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# Impacts of Improved Groundnut Varieties in India

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## Introduction

India is the largest producer of groundnut in the world. About 88% of the groundnut area and production in India is concentrated in five states: Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu, and Maharashtra. Nearly 83% of the total area is under rainy-season groundnut and the other 17% is cultivated during the postrainy season. During 1995-98, groundnut was grown in India over 7.47 Mha with a total production of 8.02 Mt (CMIE 2000). However, the past three decades have seen a slight increase in the area under the crop. Production too has increased by 50% due to increase in yield (Table 1). During 1995-98, the area under groundnut was the highest in Andhra Pradesh (2.08 Mha), followed by Gujarat (1.89 Mha), Karnataka (1.17 Mha), Tamil Nadu (0.97 Mha), Maharashtra (0.55 Mha), Madhya Pradesh (0.25 Mha), and Orissa (0.09 Mha) (Table 1). In terms of production, Gujarat ranked first (2.03 Mt), followed by Andhra Pradesh (1.95 Mt), Tamil Nadu (1.57 Mt), Maharashtra (0.26 Mt), and Orissa (0.09 Mt). However, Tamil Nadu yielded the highest (1619 kg $ha^{-1}$) followed by Maharashtra (1190 kg $ha^{-1}$), Gujarat (1076 kg $ha^{-1}$), Madhya Pradesh (1013 kg $ha^{-1}$), Andhra Pradesh (939 kg $ha^{-1}$), Orissa (923 kg $ha^{-1}$), and Karnataka (869 kg $ha^{-1}$).

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**Table 1. Trends in area, production, and yield of groundnut in India, 1970-98.**

| State | 1970-75 | 1980-85 | 1990-95 | 1995-98 |
|---|---|---|---|---|
| | | **Area ('000 ha)** | | |
| Andhra Pradesh | 1432 | 1520 | 2360 | 2077 |
| Gujarat | 1671 | 2120 | 1894 | 1888 |
| Karnataka | 872 | 788 | 1250 | 1167 |
| Madhya Pradesh | 455 | 312 | 280 | 253 |
| Maharashtra | 779 | 784 | 707 | 546 |
| Tamil Nadu | 1058 | 926 | 1098 | 972 |
| Orissa | 90 | 243 | 210 | 94 |
| India | 7183 | 7230 | 8303 | 7467 |
| | | **Production ('000 t)** | | |
| Andhra Pradesh | 1199 | 1281 | 2105 | 1951 |
| Gujarat | 1087 | 1708 | 1376 | 2031 |
| Karnataka | 620 | 656 | 1039 | 1013 |
| Madhya Pradesh | 286 | 196 | 242 | 257 |
| Maharashtra | 465 | 679 | 738 | 650 |
| Tamil Nadu | 1073 | 828 | 1618 | 1573 |
| Orissa | 124 | 348 | 275 | 87 |
| India | 5485 | 6206 | 7813 | 8023 |
| | | **Yield (kg $ha^{-1}$)** | | |
| Andhra Pradesh | 837 | 843 | 892 | 939 |
| Gujarat | 650 | 805 | 726 | 1076 |
| Karnataka | 710 | 832 | 831 | 869 |
| Madhya Pradesh | 628 | 627 | 864 | 1013 |
| Maharashtra | 597 | 866 | 1044 | 1190 |
| Tamil Nadu | 1014 | 894 | 1474 | 1619 |
| Orissa | 1384 | 1434 | 1308 | 923 |
| India | 764 | 858 | 941 | 1074 |

Source: CMIE (2000).

In collaboration with ICRISAT, NARS partners have developed many improved groundnut varieties, important among the releases being ICGSs 11, 21, 44, 49, and 76. These varieties are high-yielding, resistant to diseases and pests, and tolerant to drought. Indian NARS has also developed groundnut varieties such as JL 24, TAG 24, TG 26, Kopargaon, and Khandwa. Farmers have adopted these varieties widely in major groundnut-growing states.

This study tracks the adoption and impacts of improved groundnut varieties in farmers' fields in Andhra Pradesh and Maharashtra. It also quantifies groundnut yield gain at the district level based on secondary data.

