INDIAN AGRICULTURAL RESEARCH COUNCIL (ICAR)

MINISTRY OF AGRICULTURE
INDIA

# BASIC DESIGN STUDY REPORT

## ON

## THE PROJECT FOR DEVELOPMENT OF QUALITY SEED

## AT

## THE INDIAN AGRICULTURAL RESEARCH INSTITUTE

## IN

## INDIA

APRIL, 1995



JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

PACIFIC CONSULTANTS INTERNATIONAL

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# PREFACE

In response to a request from the Government of India, the Government of Japan decided to conduct a basic design study on the Project for Development of Quality Seed at Indian Agricultural Research Institute and entrusted the study to the Japan International Cooperation Agency (JICA).

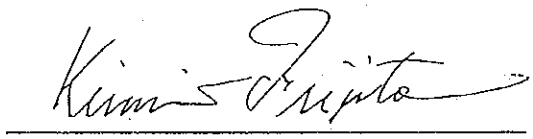
JICA sent to India a study team from January 22nd to February 20th, 1995.

The team held discussions with the officials concerned of the Government of India, and conducted a field study in the study area. After the team returned to Japan, further studies were made, and as a result, the present report has finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of India for their close cooperation extended to the study team.

April, 1995



Kimio Fujita

President

Japan International Cooperation Agency

April, 1995

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Development of Quality Seed at Indian Agricultural Research Institute in India.

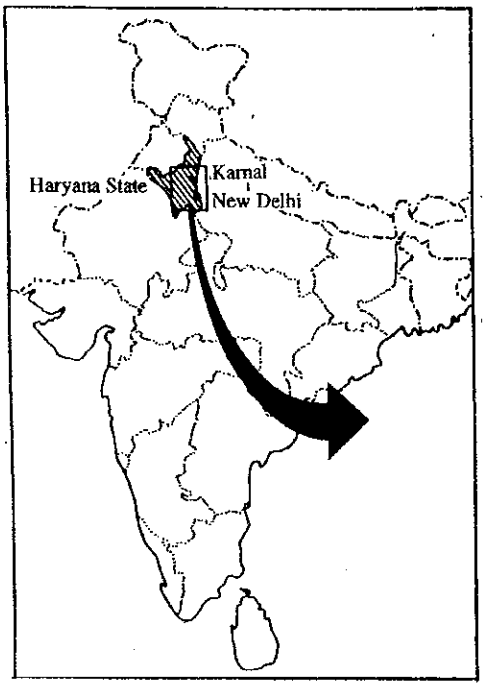
This study was conducted by Pacific Consultants International, under a contract to JICA, during the period December 20th, 1994 to April 28th, 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of India and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

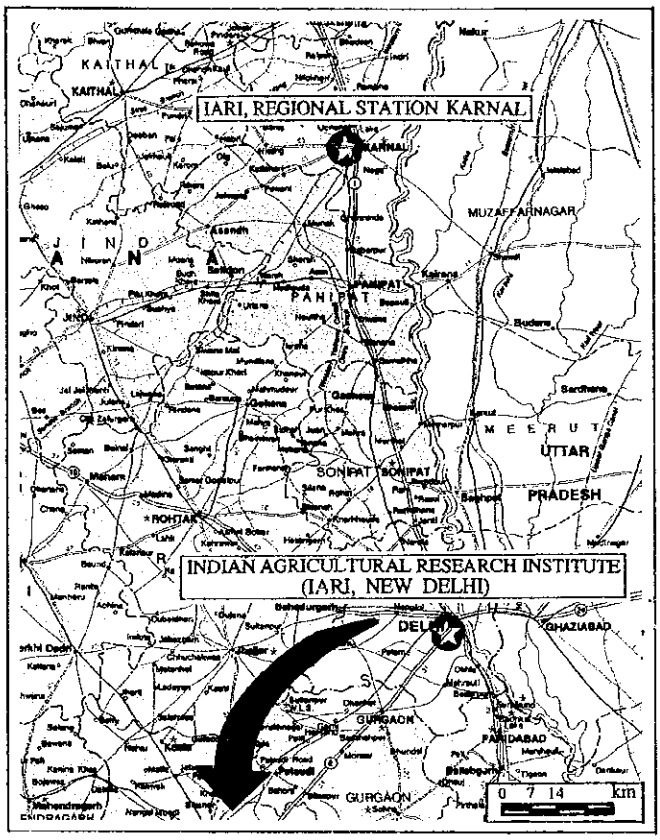
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours.

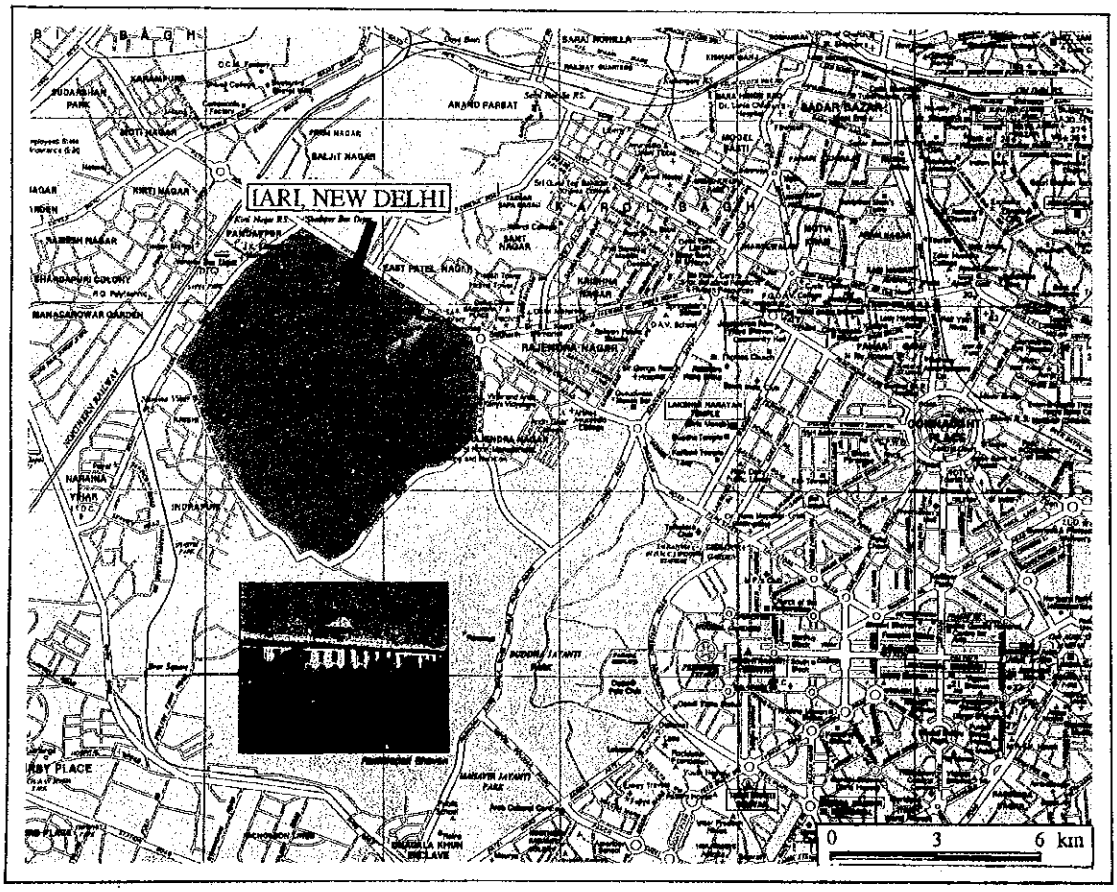
Satoru Kido,
Project Manager
Basic Design Study Team on
Project for Development of Quality Seed at Indian
Agricultural Institute,
Pacific Consultants International

