Impact Evaluation Report
India Tarai Seeds Project (Loan 614-IN) and
Indonesia Seeds I Project (Credit 246-IND)

December 31, 1986
Operations Evaluation Department

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### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPH</td>
<td>Brown Plant Hopper</td>
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<tr>
<td>CIMMYT</td>
<td>International Center for Maize and Wheat Improvement</td>
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<tr>
<td>CGIAR</td>
<td>Consultative Group for International Agricultural Research</td>
</tr>
<tr>
<td>CRIA</td>
<td>Central Research Institute for Agriculture</td>
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<tr>
<td>CRIFC</td>
<td>Central Research Institute for Food Crops</td>
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<tr>
<td>DGPCA</td>
<td>Directorate General of Food Crops Agriculture</td>
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<tr>
<td>ERR</td>
<td>Economic Rate of Return</td>
</tr>
<tr>
<td>GEU</td>
<td>Genetic Evaluation and Utilization</td>
</tr>
<tr>
<td>HYV</td>
<td>High Yielding Varieties</td>
</tr>
<tr>
<td>ICRISAT</td>
<td>International Crops Research Institute for the Semi-Arid Tropics</td>
</tr>
<tr>
<td>IRRI</td>
<td>International Rice Research Institute</td>
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<tr>
<td>MSSC</td>
<td>Maharashtra State Seeds Corporation</td>
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<tr>
<td>NSB</td>
<td>National Seeds Board</td>
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<tr>
<td>NSC</td>
<td>National Seeds Corporation</td>
</tr>
<tr>
<td>PCR</td>
<td>Project Completion Report</td>
</tr>
<tr>
<td>PPAR</td>
<td>Project Performance Audit Report</td>
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<tr>
<td>SCCS</td>
<td>Seeds Control and Certification Service</td>
</tr>
<tr>
<td>SSC</td>
<td>State Seed Corporation</td>
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<tr>
<td>TDC</td>
<td>Tarai Development Corporation</td>
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<tr>
<td>UP</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td>UPAU</td>
<td>Uttar Pradesh Agricultural University</td>
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<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
</tbody>
</table>
MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

SUBJECT: Impact Evaluation Report: India - Tarai Seeds Project (Loan 614-IN) and Indonesia - Seeds I Project (Credit 246-IND)

Attached, for information, is a copy of a report entitled "Impact Evaluation Report: India - Tarai Seeds Project (Loan 614-IN) and Indonesia - Seeds I Project (Credit 246-IND)" prepared by the Operations Evaluation Department.

Attachment
IMPACT EVALUATION REPORT

INDIA TARAI SEEDS PROJECT (LOAN 614-IN)
AND
INDONESIA SEEDS I PROJECT (CREDIT 246-IND)

TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>i</td>
</tr>
<tr>
<td>Summary and Conclusions</td>
<td>iii</td>
</tr>
<tr>
<td>I. BACKGROUND</td>
<td>1</td>
</tr>
<tr>
<td>A. The Seeds Sector</td>
<td>1</td>
</tr>
<tr>
<td>B. Bank Involvement</td>
<td>2</td>
</tr>
<tr>
<td>II. PROJECT DESIGN, IMPLEMENTATION AND PRELIMINARY RESULTS</td>
<td>3</td>
</tr>
<tr>
<td>A. The India Tarai Project</td>
<td>3</td>
</tr>
<tr>
<td>1. Existing Seeds System in India</td>
<td>3</td>
</tr>
<tr>
<td>2. Objectives and Project Design</td>
<td>4</td>
</tr>
<tr>
<td>3. Implementation and Findings of the PPAR</td>
<td>5</td>
</tr>
<tr>
<td>B. Indonesia Seeds I</td>
<td>6</td>
</tr>
<tr>
<td>1. Objectives and Project Design</td>
<td>6</td>
</tr>
<tr>
<td>2. Implementation and Findings of the PPAR</td>
<td>8</td>
</tr>
<tr>
<td>III. PRODUCTION IMPACT</td>
<td>8</td>
</tr>
<tr>
<td>A. Seed Production - India</td>
<td>8</td>
</tr>
<tr>
<td>B. Grain Production - India</td>
<td>10</td>
</tr>
<tr>
<td>C. Seed Production - Indonesia</td>
<td>11</td>
</tr>
<tr>
<td>D. Grain Production - Indonesia</td>
<td>11</td>
</tr>
<tr>
<td>E. Cropping Intensity - Indonesia</td>
<td>12</td>
</tr>
<tr>
<td>F. Estimation of Economic Impact</td>
<td>15</td>
</tr>
<tr>
<td>IV. INSTITUTIONAL IMPACT</td>
<td>17</td>
</tr>
<tr>
<td>A. Impact on Traditional Seed Systems</td>
<td>17</td>
</tr>
<tr>
<td>B. Institutional Effectiveness</td>
<td>17</td>
</tr>
<tr>
<td>1. Seed Certification and Quality Control</td>
<td>19</td>
</tr>
<tr>
<td>2. Public Sector Seed Firms</td>
<td>19</td>
</tr>
</tbody>
</table>

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TABLE OF CONTENTS (Cont'd)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. Limitations to Institutional Effectiveness</td>
<td>20</td>
</tr>
<tr>
<td>1. Seed Certification and Quality Control</td>
<td>20</td>
</tr>
<tr>
<td>2. Limitation of Public and Private Seed Firms</td>
<td>21</td>
</tr>
<tr>
<td>3. Public Seed Farms versus Contracted Production</td>
<td>21</td>
</tr>
<tr>
<td>4. Aspects of Processing Plant Design</td>
<td>22</td>
</tr>
<tr>
<td>V. IMPACT ON PRIVATE SEED INDUSTRY</td>
<td>23</td>
</tr>
<tr>
<td>A. Release of New Varieties</td>
<td>23</td>
</tr>
<tr>
<td>B. Range of Crops being Handled by the Private Sector</td>
<td>24</td>
</tr>
<tr>
<td>C. Effects of Government Subsidies</td>
<td>24</td>
</tr>
<tr>
<td>D. Financing</td>
<td>24</td>
</tr>
<tr>
<td>VI. ENVIRONMENTAL IMPACT</td>
<td>25</td>
</tr>
<tr>
<td>A. Wheat Rust in India</td>
<td>25</td>
</tr>
<tr>
<td>B. Brown Plant Hopper (BPH) in Indonesia</td>
<td>26</td>
</tr>
<tr>
<td>VII. PROJECT SUSTAINABILITY AND REPLICABILITY</td>
<td>27</td>
</tr>
<tr>
<td>A. Sustainability</td>
<td>28</td>
</tr>
<tr>
<td>1. Sustainability of Seed Certification</td>
<td>28</td>
</tr>
<tr>
<td>2. Sustainability of Public Sector Production</td>
<td>28</td>
</tr>
<tr>
<td>and Marketing</td>
<td>28</td>
</tr>
<tr>
<td>3. Sustainability of Private Sector Seed Enterprises</td>
<td>29</td>
</tr>
<tr>
<td>4. Sustainability through Farmer Participation</td>
<td>30</td>
</tr>
<tr>
<td>5. Sustainability through Training</td>
<td>30</td>
</tr>
<tr>
<td>B. Replicability</td>
<td>31</td>
</tr>
</tbody>
</table>

ANNEXES

1. Comments from the Indian Department of Economic Affairs               | 35       |
2. Comments from the Indonesian Directorate General of Food Crops Agriculture | 37       |

Maps:

IBRD - 20357 (India)
IBRD - 3284R1 (Indonesia)
IMPACT EVALUATION REPORT

INDIA TARAI SEEDS PROJECT (LOAN 614-IN)
AND
INDONESIA SEEDS I PROJECT (CREDIT 246-IND)

PREFACE

Almost two decades ago the Bank became involved in the seed industries of India and Indonesia. Since then substantial change has occurred in the varieties of basic grains planted by farmers in both countries. India Tarai Seeds and Indonesia Seeds I were approved at a time when the imports of foodgrains were causing serious drains on foreign exchange. Both projects had the general objective of increasing foodgrain production by improving seed availability of new high yielding varieties. At the time of project approval, the major potential of the new high yielding semi-dwarf varieties of rice and wheat had already been proven by growing imported seed. Attention had begun to focus on ways to improve local seed multiplication, seed processing facilities and quality control.

The Indian seed effort has been supported by the 1969 Bank Loan of US$13.0 million for Tarai Seeds (of which US$11.5 million was disbursed), a 1976 Bank Loan of US$25.0 million for National Seeds I and a 1978 IDA Credit of US$16.0 million for National Seeds II. In Indonesia, Seeds I was approved for an IDA Credit of US$7.5 million in 1971 and was followed in 1981 by a US$15.0 million Bank Loan for Seeds II.

This impact evaluation report covers the India Tarai Seeds and Indonesia Seeds I, initiated in 1969 and 1971, respectively. Both projects were completed in 1978 and audited by OED in 1979. These projects were the first Bank-supported seed projects and are the first to be the subject of an impact evaluation. Because of the 16 years of experience involved, these projects are particularly suited to an impact evaluation. During this entire period, the seed systems of both countries have confronted exceptional opportunities and a number of perplexing problems through which they have continued to evolve and search for solutions best fitted to national needs.

This report is based on a review of the Project Performance Audit Reports (No. 2551 dated June 18, 1979 and No. 2800 dated December 28, 1979), the two appraisal reports (TO-689a dated May 23, 1969 and PA-85a dated April 26, 1971) and other Bank documents. A mission to both countries was undertaken in January-February 1986 by the Operations Evaluation Department. Mission members discussed the impact of the projects with the respective authorities in India and Indonesia and held numerous interviews with field
staff and seed producers as well as with Bank staff that had been associated with these projects.

The valuable assistance provided to the mission in preparation of this report by the Government of India and the Government of Indonesia and all contacted staff and seed producers is gratefully acknowledged.

The draft version of this impact evaluation report was sent to Indian and Indonesian officials for their comments. Comments received have been attached to the report.
IMPACT EVALUATION REPORT
INDIA TARAI SEEDS PROJECT (LOAN 614-IN)
AND
INDONESIA SEEDS I PROJECT (CREDIT 246-IND)

SUMMARY AND CONCLUSIONS

India Tarai Seeds and Indonesia Seeds I, Initiated in 1969 and 1971, respectively, were the first Bank-supported seed projects and are the first to be the subject of an impact evaluation. Both projects were completed in 1978 and audited by OED in 1979. Following the 1969 Bank Loan of US$13.0 million for Tarai Seeds, the Indian seed effort has been supported by a 1976 Bank Loan of US$25.0 million for National Seeds I and a 1978 IDA Credit of US$16.0 million for National Seeds II. In Indonesia, the 1971 IDA Credit of US$7.5 million for Seeds I, was followed in 1981 by a US$15.0 million Bank Loan for Seeds II.

India Tarai Seeds and Indonesia Seeds I were approved at a time when two important conditions converged. On the one hand, the imports of foodgrains had become a serious drain on foreign exchange in both countries. On the other hand, two international research centers--CIMMYT working on wheat and maize in Mexico and IRRI on rice in the Philippines--had been successful in developing new semi-dwarf, fertilizer-responsive, high yielding varieties of wheat and rice, respectively.

Hence the main objective in both projects was to stimulate foodgrain production by improving seed availability of the new high yielding varieties. At the time of project approval, the major potential of the new high yielding semi-dwarf varieties had already been proven in both countries by growing imported seed. Consequently both projects focused on multiplication of germ plasm that had already been tested locally, on improvement of seed processing facilities, and on quality control.

Although different in various aspects, the design of Indonesia Seeds I drew on the positive experience of the India Tarai Seeds Project which had been approved about two years earlier. The incorporation of "lessons" from the Tarai experience was facilitated by participation of the Chairman of the Tarai Development Corporation (TDC) as a consultant on the Bank appraisal team for Indonesia Seeds I. Common concepts in the two projects, though applied somewhat differently, were: (a) inclusion of a plant breeding and variety testing component; (b) proximity of plant breeding research seed production and seed processing; and (c) a compact area for seed production.

Institutionally the two projects were operated differently. In the Tarai, the Vice Chancellor of the Uttar Pradesh Agricultural University (UPAU) served concurrently as Chairman of TDC. The TDC was in turn operated
essentially as a private undertaking with a capital structure of: farmers, 30%; UPAU, 30%; UP Agro-Industries Corporation, 20% and NSC, 20%. While the foundation seed was produced on UPAU land, most of the certified seed was produced by the farmer "shareholders". In contrast, Indonesia Seeds I involved three implementing entities: the National Seeds Corporation (NSC), the Central Research Institute for Agriculture (CRIA) and the Seed Control and Certification Service (SCCS). Overall direction was to have been the responsibility of a National Seeds Board, but it did not play a key role during implementation.