## Data and Research Methodology

### Data

The study is mainly based on farm surveys in Andhra Pradesh and Maharashtra. Three districts each in Andhra Pradesh (Anantapur, Chittoor, and Prakasam) and Maharashtra (Nasik, Dhule, and Kolhapur) were randomly selected based on groundnut area, production, and yield. In addition, two districts in Andhra Pradesh (Guntur and West Godavari) and three in Maharashtra (Nanded, Parbhani, and Satara) were purposively selected to ascertain the impacts of the adoption of ICRISAT groundnut varieties which is very high in these districts. A random sample of 10-12 farmers belonging to small, medium, and large-farm size groups was selected in each village. Thus a total of 485 farmers from 45 villages in 11 districts were interviewed (Table 2).

**Table 2. Distribution of sample farms in India.**

| State | Districts | Villages | Sample size |
|---|---|---|---|
| Andhra Pradesh | 5 | 23 | 261 |
| Maharashtra | 6 | 22 | 224 |
| Total | 11 | 45 | 485 |

In addition, district-level secondary data published in State Season and Crop Reports and Statistical Abstracts were collected. District-level yield data covering 92 groundnut-growing districts in five states (Table 3) — Andhra Pradesh (20 districts), Gujarat (18), Karnataka (19), Maharashtra (25), and Tamil Nadu (10) for the period 1966-68 and 1992-94 — was used to estimate yield gain. Together,

**Table 3. List of districts studied using secondary data.**

| States | Districts studied |
|---|---|
| Andhra Pradesh | Adilabad, Anantapur, Chittoor, Cuddapah, East Godavari, Guntur, Hyderabad, Karimnagar, Khammam, Krishna, Kurnool, Mahabubnagar, Medak, Nalgonda, Nellore, Nizamabad, Srikakulam, Visakhapatnam, Warangal, and West Godavari (20) |
| Gujarat | Ahmedabad, Ahwa, Amreli, Banaskantha, Bharuch, Bhavnagar, Bhuj, Jamnagar, Junagadh, Kheda, Mehsena, Panchmahals, Rajkot, Sabarkantha, Surat, Surendranagar, Vadodara, and Valsad (18) |
| Karnataka | Bangalore Urban, Belgaum, Bellary, Bidar, Bijapur, Chikmagalur, Chitradurga, Dakshin Kannad, Dharwad, Gulbarga, Hassan, Kodagu, Kolar, Mandya, Mysore, Raichur, Shimoga, Tumkur, and Uttar Kannad (19) |
| Maharashtra | Ahmednagar, Akola, Amravati, Aurangabad, Beed, Buldhana, Bhandara, Chandrapur, Dhule, Jalgaon, Kolhapur, Nagpur, Nanded, Nasik, Osmanabad, Parbhani, Pune, Raigarh, Ratnagiri, Sangli, Solapur, Satara, Thane, Yavatmal, and Wardha (25) |
| Tamil Nadu | Coimbatore, Kanyakumari, Madurai, North Arcot, Ramanathapuram, South Arcot, Salem, Thanjavur, Tirunelveli Kattabomman, and Tiruchirapalli (10) |

the five states accounted for about 89% of the total area under groundnut and 90% of the total production in India (1995-98 average).

## Analytical Procedure

Adoption rates of improved varieties and their impacts on groundnut yield, cost of production, and farm income were estimated. Information was collected for each of the varieties grown by the farmers. Adoption level was defined as the percentage of area under improved groundnut varieties to the total groundnut area. The adoption rate for each variety was defined as the percentage of area

under the variety to the total groundnut area. District-level yield gain was measured as the percentage of increase in yield during 1992-94 compared to 1966-68. Yield gain from improved varieties was measured as the percentage of increase in yield compared to the best performing local variety. To compute reduction in unit cost, the percentage of reduction in per ton cost of production of the respective improved variety compared to the best performing local variety in the respective season was used. Increase in farm income was measured on a per hectare basis. The percentage increase in per hectare net return (computed on a total cost basis), derived from the improved variety compared to the local variety, was used.