# LOCATION MAP OF PROJECT SITE




LOCATION MAP OF IARI, NEW DELHI



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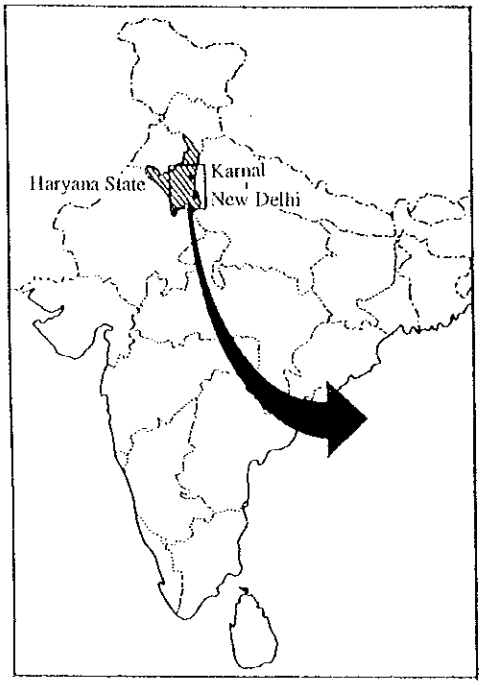



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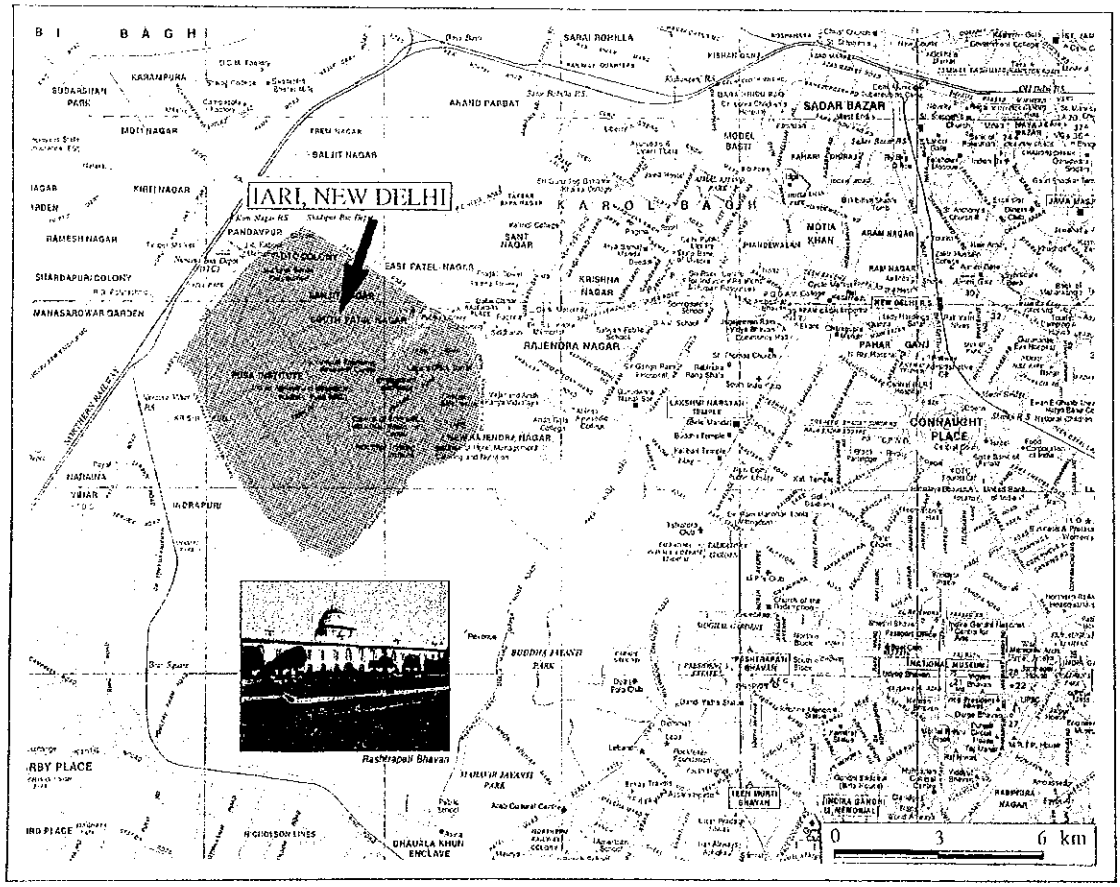

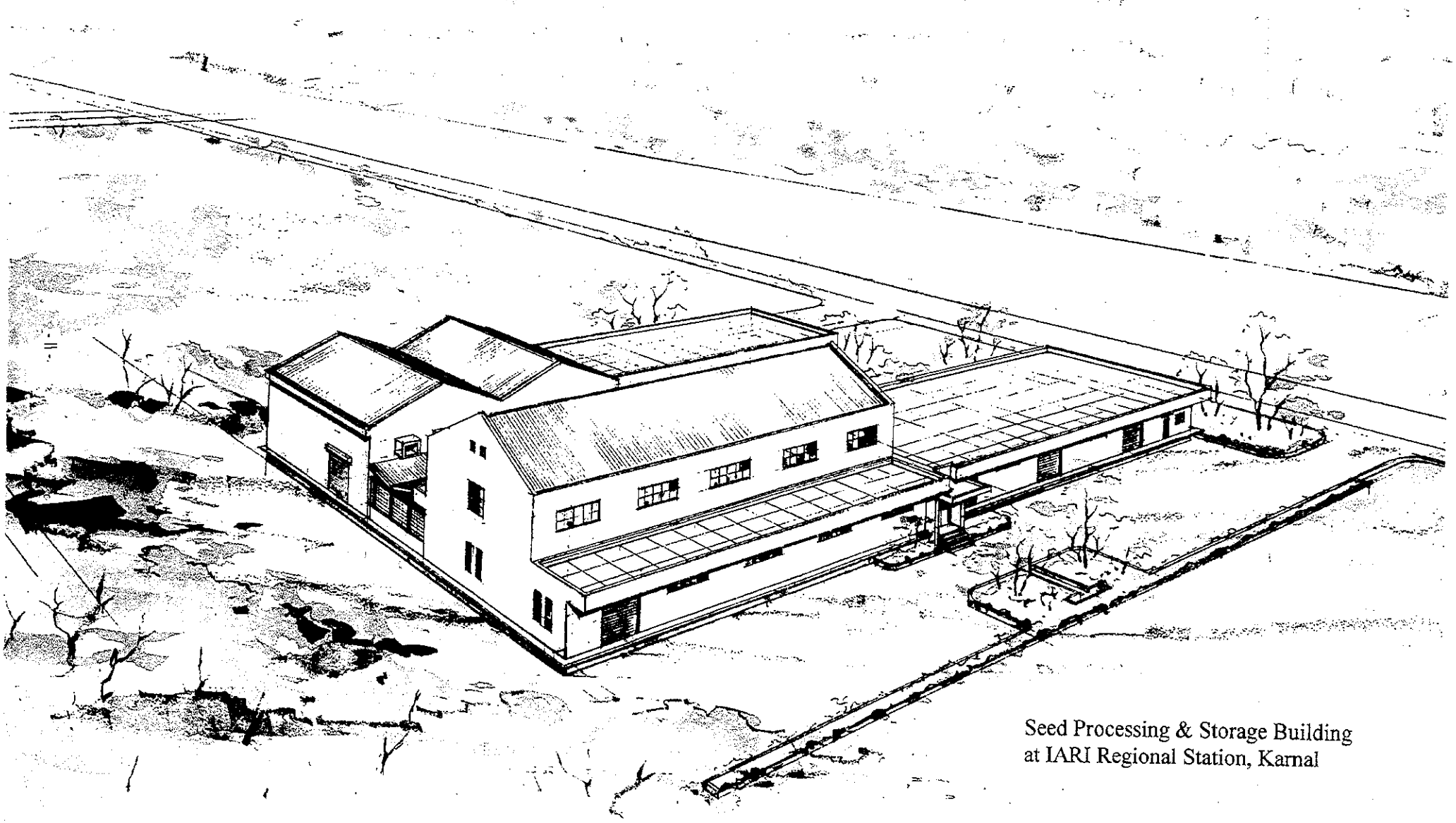

Seed Processing & Storage Building
at IARI Regional Station, Karnal

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Abbreviations

| | |
|---|---|
| B/A | Bank Arrangement |
| DARE | Department of Agricultural Research and Education, Ministry of Agriculture |
| DSST | Division of Seed Science and Technology, IARI |
| DUS | Distinctness, Uniformity and Stability Test |
| E/N | Exchange of Notes |
| IARI | Indian Agricultural Research Institute |
| ICAR | Indian Council of Agricultural Research |
| IS | Indian Standards |
| JICA | Japan International Cooperation Agency |
| NBPGR | National Bureau of Plant Genetic Resources |
| NGO | Non-Governmental Organization |
| ODA | Overseas Development Administration |
| ODA | Official Development Assistance |
| USAID | United States Agency for International Development |

# SUMMARY

## SUMMARY

India's population is projected to reach about 1 billion by 2000 A.D. and it is estimated that a total of 235 million tons of food will be required to satisfy this increasing population. This future food demand is equivalent to an increase of 30% over the current production level (180 million tons). Generally speaking, there are two ways to increase agricultural output, one is to incorporate more land into production and the other is to intensify production per unit of land. So far as India is concerned, the former is less viable because very little virgin land that can be used for agricultural purpose still remains; thus, the Government has to direct its policy to the intensification of land productivity. In this connection, the introduction and diffusion of high yielding and high quality seeds, one of the agricultural inputs that serves to enhance crop productivity, becomes an indispensable task that the Government of India must put into force.