The main findings of the Tarai PPAR were that the project had been generally successful and the recomputed economic rate of return (ERR) at the time of completion was 18% compared to 17% estimated at appraisal. At that time seed production had increased from 420 tons of processed seed in 1966 to an average of over 28,000 tons per annum from 1973 onward. As a result of the project, it was estimated that incomes of 1,150 participating seed growers had increased, as well as those of 2,500 seed dealers of the Tarai Development Corporation and the estimated 400,000 smallholders using seed of improved varieties. The main finding of the PPAR for Indonesia Seeds I was that it fell short of its production goals, particularly during its early years. The principal project site at Sukamandi in West Java, though suitable for rice seed cultivation and research, in the early years lacked adequate housing, secondary schools or a hospital, so there was difficulty in obtaining resident staff. Land development was delayed because of delays in procurement of machinery and equipment. Mechanized rice production had not been well tested in Indonesia, and the climate and soils at Sukamandi were such that mechanized double cropping proved difficult because of the short dry season. On the positive side, the PPAR has pointed out the effective Seed Control and Certification Service established through the project as well as the contribution of project-funded research in helping to prevent serious production losses in rice from Brown Plant Hopper (BPH) infestations. The PPAR, written in 1979, considered Indonesia Seeds I only marginally successful. The recomputed ERR at completion was 11% versus the 58% estimated at appraisal.

During the seven years since project completion, the seed systems have continued to evolve in both countries, assisted in part by two follow-on projects in India and one in Indonesia. In India the two follow-on projects have modified the Tarai approach, and extended the area by supporting a National Seed Program (NSP) to develop a decentralized network of seed production, processing, storage and marketing agencies. The Tarai project as such has been incorporated into the Uttar Pradesh State Seed Corporation (SSC) and has received further support, including finances for construction of two additional seed processing plants under the National Seeds II project. However, the Uttar Pradesh SSC, along with other SSCs that constructed additional processing facilities under NSP I and NSP II, now has capacity beyond current demands. In Indonesia, Seeds I focused primarily on rice and on the island of Java, the main rice-producing area. Seeds II has expanded the focus to operate nationwide and to include four main additional crops: maize, soybeans, groundnuts and mungbeans.
During this period, farmer participation in the seed industry in both countries has been primarily in the form of contract production. The dominant firms in processing and marketing of certified seed have been controlled by the provincial and federal governments. The involvement of more than one publicly controlled firm in each country has provided an element of competition. However, because of various interventions with respect to pricing and subsidies, the development of private seed firms has been constrained.

The Impact Study finds that, on balance, both projects have been successful in achieving their broad objectives, although adequate data are not available to confirm or reject the rate of return estimates of the appraisals and the PCRs. The Study recommends that in future seed projects, specific field trials should be carried out to verify the benefits attributed to the use of certified seed.

A number of important lessons have been learned or confirmed through the projects that should be kept in mind by Bank staff in considering future seed projects in these and other countries.

Of particular relevance with respect to market demand:

(a) Initial demand for certified seed depends primarily on a source of new already-proven high yielding germ plasm. In these projects, the plant breeding research of CIMMYT on wheat and IRRI on rice, and their continued cooperation with national institutions, was a key element in justifying the expansion of processing capacity for the seed industry. However, the lack of outstanding new HYV in recent years has constrained the demand for certified seed.

(b) Maintenance of demand for certified seed in the case of self-pollinated crops such as wheat and rice, depends primarily on the farmers' perceptions of the economic advantages of buying new certified seed each year versus keeping their own seed. When there are new varieties that have proven yield advantages, farmers tend to buy new certified seed. In the meantime, they save their own seed each year until there is clear evidence of decreasing yields. Consequently, appraisal projections of seed demand are easily overestimated as has been found in India under National Seeds Projects I and II. Responding to this, proposals for a third national seeds project in India include provisions for strengthening plant breeding research and for extension services to improve farmer seed plot techniques in producing their own seed of established varieties.

(c) Surges in seed demand may occur from time to time as the result of a build-up of damaging insects or disease organisms such as occurred in Indonesia with BPH and the virus diseases for which it
is the vector. Over time, a series of varieties with improved genetic resistance have been bred and released to seed producers, and these have provided a series of demand surges for processed seed.

(d) For seeds such as hybrid maize, which loses hybrid vigor in subsequent generations, or soybeans, which require special handling to maintain seed viability, many farmers will purchase certified seed each year.

(e) Another major factor that influences demand is consistency of supply over time in terms of: genetic and physical seed quality, timely availability of seed at local outlets, and consistent pricing at reasonable levels. However, in some instances, to encourage use of certified seeds, governments have subsidized seed distribution to the extent that farmers have simply found it cheaper to purchase certified seed each year than to save their own. As government policy, this type of subsidization should be discouraged because of the market distortions which are introduced.

With respect to national seed policy:

(f) The optimum roles of the private and public sectors may vary from country to country depending in part on the stage of development of the seed industry. Usually most funding for crop breeding research will be from the public sector because the costs of such long-term investments are difficult to recover by any single firm. Quality control and seed certification is also a key public role which must be independent from other seed activities in order to provide farmers with assurance of genetically pure seed of the variety identified on the label.

(g) The private sector is frequently more adept than government in seed multiplication, marketing and distribution, and should be encouraged.

(h) Government must, however, provide the basic legal and policy framework to encourage progressive farmers, cooperatives and private seed firms to make long-term investments in the seed industry. Pricing policies must allow an adequate margin to the seed growers; subsidization of the public sector is a potential threat to the growth and usefulness of the private sector.

With respect to processing plants:

(i) Design and sizing of future plants should take into account key aspects of a country's overall seed system including best sites for production of various seeds, best natural sites for seed storage,
convenience to seed producing and distribution areas, transport facilities, etc. When the first seed projects were initiated, there was a lack of experience with marketing and demand analysis, and with respect to appropriate size, location and design of processing plants for conditions of developing countries in the tropics. Plants were frequently over-designed and too sophisticated. Lessons can be learned from this experience and from some small but very efficient private plants and should be taken into account in future designs. Particular attention should be given to this aspect in selection of the consulting engineer.

With respect to Bank Involvement:

(1) Bank involvement in the seed sector generally occurs because of an identified urgent need for better availability of improved seeds. However, at the time the need is identified there is usually little institutional capability in place. Rate of return estimates may indicate a high potential return, but if a realistic assessment of risk were made taking into account the lack of institutional capacity, the results might be quite modest. For example, in Indonesia the objectives of the first seed project included establishment of a National Seeds Corporation, creation of a Research Branch to ensure an adequate flow of high yielding plant varieties, enactment of seed legislation and establishment of a government regulatory organization to administer the law. Indonesia now has a much improved institutional capacity but this is still not the case in many countries that need improved seed systems. For technical back-up the Bank does not have a full-time seed expert nor a source of regular consulting facilities with the full development expertise needed. This merits priority attention.
IMPACT EVALUATION REPORT

INDIA TARAI SEEDS PROJECT (LOAN 614-IN)
AND
INDONESIA SEEDS I PROJECT (CREDIT 246-IND)

I. BACKGROUND

1.01 This study is an effort to assess concurrently the impact of the first two seeds projects supported by Bank funding. The impressive success both of India and Indonesia in reducing foodgrain deficits in recent years, through substantial increases in production per unit area, makes these two seed projects of special interest for an impact evaluation.

A. The Seeds Sector

1.02 Genetic Design. New improved varieties are the foundation of a good seed program whether the varieties are the result of testing a large number of varieties brought in from abroad or are the result of a good local breeding program. In either case, the plant breeder sets priorities for the characteristics to be improved and then isolates gene pools (seeds) which have the capability of transmitting to subsequent generations such characteristics as high yield, resistance to specific diseases and insects, better protein or higher oil content, drought or flood tolerance, etc. As soon as a variety is developed that is superior to those currently in use, it is released and research continues in order to further improve it, perhaps adding resistance to a new biotype of an insect or race of rust. Thus, the development of varieties is a continuous and ongoing process to meet the challenges of nature or special market demands. When the plant breeders have successfully created a new variety of a given crop, there is then justification for a seed enterprise to maintain and multiply it for as long as it might be used and in such quantities as the market would demand. Both India and Indonesia now have breeding programs at various stages of development and they collaborate with the international agricultural research centers.1/

1.03 Seed Multiplication. The standard procedure followed internationally is to have four generations of seed: breeder, foundation, registered and certified. Breeder seed genetically represents the end product or gene pool which the plant breeder has evaluated extensively and found to be superior in one or more characteristics. It is multiplied in small quantities under the supervision of the plant breeder. Breeder seed is the first major seed increase of the variety and is again subject to very careful

supervision. If the production meets all minimum standards it will be certified and sealed as foundation seed. Its progeny can either be registered or certified seed. If it is registered seed, then its progeny can only be certified seed. Certified seed cannot be re-certified. The certified generation is the one used for commercial production. To start the cycle again the seed grower must either purchase foundation or registered seed. Thus, the agency maintaining and multiplying foundation seed must have good marketing intelligence data at hand to make wise decisions relative to anticipated quantities of foundation seed which must be maintained and multiplied to meet fluctuating market demands. For hybrids there will be 100% replacement each planting season. For self-pollinated varieties there is often high demand when first released and then a substantial drop in demand in later years if the farmers only replace their seed every three or four years. In other cases, where farmers plant back-to-back with different varieties, they may buy all of their seed needs each season.

1.04 Foundation seed maintenance and multiplication of publicly released varieties is a public responsibility. In India, it was the responsibility of its NSC, the State Seed Corporations and private seed companies which have equal access to public sector-produced breeder seed. In Indonesia, both its NSC and the provincial seed farms assumed this role.

1.05 International Transfer of Technology. During the early 1960s, two International Research Centers were established: one in Mexico for wheat and maize (CIMMYT) and one in the Philippines for rice (IRRI). The success of these first centers led to the creation of others for a total of 13 which are the members of the Consultative Group for International Agricultural Research (CGIAR).

1.06 Both CIMMYT and IRRI gave top priority to plant breeding focused on higher sustainable yields. Within a few years, their scientists were successful in developing semi-dwarf varieties that were resistant to lodging, responsive to high rates of fertilizers and photosynthetically efficient, enabling the plant to produce more food in less time. These varieties generally had a type of foliage that took better advantage of the sunlight than the traditional tall types. They also required a shorter growing period. For example, traditional rice varieties took anywhere from 150 to 260 days to mature, whereas HYVs would mature in 110 to 125 days with better yields.

1.07 In-country Modification of the Technology. Scientists in both India and Indonesia have benefited from collaborative work with IRRI and CIMMYT. Both of these international centers sent germ plasm of their new material for evaluation under a wide range of conditions. When a certain line performed well, the collaborating country could: (a) release the line directly, avoiding thereby many years of breeding work to develop a new variety in-country, or (b) use this material for further selection to develop varieties more suitable for specific environments.

B. Bank Involvement

1.08 A key component of the agricultural strategy of most countries is a rapid increase in the yield and production of basic grains and other crops.
To support these efforts, over the past two decades the Bank has attempted in various ways to assure availability of good quality seed of improved varieties. The efforts for improving genetic quality have included support for plant breeding at several of the international centers associated with the CGIAR as well as funding for several national research projects. To bolster the availability of quality seed at the farm level, over the past 16 years Bank lending has also been expanded to include projects specifically focused on seed multiplication, quality control, processing and distribution, and strengthening the institutions involved. During this period the Bank has financed 13 seed projects in 9 countries and, in addition, has financed seed components, typically with total costs less than one million dollars, in a large number of other agricultural projects. While there is general agreement that the potential returns to these projects are very high, many problems have been encountered in implementation, so it is of particular interest to examine whether some more generally applicable lessons can be extracted from this experience.

II. PROJECT DESIGN, IMPLEMENTATION AND PRELIMINARY RESULTS

2.01 Governmental support for these projects stemmed in both cases from two main facts: (i) a substantial balance of payments drain to pay for foodgrain imports, and (ii) a new awareness of the potential of a strategy for increasing agricultural production based largely on new high-yielding germ plasm of wheat emanating from CIMMYT and rice from IRRI. Further, it had been noted that progressive farmers were taking up the new technology eagerly but that a significant lag existed between the high yields already achieved by a few farmers and the lower yields of others.

A. The India Tarai Project

1. Existing Seeds System in India

2.02 At the time of appraisal the Indian seed industry was little developed. The private sector produced small quantities of high-value flower and vegetable seed. The public sector attempted to disseminate improved seed from small, government-run farms located in each Community Development Block, with little success. The difficulties of managing so diffuse a scheme resulted in poor quality seed and an imbalance in supply and demand.

2.03 The release of India's first maize hybrids in 1961 had been followed by hybrids of sorghum and pearl millet, then by high-yielding semi-dwarf rice varieties and finally by the high-yielding semi-dwarf wheats. All were highly responsive to higher input use, gave greater profits, and created a strong demand for quality seed.

2.04 In response there was a rapid growth of private sector seed companies. In the public sector, the Government of India decided to create a central seed organization and to promote legislation to establish quality
control. In 1963 NSC was established and in 1966 a Seeds Act was passed. NSC was charged to promote seed industry development, from production through processing, storage and marketing, and to establish a system of quality control.

2.05 Through the mid-sixties seed output expanded rapidly—the certified seed production area grew from 360 ha to 35,000 ha between 1963/64 and 1968/69, mainly in the private sector. During this period NSC was concerned mainly with foundation seed production and, after the passing of the Seeds Act in 1966, with seed certification.