## Results and Discussion

### Adoption of Improved Groundnut Varieties

Farmers of Andhra Pradesh grew several improved groundnut varieties (JL 24, Kadiri, and ICGS 44) while farmers of Maharashtra adopted JL 24, TAG 24, UF-70-103, TG 26, and Karad 4-11 in the year 1997. ICRISAT varieties were popular in Guntur and West Godavari districts (Andhra Pradesh) and in Nanded, Parbhani, and Satara districts (Maharashtra) (Table 4). ICGS 44 was widely grown by farmers in Guntur and West Godavari; its adoption rate among sample farmers was 98% during the rainy season, 58% during the postrainy season, and 32% during the summer season in 1997. It may be mentioned here that TMV 2 was widely cultivated in Andhra Pradesh and SB 11 in Maharashtra. These two varieties, which were recommended by the Government of India in the early 1940s, were widely cultivated because of seed availability, drought resistance, and yield stability.

ICGS 11, ICGS 44, ICGS 21, and ICGS 49 were observed on farmers' fields in locations where technology was disseminated and seeds were made available. The low adoption of these varieties in Maharashtra was mainly due to the nonavailability of seed and longer duration. The most preferred traits in rainy-season groundnut varieties were medium duration, high pod yield with more oil content, and shelling percentage. On the other hand, farmers in Andhra Pradesh preferred varieties with high pod yield with pest and disease resistance. (Bantilan et al. 1999).

**Table 4. Adoption level (%) of improved groundnut varieties in Andhra Pradesh and Maharashtra, 1997.**

| Districts | Variety | Season | Adoption rate (% ground-nut area) |
|---|---|---|---|
| **Andhra Pradesh** | | | |
| Guntur, West Godavari | ICGS 44 | Rainy | 98.00 |
| Guntur, West Godavari | Local (TMV 2) | Rainy | 2.00 |
| Anantapur, Chittoor, Prakasam | JL 24 | Rainy | 30.00 |
| Anantapur, Chittoor, Prakasam | Kadiri | Rainy | 7.00 |
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Rainy | 63.00 |
| Guntur, West Godavari | ICGS 44 | Postrainy | 58.00 |
| Guntur, West Godavari | ICGS 91117 | Postrainy | 2.00 |
| Guntur, West Godavari | Local (TMV 2) | Postrainy | 40.00 |
| Anantapur, Chittoor, Prakasam | ICGS 44 | Postrainy | 1.00 |
| Anantapur, Chittoor, Prakasam | JL 24 | Postrainy | 24.00 |
| Anantapur, Chittoor, Prakasam | Kadiri | Postrainy | 15.00 |
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Postrainy | 60.00 |
| Guntur, West Godavari | ICGS 44 | Summer | 31.74 |
| Guntur, West Godavari | Local (TMV 2) | Summer | 68.36 |
| **Maharashtra** | | | |
| Nanded, Parbhani, Satara | JL 24 | Rainy | 39.05 |
| Nanded, Parbhani, Satara | Karad 4-11 | Rainy | 5.71 |
| Nanded, Parbhani, Satara | TAG 24 | Rainy | 49.52 |
| Nanded, Parbhani, Satara | Local (SB 11) | Rainy | 5.71 |
| Nasik, Dhule, Kolhapur | JL 24 | Rainy | 11.24 |
| Nasik, Dhule, Kolhapur | TMV 10 | Rainy | 9.08 |
| Nasik, Dhule, Kolhapur | Kopargaon | Rainy | 0.37 |
| Nasik, Dhule, Kolhapur | Local (SB 11) | Rainy | 74.25 |
| Nanded, Parbhani, Satara | ICGS 21 | Postrainy | 31.71 |
| Nanded, Parbhani, Satara | TAG 24 | Postrainy | 48.78 |
| Nanded, Parbhani, Satara | Local (SB 11) | Postrainy | 19.51 |

*Contd.*

**Table 4 — Contd**

| | | | |
|---|---|---|---|
| Nanded, Parbhani, Satara | ICGS 11 | Summer | 3.31 |
| Nanded, Parbhani, Satara | ICGS 49 | Summer | 14.92 |
| Nanded, Parbhani, Satara | JL 24 | Summer | 1.10 |
| Nanded, Parbhani, Satara | TAG 24 | Summer | 56.35 |
| Nanded, Parbhani, Satara | UF-70-103 | Summer | 9.94 |
| Nanded, Parbhani, Satara | Local (SB 11) | Summer | 9.94 |
| Nasik, Dhule, Kolhapur | JL 24 | Summer | 4.49 |
| Nasik, Dhule, Kolhapur | Local (SB 11) | Summer | 95.51 |

## Impacts of Improved Varieties

To estimate the contribution of improved varieties as well as other yield-contributing factors such as fertilizer, labor, irrigation, and location, a multiple regression analysis was conducted. Following are its results.