Under the ongoing National Development Plan, the Government of India has placed the attainment of self-sufficiency of food grains as one of the most important policies and , as catalyst to attain this goal, emphasis is laid on the production of high yielding and high quality seeds for distribution to farmers. Quality seeds are generally produced through the following three steps: 1) Collection and preservation of genetic resources of useful plants, 2) Development and research of seed production (including breeder seed), and 3) Multiplication of produced seeds and their distribution to farmers.

With regard to the collection and preservation of genetic resources of useful plants, a project is currently underway with assistance from USAID. Meanwhile, the World Bank has financed several projects for the seed multiplication and distribution program up to date. This seed multiplication and distribution system intensification project, which is the phase III of the program, is presently being implemented. By contrast, no program has been realized concerning the development and research of quality seed (production of breeder seed) in spite of its importance within a series of seed production processes.

Therefore, the implementation of this relevant program constitutes a pressing subject for the Indian Government.

Under these circumstances, the Government of India envisaged making the necessary arrangements to strengthen institutions responsible for the development and research of quality seeds and proceeded to formulate a project aimed at upgrading equipment and facilities for the research and multiplication of seeds at the Indian Agricultural Research Institute (IARI) and at other agencies. However, this project has not put forward due to an absence of appropriate technology to preserve quality and to control storage environment in association with the lack of financial resources. In the phase of this constraint, the Government of India, in order to strengthen quality seed multiplication and distribution system, requested grand aid from the Government of Japan to procure the necessary equipment and facilities for the development and research of quality seed at IARI.

In response to the said request, the Japan International Cooperation Agency (JICA) dispatched a preliminary study mission in August 1994 to confirm the components of the project and to appraise the project's appropriateness and readiness for implementation. The preliminary mission had opportunities to exchange views with Indian officials concerned with the project so as to become acquainted with its concepts and to conduct fact finding in relation to the current situation and future programs on development, research, production, multiplication and distribution of seeds in India as well as on the present conditions of the proposed facilities to be upgraded and capability of the project implementation agency. Following the exchange of views and fact finding, the mission began evaluating the facilities and equipment listed by the Government of India for procurement under the grand aid program of the Government of Japan.

As a consequence of the above-mentioned evaluation, the preliminary study mission identified proposed facilities and equipment to be studied by the Basic Study Team employing the following criteria:

- Facilities and equipment which are indispensable for research, production and preservation of seeds.

- Facilities and equipment which are neither overlapped with those actually possessed by the recipients nor contemplated in bilateral and multilateral assistance projects/programs.

- Facilities and equipment which are added to the list in accordance with the recommendation of the mission.

The equipment and facilities thus identified are:

(1) For the Division of Seed Science and Technology, IARI

1) Seed storage facility for breeding stocks and authentic samples of varieties

2) Seeds research equipment and environment control equipment

Growth cabinet, controlled temperature glass house, seed X-ray unit, electrophoretic system, micro centrifuge, vacuum seed counter, photometer, leaf area meter, laboratory model seed processing machine, digital moisture meter, compound research microscope, ELISA kit, temperature and humidity meter, electronic balance, electronic color sorter, computer set, generator to support seed storage facility

(2) IARI Regional Station, Karnal

1) Breeder and nucleus seed storage facilities

2) Seed processing and packing facility for cereals

3) Seed processing and packing facility for vegetables

4) Seeds research and inspection equipment

Laboratory model seed processing machine, vacuum fumigation chamber, temperature and humidity meter, sample divider, germination chamber, moisture meter

At the time of the preliminary study, the Indian side planned to reconstruct the seed processing and storage unit to receive the facilities and equipment to be procured under the Japanese grant aid program. Nevertheless, as no definite plan including implementation schedule to reconstruct the said unit was presented by the Indian side and that the coordination between both the seed storage and seed processing facilities and the building unit is prerequisite at the detailed design stage, the preliminary study mission offered to include the construction of seed processing and storage unit as part of Japanese grant aid. This offer was supported by the Indian side;thus, so the construction of the seed processing and storage unit becomes part of the present project.

The preliminary study mission concluded that the implementation of the present project under the Japan's grant aid was justified because it would contribute to strengthening the quality seed distribution system in India, and convinced themselves of the necessity to carry out the basic design study.

Pursuant to the confirmation by the preliminary study mission, JICA dispatched the Basic Design Study Team to India from January 22 to February 20, 1995 to conduct the field survey. The Basic Design Study Team had meetings with officials of the Government of India and conducted the field survey so as to confirm the justification and necessity of the project.

The Basic Design Study Team, within the course of their home office work in Japan, reviewed once more the justification of the project on the basis of information and data collected during the field survey, and prepared the basic design of the project including the definite selection of the facilities and equipment for the Japan's grant aid. The fruits of the field survey as well as the home office work are compiled in this Basic Design Report.

The present basic design study has been carried out to formulate the construction and procurement plan for the facilities and equipment which had been identified by both the Japanese preliminary survey mission and the Indian side. In formulating this plan, the consensus reached with the Indian Government and the analytical results on information and data collected during the field survey are duly taken into account. The facilities and equipment, which have been selected by taking into account the budgetary allocation to the Division of Seed Science and Technology (DSST) of the IARI, the number and capacity of existing equipment and facilities, the convenience and cost saving in operation and maintenance, are summarized in Table S-1.

The facilities and equipment will be provided aiming at upgrading seed research, and the processing and storage capacity of the DSST, IARI and IARI Regional Station, Karnal.

The implementation agency of the project shall be the Indian Council of Agricultural Research (ICAR), while IARI shall take charge of the implementation of the project and DSST shall be responsible for the operation and maintenance of the project. After signing the Exchange of Notes (E/N) for the implementation of the project, ICAR shall proceed to recruit necessary personnel at their cost, undertake preservation of breeding stocks and authentic samples of varieties, research on seeds, production and storage of nucleus and breeder seeds production and storage by means of proper management of supplied facilities and equipment, and take charge of the operation and management for adequate functioning of the facilities and equipment.

The overall implementation schedule of the project shall be 15 months; 3 months are assigned to the detailed design and preparation of the tender documents, while 12 months are contemplated for the construction of facilities and the procurement, manufacturing, transport, delivery and installation of equipment.

In implementing this project, it is essential that the executing agency should comply with the matters agreed upon between the Basic Design Study Team and the Indian side. In addition, for the purpose of producing the anticipated benefits of the project, it is recommended that the executive agency of the project should undertake the following items:

(1) As a result of Project execution, quality breeder seeds will be developed. For the effective functioning of the extension of created quality breeder seeds, the strengthening of national seed cooperation, agricultural universities and private seed companies is required for the production and distribution of seeds.

(2) For the self-sufficiency of food, the replacement of seed is very important. For this purpose, it is recommended that high quality IARI seed be produced and distributed directly to the farmers. This will contribute to creating a demand and extension for quality seed.

(3) To use the facility and equipment to be procured under this project efficiently, the strengthening of the operation and maintenance system and budgetary aspect are necessary.

(4) By this project, improvement of the research and breeding of seed will be attained. However, close cooperation with the USAID Project (Collection and conservation of plant genetic resources) and the World Bank Project (Production and distribution of seed) will be required.

(5) Considering that the equipment and facility to be procured under this project are quite

advanced, their utilization for the technical training regarding the processing and storage method are recommended.

