientist (Agricultural Economics), Directorate of Oilseeds Research for their constructive comments on an earlier draft. Any errors that remain are ours.

7.0 References

Alston J M, Norton G W and Pardey P G (1995) Science under Scarcity: Principles and Practices for Agricultural Research Evaluation and Priority Setting. Cornell University Press, Ithaca, 585pp.

Directorate of Oilseeds Research (2000) Oilseed Situation, Directorate of Oilseeds Research (ICAR), Hyderabad

Gulati A and Kelley T (2001) Trade Liberalization and Indian Agriculture. Oxford University Press, pp. 285.

Kiresur V, Reddy P S, Prasad M V R and Reddy B N (1995) Economic Sustainability of Improved Oilseed Production Technology under Real Farm Situations. Technology Bulletin, Directorate of Oilseeds Research, Hyderabad.

Rama Rao C A (2000) Growth and Efficiency in Crop Production in Andhra Pradesh. Ph.D. Thesis submitted to ANGR University, Hyderabad.

Reddy B M K, Subba Reddy G, Rama Rao C A, Srinivasa Rao M and Sree Rekha M (1997) Diagnosing farmers' problems using participatory approach. Indian Journal of Dryland Agricultural Research and Development 12(1) 43-50

Farmers turn up in large numbers to buy GRF-castor seed