Yield = 3.307 - 0.0307 FERT + 0.85334 LAB** + 0.0979 IRRG + 0.132 IMPV* +
(0.3625) (0.0514) (0.0823) (0.06827) (0.05564)
0.2155 APDUM**
(0.05387)
Adjusted $R^2$ = 0.7256

The results show that the location where groundnut is grown has a significant positive effect on yield. Groundnut yield in Andhra Pradesh was higher than that in Maharashtra. The dummy for Andhra Pradesh had a significant positive effect at 1% level of significance. Human labor too had a significant positive effect on yield at 1% level of significance. Improved groundnut varieties had a significant positive effect at 5% level of significance.

Table 5 details the impacts of improved groundnut varieties on yield in Andhra Pradesh and Maharashtra. Yield gain from improved varieties, compared to the best performing local varieties, ranged between 13 and 108% in Maharashtra and 27 and 107% in Andhra Pradesh in 1997. In Andhra Pradesh, the highest yield gain (107%) was observed in the case of Kadiri during the summer season. However, the highest yield during the postrainy season was obtained by JL 24 (3118 kg $ha^{-1}$). In Maharashtra, the highest yield gain was observed during the summer season (108%) with TAG 24 yielding the highest (3152 kg $ha^{-1}$) during the summer season in Nanded, Parbhani, and Satara districts.

**Table 5. Impacts of improved varieties on groundnut yield in Andhra Pradesh and Maharashtra, 1997.**

| Districts | Variety | Season | Yield ($kgha^{-1}$) | Yield gain (%) |
|---|---|---|---|---|
| **Andhra Pradesh** | | | | |
| Guntur, West Godavari | ICGS 44 | Rainy | 2518 | 50 |
| Anantapur, Chittoor, Prakasam | JL 24 | Rainy | 2635 | 57 |
| Anantapur, Chittoor, Prakasam | Kadiri | Rainy | 2347 | 40 |
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Rainy | 1680 | - |
| Guntur, West Godavari | ICGS 44 | Postrainy | 2591 | 27 |
| Anantapur, Chittoor, Prakasam | JL 24 | Postrainy | 3118 | 52 |
| Guntur, West Godavari, Anantapur, Chittoor, Prakasam | Local (TMV 2) | Postrainy | 2058 | - |
| Guntur, West Godavari | ICGS 44 | Summer | 2649 | 91 |
| Guntur, West Godavari | Kadiri | Summer | 2865 | 107 |
| Guntur, West Godavari | Local (TMV 2) | Summer | 1383 | - |
| **Maharashtra** | | | | |
| Nanded, Parbhani, Satara | JL 24 | Rainy | 1248 | 20 |
| Nanded, Parbhani, Satara | Karad 4-1 | Rainy | 1383 | 33 |
| Nasik, Dhule, Kolhapur | JL 24 | Rainy | 1362 | 31 |
| Nasik, Dhule, Kolhapur | TMV 10 | Rainy | 1179 | 13 |
| Nasik, Dhule, Kolhapur | K2 | Rainy | 1729 | 66 |
| Nasik, Dhule, Kolhapur | Local (SB 11) | Rainy | 1039 | - |
| Nanded, Parbhani, Satara | ICGS 21 | Postrainy | 1328 | 37 |
| Nanded, Parbhani, Satara | TAG 24 | Postrainy | 1811 | 86 |
| Nanded, Parbhani, Satara | Local (SB 11) | Postrainy | 972 | - |
| Nanded, Parbhani, Satara | ICGS 11 | Summer | 1803 | 19 |
| Nanded, Parbhani, Satara | ICGS 49 | Summer | 2822 | 86 |
| Nanded, Parbhani, Satara | TAG 24 | Summer | 3152 | 108 |
| Nanded, Parbhani, Satara | UF-70-103 | Summer | 2190 | 44 |
| Nasik, Dhule, Kolhapur | JL 24 | Summer | 2964 | 95 |
| Nasik, Dhule, Kolhapur | Khandwa | Summer | 2865 | 85 |
| Nanded, Parbhani, Satara, Nasik, Dhule, Kolhapur | Local (SB 11) | Summer | 1517 | - |