The implementation of this project will serve to preserve genetic purity and vigor of breeder seed which is located in the upper part of the multiplication and distribution network of quality seed and, at the same time, will have positive effect on the foundation seed of the next generation and, in turn, on the certified seed to be distributed to farmers. Consequently, this project will contribute not only to achieve one of the governmental policies by increasing food production, but also to ameliorate the living standards of farmers by elevating their farm income.

Summing up, the implementation of the present project under the Japan's grant aid program is justified by the said explanation. Furthermore, it is judged that there will be no major constraint on (the implementation organization) the IARI from the viewpoint of operation and maintenance of the project.

Table S-1 List of Facilities and Equipment

For IARI, New Delhi

| No. | Name | Requested | To be procured |
|---|---|---|---|
| 1. | Seed Storage Facilities for Breeding Stocks and Authentic Samples of Varieties. | 1 | 1 |
| 2. | Growth Cabinet | 1 | 1 |
| 3. | Controlled Temperature Glass House | 1 | 1 |
| 4. | Seed X-Ray Unit | 1 | 1 |
| 5. | Electrophoretic System | 1 | 1 |
| 6. | Micro Centrifuge (Refrigerated) | 1 | 1 |
| 7. | Vacuum Seed Counter | 1 | 1 |
| 8. | Photometer | 1 | 1 |
| 9. | Leaf Area Meter | 1 | 1 |
| 10. | Laboratory Model of Seed Processing Machine | 1 | 1 |
| 11. | Moisture Meter | 2 | 2 |
| 12. | Research Microscope System | 1 | 1 |
| 13. | ELISA Kit | 1 | 1 |
| 14. | Temperature and Humidity Meter | 2 | 2 |
| 15. | Electric Balance | 1 | 1 |
| 16. | Electronic Color Sorter | 1 | - |
| 17. | Generator to Support Seed Storage Facility | 1 | 1 |
| 18. | Computer System | 1 | 1 |

For IARI Regional Station, Karnal

| No. | Name | Requested | To be procured |
|---|---|---|---|
| 1. | Storage Facilities for Breeder and Nucleus Seed | 1 | 1 |
| 2. | Seed Processing and Packing Facility for Cereals | 1 | 1 |
| 3. | Seed Processing and Packing Facility for Vegetables | 1 | 1 |
| 4. | Laboratory Model of Seed Processing Machine | 1 | 1 |
| 5. | Vacuum Fumigation Chamber | 1 | 1 |
| 6. | Temperature and Humidity Meter | 2 | 2 |
| 7. | Sample Divider | 1 | 1 |
| 8. | Germination Chamber | 1 | 1 |
| 9. | Moisture Meter | 2 | 2 |

# CHAPTER 1 BACKGROUND OF THE PROJECT

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## 1.1 Background of the Project

India is the second most populous country in the world with a population of about 850 million. The population in the country is growing at a rate of 2.1% a year and is projected to reach about 1 billion in 2000 A.D.

In the year 2000 A.D. about 235 million tons of food will be needed to aliment this ascending population and there will be a deficit of 55 million tons of food in that year, if the food production level of the country remains as it is at present.

The supply of food in India has been dependent upon the introduction and extension of high-yielding varieties owing to the green revolution, development and improvement of agricultural infrastructures, boosting of grain output (in particular, wheat) brought on by the application of more inputs. Generally speaking, an expansion of the cultivated area in combination with the enhancement of productivity per unit of land is a practical catalyst to achieve an increase of food production. In India's case, an expansion of the cultivated land is less viable because arable lands have almost reached a saturation point covering close to 65% of the total territory of the country. Thus, the government policy to boost food production has to be addressed to the improvement of land productivity and, in this sense, the introduction and extension of high-yielding varieties becomes a subject of immediate enforcement.

The Government of India has formulated several Five Year Development Plans placing the self-sufficiency of food and the amelioration and stabilization of living standards as one of target policies.

The 8th Five Year Development Plan (1992/93-1996/97) is ongoing. In the agricultural development policy of this plan, emphasis is laid on the self-sufficiency of food and the

exportation of agricultural products and processed food. In particular, special attention is paid to the improvement of land productivity in order to count on the food output to satisfy the pressing demands brought on by the expansion of population. As measures for attaining this goal, a consistent supply of inputs (seeds, fertilizers, agro-chemicals and agricultural machinery), the improvement and development of infrastructures (irrigation system, fields level and in-farm roads), the development and extension of advance technology, and the provision of agricultural credit are envisaged. The highest priority within the consistent supply of inputs, is placed on the supply of superior seeds. The "New Policy for the Development of Seeds" is implemented with a view to distribute high quality seeds and to transfer appropriate technology to farmers.

In the field of seed development and production, apart from Indian institutions and agencies, USAID is rendering its technical and financial assistance for the procurement of equipment and the institutional strengthening necessary for the preservation of genetic resources of plants, data processing and plants quarantine at the National Bureau of Plant Genetic Resources (NBPGR), while World Bank's assistance covers the strengthening of the integrated network for seed multiplication and distribution.

In India, seed production and distribution process is represented by three steps: collection and preservation of useful plants, development and research on seed production (including breeder seeds), and the multiplication of quality seeds and their distribution to farmers. And, with regards to development and research of quality seeds, the Government of India has planned to provide the necessary facilities and equipment to upgrade research and multiplication of seeds at the Indian Agricultural Research Institute (IARI), the Govind Ballabh Pant University of Agriculture and at the Technology and Tamil Nadu Agricultural University so that they may adequately undertake such services as the preservation of nucleus reproductive substances, the production of quality seeds, and the production and preservation of nucleus and breeder seed. Despite the effort, this plan has not borne fruit. The said facilities and equipment were not procured due to the absence of appropriate technology for a quality storage environment to preserve seeds for long period in association with the lack of financial resources. To overcome this bottleneck, the

Government of India, as a first phase of the program, requested the Government of Japan to upgrade the facilities and equipment at the IARI.

In response to this request, the Japan International Cooperation Agency (JICA) dispatched a preliminary study mission in August 1994 to ascertain the background, priority, justification, components and implementation arrangements of the Project together with multilateral and bilateral aided programs and projects. The preliminary study mission could clarify the concept of the project through discussions with relevant Indian officials and make fact-finding in connection with the actual situation and future programs on development, research, production, multiplication and distribution of seeds in India, socio-economic and physical conditions of the study area, capacity and organization of the project executive agency, etc. Based on these discussions and fact-findings, the preliminary study mission examined facilities and equipment requested by the Government for grant aid. As a consequence of these tasks, the mission concluded that the implementation of the basic design study for the project under the Japan's grant aid program is justifiable in view of upgrading the quality seed system in India.

Pursuant to the conclusion of the preliminary study mission, JICA decided to realize the basic design study under the grant aid program and, accordingly, dispatched the study team to conduct field surveys in India from January to February 1995.

The information and data collected in the course of the field surveys served to make the home office analysis in Japan which aimed at clarifying the justification and benefits of the project and to formulate the most feasible plan for facilities and equipment to be procured under Japan's grant aid program. The summary of these studies and analyses are compiled in the present Basic Design Report which includes, among others, the basic design, procurement plan and preliminary cost estimation for facilities and equipment.

## 1.2 Outline and Major Components of the Project

### 1.2.1 Outline of the Project

The Government of India requested developing seed research, production and storage facilities for the Indian Agricultural Research Institute (IARI) and nominated the Department of Agricultural Research and Education (DARE) of the Ministry of Agriculture and the Indian Council of Agricultural Research (ICAR) as the implementing agencies of the Project. The project sites are located at the Division of Seed Science and Technology and the at Regional Station, Karnal, both of which belong to the IARI.

The short and medium-terms objectives of the Project are as follows:

(1) Short-term Objectives

1) Increase production of nucleus and breeder seeds

2) Storage of nucleus and breeder seeds under controlled conditions

3) Research on seed deterioration

4) Seed drying and packing in hermetically sealed containers (particularly vegetable seeds)

5) Standardization of techniques for hybrid seed production in general and vegetable production in particular

6) Training of scientists and technicians involved in seed technology research/production/processing/storage

(2) Medium-term Objectives

1) To check the genetic shift of variety by storage of seed for medium-term (5-10 years)

2) Use of nucleus and breeder seed to improve quality production and the availability of foundation and certified seed to the seed industry and farmers for increasing food production

3) To improve the research capabilities of scientists by advanced training in the discipline of seed science and technology

The facilities and equipment requested by the Government of India are as follows:

For the DDST, New Delhi

- Seed Storage Facility for Breeding Stocks and Authentic Samples of Varieties
- Equipment for Research and Environment Control

For the IARI Regional Station, Karnal

- Storage Facility for Breeder and Nucleus Seed
- Seed Processing Facilities for Cereals and Vegetables

1.2.2 Major Components

During the preliminary study the following research items were confirmed as being appropriate to be involved in the present Project.