2. Objectives and Project Design

2.06 By initiation of the Tarai Seeds Project in 1969, NSC occupied a strong position in India's growing seed industry. However, improvements brought about by NSC did not yet assure seed production of highest quality. Typically, seed production and distribution were undertaken by scattered inefficient farms which were rarely equipped with proper processing or storage facilities. Arrangements for breeder stock and foundation seed stock were also weak. The Tarai Seeds Project was conceived to address these weaknesses through the combined efforts of NSC, the Uttar Pradesh Agricultural University (UPA) at Pantnagar and neighboring progressive farmers.

2.07 As appraised, the project entailed the development over five years of seed farms on about 18,600 ha of land in the Tarai region of Uttar Pradesh (UP) in northern India. At full development, certified seed production was projected to reach 46,000 tons per annum—sufficient to sow over 400,000 ha each of rice and wheat, and over 1.2 million ha of other foodgrains. Project components included:

(a) on-farm development (i.e., land leveling, irrigation and tubewell electrification) on some 400 farms;

(b) provision of farm machinery, fertilizer and foundation seed to project farms;

(c) execution of soil and topographic surveys of seed farms;

(d) preparation of farm plans;

(e) extension of electric power distribution system;

(f) provision of seed processing facilities; and

(g) credit and technical assistance for the above purposes.

27 For consistency, any non-metric measures used in the project documents have been converted to the metric system.
The Bank Loan (614-IN) of US$13.0 million was for 30 years, including 10 years' grace, at an interest rate of 6.5%.

3. Implementation and Findings of the PPAR

2.08 The Loan Agreement was signed on June 18, 1969, with project completion expected by December 31, 1974. Subsequently, the project Closing Date was extended twice, for two years (to December 1976) and then for one year (to December 1977). Total withdrawals were US$11.5 million, leaving an undisbursed loan balance of approximately US$1.5 million which was cancelled.

2.09 The project was considered generally successful in achieving its objectives. At project completion, annual certified seed production was averaging 28,000 tons. To produce this quantity of seed, 6,883 ha of land were leveled by the end of 1977 (versus 14,575 ha projected at appraisal), tubewells were constructed to serve 10,526 ha (as envisaged at appraisal), but the underground water distribution systems were not installed (a command area of 16,600 ha was assumed at appraisal). In addition, 196 km of power transmission lines were built (in line with appraisal estimates). The farm mechanization program as implemented was successful (though different from appraisal projections) and fertilizer was provided only at much higher prices. Processing capacity was provided for 53,000 tons of seed by expanding three existing plants at lower cost instead of constructing two new plants with a total capacity of 45,000 tons (as envisaged at appraisal). The number of Tarai Development Corporation (TDC) distributors and dealers for seed marketing exceeded 2,500 in 1977 (no specific target was given during appraisal).

2.10 Several major problems and changes of original plans occurred including:

(a) the idea of constructing new seed processing plants was gradually abandoned in favor of expanding capacities of existing seed processing plants;

(b) the absence of suitable contractors for land leveling forced the project to arrange for alternatives (UPAU and State Agro-Industries Corporation) to carry out the work;

(c) legislation introducing ceilings on farm sizes contributed to lower than projected investments in land leveling and no investment at all in underground irrigation water distribution systems;

(d) crop areas deviated from plans as follows: (i) for maize, the Bhabar area, where maize was to be grown, was much less developed than anticipated due to the decision to drill fewer deep wells there, while in the main project area maize suffered from disease, (ii) for soybeans, due to a change in seed demand, and (iii) for wheat and rice, areas were much larger than projected;
(e) actual mechanization differed from appraisal assumptions partly due to a larger number of smaller farming units participating and partly due to other cheaper funds available for financing farm machinery;

(f) high standards of TDC management declined temporarily during the second half of the project period;

(g) toward the end of the project, farmers shifted from seed production to other crops (including sugar cane) due to a weakening of seed prices making them less competitive with alternative crops; and

(h) considering the very slow pace of disbursements under TDC, the Government of India suggested that the Tarai loan balance (US$1.5 million) be cancelled and that future requirements be addressed in the context of the follow-on project.

2.11 Despite the above-mentioned problems and changes from the appraisal concept, the project's recomputed ERR was 18%, compared to 17% estimated at appraisal. Incomes of the 1,150 participating seed growers had increased as a result of the project, as well as those of the 2,500 TDC dealers and the estimated 400,000 smallholders using the improved seed. The project also served, in part, as a model for two follow-on projects covering most of India.

2.12 Several factors contributed to the project's success. First, the timing of the project was appropriate as there was initially great farmer demand for seed of the newly released HYV, and at that time TDC faced no real competition in producing and marketing this seed. Second, the Tarai area has a suitable climate and good soils conducive to producing quality seed. Third, the project had highly motivated and well qualified management and a good organizational structure. Fourth, seed production was already in progress in the Tarai area prior to the project, providing UPAU's Seed Production Division, progressive farmers and UP State marketing agencies with some experience. Fifth, the project received support from virtually every group or agency affected by it.

B. Indonesia Seeds I

1. Objectives and Project Design

2.13 The project was to be the initial development phase of a modern seed industry in Indonesia. It would focus primarily on rice but small quantities of maize and soybean seed would also be produced. The following were the broad objectives:

- establishment of a National Seeds Corporation (NSC) as an autonomous body responsible to Government through the Minister of Agriculture for seed production, processing, packaging and marketing of commercial seed, assisted by managing agents and including:

  (a) development of 2,450 ha of Sukamandi Estate as a mechanized and irrigated seed production farm to be operated by NSC; and
(b) establishment of NSC facilities in three seed districts in East and Central Java for collecting and processing seed produced by farmers in selected villages under contract to NSC, and the provision of credit facilities to such farmers;

- creation of a 250 ha semi-autonomous Research Branch of the Central Research Institute for Agriculture (CRIA) at Sukamandi to ensure a flow of high-yielding plant varieties to support the seed production program and initially to provide a seed certification service—to carry out these functions, qualified and experienced staff would be employed;

- enactment of appropriate seed legislation, and establishment of a small government regulatory organization to administer the law and to provide a permanent seed certification service; and

- development of facilities at Sukamandi by NSC and the CRIA Sukamandi Branch for training their staff, government extension staff and farmers.

The Minister of Agriculture, advised by the National Seeds Board (NSB), was to have overall responsibility for the project, and agencies of the Ministry would be responsible for its implementation.

2.14 The project was designed to rehabilitate a large estate previously under private operation into a tract of some 2,450 ha for seed production and 250 ha for a research station. The seed to be processed and marketed from the Sukamandi site (province of West Java) would be produced primarily on land under the control of the Sukamandi branch of NSC. There would be three other districts (Klaten, Batang and Kepanjen) which would serve as satellite centers in the provinces of Central and East Java where seed would be produced under contracts with farmers. A Seeds Act would be promulgated which would embrace a Seed Certification Institution, Seed Policy (including formal variety release) and Truth of Labelling.

2.15 A system of marketing and distribution of seed would be set up and operated by NSC. The provincial seed farms would be phased out. Appropriate consultants would be used both for the development of the seed production program including processing plants, etc., and the scientific dimension of the Sukamandi research center of CRIA.

2.16 Since the Sukamandi area is located within the Jatiluhur irrigation district, which was being rehaillitated under Credit 195-IND, it was planned to use the district facilities and expertise to expedite land preparation for irrigation of both the seed farm and the research station. In this way both institutions could become effective at an early date. There would be a resettlement of the 860 families who were ex-employees of the original private estate in August/September 1971 and May/June 1972. There would be seven scientific expatriate consultants located at the research center and management consultants with NSC. A marketing consultant was to assist in
setting up a Marketing and Distribution Program. There would be a National Seeds Board which would be concerned with planning, formulating policies for development and operation of a national seeds industry. It was anticipated that a Seeds Law would be enacted at an early date. The total project was estimated to cost US$12.0 million equivalent. The Bank would finance US$7.5 million or 62.5% of the total cost.

2. Implementation and Findings of the PPAR

2.17 At project completion, Indonesia Seeds I was considered only moderately successful. The ERR was reestimated at 11% compared with 58% at appraisal and this high only because it was favorably influenced by the sharp rise in the relative world price of rice in the 1972-75 period. The PPAR concluded that the project fell short of its production goals primarily because of poor preparation, design and management. It indicates that inappropriate production technology was specified for the seed farm at Sukamandi and that staffing of the project with expatriate and Indonesian scientists was slow because of the remote location of the main project site. On the positive side, the PPAR acknowledges that an effective Seed Control and Certification Service was established through the project and continues to be one of the most successful components. It also points out that through the research and seed multiplication complex at Sukamandi it was possible to prevent serious rice production losses that would have occurred as a result of BPH infestations. Finally, it was concluded that NSC management should be considerably strengthened.

III. PRODUCTION IMPACT

A. Seed Production - India

3.01 In India, the Tarai Seeds Project in the State of Uttar Pradesh (UP) had a substantial impact on seed production which increased from 420 tons of processed seed in 1966 to an average of over 28,000 tons per annum at full development since 1973. During this period the Indian seed industry was studied in depth by a Government of India (GOI)-commissioned Seed Review Team in 1969 and reviewed further by the National Commission on Agriculture in 1971. Based on their findings, and the encouraging results of the Tarai project, the GOI decided to reorganize and expand the seed industry. A working group was established in 1975 to prepare proposals for a National Seed

3/ The 58% estimate at appraisal was based on the normal assumption that each year's net benefits would be reinvested for the remainder of project life at the internal rate of return. The overall return was also calculated on the assumption that annual net benefits would be reinvested, not at 58% but at 20% and, alternatively, 15%. This assumption reduced the estimated return to 41% and 37%, respectively.
Program (NSP). The group proposed that the states accept greater responsibility. Hence, under India National Seed Projects I and II, State Seed Corporations (SSCs) were to be established in nine States using the basic parameters which had been successful in the Tarai project. In order to retain the Tarai project and build a more comprehensive seed program for the State of Uttar Pradesh, TDC was restructured to become a component of the State Seed Corporation of Uttar Pradesh. The name of this Corporation became the U.P. Seeds and Tarai Development Corporation, Ltd.

3.02 Table 3.1 shows the performance of the new SSC during the first four years of the current decade.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>22,140</td>
<td>16,840</td>
<td>29,571</td>
<td>34,000</td>
</tr>
<tr>
<td>Rice (paddy)</td>
<td>9,223</td>
<td>7,550</td>
<td>6,497</td>
<td>6,581</td>
</tr>
<tr>
<td>Maize</td>
<td>1,945</td>
<td>1,900</td>
<td>802</td>
<td>1,399</td>
</tr>
<tr>
<td>Soybeans</td>
<td>104</td>
<td>137</td>
<td>248</td>
<td>242</td>
</tr>
<tr>
<td>Pulses and</td>
<td>780</td>
<td>756</td>
<td>634</td>
<td>1,000</td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>34,192</td>
<td>27,183</td>
<td>37,752</td>
<td>43,222</td>
</tr>
</tbody>
</table>

3.03 This longer term impact of the sequence of projects on production of certified and quality seed throughout India is indicated in Table 3.2 with data from the 1984-85 Annual Report of the Indian Ministry of Agriculture and Rural Development.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>50,810</td>
<td>101,666</td>
<td>98,551</td>
<td>113,150</td>
<td>112,428</td>
</tr>
<tr>
<td>Rice (paddy)</td>
<td>36,625</td>
<td>64,156</td>
<td>55,979</td>
<td>88,892</td>
<td>98,460</td>
</tr>
<tr>
<td>Maize</td>
<td>4,876</td>
<td>8,466</td>
<td>16,653</td>
<td>12,586</td>
<td>14,199</td>
</tr>
<tr>
<td>Sorghum</td>
<td>15,457</td>
<td>15,083</td>
<td>17,318</td>
<td>20,391</td>
<td>29,687</td>
</tr>
<tr>
<td>Millet</td>
<td>5,534</td>
<td>10,453</td>
<td>12,778</td>
<td>13,908</td>
<td>17,245</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>113,302</td>
<td>199,824</td>
<td>201,279</td>
<td>248,927</td>
<td>272,019</td>
</tr>
</tbody>
</table>
3.04 The SSCs developed under NSP I and NSP II have provided a substantial increase in seed processing capacity, to the extent that for the moment at least most of the SSCs are suffering from slow expansion of demand, under-utilization of plant capacity and low profit margins. The Maharashtra State Seeds Corporation (MSSC), established under NSP I in April 1976, is an example of one of the more successful SSCs. MSSC has 16 well equipped processing plants. Its gross income increased from US$3.5 million in 1979 to US$22.5 million in 1985. It handles a wide range of crops which include hybrids and varieties of sorghum, millet and cotton, varieties of wheat, and many oil seed crops. MSSC is also a major producer of jute seed for the States of Bihar and West Bengal which are major jute production states but have climates not suitable for seed production. The corporation is currently installing facilities to de-lint its cotton seed and thus reduce seed-carried diseases and increase germination percentage.

B. Grain Production - India

3.05 India’s advance from large-scale importation of foodgrains to self-sufficiency has been the result of many factors in addition to the use of improved seed. These include the major initiatives taken by the Government of India in the fields of irrigation, fertilizers, farm credit, agricultural research and development and the like. There is no good measure of the contribution of each; however, the existing evidence would suggest that the availability of new high-yielding varieties and the broad distribution of quality seeds made possible by the Tarai project and its successors, have been key elements in India’s success. The extent of success is shown in Table 3.3. In 1985, India had an inventory of some 30 million tons of foodgrains in excess of its anticipated consumption. Per hectare yields of rice increased 44% from 1960-61 to 1983-84 and yields of wheat increased 117% in the same period.