The impact of improved groundnut varieties on per unit cost of production is reported in Table 6. Per ton cost of production was 15-37% lower in Maharashtra except for TMV 10, which had higher per ton production cost compared to the best performing local variety (SB 11). In Andhra Pradesh, the per ton production costs of improved varieties were 11-37% lower, except for ICGS 44, which had a slightly higher per ton cost of production.

**Table 6. Impacts of improved groundnut varieties on per unit cost of production in Andhra Pradesh and Maharashtra, 1997.**

| Districts | Variety | Season | Per ton total cost of production (Rs) | Reduction per ton of cost of production (%) |
|---|---|---|---|---|
| **Andhra Pradesh** | | | | |
| Anantapur, Chittoor, Prakasam | JL 24 | Rainy | 7956 | 14 |
| Anantapur, Chittoor, Prakasam | Kadiri | Rainy | 5807 | 37 |
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Rainy | 9239 | - |
| Guntur, West Godavari | ICGS 44 | Postrainy | 7159 | -4 |
| Anantapur, Chittoor, Prakasam | JL 24 | Postrainy | 6919 | 0 |
| Guntur, West Godavari, Anantapur, Chittoor, Prakasam | Local (TMV 2) | Postrainy | 6915 | - |
| Guntur, West Godavari | ICGS 44 | Summer | 6212 | 11 |
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Summer | 6952 | - |
| **Maharashtra** | | | | |
| Nanded, Parbhani, Satara | JL 24 | Rainy | 8764 | 24 |
| Nanded, Parbhani, Satara | Karad 4-11 | Rainy | 6498 | 44 |
| Nanded, Parbhani, Satara | Local (SB 11) | Rainy | - | |
| Nasik, Dhule, Kolhapur | JL 24 | Rainy | 9801 | 15 |
| Nasik, Dhule, Kolhapur | TMV 10 | Rainy | 10826 | -27 |

*Contd.*

**Table 6 — Contd.**

| | | | | |
|---|---|---|---|---|
| Nasik, Dhule, Kolhapur | Kopargaon | Rainy | 9702 | 31 |
| Nasik, Dhule, Kolhapur | Local (SB 11) | Rainy | 11503 | - |
| Nanded, Parbhani, Satara | TAG 24 | Postrainy | 6597 | 23 |
| Nanded, Parbhani, Satara | Local (SB 11) | Postrainy | 8513 | - |
| Nanded, Parbhani, Satara | ICGS 11 | Summer | 6800 | 25 |
| Nanded, Parbhani, Satara | ICGS 49 | Summer | 6897 | 24 |
| Nanded, Parbhani, Satara | TAG 24 | Summer | 5736 | 37 |
| Nanded, Parbhani, Satara | UF- 70-103 | Summer | 5696 | 37 |
| Nasik, Dhule, Kolhapur | JL 24 | Summer | 6596 | 27 |
| Nanded, Parbhani, Satara, Nasik, Dhule, Kolhapur | Local (SB 11) | Summer | 9044 | - |

Table 7 provides information about impacts of improved groundnut varieties on farm income. All improved varieties provided higher net returns on a per hectare basis. Compared to the best performing local variety, per hectare net return was 50-594% higher in Maharashtra and 36-191% higher in Andhra Pradesh. ICGS 49 gave the highest net return (Rs 47217 $ha^{-1}$) followed by TAG 24 (Rs 37124 $ha^{-1}$) during the summer season in Nanded, Parbhani and Satara districts.