1. Characterization of varieties of wheat, rice, soybean, mustard, pearl millet, soybean, castor and mung bean.
2. Improvement of seed storability for rice, soybean, sunflower, onion, maize and cole crops seeds

3. Seed-borne diseases and their management in rice, wheat, pearl millet and soybean

4. Post-harvest handling and management of seeds of cereals, pulses, oilseeds and vegetables for efficient packaging, storage, treatment and sowing.

The preliminary study team has taken up facilities and equipment to be procured under Japan's grant aid in accordance with the following criteria :

- Facilities and equipment which are indispensable for research, production and preservation of seed; some equipment was added by recommendation of the study team although they are not contemplated to be added to the list requested by the Government of India

- Facilities and equipment which are not actually in the possesion of by the recipients, with the exception of such equipment which are recommended to be provided more than one unit as they are required to be replaced for having significant physical deterioration and having wide range of utility

- Facilities and equipment not overlapping those included in the programs/projects assisted by the World Bank (Except for research equipment to be used for the Central Seed Inspection Office)

This appraisal is resumed in the Table 1-1.

The equipment and facilities thus identified are:

(1) For the Division of Seed Science and Technology, IARI

1) Seed storage facility for breeding stock and authentic samples of varieties
2) Seed research equipment and environment control equipment

Growth cabinet, controlled temperature glass house, seed X-ray unit, electrophoretic system, micro centrifuge, vacuum seed counter, photometer, leaf area meter, laboratory model seed processing machine, digital moisture meter, compound research microscope, ELISA kit, temperature and humidity meter, electronic balance, electronic color sorter, computer set, generator to support seed storage facility

(2) IARI Regional Station, Karnal

1) Breeder and nucleus seed storage facilities
2) Seed processing and packing facility for cereals
3) Seed processing and packing facility for vegetables
4) Seeds research equipment

Laboratory model seed processing machine, vacuum fumigation chamber, temperature and humidity meter, sample divider, germination chamber, moisture meter

At the time of the preliminary study, the Indian side planned to reconstruct the seed processing and storage unit to receive the facilities and equipment to be procured under the Japanese grant aid program. Nevertheless, as no definite plan for including the implementation schedule to reconstruct the said unit was presented by the Indian side and that the coordination between both the seed storage and seed processing facilities and the building unit is prerequisite at the detailed design stage, the preliminary study mission offered to include the reconstruction of the seed processing and storage unit as part of the Japanese grant aid. This offer was supported by the Indian side, so the reconstruction of seed processing and storage unit becomes part of the present Project.

# CHAPTER 2 CONTENTS OF THE PROJECT

# CHAPTER 2 CONTENTS OF THE PROJECT

## 2.1 Objectives of the Project

The Indian Government has set an important target on self-sufficiency of food to cope with its population increase. To play this important role, an increment of food supply through agricultural products is urgently required.

Analyzing the successful green revolution that took place in the 60's, one of the important factors for the increment of agricultural products was the extension of high yield and high quality seeds. Since then, it is said that the strengthening of a system for the production and distribution of quality seed is desirable.

The objectives of this Project are to support the Indian Agricultural Research Institute, in relation with seed research and production, through the construction of facilities and the procurement of equipment to improve the investigation of new variety seeds, processing and storage for the nucleus and breeder seeds. By the execution of this Project, the elevation of seed science and technology standards will be realized through education and training of seed producers, processing and storage. Furthermore, it will contribute to the strengthening of the organization and system of seed research and production.

The project site is divided into two sites: DSST New Delhi and Regional Station, Karnal. In DSST New Delhi, the Project consists of the construction of a storage facility for the active breeding stock and authentic samples of varieties, and the procurement of laboratory equipment. For Regional Station Karnal, the Project includes the construction of a processing and storage building with nucleus and breeder seed storage facilities, and the procurement of equipment for cereal and vegetable seed processing and packing equipment.

## 2.2 Project Concept

In order to achieve the Project objectives, an analysis of the facilities and equipment requested by the Indian Government was carefully made. As the shares of the IARI breeder seed production in India are 11.8 % of wheat, 3.9 % of rice and 6.4 % of sorghum, the project's influence on seeds production is highly anticipated.

By 2000 A.D., the Indian population will be one billion. To support this huge population, the production quantities of food grains and seeds are predicted to increase. Based on this prediction, seed production programs are established for each seed producer with each plant and seed variety. For the Regional Station Karnal, the breeder seed production program was established based on the 2000 A.D. requirements. It is assumed that this seed production quantity will be achieved through the provision of farm machinery by the World Bank Project. Considering these factors, the foreseen seed production quantity for 2000 A.D. will be employed for determining the scale of the seed processing and storage facilities.

The existing equipment for cereal and vegetable seed processing in Regional Station Karnal is quite old and requires complete renewal. In the analysis of the optimum processing facilities, it is considered that the harvest periods of the breeder seeds are limited; thus, the processing periods are also limited to avoid the seed inferiority. Taking into account this time limitation, the capacity of 1.0 to 1.5 ton/hour for the cereal processing line is recommended. For the vegetable processing facility, the processing quantities of each seed is small, so that the small-scale processing equipment is set individually.

Seeds storage facilities are requested for DSST New Delhi and Regional Station Karnal as well since the existing storage facility in the latter has insufficient storage capacity and inadequate seed storage condition. Therefore an increase in capability and facility improvement are urgently requested.

There are two kinds of storage facilities in Regional Station, Karnal: a normal temperature storage room for short-term preservation and a low temperature storage

facility for buffer stock and carry-over stock preservation. The storage amounts for the buffer stock and carry over stock are decided upon based on the foreseen 2000 A.D. production, which is considered to be 32 tons and 12 tons respectively. For the normal temperature storage, the storage amount for cereal seeds and pulse and oil seeds are established at 80 tons and 30 tons respectively.

On the other hand, the vegetable seed storage amount is determined by taking into consideration a three year production amount, and the future buffer stock and its consumption. Thus, a total of 4 tons of seeds will be stored in the low temperature storage.

Based on the 2000 A.D. production at future increment amounts, 10 tons of nucleus seeds will be stored in this low temperature storage.

In DSST New Delhi, two types of seeds are stored in the reconstructed facilities (the laboratory shall be transformed into a low temperature storage): 3.3 tons of 20 thousand varieties of active samples and 700 kgs of authentic seeds for DUS testing and stock for obligation to new breeding seeds for seven years storage.

As a result of the analysis on the requested seed laboratory equipment, it is judged to be adequate, because of the mentioned reasons to achieve its objectives, the four research programs, in conformity with the existing equipment and availability of supplies, such as reagents, in the local market.

Regarding the plan of the new building in the Regional Station Karnal, it is considered to be appropriate to provide the alignment and layout of the cereal seed processing facility, vegetable seed processing equipment, storage of nucleus and breeder seeds, office space, mechanical equipment room, spare parts and parts storage, and a space required for trainees and visitors. As a result of the analysis, the new processing and storage building is designed as a one-story house with 1,125 $m^2$ of inner floor area and 315 $m^2$ of outer floor area.

This Project aims at providing the building facility and equipment needed for seed

research, processing and storage of nucleus and breeder seeds produced by IARI. Furthermore, it will strengthen the structure of the flow of seeds, such as nucleus seeds, breeder seeds, foundation seeds and certified seeds in India, being a seed processing and storage facility model. Therefore, the strengthening of research activities in IARI through this Project will definitely contribute to the quality of seed production and distribution in India.

## 2.3 Basic Design

### 2.3.1 Basic Design Concept

The facilities, building, and equipment proposed in the Project will be designed based on the following concepts while taking other factors into account, such as natural and social conditions of India, construction period, construction and procurement conditions, special characteristics of the Project and the system of Japan's Grant Aid Assistance:

(1) The plan shall suit the natural conditions of New Delhi and Karnal area.
(2) The facilities and equipment shall be designed in accordance with the technical and management capabilities of the implementing agency.
(3) The facilities and equipment shall be designed subject to the utilization of existing facilities and equipment.
(4) The construction work plan shall be appropriate to the skill level of local labors.
(5) The construction materials shall be procured from local manufacturers as much as possible on the condition that their quality, quantity and price are appropriate.
(6) The facilities and equipment shall be designed to minimize the work and cost for maintenance.