Table 3.3: Foodgrain Production in all India, 1960/61 to 1983/84

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Millions of Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice (paddy)</td>
<td>34.6</td>
<td>45.2</td>
<td>53.6</td>
<td>53.2</td>
<td>47.1</td>
<td>59.8</td>
</tr>
<tr>
<td>Wheat</td>
<td>11.0</td>
<td>23.8</td>
<td>36.3</td>
<td>37.5</td>
<td>42.8</td>
<td>45.1</td>
</tr>
<tr>
<td>Total Cereals</td>
<td>69.3</td>
<td>96.6</td>
<td>119.0</td>
<td>121.8</td>
<td>117.6</td>
<td>138.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kilograms per Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice (paddy)</td>
</tr>
<tr>
<td>Wheat</td>
</tr>
<tr>
<td>Total Cereals</td>
</tr>
</tbody>
</table>
C. Seed Production - Indonesia

3.06 In Indonesia, over the ten years 1975-84, the total tonnage of rice seed produced (Certified and Labelled) increased from 2,898 to 43,937 (Table 3.4). It is estimated that the annual total seed requirements during this decade were approximately 168,336 tons. Approximately one-third of this amount, or 56,112 tons, was purchased by farmers and the balance was from their own production. Within this frame of reference the total supply of 43,937 tons in 1984 was beginning to approach the anticipated market requirements. However, NSC advised that it was having difficulties in providing sufficient seed of the variety Cisadane, whose popularity with the farmers had increased more rapidly than anticipated in some cases. Better marketing surveillance is clearly needed in order to be more responsive to market demand.

<table>
<thead>
<tr>
<th>Year</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>2,898</td>
</tr>
<tr>
<td>1976</td>
<td>3,850</td>
</tr>
<tr>
<td>1977</td>
<td>4,533</td>
</tr>
<tr>
<td>1978</td>
<td>3,725</td>
</tr>
<tr>
<td>1979</td>
<td>8,185</td>
</tr>
<tr>
<td>1980</td>
<td>29,794</td>
</tr>
<tr>
<td>1981</td>
<td>27,940</td>
</tr>
<tr>
<td>1982</td>
<td>33,602</td>
</tr>
<tr>
<td>1983</td>
<td>41,487</td>
</tr>
<tr>
<td>1984</td>
<td>43,937</td>
</tr>
</tbody>
</table>

3.07 Table 3.5 reflects the start which NSC has made on other crops, which is modest but growing. The Government's current strategy is to increase production of these crops, particularly maize and soybeans.

<table>
<thead>
<tr>
<th>Year</th>
<th>Maize (tons)</th>
<th>Soybean (tons)</th>
<th>Peanut (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>68</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>1983</td>
<td>406</td>
<td>505</td>
<td>54</td>
</tr>
<tr>
<td>1984</td>
<td>2,798</td>
<td>464</td>
<td>329</td>
</tr>
</tbody>
</table>

D. Grain Production - Indonesia

3.08 During the 1975-84 decade, annual rice production rose from 16 to 25 million tons of milled rice. By 1984/85, Indonesia had reached self-sufficiency in rice production. Table 3.6 indicates that the total area in
rice grew only slightly during this period, while the area planted to HYVs in the main rice-producing areas grew from 51% of the total in 1975 to 82% in 1983. During this period, NSC multiplied and maintained 39 different rice varieties.

Table 3.6: Total Area in Lowland and Rainfed Bunded Rice; Percentage of Area in all HYVs, and in PB36 and Cisadane. Indonesia, 1975-83

<table>
<thead>
<tr>
<th></th>
<th>Total ha (millions)</th>
<th>% HYVs</th>
<th>% PB36</th>
<th>% Cisadane</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>7.1</td>
<td>51</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1976</td>
<td>7.2</td>
<td>60</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>1977</td>
<td>7.6</td>
<td>61</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>1978</td>
<td>8.1</td>
<td>55</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>1979</td>
<td>7.9</td>
<td>67</td>
<td>37</td>
<td>-</td>
</tr>
<tr>
<td>1980</td>
<td>8.3</td>
<td>68</td>
<td>37</td>
<td>3</td>
</tr>
<tr>
<td>1981</td>
<td>8.6</td>
<td>67</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>1982</td>
<td>7.7</td>
<td>76</td>
<td>34</td>
<td>16</td>
</tr>
<tr>
<td>1983</td>
<td>8.2</td>
<td>82</td>
<td>33</td>
<td>21</td>
</tr>
</tbody>
</table>

3.09 Currently the most popular varieties are PB36 and Cisadane. The percentage of total hectarage planted to these two varieties is shown in Table 3.6. Cisadane is a longer maturing variety than PB36. When PB36 first became popular for its BPH resistance and high yield, it presented a problem in that it would ripen in January during heavy rains. The rainy season usually extends until late April or early May, but frequently there is a break in February. Thus, using the two varieties—planting Cisadane first so it would ripen in February and then immediately planting PB36—had a major advantage in harvesting. However, genetically pure seed was necessary to meet this demanding timetable.

E. Cropping Intensity - Indonesia

3.10 In Indonesia, two crops of rice during the rainy season became a standard pattern during the decade of the 1970s with the introduction and wide usage of the short season HYV. Frequently, this was followed in the rotation by another crop such as maize, soybeans or mung beans, on residual moisture. Where irrigation was available, a third crop of rice could be grown in some cases. Hence the cropping intensity could be dramatically increased.

3.11 The total area in rice grew only slightly, fluctuating between 8 and 9 million hectares per year, while total production increased from about 12 million tons (milled rice) in 1967 to 24 million tons in 1984 and over 25 million in 1985. The average yield expressed in milled rice increased from approximately 1.7 tons to over 2.6 tons per hectare. This trend is shown in Figure 3.1.
3.12 During the period of 1979-84 the annual production growth for rice was about 6%. The rapid increase in production has been attributed to substantial yield increases mainly in Java and Bali. In 1981 some 17 million farmers participated in various intensification programs using HYVs and had an average yield of 3.8 tons/ha per crop. These changes in degree of intensification were primarily in lowland areas.

3.13 New approaches were also possible in the upland rainfed areas. The short season varieties of rice permitted flexibility in cropping patterns. Table 3.7 shows how new cropping patterns produced double and more protein per hectare than traditional cropping patterns. These were rice-based and got their impetus from the short season PB36 which is adapted to upland as well as lowland conditions. Once improved and adapted varieties of the other crops are developed, a much higher total production per hectare per year can be expected.

![Figure 3.1]

Increases in area, yield, and production of rice in Indonesia 1960-83 (yield and production measured in million kg). Source: Director General for Food Crops and Central Bureau of Statistics.
Table 3.7: Yield of Crops, Calories, and Protein from Alternative Cropping Patterns in Year-round Cropping Systems Studies at Way Abung, Sumatra, 1977-78

<table>
<thead>
<tr>
<th>Cropping pattern</th>
<th>Yield (kg/ha)</th>
<th>Calorie (kcal/ha)</th>
<th>Protein (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduced pattern</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maize +</td>
<td>2,553</td>
<td>9,063</td>
<td>235</td>
</tr>
<tr>
<td>dryland rice +</td>
<td>3,688</td>
<td>8,829</td>
<td>250</td>
</tr>
<tr>
<td>cassava +</td>
<td>19,888</td>
<td>23,866</td>
<td>139</td>
</tr>
<tr>
<td>peanut +</td>
<td>580</td>
<td>2,266</td>
<td>148</td>
</tr>
<tr>
<td>rice bean</td>
<td>280</td>
<td>1,266</td>
<td>70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>45,646</td>
<td>843</td>
</tr>
<tr>
<td><strong>Introduced pattern</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maize +</td>
<td>1,815</td>
<td>6,443</td>
<td>167</td>
</tr>
<tr>
<td>mungbean I +</td>
<td>320</td>
<td>1,104</td>
<td>71</td>
</tr>
<tr>
<td>dryland rice +</td>
<td>3,456</td>
<td>1,104</td>
<td>235</td>
</tr>
<tr>
<td>cassava +</td>
<td>28,725</td>
<td>34,470</td>
<td>201</td>
</tr>
<tr>
<td>mungbean II +</td>
<td>280</td>
<td>966</td>
<td>62</td>
</tr>
<tr>
<td>cassava II</td>
<td>2,373</td>
<td>2,848</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>54,105</td>
<td>753</td>
</tr>
<tr>
<td><strong>Farmers' pattern</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maize +</td>
<td>634</td>
<td>2,251</td>
<td>58</td>
</tr>
<tr>
<td>dryland rice +</td>
<td>2,432</td>
<td>5,822</td>
<td>165</td>
</tr>
<tr>
<td>cassava</td>
<td>10,906</td>
<td>13,087</td>
<td>76</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>21,160</td>
<td>299</td>
</tr>
</tbody>
</table>

Source: Science and Rice in Indonesia, USAID, 1985, p. 78.

Figure 3.2 shows how cropping patterns can be engineered under upland conditions to take advantage of available moisture in keeping with the moisture requirements of a crop. In lowland areas, where irrigation was available for nine months per year, two successive rice crops of a variety like PB36 could be harvested within 240 days, producing average yields of 6.8 tons per hectare in the first crop and 5.7 tons per hectare in the second. There was normally sufficient time and water left to grow a soybean crop. Previously only one long season rice crop was grown in the same time frame. Another system, where only five months of irrigation was available, used a direct-seeded short season rice variety just before the rainy season started. It was followed by a short season drought-resistant legume like cowpeas. This intensification was expedited by availability of seed of appropriate varieties.
F. Estimation of Economic Impact

3.15 As appraised, the projected rates of return for the two projects were quite different: 17% for the Tarai project and 58% for Indonesia Seeds I. At completion, the Tarai estimate was revised slightly upward to 18% and Indonesia Seeds I revised sharply downward to 11%. The differences reflect: (i) different bases for the initial estimates, as well as (ii) some indication of relative success during the disbursement period. It is acknowledged that these estimates are very imprecise. However, if one accepts the assumptions of the PCR, then the estimated net benefits generated since completion are broadly consistent with earlier projections and the ERRs reestimated at audit can be retained as current best estimates. However, it should be kept in mind that the ERR estimates are very sensitive to changes in underlying assumptions. For example, the PPAR for Indonesia Seeds I indicates that if estimated benefits due to avoided crop losses were included, this would have produced an ERR of 28%. This type of estimate is by nature subject to a large margin of error because of the leverage of slight errors in yield estimates applied to the large number of hectares involved. Improved estimates would require careful farm level research focused specifically on measuring the incremental yield of certified seed over farmers seed.

Figure 3.2
In the case of Tarai, benefits were estimated using a typical seed farm as a model and taking into account only those benefits perceived as arising directly from the investments, namely:

(a) increased value of seed over commercial grain production;
(b) increased seed production due to on-farm investments in land leveling and irrigation; and
(c) reduced seed farm operating costs due to mechanization.

This procedure reflected the focus of the Tarai project on developing on-farm seed production and seed processing in a specific geographic area—the Tarai area of Uttar Pradesh.

In contrast, Indonesia Seeds I was defined in broader terms as the initial development phase of a modern seed industry for the country. It included the establishment of a National Seed Corporation, creation of a research branch of CRIA, and enactment of appropriate seed legislation as well as the major project investment in development of the seed production farm and seed processing facilities at Sukamandi. Thus, it was considered that the main project benefits would be increased national rice production and related foreign exchange savings brought about by higher paddy yields and better milling outturn through the use of project-produced rice seed. It was estimated that when the new seed stream reached full production (1977/78), the incremental benefits would be some 320,000 tons of rice resulting in foreign exchange savings of US$28 million per year; yield improvements would be 10% in the first season of seeding, falling to 7-1/2% during the second and 5% in the third. Valuing the additional rice output at the US$87/ton world price forecast by the Bank for the late 1970s, the project's economic return would be 58%.

The reestimation of ERR at project completion for Indonesia Seeds I followed essentially the same methodology used at appraisal. The main factors accounting for the sharp reduction were: (i) a 90% overrun in

Other benefits not taken into account in calculating the ERR were: seed of better quality and purity that should ensure a more homogeneous grain which could lead to an increase in milling yields estimated to be as high as 4%; disease and insect resistance leading to healthier crops; and better utilization of farm inputs. The appraisal estimate, while including downstream benefits, was limited to the production benefits directly attributable to increased yields from the new seed stream.
project costs, due primarily to price inflation; and (ii) the slow
development of NSC seed production and processing which had reached only 20% of the appraisal estimate by 1978.

3.20 During the following years, the NSC continued to increase its rice seed production, but its share of the national total decreased (Table 3.8).