**Table 7. Impacts of improved groundnut varieties on farm income in Andhra Pradesh and Maharashtra, 1997.**

| | | | Returns $ha^{-1}$ (Rs) | | | |
|---|---|---|---|---|---|---|
| **District** | **Variety** | **Season** | **Gross return** | **Net return (variable cost basis)** | **Net return (total cost basis)** | **Increase in net return $ha^{-1}$ (%)** |
| **Andhra Pradesh** | | | | | | |
| Anantapur, Chittoor, Prakasam | JL 24 | Rainy | 28027 | 10566 | 7066 | 36 |
| Anantapur, Chittoor, Prakasam | Kadiri | Rainy | 28776 | 18650 | 15150 | 191 |

*Contd.*

**Table 7 — Contd.**

| | | | | | | |
|---|---|---|---|---|---|---|
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Rainy | 20723 | 8705 | 5205 | - |
| Guntur, West Godavari | ICGS 44 | Postrainy | 31308 | 16255 | 12755 | 71 |
| Anantapur, Chittoor, Prakasam | JL 24 | Postrainy | 33673 | 15596 | 12096 | 62 |
| Guntur, West Godavari, Anantapur, Chittoor, Prakasam | Local (TMV 2) | Postrainy | 23829 | 10952 | 7452 | - |
| Guntur, West Godavari | ICGS 44 | Summer | 27238 | 13969 | 10647 | 45 |
| Anantapur, Chittoor, Prakasam | Local (TMV 2) | Summer | 16954 | 10839 | 7339 | - |
| **Maharashtra** | | | | | | |
| Nanded, Parbhani, Satara | JL 24 | Rainy | 17500 | 9743 | 6243 | 100 |
| Nanded, Parbhani, Satara | Karad 4-11 | Rainy | 20023 | 14534 | 11034 | 254 |
| Nasik, Dhule, Kolhapur | JL 24 | Rainy | 19712 | 9862 | 6362 | 104 |
| Nasik, Dhule, Kolhapur | TMV 10 | Rainy | 17456 | 8187 | 4687 | 50 |
| Nasik, Dhule, Kolhapur | K2 | Rainy | 22069 | 11859 | 8359 | 168 |
| Nasik, Dhule, Kolhapur | Local (SB 11) | Rainy | 15071 | 6617 | 3117 | - |
| Nanded, Parbhani, Satara | TAG 24 | Postrainy | 27211 | 18762 | 15262 | 109 |
| Nanded, Parbhani, Satara | Local (SB 11) | Postrainy | 15582 | 10811 | 7311 | - |
| Nanded, Parbhani, Satara | ICGS 11 | Summer | 27167 | 18407 | 14906 | 119 |
| Nanded, Parbhani, Satara | ICGS 49 | Summer | 66681 | 50717 | 47217 | 594 |
| Nanded, Parbhani, Satara | TAG 24 | Summer | 55202 | 40624 | 37124 | 445 |
| Nanded, Parbhani, Satara | UF-70-103 | Summer | 28364 | 19389 | 15889 | 133 |
| Nasik, Dhule, Kolhapur | JL 24 | Summer | 43472 | 27422 | 23922 | 251 |
| Nasik, Dhule, Kolhapur, Nanded, Parbhani, Satara | Local (SB 11) | Summer | 20560 | 10307 | 6807 | - |

In another farm survey conducted in Maharashtra in 1994-95 covering 355 farm households (Joshi and Bantilan 1998), data on adoption of improved groundnut varieties was gathered for the period between 1989 and 1994, while information on yield and cost of production was gathered for the period 1994-95. The rate of adoption of improved varieties among the sample farms in 1989 was 6%, which increased to 84% in 1994. Yield of improved groundnut varieties

using traditional management practices was 2.6 t $ha^{-1}$ whereas yield of local varieties was 1.7 t $ha^{-1}$, indicating a yield gain of 53%. The per ton cost of production for improved varieties was Rs 2566 while it was Rs 3201 for local varieties, meaning a 20% decrease in unit cost of production.

## Conclusions

It was found that the adoption level of improved groundnut varieties was high among sample farmers. Varieties jointly developed by the NARS and ICRISAT were adopted in specific locations where technology was disseminated and seeds were made available. Promotion and extension through NARES, and ensuring timely supply of seed will definitely enhance the adoption of ICRISAT varieties in the future. Improved varieties provided higher yield, reduced per unit cost of production, and increased farm income.

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