### 2.3.2 Study on the Precondition for Basic Design

(1) Study on the Seed Production Plan at Regional Station Karnal

Seed production during 1989 - 1993 and the production plan for 2000 A.D. are

shown in Figure 2-1, Table 2-1.

The average of total seed production for 5 years is 168 tons. The fluctuation of annual production is within the range of 40 - 60 tons for the last 5 years. This fluctuation was caused mainly by the fluctuation of wheat production ,while the production of other crops was relatively stable.

It is planned to increase the total production up to 262 tons by 2000 A.D. As compared with the largest production during the last 5 years, this is only an increase of 50 tons. In addition, farm and irrigation machinery shall be procured under the National Seeds Project-III with World Bank's assistance. Considering these circumstances, the production target in 2000 A.D. is judged as being feasible enough.

IARI has been producing three types of seed: nucleus seed; breeder seed; and IARI seed. In the production plan, the increase of IARI seed production is planned to be larger than the increase of nucleus seed and breeder seed, especially in wheat and paddy seed. IARI seed is produced with an aim at new variety extension and knowledge extension about "high quality seed" among farmers. IARI seed has higher genetic purity than certified seed which is produced under the normal seed multiplication system. Because IARI seed is produced with the similar husbandry method of breeder seed production, its quality is maintained by IARI following the seed quality standard of the certified seed.

The advantages of IARI seed are as follows :

- Extension service of new variety can be started three years in advance compared with certified seed distribution in the normal multiplication system.
- Quality of the seed is high (genetic, vigor and purity).

In India, the seed replacement rate for major crops is estimated at approximately 5%. Especially, wheat and paddy seeds have a lower replacement rate and it is considered essential to increase the replacement rate in order to increase national food production.

Considering the aim and advantages of IARI seed, it is judged that increasing IARI seed production and extending the knowledge about "high quality seed" directly to farmers shall be a useful measure for increasing the seed replacement rate.

With consideration of the feasibility of the production target and the propriety of seed types, the seed production plan of 2000 A.D. is judged to be appropriate for used in determining the facility scale and equipment ability in this Project.

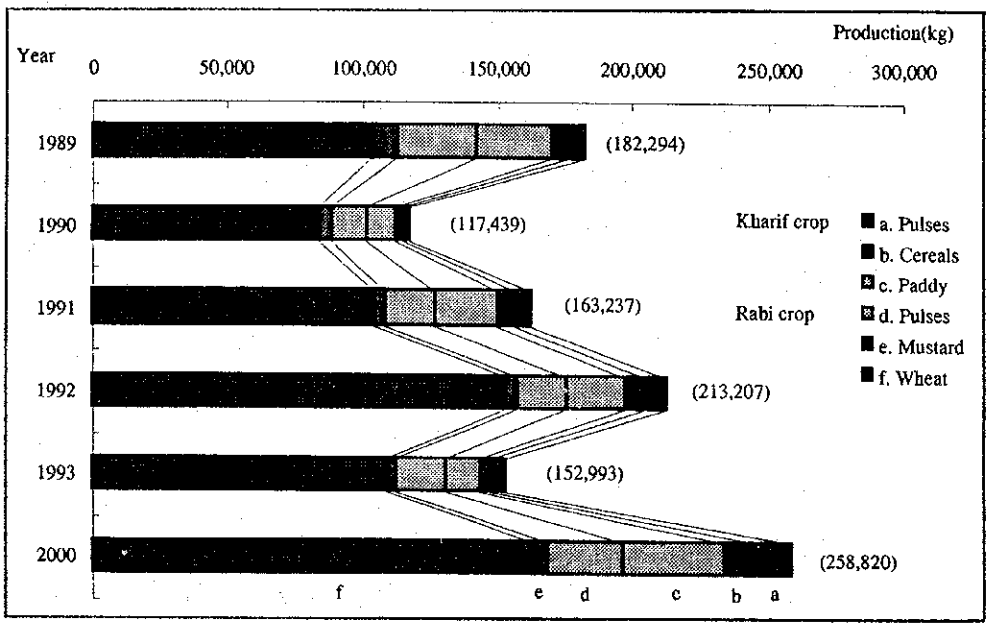



Fig 2.1 Seed production during 1899 - 1993 & 2000

Table 2.1 Production Plan of Major Seeds in 2000 A.D.

| | Nucleus Seed | | Breeder Seed | | IARI Seed | | Total | |
|---|---|---|---|---|---|---|---|---|
| | A(Kg) | B | A'(ton) | B | A(ton) | B | A'(ton) | C |
| Wheat | 5,000 | 10 | 88.0 | 20 | 70.0 | 15 | 163.0 | 45 |
| Paddy | 125 | 5 | 7.2 | 4 | 30.0 | 10 | 37.33 | 19 |
| Maize | --- | -- | 0.4 | 4 | 0.5 | 4 | 0.90 | 8 |
| Sorghum | 150 | 4 | 3.6 | 4 | 7.5 | 3 | 11.25 | 11 |
| Bajra | --- | -- | 0.16 | 2 | 0.1 | 2 | 0.26 | 4 |
| Triticale | --- | -- | 0.16 | 1 | 0.5 | 1 | 0.66 | 2 |
| Gram | 150 | 3 | 12.0 | 8 | 6.0 | 2 | 18.15 | 13 |
| Peas | 300 | 3 | 5.6 | 3 | 3.0 | 3 | 8.90 | 9 |
| Pigeon peas | 150 | 3 | 0.8 | 3 | 3.0 | 3 | 3.95 | 9 |
| Cowpeas | 50 | 1 | 2.4 | 3 | 1.0 | 2 | 3.45 | 6 |
| Mung beans | 100 | 2 | 4.0 | 3 | 3.0 | 2 | 7.10 | 7 |
| Lentils | --- | -- | 0.4 | 2 | 0.6 | 2 | 1.00 | 4 |
| Soy beans | --- | -- | 0.4 | 2 | 0.5 | 2 | 0.90 | 4 |
| Mustard | 20 | 2 | 0.6 | 2 | 5.0 | 3 | 5.62 | 7 |
| Total | | | | | | | | |

Remarks : A = production
A'= Production (exclude quantity for buffer stock)
B= no. of variety C= no. of lots

(2) Study on Seed Processing Plan at Regional Station Karnal

The determination of appropriate ability and selection of necessary equipment shall be done based on the conditions described below :

- to improve seed quality
- to avoid duplication with existing equipment
- to set the ability of equipment in accordance with the 2000 A.D. production plan.

1) Study on existing equipment

As confirmed in the preliminary study, the existing equipment of seed processing for major crops, including vegetables, are reconfirmed as being necessary to replace because of their poor performance.

2) Study on expected workload for cereals seed

After careful study of the cropping system and the processing schedule (shown in Figure 2.2), it is judged that the appropriate ability of seed processing equipment for cereals (including pulse and oil seeds) shall be determined according to the quantity of wheat seed.

Following are the conditions for calculating the processing rate per hour for wheat seed in 2000 A.D. These conditions are set by taking the production data of 1993 and the processing practices at present into account.

| | |
|---|---|
| - wheat seed production in 2000 A.D. | : 163 tons, 45 lots |
| - object of processing | : more than 500 kg per lot |
| - seed amount with more than 500 kg/lot * | : 161 tons, 38 lots |
| - period of processing | : 45 days |
| - hours for cleaning equipment | : 3 hrs./lot |
| - hours for operating equipment | : 6 hrs./day |

* estimated by referring to 1993 production data

161 tons ÷ {(45 days × 6 hrs.) − (3 hrs. × 38 lots)} = 161 ÷ 156 = 1.03 tons/hr

With surplus ability, 1.0~1.5tons/hr is judged as being the appropriate ability of equipment.

Paddy, sorghum, triticale, gram, peas, pigeon peas, cowpeas, mung beans and mustard seed are also planned as objects of processing with the equipment. Total amount of processing seed is estimated as 246 tons, 81 lots in 2000 A.D.