Table 3.8: Total Rice Seed Production in Indonesia 1981/82 - 1984/85

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<tr>
<td>National Seed Corporation (Perum SUS and PT-Pertant)</td>
<td>15,616</td>
<td>45</td>
<td>16,574</td>
<td>39</td>
<td>16,973</td>
<td>36</td>
<td>19,274</td>
<td>35</td>
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<tr>
<td>Seed Farms</td>
<td>2,703</td>
<td>8</td>
<td>3,984</td>
<td>9</td>
<td>7,357</td>
<td>16</td>
<td>3,273</td>
<td>6</td>
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<tr>
<td>Private Seed Growers (Including Cooperatives)</td>
<td>16,414</td>
<td>47</td>
<td>22,536</td>
<td>52</td>
<td>22,026</td>
<td>48</td>
<td>32,947</td>
<td>59</td>
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<tr>
<td>Total</td>
<td>34,733</td>
<td>43,094</td>
<td>46,176</td>
<td>55,494</td>
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3.21 During this period, the Indonesian Government encouraged the expansion of seed production on provincial seed farms and among private seed growers and cooperatives in order to speed up the multiplication of BPH-resistant varieties. This was facilitated by investments in research and seed certification that were part of the project accounting for 11.8% and 2.1% of total project costs, respectively. Research staff played a "key" role in selecting and field testing HYV varieties for resistance to attack by BPH (see also Chapter VI). The seed certification service, through its field inspection, laboratory testing and seed labeling, established quality control that made it possible for the seed industry to expand capacity beyond the limitations of the NSC plants so that today 65% of the rice seed is produced by private seed growers, cooperatives and provincial seed farms (Table 3.8).

IV. INSTITUTIONAL IMPACT

A. Impact on Traditional Seed Systems

4.01 Neither India nor Indonesia had a significant seed industry prior to the 1960s. With the advent of plant breeding research and the resulting HYVs there was a surge of interest in producing and merchandising seed.
4.02 In India, the seed industry developed rapidly in the 1960s and farmers actively exchanged seed of new self-pollinated crop varieties. However, within a few years, many varieties became badly contaminated through admixtures and lost their genetic integrity as varieties. In the face of decreasing demand for this seed of variable quality, production exceeded demand and many seed firms went bankrupt in the late sixties at the time the Tarai project was being conceived.

4.03 There was a revival of interest in the Indian seed industry in the early seventies as the Tarai project got underway. During the interim, a seed law had been enacted and a seed certification program had begun to provide assurance and documentation of varietal purity.

4.04 In Indonesia, several varieties of rice had been developed by the Ministry of Agriculture in the 1950s. In order to multiply and distribute seed of these new varieties, provincial agricultural officials used land belonging to the Agricultural Schools which subsequently became known as Provincial seed farms. As demand increased beyond their capabilities they would contract with individual growers. Transportation infrastructure was poor. The seed farms made money when a new variety was released, but had great difficulties in the interim. Quality varied from one region to another, usually correlated with adequacy of the provincial budget and the training level of personnel.

4.05 When Indonesia Seeds I was conceived and implemented, the provincial seed farms were to be phased out in favor of NSC. However, when the BPH epidemic threatened, NSC was not able to multiply and distribute a large enough volume of new BPH-resistant varieties to counteract the threat. Consequently, the Government used all of the seed multiplication resources at its command, which included 350 provincial seed farms. As a result, in 1977/78 sufficient seed of PB 36 was increased to plant approximately 900,000 hectares in 1978/79. This led to the containment of BPH to endemic proportions and was the beginning of Indonesia's move to self-sufficiency in rice. As a result of the successful participation of the provincial seed farms, the Seeds II project has now provided some assistance to upgrade these seed farms.

4.06 Subsequently two other semi-government corporations have been given seed increase and distribution responsibilities. P.T. Pertani, an agricultural supply corporation (mainly fertilizer), has established seed processing centers in provinces where NSC is not based as yet. Patra Tani, a sister company of the State Oil Corporation (Pertamina), concentrates on seed production of soybeans and coconut. It does some contracting with farmers in addition to growing seed on property which it has in the province of South Sumatra. In this evolution, the competition is such that the individual seed grower generally has to contract with a firm or cooperative to facilitate selling his seed. Nevertheless, the present system more adequately meets the seed requirements of the country than was previously the case.
B. Institutional Effectiveness

1. Seed Certification and Quality Control

4.07 In India, the in-depth study and discussion of a Seed Act before it was finally enacted in 1966, was a major contributing factor to the successful establishment of an effective seed certification institution. During this period one of the best qualified international seed technologists worked as a consultant with Indian officials. This, plus the training programs which he conducted on seed technology, set the stage for an effective seed certification institution. Funding from Seeds I (India) facilitated setting up seed laboratories which are essential to seed quality control. In the mid-seventies, seed certification became a State Government function.

4.08 In Indonesia, seed certification and quality control was formalized by ministerial decree in 1971, as a National Government function. Certification of maize was begun in 1982; soybeans, peanuts and mungbeans followed in 1984. However, the number of crops is small in comparison to the Indian programs. Lack of trained personnel and facilities curtailed faster growth. Funding from Indonesia Seeds II helped to establish Seed Certification centers, including seed labs, at 13 key locations around the country and provided a new seed technology training facility at Bogor University, to strengthen on-the-job training and meet academic training needs.

4.09 In both India and Indonesia there has been a steady growth in the volume of certified seed and in the number of crops included. The Blue Label used internationally to designate certified seed is recognized by farmers in both countries as the hallmark of quality seed. Both countries regularly schedule in-service training of seed certification officers (inspectors) and seed laboratory technicians. However, this is recent and there were very few trained seed technologists. Thus, as seed certification grew rapidly it was necessary to select personnel who had some training in related areas such as crop production, agronomy and botany, and have them learn as apprentices. By contrast, in India some training sessions had been conducted earlier and there was a cadre of trained seed technologists available when the Tarai project was implemented. Marathwada Agricultural University in Parbhani, Maharashtra State has a modest but very practical program in seed technology research and teaching, which includes aspects of seed certification.

4.10 A large measure of the success of the Tarai project is attributed to the enthusiastic and knowledgeable leadership provided by the then Vice Chancellor of Pantnagar University. The implementing agency in Indonesia, NSC, was not successful initially due largely to inexperienced management and inadequate preliminary planning.

2. Public Sector Seed Firms

4.11 Both countries had a National Seed Corporation involved in processing and marketing. In Indonesia, the NSC was also the project implementing agency. In India, the NSC was on the advisory committee and held 20% of the equity shares in the Tarai Development Corporation (TDC), but implementation
was carried out by the TDC. Later this corporation served in part as a model for the SSCs established under Seeds I and II. Today the NSC has some responsibilities for production and distribution on an interstate basis and it serves as a national coordinating body. In Indonesia the NSC does not have provincial counterparts as such.

C. Limitations to Institutional Effectiveness

1. Seed Certification and Quality Control

4.12 Seed Certification can only maintain its integrity if it is staffed with well-trained personnel and is able to work within an independent environment. In India it was able to operate within these parameters initially, but in some States it now appears that it is being absorbed into the State's political bureaucracy. This reflects a potential weakness. Preferably it should underwrite its costs of operation by assessing adequate fees for services rendered. There is now in India a Central Seed Certification Board which provides coordination with the responsible State certification agencies throughout the country and will serve as clearing house for matters of mutual interest. National workshops on seed certification are being held. These steps will help to prevent deterioration of its effectiveness as an institution.

4.13 In Indonesia, throughout Seeds I there was a lack of communication among the institutions involved in plant research, seed multiplication and seed certification. These institutions need to know what one another is doing. This can be accomplished through seminars, conferences, field trips and personal interaction. Gradually this weakness is being corrected through participation in the monthly Genetic Evaluation and Utilization (GEU) meetings held by the Central Research Institute for Food Crops (CRIFC).

4.14 Lack of transport for the field officers has been a major weakness in Indonesia. Bank and seed certification officials recognize this problem and have stressed that it must be corrected. However, for budget reasons Government has been reluctant to permit purchase of the vehicles.

4.15 The certification tag signifies that the seed in the bag meets all minimum standards. If it is mutilated or lost the seed loses its identity. In this aspect the Indonesian label is of good durable quality while the quality of cardboard of the Indian tag is not of best quality.

4.16 In certification agencies in both India and Indonesia there is a tendency for field inspectors to rely too much on uniformity of height as a criterion of purity, particularly in cereals such as rice and wheat. The prime purpose of seed certification is to document that proper seed is used of the variety being multiplied, that the potential for contamination in the field is minimal (through field history), and that harvesting, threshing and processing has been carefully monitored. Genetic purity is an absolute requirement. Sometimes when seed supplies are short, seed having a germination below the minimum can be used providing appropriate adjustment is made in planting rates. A variety having important genetic characteristics can
thus be retained and increased. Some seed labs frequently place an inordinate emphasis on the minimum germination percentage requirement for certification. It is a decision which should be made jointly by the plant breeder and the head seed certification official.

4.17 There is an urgent need to expand and intensify seed technology training to provide staff for the future. The seed industry is developing rapidly in both countries, and many of the early seed certification staff will retire soon.

2. Limitations of Public and Private Seed Firms

4.18 Governments of both countries have stated their interest in encouraging the private sector. Table 3.8 shows that in Indonesia the private sector is now producing as much seed as the NSC. However, at times NSCs and SSCs can be unfairly competitive if they are subsidized by Government and produce large quantities of certified seed. As the private seed sector develops and shows a capability of meeting the needs of the farmers through efficient seed processing and distribution, the role of the public sector in the seed system should gradually be reduced. The public sector institutions will need to continue to handle maintenance of "stock seed" and the multiplication of foundation and certified seed of those crops not being handled by the private sector. In India, the private sector is still producing, for the most part, F1 hybrids and low-volume high-value crops such as vegetables while the State seed corporations and NSC produce most of the seed of wheat, rice and other crops where F1 hybrids are not involved.

4.19 In Indonesia, the private sector is effectively involved in handling the high-volume low-value rice crop. Frequent evaluation and a good marketing surveillance system by competent seed marketing specialists is needed to gauge these potential changes of responsibility so that the farmer will always have the right variety, at the right time and at the right place, and to encourage the development of the private sector.

3. Public Seed Farms versus Contracted Production

4.20 The design of Seeds I (Indonesia) provided for a large centralized seed farm of several thousand hectares at Sukamandi. Two major factors had to be taken into account in its development and operation. First, the land needed development for irrigation and drainage. To handle this large area as a unit, a mechanized farming approach was planned. However, contractors with expertise on leveling and drainage could not be found. It was difficult and slow to obtain government authorization to import the large farm equipment. Lacking experience and training, equipment operators were generally poor and maintenance costs were high. As a result of these factors plus inexperienced management, the cost of production was high and volume of production was low. In addition, the Government required that the NSC employ several hundred employees of the previous operator of this estate who were not necessarily qualified employees for a seed operation. On the other hand, the Klaten I plant, also built under Seeds I, successfully used contract growing with farmers. At the Sukamandi Seed Farm the land that has been developed
now used primarily for increasing foundation seed and producing initial increases of new promising experimental lines not yet released, while production of certified seed is now done primarily under contract. This has permitted increasing the volume of seed produced and has substantially reduced production costs.

4. Aspects of Processing Plant Design

4.21 Processing plants are one of the most expensive capital investments of a seed enterprise. There are three main features: processing (removal of off types, foreign material and sizing of the seed), drying to below 11% moisture, and storage. Wheat is usually quite low in moisture content when harvested under normal conditions. Hence the needed drying is minimal.

4.22 Prior to these two projects, very little experience had been accumulated on designing seed processing plants in the tropics. As a result, much had to be learned relative to appropriate size and design. Hence the plants were probably no more than 40% effective.

4.23 The renovated plant used by the Tarai project had capacity to handle up to 10,000 tons per year. The Bank was flexible in permitting the renovation of an old plant rather than constructing a new one as originally scheduled. Thus, the effectiveness of this design was reasonably good although there were some shortcomings which will be discussed later.

4.24 The Sukamandi plant, on the other hand, was over-built and more sophisticated than necessary. Klaten I, also built on Seeds I funds, was an improvement in that it was less complex than Sukamandi. Klaten II benefited from the experiences gained with Sukamandi and Klaten I. It has a dust collector which the earlier plants did not have. Thus, work areas are easy to maintain. The quality of the concrete appears to be good. These features are essential for minimizing contamination due to spillage and for ease of cleanup between lots. The artificial drying facility, however, is inefficient. Thus, the overall effectiveness of the Indonesian processing plants was low, in spite of the better recent construction.

4.25 The bulk storage at the Tarai and Sukamandi was not efficient for handling varying quantities of many varieties. As farmers deliver the raw product (seed) to the processing plant in sacks where it is processed and then bagged again, storage warehouses such as those built for Klaten II proved more functional.

4.26 Checking the moisture content of the seed is an important quality criteria. Too frequently moisture meters were located in a dark environment where it is difficult to make accurate and quick readings. A relatively large digital readout instrument is needed. Also, not enough thought was given to conditions for efficient cleaning of equipment and work areas between lots to prevent or at least minimize contamination of one lot with seeds from another.
4.27 The configuration for installation of equipment in the provincial seed farm facilities in Indonesia was poor. It created an environment for inefficient use of manpower and potential contamination. Too often, in the interest of saving funds, there was a tendency to buy locally made equipment. For processing seed only the best equipment is the best investment. The turnkey contract approach continues to be the best until more experience is gained and expertise is readily available. High quality concrete is essential. Cracks and crumbling directly contribute to unsatisfactory work areas and a major contamination factor. In contrast, a private firm in Jalna, Maharashtra State in India had excellent concrete work.