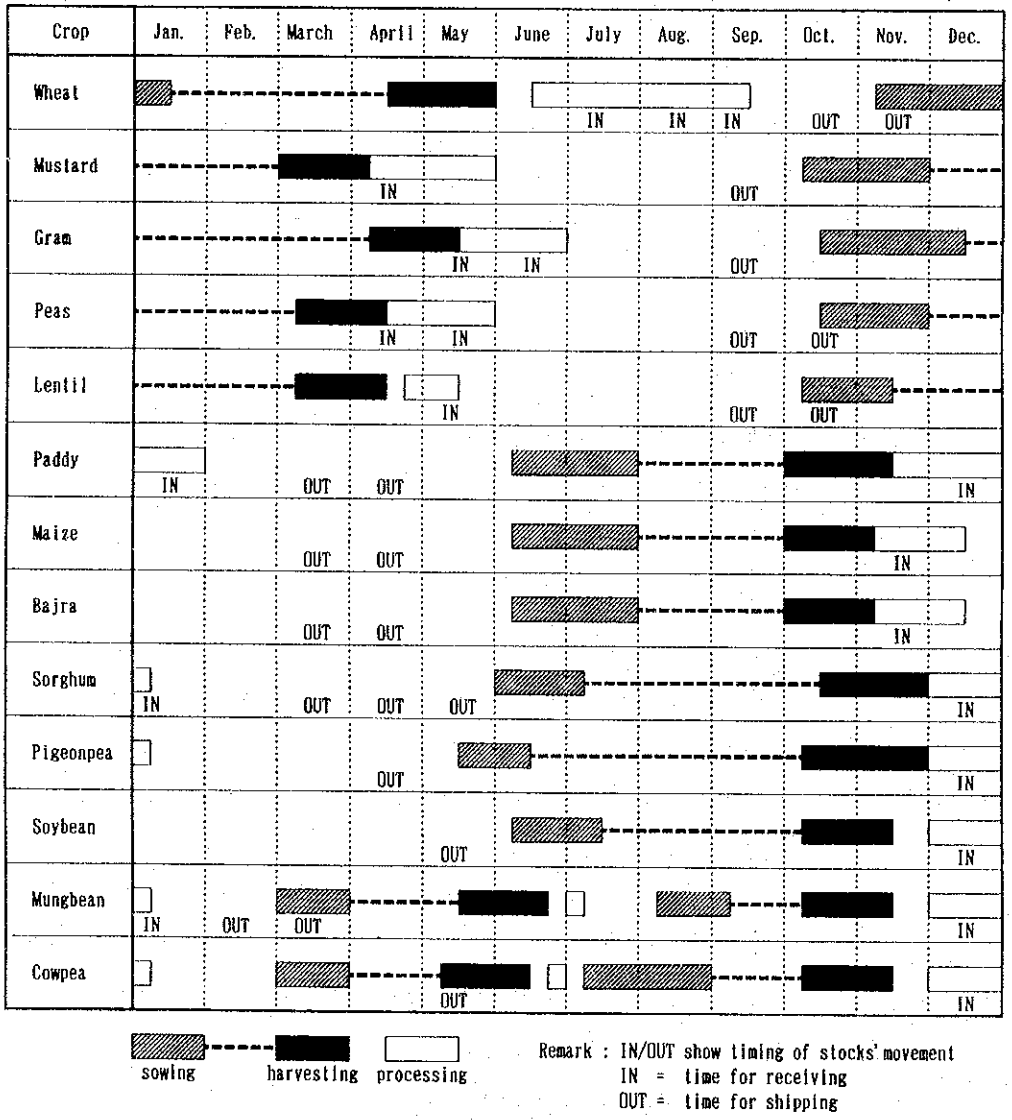



Fig. 2.2 Cropping System of Major Crops

3) Study on processing method for cereal seeds

Considering the work load, the conditions of post harvest seed and present processing customs, the flow diagram of cereal seed processing is designed as follows:

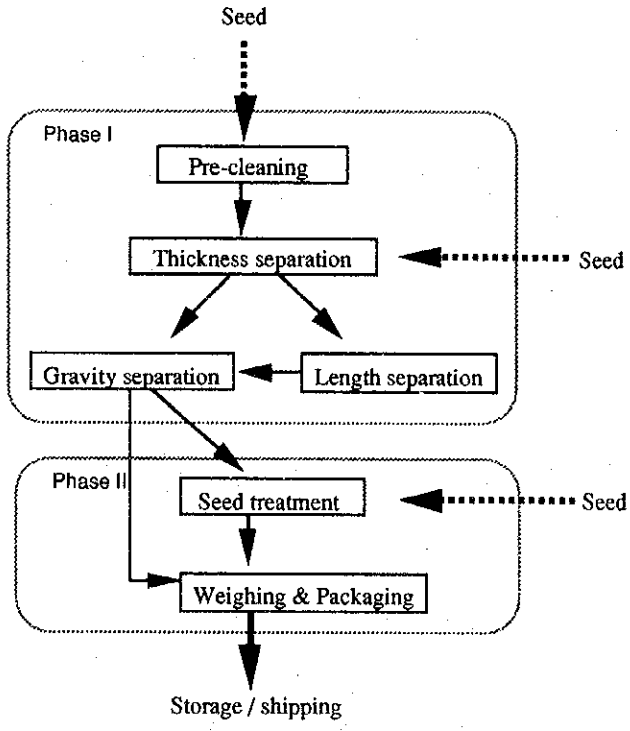



Fig. 2.3 Processing Flow Diagram

4) Study on vegetables seed processing

The vegetable seeds produced in Regional Station Karnal have a wide variation but each quantity is limited. Vegetable seed production in 2000 A.D. shall be set at 3 tons based on the production over the past few years.

Considering the expected work load and types of existing processing equipment, it is judged as being appropriate to utilize the small-size processing machine that is normally used in laboratory for testing purposes, in accordance with the physical characteristics and post harvest conditions of seeds.

(3) Study on Seed Storage Plan at Regional Station Karnal

The scale and types of storage facilities shall be determined based on the conditions described as follows;

- to maintain seed quality during storage, especially to reduce the damages caused by insects
- to reserve an adequate amount of buffer stocks
- to reduce the cost of electricity
- to secure adequate storage conditions in accordance with seed type and storage period
- to set the scale of storage in accordance with the 2000 A.D. production plan

1) Study on Seed Storage Problems

Seed storage problems in Regional Station Karnal are summarized as follows:

a. Shortage of storage capacity

- During the period of wheat harvesting and its processing, the amount of seed to be stored is maximum. During this period, some of the seeds are stored outside covered with vinyl sheets. This inadequate storage causes deterioration of the seed quality due to rain and increases the chances of insect infestation.

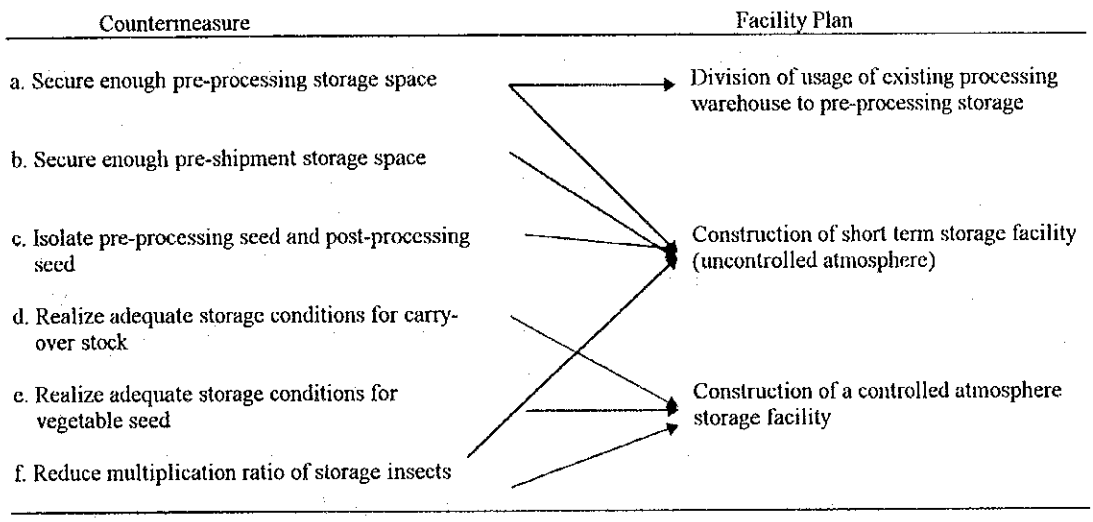
- During the maximum storage period, the processing warehouse is filled with stacks of bagged seed. This situation interrupts smooth seed processing work.