4.28 Artificial drying is a key facility in the tropics. At some sites sunshine is adequate, but most will require better drying provisions for the rainy seasons. At Klaten I and II in Central Java, Indonesia, an otherwise good facility had a sack drier which was inefficient because of the resistance due to the sack. Holes were poked in the sack to reduce this resistance. This automatically contributed to contamination. Some type of bulk batch drier would be much more satisfactory. This feature definitely limited the effectiveness of this plant.

4.29 There is a tendency to design the seed processing plants too large. It would be better to keep them to about a 5,000-ton capacity per year for cereals such as wheat and rice. Plans should also have taken into account the potential need to process seeds of other crops in the future. A private processor near Solo in Central Java, Indonesia was doing an excellent job with a plant having about a 3,000-ton capacity per year and a relatively small warehouse. He moved his seed quickly, thus avoiding a large inventory and the need for a large storage warehouse.

V. IMPACT ON PRIVATE SEED INDUSTRY

A. Release of New Varieties

5.01 In most developing countries there are three potential sources for new varieties: national research agencies, universities and international agricultural research centers. One of the features of both the Tarai (India) and Seeds I (Indonesia) projects was a National Seed Board (NSB) which would have among its responsibilities the release of new varieties and F1 hybrids developed by public institutions.

5.02 IRRI and CIMMYT have international networks for evaluating germplasm throughout the world. Any country can participate. If a line performs well in a certain country, that country can either release it as a variety or use it as parental material for further plant breeding research.

5.03 Foundation seed of publicly developed varieties is usually also available to the private seed firms for their increase and marketing.
B. Range of Crops being Handled by the Private Sector

5.04 The majority of the private seed firms in these two countries are quite modest. They include growers who produce, process and market their own production; associations of seed growers, village cooperatives who frequently produce seeds primarily for their own members; processors who contract for production and then market it; and seed dealers who buy and sell.

5.05 In some states of India there are also progressive seed firms which have their own plant breeding programs but contract with neighboring farmers for the production of their F1 hybrids or varieties. They then do their marketing through a network of sales locations. There are also a few international plant breeding firms with limited operations in India. These firms typically develop their own germ plasm of one or many crops, evaluate it internationally and market it in many countries under franchise arrangements with local dealers, providing government permits can be obtained. These firms deal almost exclusively with F1 hybrids and vegetables (low volume, high value).

5.06 The private sector is producing about half the seed distributed in Indonesia (Table 3.8), but none of these firms have their own breeding programs. There are three private international firms, one based in Thailand and two in the Philippines, which have franchises for the production of hybrid maize in Indonesia and are producing their first crops in 1986.

C. Effects of Government Subsidies

5.07 The private sector must make a profit either for the individual owning the firm or its shareholders. If possible, these firms prefer to market an item (variety or hybrid) which their competition does not have. Hence if there is the potential and they have the working capital to retain an appropriate scientific staff they will concentrate on F1 hybrids. Otherwise, if they are merchandising publicly developed varieties, they must have a good marketing program and handle large volumes at a small mark-up in order to compete profitably. They are frequently put in a difficult position if they have to compete with national or state seed corporations, which are usually given a government subsidy that enables them to undersell the private sector.

5.08 One example of private firms placed at a disadvantage was in West Java (Indonesia) where some individual seed growers, who had a modest income from a seed enterprise previously, are now having difficulty in marketing their production at a profitable level because of the low prices at which the NSC sells the same variety.

D. Financing

5.09 Both governments (Indonesia and India) have stated their intent to encourage the private sector. However, the small- and medium-sized private firms need a reliable and continuing source of credit. Their needs fall
primarily into three forms: production credit, investment credit and operating credit (for purchase and sale). Any seed activity involving research or seed processing and storage will need some investment credit as well as production credit. From the time a plant breeding program is initiated until it may have a "payoff" will take from 10 to 15 years. Thereafter there should be something coming off the "heltline" every two or three years. Hence assistance of long-term low-interest loans is needed during this development period. Those firms which are processing and marketing need operating credit to purchase from the seed growers upon delivery and meet expenses until they get paid for the certified seed they sell.

5.10 A case in point was a small, private, efficiently operated firm in Central Java, Indonesia which usually received only half the value as a down payment for seed sold until those who purchased it could pay in full after about a month's time. To obtain operating credit from the local bank, this entrepreneur had to mortgage his home. The local bank would not consider his inventory of seed or accounts receivable as collateral.

5.11 During the rainy season the rice farmers plant "back to back"; that is, they harvest a crop and immediately prepare the soil and plant a second crop to take maximum advantage of the short maturing HYVs. To handle two crops in one rainy season the seed dealer must purchase, clean and sell a large quantity of seed in a short period if he wishes to retain his share of the market. Thus, operating credit is critical. Some promising new firms in India were also having difficulty in obtaining reliable credit to keep their research going at critical stages.

VI. ENVIRONMENTAL IMPACT

6.01 The dense compact foliage of the new high-yielding varieties, when well irrigated and heavily fertilized, provides an ideal micro environment for the growth of plant pests. Diseases and insects, which have previously been endemic, can suddenly become epidemic. This occurred in both of the primary crops involved in these two projects: wheat in the India Tarai and rice in Indonesia.

A. Wheat Rust in India

6.02 There are three major species of rust which attack wheat: black stem rust, brown leaf rust and yellow stripe rust. To make the problem more complex: (i) each species consists of several races. (ii) the disease organism has an alternate host other than the wheat crop that it attacks, and (iii) it is capable of hybridizing on the alternate host and producing new races in nature.

6.03 Thus, a wheat variety resistant to one race of rust or several races, can be susceptible to other races. In India, more than 70 physiologic races of wheat rusts have been identified. In the Tarai region, the black stem and brown leaf rusts are the most prevalent.
6.04 Although losses can be controlled in part through appropriate
cultural practices and sanitation methods or with chemicals, the preferred
approach, used in India, is to find or develop varieties with resistance to
the prevalent races of rust. In India, new races evolve in the foothills of
the Himalayas or in high elevations in the south. The spores are carried
over great distances (North and South) by wind currents. All new germ plasm
developed by wheat breeders is systematically screened by the plant
pathologists at a rust research center at Simla in Himachal Pradesh State.
To keep current on the disease situation, plant pathologists operate an
All-India Wheat Disease Surveillance Program.

6.05 When the original germ plasm was received from CIMMYT (mid-1960s),
some of it was still segregating for characters such as rust resistance,
maturity and grain type. Indian scientists selected strains more suitable to
Indian conditions from this segregating material. This research resulted in
the development of the varieties Sonalika and Kalyan Sona. They became very
popular with the farmers because of their high yields, rust resistance, amber
or white grains (in contrast to the red grains of the original seed imported
from Mexico) and adaptability to a wide spectrum of soil and climatic
conditions throughout the country. The Tarai project played a key role in
their initial seed increase and continued maintenance. The variety Sonalika
is still widely used. Even though new races of rust have evolved, it still
gives good performance since it is very early maturing and it escapes the
most serious rust attacks. Thus, by use of resistant varieties and good
cultural practices, wheat production has steadily increased without the need
for heavy fungicide applications which could have deleterious effects on the
environment.

B. Brown Plant Hopper (BPH) in Indonesia

6.06 This insect had been noted more than a century ago in Java. It was
endemic on rice until the early 1970s. With the advent of HYVs, it suddenly
became epidemic. It is a sucking insect which can reduce the rice plant to a
wilted or burned state within a few hours when present in large numbers. It
is also the vector or carrier of two serious virus diseases of rice—ragged
stunt and grassy stunt.

6.07 In the past, the only effective control for BPH had been use of an
insecticide. Furadan was the most effective. IRRI was successful in
isolating genetic resistance. The first variety carrying such resistance was
IR20 and it was followed by IR26 which, after local testing, Indonesia
released in 1975 (as PB26) in an endeavor to control the spread of BPH. By
1977, the PB26 resistance was breaking down. It was then realized that there
was another biotype of BPH. Through the collaboration of IRRI's
International Rice Testing Program with Indonesia's CRIFC, an experimental
line from IRRI, identified as IR2071,5/ proved to be resistant to both

5/ The pedigree of IR2071 included 13 varieties from 6 countries, including
the variety Peta from Indonesia.
biotypes 1 and 2. The rapid increase of this seed as Indonesian variety PB36 is described in Chapter 4.

6.08 The Sukamandi entomology research (funded by Seeds I) made a significant contribution to understanding better the spread of BPH throughout Indonesia. Research coordinated by CRIFC at Bogor developed a method to map emerging biotypes employing reports twice a year from 1,000 locations throughout the country. The identification is based on a set of rice variety differentials which enables the scientists to determine the prevailing biotypes. This "early warning" system, designed and calibrated by Indonesian scientists, enabled NSC to organize its seed production program more effectively.

6.09 From 1978 to 1982, the gene for resistance to biotype 2 kept the brown plant hopper population under control, but then there was evidence of a possible new biotype emerging in the province of North Sumatra. As an interim emergency control measure, extensive spraying was done. In the meantime, experimental results indicated that the TRRI variety, IR56, was resistant to this apparent new biotype. In quick response, 21 tons of seed was airlifted from the Philippines by the Indonesian Air Force in February 1983. Most of it was planted in North Sumatra in early March and the remainder in other provinces of Sumatra as well as on Java and Bali. As a result, this biotype did not cause serious damage to Indonesian rice production.

6.10 The North Sumatra emergency is an example of the speed with which a new variety can be made available to the farmers when varieties or germ plasm have been developed in anticipation of future challenges and when pilot seed "stocks" have been multiplied and maintained (in this case in the Philippines). The BPH problem illustrates the need to integrate varietal resistance, biological and cultural controls, and when necessary the use of insecticides in an economically and ecologically suitable means of control. The availability of genetically pure seed of resistant varieties is a key aspect.

VII. PROJECT SUSTAINABILITY AND REPLICABILITY

7.01 India Tarai Seeds and Indonesia Seeds I were both conceived to help farmers realize the potential high returns from adoption of new high-yielding varieties. The objective of both projects was to set up mechanisms for multiplying and distributing seeds of these HYVs in such a way that the genetic characters for high yield would be carried through to the ultimate users by carefully supervised production and distribution of the new varieties. At appraisal, there was good evidence of the need for such improvements in the seeds system. The issues that arise now do not dispute the need nor the positive impact of these projects. Rather, they relate to sustainability and replicability of the projects—to the effectiveness and efficiency of the specific strategy employed, to the types of institutions created, and to aspects of project design and implementation.
A. Sustainability

7.02 In spite of various implementation problems confronted during the disbursement period and in the period since project completion, both of these projects appear to have good underlying bases for sustainability. The importance of a good national seeds system is now generally accepted in both countries and is seen not as a one-time change of varieties but as a process that must continue. Within this context, the learning process is still continuing and both countries are seeking the optimum mix of public and private involvement in the various components of the seeds system. Both countries have developed follow-on projects that take into account lessons learned from these first projects.

7.03 Thus, the focus here is on the sustainability of the various components of the two national seed systems as now constituted.

1. Sustainability of Seed Certification

7.04 Seed certification is the only system yet devised to document the genetic purity of a variety. It is not possible to distinguish one variety from all other varieties of that crop only on the basis of visual characteristics of the seed or plant. The establishment of a seed certification institution was a key function in the design of both of these projects. In India, certification had been set up just prior to the initiation of the Tarai project. In Indonesia it was decreed for rice by the Minister of Agriculture in time (1971) for implementation of Seeds I. In India it is a function of state governments, while in Indonesia it is a national government function.

7.05 In both cases, seed certification has a fair degree of autonomy and is staffed with competent officers. However, it is limited by lack of budget funds and vehicles. Field officers should not be expected to depend on the vagaries of public transport. If they are not at the right spot at the right time, a seed crop may be lost. However, the value of seed certification is now broadly recognized and well institutionalized. To permit greater autonomy, it should be financed to the extent possible by fees assessed for services rendered.

2. Sustainability of Public Sector Production and Marketing

7.06 The overall strategy employed in these two projects was to expand the role of public sector institutions in the seed industry to handle not only plant breeding, production of foundation seed and quality control, but also large-scale production, processing, certification and distribution of seeds. The importance to the nation of a good seed system seemed at the time to justify major public investments in the seed industry.

7.07 This was the justification for the Tarai project, namely that prior to the project, seed production and distribution was undertaken by scattered inefficient farms which were rarely equipped with proper processing or
storage facilities. The project also sought to expand seed production on a fairly concentrated area of some 18,623 ha through land leveling, irrigating and mechanizing seed farms and through processing and marketing of the seed produced.

7.08 The Indonesian approach was similar in that the major investments were in physical improvements for a seed farm and in establishment of processing and marketing facilities. Only limited provision was made in either project for private sector involvement in processing and marketing. The heavy reliance on public funding is now receiving more careful scrutiny for several reasons, including: the growing budget subsidy required, the political difficulties of raising seed prices to cover all costs, and questions about the efficiency of public enterprises for this kind of endeavor. Costs are usually high and production is not as efficient as that of a farmer whose profession it is to grow crops. If the farmer is allowed sufficient incentive for the extra work and care to produce good quality seed, he will generally do a better job and get higher yields than a government-operated farm. However, if he has never been a seed grower he will need guidance and counsel.

7.09 If the private sector can take on more of the production, processing and distribution of certified seed to farmers, the future role of public sector corporations, such as NSC and SSC, is expected to focus on rapid production and dissemination of certified seed of newly released varieties, thereafter maintaining and multiplying stock seed (breeder and foundation). As certified seed supplies become adequate, the national and state seed corporations and provincial seed farms should phase out their certified seed production. A well informed National Seed Board should by this time have developed a policy which will provide for adequate certified seed supplies through some or all sectors of the private industry. It would be expected that under favorable conditions the seed industry might reach an equilibrium of approximately 75% private versus 25% public production and distribution of seeds.

3. Sustainability of Private Sector Seed Enterprises

7.10 The private sector includes three main categories of firms: (i) cooperatives; (ii) private processors; and (iii) firms with their own research capacity. Cooperatives are primarily interested in, and legally responsible to, their members. In those cases where a cooperative has a seed enterprise it generally takes one of three forms: (i) contracting with grower members to produce seed; (ii) purchase of seed for their members from outside sources; or (iii) a franchise with a domestic or international plant breeding firm. Processors contract for production and market it through a network of seed dealers in a district or region. Firms having their own research program endeavor to concentrate on F1 hybrids which give them an exclusive product. Usually they do not handle publicly released varieties since their competition has access to the same varieties and the margin of profit is small. They have a good marketing system with their own sales force and good advertising.
7.11 The private firms have difficulty in getting prompt information on availability of public seed releases. Their representation on the national seed board is only token. In both countries the private sector could play a more important role. However, it needs more encouragement by policies which would provide it more latitude and flexibility to operate. Competition is a healthy feature and efforts should be made to reduce and remove the subsidies to the seed corporations which permit them to consistently undersell the private sector. Farmers who are knowledgeable of the value of good seed are willing to pay a reasonable price for this input. A comprehensive seed extension program is essential both for the seed industry as a whole and for the farmer-user.

4. Sustainability through Farmer Participation

7.12 When allowed appropriate incentives, farmers are generally ingenious and efficient seed producers. With the development of a seed industry there is an opportunity for a new source of income for the farmer and, in some cases, other members of his family. The evolving farmer participation as seed producers in both India and Indonesia is thus seen as a major factor in long-term sustainability of these modern seed systems. In the Tarai, where the farms are relatively large, some of the wheat seed farms are growing 60 ha for seed on an 80 ha farm and have done so for 20 years. In Maharashtra State, a typical seed producer had 20 ha and grew cotton, sorghum and pearl millet for seed. In this State, which excels in hybrid cotton seed production, village youth are trained in how to hand-pollinate. This provides rural income not otherwise available. In Indonesia, where farms are very small (one hectare or smaller on the average), a group of farmers (150 ha in one block and 171 farmers) were growing excellent rice seed crops. They had one person in charge of irrigation, one for fertilizer, one for pesticides, one for harvesting, etc., and an overall chairman. The NSC at Sukamandi has learned that it can cut costs and get more seed by contracting with farmers than by using the large-scale mechanized estate approach.

5. Sustainability through Training

7.13 Where there were no previously trained seed technologists available, as was the case in Indonesia, full-time consultants for start-up and in-service training helped to rapidly establish a basis for sustainability. By contrast, in India, where there had been considerable training in seed technology during the 1960s, the Tarai project could be implemented with occasional consultant advice of a few months' duration.

7.14 Academic and non-academic training has provided further foundation. In Indonesia, a special seed technology training facility has been established through Seeds II funding and is functioning effectively at the Agricultural University at Bogor. The seed section of the production division of the Directorate General of Food Crops Agriculture (DGPCA) in Indonesia also holds regular in-house training on a non-academic basis. India is developing seed technology research and teaching programs in several
of its agriculture universities. The Tarai project, in the interest of economizing, cut out the budget item for training. However, training components were included subsequently in National Seeds I and II.

B. Replicability

7.15 In spite of the pioneering nature of these projects and the problems encountered, on balance both projects are considered successful. In terms of lessons learned, this raises the question of what can be extracted from this project experience that could be applied to other projects now under consideration or in process. Which aspects depend on the particular ecological or political and social conditions of these countries, and which aspects may have broader application?

7.16 The first lesson that can be drawn is that the emergence of new high-yielding varieties of basic grains was a key factor in establishing demand for a better seed industry. Neither farmers, seed growers nor the government were ready to invest in seed production, processing and distribution until something occurred to jar farmers away from the traditional varieties. In India, the first stimulus was some success with new corn hybrids which, being an open pollinated crop, required particular care in seed multiplication. However, the main stimulus came from two self-pollinated crops: (a) when the new semi-dwarf fertilizer-responsive, rust-resistant varieties of wheat from CIMMYT were shown to be well adapted in Northern India; and (b) when the discovery that the new semi-dwarf IRRI rice varieties would give high yields in Indonesia, setting off similar excitement among farmers in that country.

7.17 The second lesson is that multiplication and distribution of a new variety is not a single occurrence. It initiates a combination of changes in fertilization, plant density and better moisture control that in addition to substantial yield increases, will likely create new problems as new varieties and new production systems are extended over broad areas. This has occurred in both countries and has required subsequent changes in varieties in response to threatened epidemics of a particular insect or disease. Special efforts have been made to maintain genetic diversity by not allowing entire areas to be planted to a single most productive variety. Thus, a replicable seeds program needs to have available the kind of research back-up from national scientists and international agricultural research centers as was provided to these projects.

7.18 The plant pathologists, entomologists, agronomists and plant breeders as a team designed the new varieties. The pathologists and entomologists designed techniques to screen for resistance. The agronomists developed management practices to maximize yields. The plant breeder put this matrix together based on his knowledge of genetics. The experience of national and international research institutions expedited the identification of disease- and insect-resistant material suitable for prevailing conditions. It also gave the national research institution confidence and encouragement.
7.19 A third lesson is the use of plant resistance, conveyed through seeds to control pests while avoiding damage to the environment. A comprehensive "wheat rust" research program is evolving in India which is providing wheat breeders with "tools" to scientifically search for resistant germ plasm to suppress and/or contain future races of rust which will occur in nature. The integrated pest management approach being used in Indonesia by Central Research Institute for Food Crops (CRIFC) scientists in combatting BPH in rice through their Genetic Evaluation Unit (GEU) team effort and an appropriate balance of resistance varieties, pesticides (as a last resort and when necessary), biological control and a high level of sanitation in seed bed nurseries is helping to maintain a desirable environment for mankind. This technology has encouraged, maintained and multiplied biological predators and disease organisms (fungi) which are natural enemies of the BPH.

7.20 A fourth lesson from these projects refers to the need for a clear definition of the roles of the public and private sectors in a national seed system. This Study holds that as a general principle, the public sector should give primary attention to developing appropriate policy which will encourage and expedite a sustainable modern seed industry involving both public and private dimensions. The public should also keep primary responsibility for "stock seed" (breeder and foundation) of publicly developed varieties and should help to provide reliable and current seed marketing intelligence and training through seed extension specialists. The public sector should gradually phase out of certified seed production, marketing and distribution, and should encourage the private sector to pick up these tasks. For self-pollinated crops, seed multiplication by farmers for their own future plantings should be encouraged instead of pushing complete annual replacement with certified seed. To permit the development of a useful private seed sector and thus improve the efficiency of the seed industry, subsidization of public sector firms needs to be curtailed. In this respect, it is noted that both of the countries subject of this Study have recognized the need for an expanded private sector role in the seed industry.

7.21 A fifth lesson from these projects is the need for a strong national seed board. Such an institution was provided for in both projects, but it either did not function or emerged very slowly. By virtue of its function, an NSB should have top level policy-makers representing the main public and private interests in the seed industry. It also needs technical expertise and a good degree of continuity. Since high level government officials are frequently rotated to other assignments, to provide continuity the Executive Secretary of the board could be a professional seed technologist who presumably, if well qualified, would remain in this post for several years. The NSB would coordinate those aspects of production, research and extension dealing with seed and the relation of the seed certification institution to them.

7.22 The sixth lesson is the key role of the seed certification institution. The farmer's (seed users) attitude was changed once he became convinced that the HYVs would out-perform his traditional seed. The Blue Label became synonymous with quality and high performance. Also, the packaging of certified cereal seeds in small 5 kilogram packages was an attractive
incentive for small farmers as it was not necessary to subdivide certified bags at retail outlets. The lesson for replicability is that the act of certifying or documenting each step in the production process is the only way of assuring the farmer that it is genetically pure seed of the variety identified on the label. Both countries (India and Indonesia) now have well established seed certification institutions.

7.23 The seventh lesson to be drawn from these projects is the need for better design of seed processing plants. There is a minimum of expertise available on appropriate design for conditions of developing countries in the tropics. Consequently, there is a tendency to pattern installations after the large plants which are most efficient in the Western world and hence they are over-built and too sophisticated. This was exemplified in Sukamandi. Also, in both India and Indonesia, locally made equipment was used extensively in order to save money or because of failure to get government import permits. Its fabrication was frequently inferior. The equipment was difficult to clean between seed lots leading to potential genetic contamination. The following conclusions are drawn with respect to design and equipping seed processing plants:

(i) the best equipment available is the soundest investment;

(ii) plant size should be relatively small—perhaps 5,000 tons or less, and not more than 10,000 tons per year;

(iii) all work areas, receiving aprons and drying yards should be of high quality concrete to avoid crumbling, which automatically becomes a source of contamination;

(iv) when buildings are constructed with funds from one donor and equipment is provided by another donor, there should be carefully coordinated advance planning so that the most efficient configuration of equipment is used and the building is sized to conveniently accommodate it; and

(v) a well-qualified consulting engineer, knowledgeable in seed technology, should remain on the assignment until the plants are fully operable and a well-trained national counterpart is ready and qualified to take over.
COMMENTS FROM THE INDIAN DEPARTMENT OF ECONOMIC AFFAIRS

FROM SHRI SUNDARAM KRISHNA DY SECY ECOAFFAIRS NEW DELHI
TO SHRI CM VASUDEV ADVISER TO ED ( INDA)WO+ INTBAFRAD WASHINGTON

P:LEASE PASS ON THE FOLLOWING MESSAGE TO MR OTTO MAISS ACTING
DIRECTOR OED(.) QUOTE: REGARDING THE DRAFT IMPACT EVALUATION
REPORT ON TARAI SEEDS PROJECT ( LN 64+ 614-IN)(. ) WHILE WE
ARE IN GENERAL AGREEMENT WITH THE CONTENTS WE WOULD LIKE TO
POINT OUT WITH REFERENCE TO PARA 3.05 PAGE 16 THAT INDIA'S
TRANSITION FROM A MAJOR IMPORTER OF FOODGRAINS TO SELF-
SUFFICIENCY HAS BEEN THE RESULT OF MAJOR INITIATIVES TAKEN BY THE
GOVT OF INDIA IN THE FIELDS OF IRRIGATION FERTILISERS AGRICULTURAL
RESEARCH AND DEVELOPMENT MARKETING SUPPORT AGRICULTURAL CREDIT AND
THE LIKE (. ) TO IMPUTE A MAJOR PART OF THE CREDIT FOR THIS
TRANSITION TO BANK-ASSISTED SEED PROJECTS AS PARA 3.05 DOES IS NO:
CORRECT (. ) THEIR CONTRIBUTION IS SIGNIFICANT BUT NOT ON THE
SCALE IMPLIED (. ) UNQUOTE REGARDS (. )
MESSAGE NO 6826 DATED 12/12/1986 KEVAL

[See comment in para. 3.05]
Dear Sir,

Please kindly find the attached response with regard to your impact Evaluation Report - India Tarai Seed Project (Loan 614-IN) and Indonesia Seed I Project (Credit 246-IND) August 8, 1986.

Please also note that the response considered to update and add to our previous comment which was submitted to you on November 10, 1979 No. I. C.8.79.1336.

The response does not necessarily disputed but rather complementing to your report Impact Evaluation Report India Tarai Seed Project (Loan 614-IN) and Indonesia Seed I Project (Credit 246-IND) August 8, 1986.

I deeply appreciate for your coming cooperation.

Yours sincerely,

[Signature]

cc.
The World Bank
Resident Staf in Indonesia
TIME SERIES ANALYSIS OF SEED I PROJECT IN INDONESIA

- a response to the World Bank Impact Evaluation Report about India Tarai Seed Project (Loan-614-Ind) and Indonesia Seed I Project (Credit-246-Ind)-

DIRECTORATE GENERAL OF FOOD CROPS AGRICULTURE

1986
INTRODUCTION

The World Bank Impact Evaluation Report about India Tarai Seed Project (loan 614-In) and Indonesia Seed I Project (Credit-246-Ind) concluded (among others) that the Tarai PPAR were that the project had been generally successful and the computed ERR at the time of project completion was 18% compared to 17% estimated at appraisal. The main finding of the PPAR for Indonesia Seed I was that it fell short of its production goals, particularly during its early years. The PPAR written in 1979 considered Indonesia Seed I only marginally successful and the recomputed ERR at completion was 11% versus 58% estimated at appraisal.

Development program is a dynamic process where time horizon becomes important to link the project operational stage or life and its continuing impacts in the post project period. Realistic estimation and assumption and time series analysis can complement above PPAR cross section analysis to measure and more clarify the complete dynamic impacts of the project.

The high estimated economic rate of return at 58% for Indonesia Credit 246 was considered unrealistic, therefore IBRD report number PA85A page 22, April 26, 1971 also suggested alternate ERR at 20% and 15%. The lowest estimated ERR at 15% at appraisal should not dramatize the difference between the estimated ERR at 58% versus the achieved ERR at 11% at the project completion.

Segmented of time series analysis into four stages should be fairly justified which are consisted of: (a) learning process 1971-1978, (b) transition stage 1978-1981, (c) progressing/developing stage 1981-1990 and (d) established stage after 1990.

This time series analysis does not necessarily disputes against financial evaluation analysis in PPAR which is purposely excluded in this time series scope.
II. THE DEVELOPMENT PROCESS OF SEED PROJECT IN INDONESIA

(a). Learning process (1971-1978)

The learning process is characterized by: (a) low productivity (b) high investment (c) slow adoption of new technology being introduced (d) insufficient number qualified and skill human resources.

Due to these identified characteristics, the project was assisted by team of consultant to supervise and directly managed the operation of Seed Project, particularly in Sukamandi. In this learning experience stage, project preparation and construction was implemented some what delay compared to the schedule plan. It was found also the big scale mechanized technology being utilized with Western Oriented Model of Farm corporation was not appropriate.

Four components of Seed Development System (NSB, CRIA, SCCS, and Seed producer) in Indonesia were trying to synchronized each other functionally to start establishing a network system in this period.


Transitional stage is characterized by: (a) uncertainty and (b) unstable project performance. However, the progress of project development already indicated fairly increasing trend.

In this stage, full project and supervision were already in the hand of Indonesian personels. The transitional period was relatively short and there were a lot of adjusment and correction with regard to particularly the functioning of National Seed Institutions in the Network. This stage was soon followed up by the progressive/developing stage.

(c). Progressing/Developing Stage (1981-1990)

The period is characteristized by stable and sharp rising trend of (a) productivity and eficiency (b) volume of seed being sold (c) high response of farmer on certified seed (d) supporting institutuions and facilities being strengthened and (e) growth of seed grower number was in optimum nature.

Complemented with other socio economic inovation at farm level, the National rice production steadily increase at high rate (6.58%/annually). This stage is estimated to be continued until 1990, whereby the targeted certified seed at 75,000 ton annually will be reached.

(d). Established Stage, after 1990.

Established stage is marked by sustainabilty of the optimum
seed industry, efficiency, consolidation, flexibility and more dynamic performance to respond to the quality and volume of variety of seed demanded by farmers.

All of the time series analysis are proven by the following figures and information.

III. Historical evidence and parameter

1. Yield and Production Cost

Level of yield and production cost are two parameters that can help to explain the degree of effectiveness of rice seed production financial and technical management. This two parameter behaviours can be clearly observed in figure 1 and 2.

LEVEL OF CERTIFIED SEED PRODUCTION

(TON/HA)

Figure 1.
TOTAL DEFLETED SEED PRODUCTION COST
AND SALES VALUES

Figure 2.
* Private growers

Yield level was recorded in Ton/ha. The average yield at the National level was significantly changed from time to time. In the beginning of the learning process (1971), the yield level was 1.01 ton/ha and slightly increased at 1.02 ton/ha in 1972 after that it extremely decreased to 0.21 ton/ha in 1973. It was due to the damage caused by Brown Plant Hopper. At the end of the learning process (1978), the yield was also decreased to 0.50 ton/ha only, due to suffered by Brown Plant Hopper. At the same time, the cost of production increased at the peak level (Rp 43.67/kg), this was attributed by the low level of yield.

In the transitional stage the average yield was almost increasing steadily until 1984. During that time the production cost gradually decreased, however, it slightly increased again during the progressing stage (1981-1990) and it reached at stable condition in 1985 and 1986. During 1981 to 1984, the average yield gradually increased from 1.64 ton/ha to 1.92 ton/ha.

Production cost was recorded in Rp/kg and since the current rupiah value changed from time to time, it was necessary this value to be depleted against price index of the other 8 food commodity values.

In the first stage (learning process) the depleted production cost gradually increased from Rp 20.71/kg (1971) at seed grower level and reached Rp 43.67/kg in 1978.

Effective production management at private seed grower level in the transition and development stages made it possible to reduce production cost and finally reached Rp 31.64/kg in 1984.

* National Seeds Corporation

In the learning and transition stage, the yield/unit of area of NSC was similar compared to the seed grower. The performance of NSC in the developing stage (1981-1984), indicated that the yield of NSC increased sharply (figure 1). The highest certified yield was 2.92 ton/ha (in 1984).

Unfortunately this significant technical performance did not cause reduction of production cost, but in the other hand it's production cost was remained steadily coincided with lower selling price compared to private seed growers (Figure 2 and 3).
CERTIFIED SEED PRODUCTION COST & SALES

At NSC level

<table>
<thead>
<tr>
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<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>COST</td>
<td>62.40</td>
<td>55.71</td>
<td>58.52</td>
<td>59.04</td>
</tr>
<tr>
<td>SALES</td>
<td>44.50</td>
<td>38.17</td>
<td>40.89</td>
<td>42.57</td>
</tr>
</tbody>
</table>

Figure 3.
The situation of NSC R/C ratio unfortunately was only 0.5, it met that NSC was continuing in lost. Meanwhile the private growers, although their technical performance was lower compared to NSC, their financial business indicated their R/C was 1.7. The unefficient financial management of the NSC was claimed due to policy and pioneering oriented business, therefore this financial empirical evidence may direct future seed programme operation.

All of certified seed produced is totally distributed and sold over. National Certified seed production level was below 1000 ton at the early period of the learning process and gradually increased to the peak level at 6,496 ton in 1976. This level of production decreased again at 3,106 in 1978. Data in Table 1 definitely shows the increased of certified seed production in the transition period and then this level of production jumped in the developing stage at 94.35% growth annually.

This trend of production behaviour was similarly happened in NSC (sang Hyang Sari) within the respected stages of the development. This coefficient and information mark that in the progressing/developing stage, trend of production is characterized by higher efficiency (see figure 1 and 4).

Certified Seed Production

1971 - 1984

Figure 4.
3. Sales and Distribution Volume

The agregative National Sales Volume is presented on seed production curve in figure 4. The National seed corporation sales of certified seed volume was already included in this figure. The total sales volume (certified and non certified seed) of National Seed Corporation is presented in Figure 5.

![Total Sales Volume of National Seed Corporation (Ton)](image-url)

Figure 5.
Specific total sales volume of NSC during the learning period (1972 -1978) was 17,233 tons. The average growth per year was 72.5% if 1972 sales was included, otherwise it would only 13% if 1972 sales was excluded.

Problem encountered during this period are as follows:

(a). Risk of unsold seed was still high, because farmer's perception on seed quality (certified seeds) was still low. Most farmers were still variety oriented.

(b). Risk of losses because of several and sudden change in varieties recommended by Government or demanded by farmer, due to pest and deseases outbreak.

(c). The marketing pattern was not well established yet (the marketing system was still passive).

In the transitional stage, (1978-1981), NSC total sales volume was 19,077.4 tons. The average growth per year was 26%. And in the development or progressing stage, the accumulative total volume increased significantly at 51,546 tons. It was indicated that the supporting system for seed development in this stage was became more stable and strongly established. The growth of NSC sales was 38% in this period.

Total National sales in the learning and transition period had similar trend compared to NSC sales. However in the progressing/developing stage (1981-1985) the total National sales grew much more vigorously compared to NSC sales. (Fig. 4 )
DEFLETED SEED PRODUCTION COST
AND SALES VALUES (PER KG)

At seed grower level

| COST (RP/KG) | 27.71 27.71 33.74 32.48 32.48 38.34 42.57 43.67 39.73 35.15 29.75 27.96 30.15 31.64 |
| VALUES (RP/KG) | 60.00 60.00 54.82 46.39 61.86 72.46 64.55 69.82 72.58 66.59 56.43 49.84 55.43 51.47 |

Figure 6.
4. Seed Grower Development (Excluded NSC)

The growing number of area being utilized for seed production in the private sector reflects to the profitability of seed business. Free and heavy competition naturally screen out uncapable seed growers, efficient seed grower on the other hand remained stay in the seed business.

This healthy rice seed business generates tremendous increment of certified seed production being sold in the progressing period as indicated in Table 1.

<table>
<thead>
<tr>
<th>Years</th>
<th>Seed Certified Production (Ton)</th>
<th>Total Cost Production Deflated (x Rp 1,000)</th>
<th>Seed Value Deflated (x Rp 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>485</td>
<td>13,439.35</td>
<td>29,100.00</td>
</tr>
<tr>
<td>1972</td>
<td>693</td>
<td>19,203.03</td>
<td>41,580.00</td>
</tr>
<tr>
<td>1973</td>
<td>167</td>
<td>5,634.58</td>
<td>9,488.94</td>
</tr>
<tr>
<td>1974</td>
<td>2,488</td>
<td>80,810.24</td>
<td>115,418.32</td>
</tr>
<tr>
<td>1975</td>
<td>4,114</td>
<td>133,622.72</td>
<td>254,492.04</td>
</tr>
<tr>
<td>1976</td>
<td>6,496</td>
<td>249,056.64</td>
<td>470,700.16</td>
</tr>
<tr>
<td>1977</td>
<td>3,722</td>
<td>158,445.54</td>
<td>240,255.10</td>
</tr>
<tr>
<td>1978</td>
<td>3,105</td>
<td>135,595.35</td>
<td>216,791.10</td>
</tr>
<tr>
<td>1979</td>
<td>8,250</td>
<td>327,772.50</td>
<td>598,785.00</td>
</tr>
<tr>
<td>1980</td>
<td>8,251</td>
<td>290,022.65</td>
<td>549,434.09</td>
</tr>
<tr>
<td>1981</td>
<td>14,823</td>
<td>440,984.25</td>
<td>836,461.89</td>
</tr>
<tr>
<td>1982</td>
<td>18,127</td>
<td>506,830.92</td>
<td>903,449.68</td>
</tr>
<tr>
<td>1983</td>
<td>21,639</td>
<td>652,815.85</td>
<td>1,199,449.77</td>
</tr>
<tr>
<td>1984</td>
<td>30,244</td>
<td>956,920.16</td>
<td>1,556,658.68</td>
</tr>
</tbody>
</table>

Number of seed grower almost did not change, where in the 1978 (end of the learning process) they were 1249, in the end of transition stage (1981) number of seed grower were 1078 and this number was recorded as 1268 farms at the end of 1984.

Meanwhile the average area being planted by each seed grower was increasing significantly from 3.62 ha in 1978 move to 6.54 ha in 1981 and reached 8.82 ha in 1984. It is clear on Table 2 and Figure 2 that in 1984 there were 2370 families (including 1102 seed traders) engaged in seed business network. This fact is one of the measure of multiplying socio economic long term impact of Seed I project.
5. Software infrastructure.

The historical evidence of the Institutional Building and quality of human resource development, had been dramatically improved during the progressing stage (1981-1985). Particularly the working mechanism among each components (National Seed Board, CRIA, SCCS and Seed Grower) in the seed development program was strengthened and well synchronized.

Number of qualified personels involved directly and indirectly in seed development program increased sharply in the progressing stage. Number of University graduates were 6 (including 3 person holding Phd degree) in 1978, compared to 29 (including 6 persons holding PhD degree) in 1985.

All of those scientist and qualified technicians were in the Government Institution (CRIA, University, SCCS, Government Seed Farm). Qualified Technical personels in the NSC were 388 persons in 1978 and increased to 688 person in 1985. In the same period persons engaged in the private seed business was 3406 (1978), and in 1985 was recorded as 5254 persons.

The sharp increase of qualified person was resulted from intensive training implemented internally and overseas graduate study program. Seed quality improvement training itself was accounted for about 50 to 60 each year from 1976 to 1985.
IV. Future outlook

It becomes clear from time series analysis that seed I project had no doubtly successful in the technical management either in the terms of yield per ha or total national certified seed being sold and planted by rice farmers. The other indicator of success is healthy and profitable seed business at seed grower level particularly in the progressing stage. The crucial problem at NSC is that selling price of certified seed is much lower compared to production cost.

Adjustment due to Integrated Plant Protection policy and pioneering oriented business are two main factors claimed as the causes of unprofitable high economic cost of NSC.

In this regard Government subsidy helps NSC stay in seed business. Subsidy is always justified for early stage of strategic business with future feasible in its ERR (for example seed I project). Therefore serious concideration should be taken for NSC business expansion in the future, since this expansion will bring continous consequence of expanding government subsidy too.

The multiplying positive socio economic impact at rice farm level has not been assesed. Further research in this respect will clarify more about the multiplying socio economic impact coefficient to the beneficiaries.

Jakarta, October 18, 1986
INDIA
TARAI SEEDS PROJECT

MARKETING:
△ Main Project Center
● Buffer Warehouse
▲ Major Markets and Centers
● Dealers (number in area)
▲ Distributors (number in area)
△ Regional Office
● State Capitals
▲ National Capital
▲ State Boundaries
—— International Boundaries

Due to scale consideration some areas could not be included in the map. In Assam there are 30 dealers, 1 distributor, and a major market in Guwahati. In Meghalaya there is a major market in Shillong.