- The post-processing seed and the pre-processing seed are stored in the same storage space. This situation increases the chances of insect transmission.

b. Inadequate storage conditions

- Although the existing storage is equipped with a small air-conditioning unit in each room, it is difficult to realize adequate storage condition because the building structure makes it impossible to cut off the inflow of outside air into the storage area. During the rainy season, high temperature and high humidity lead to an increase of seed moisture content and damage by storage insects.

Considering the above, it is deemed necessary to take the following countermeasures to improve the present situation in Regional Station Karnal:




2) Study on appropriate scale of seed storage

The following conditions are being set up for calculating the appropriate scale of seed storage based on the 2000 A.D. planned seed production by taking into account such factors as the production data of 1993, the operating schedule of seed production / processing and past monthly inventory data.

- Assume that the annual leftover seed stock resulting from overproduction, no lifting due to changes of receivers' needs, etc. is set

at 10% of the planned production.

- Assume that the buffer stock is 25% of the planned production for cereal, pulse and oil seeds , and 50% for vegetables.

(Note 1) The annual carry-over at Regional Station Karnal resulting from overproduction and accumulation of leftover becomes a rather large quantity of 60 - 70 tons compared to the current seed production of 150 - 200 tons. While nucleus seed and breeder seed are estimated as overproduction in India, the Ministry of Agriculture will execute severe administrative guidance to the receivers who deny lifting the whole ordered quantity of seed. The Ministry will suspend seed supply to such receivers in order to achieve more accurate ordering matched with the demand and to reduce unnecessary production and carry-over. As the result of executing the guidance, the reduction of carry-over of seed stock is forecasted at the Karnal Regional Station.

(Note 2) In the buffer stocking scheme of seeds, the producers' task to achieve seed stock is as follows:

| | |
|---|---|
| Breeder Seed | x 50% |
| Foundation Seed | x 25% |
| Certified Seed | x 10% |

However, the executing agency for the Project requested that the breeder seed buffer stock of cereal and pulse be set at 25% with consideration of storage cost and no liftings.

- According to the rate shown below, adjust the seed quantity to be stored which is calculated from seed production plan in 2000 A.D. considering the trend of seed production in the further future.

| | | |
|---|---|---|
| Breeder Seed | : Wheat, Pulses | - 10% |
| | : Vegetables | + 10% |
| Nucleus Seed | : All crops | + 10% |

a. Short-term Storage (storage after processing till shipping)

As shown in Figure 2.4 "Seed Stock of Major Crops at the End of Each Month", the maximum seed stock in a year appears at the end of September when the processing of wheat seed is completed.

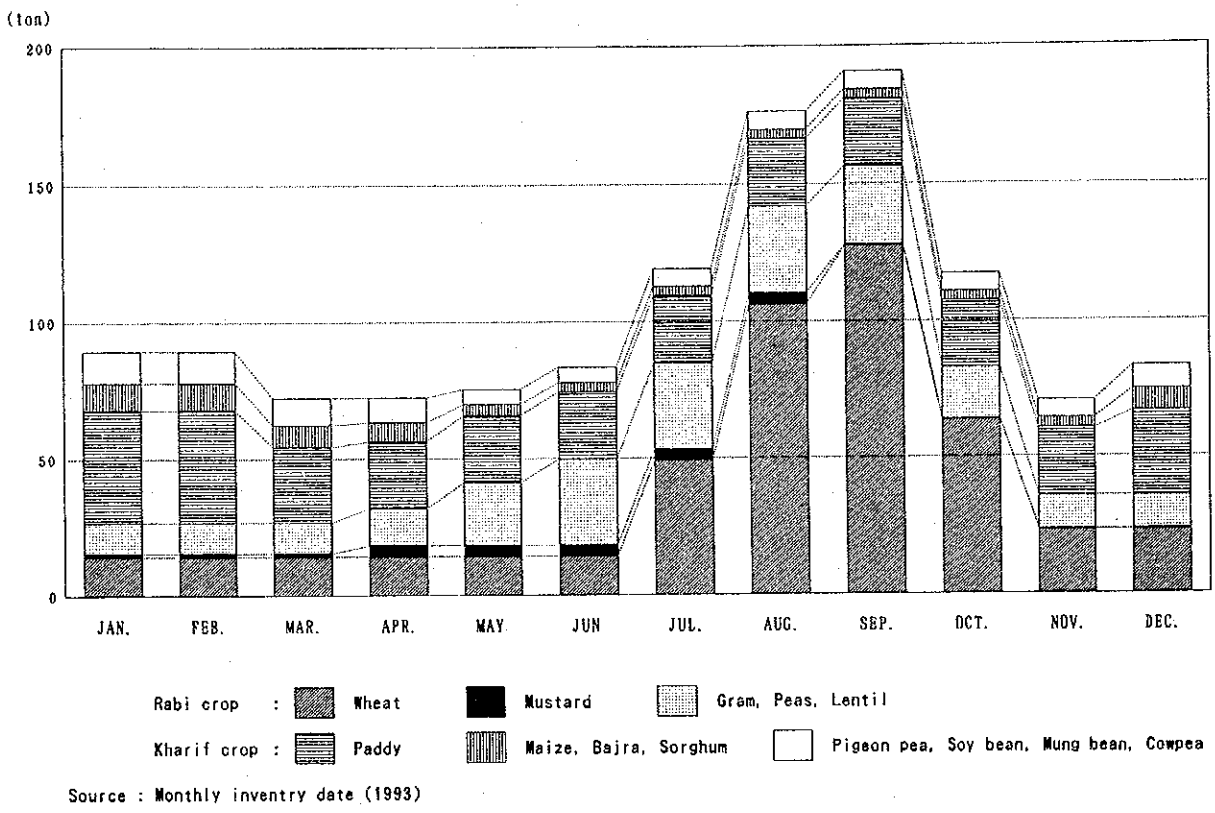



Figure 2.4 Seed Stock of Major Crop at the End of Each Month

Considering the timing of stock and shipment, the maximum stock of short-term storage seed is calculated as follows :

Maximum Stock = Wheat Seed Production + Seed Production of Rabi Crop ( Mustard, Gram, Peas, Lentil)

(Note) Wheat : July - Sep. stock / Oct. - Nov. shipment
Rabi-period Crop : Apr. - July stock / Sep. - Oct. shipment

The planned seed production in 2000 A.D. for each crop is as follows :

Table 2.2 Production Plan of Wheat and Rabi Crop Seeds ( year 2000 )
( unit : ton )

| Crop | Breeder seed | IARI seed | Total |
|---|---|---|---|
| Wheat | 88.0 | 70.0 | 158.0 |
| Gram | 12.0 | 6.0 | 18.0 |
| Peas | 5.6 | 3.0 | 8.6 |
| Lentil | 0.4 | 0.6 | 1.0 |
| Mustard | 0.6 | 5.0 | 5.6 |
| Total | 106.6 | 84.6 | 191.2 |

As the existing storage is used for storing wheat of IARI seed, the shortage of capacity will be 88 tons for wheat and 33.6 tons for pulse and oil seeds. Accordingly, these figures are adjusted to 80 tons for wheat and 30 tons for pulse and oil seeds.

b. Storage of Carry-Over Stock

It is assumed that 25% of the buffer stock of breeder seed, 10% of leftover due to overproduction and no lifting shall be accounted for as the carry-over stock.

| | | |
|---|---|---|
| Wheat | 88.0 | |
| Paddy | 7.2 | |
| Maize | 0.4 | Cereals total : 99.36 x (25 + 10)% = 34.8 tons (35 tons) |
| Sorghum | 3.6 | |
| Bajra | 0.16 | |
| Triticale | 0.16 | |
| | | |
| Gram | 12.0 | |
| Peas | 5.6 | |
| Pigeon peas | 0.8 | |
| Cowpeas | 2.4 | Pulses and Oil Seeds total : 26.2 x (25 + 10)% = 9.17 tons (10 tons) |
| Mung beans | 4.0 | |
| Lentil | 0.4 | |
| Soybeans | 0.4 | |
| Mustard | 0.6 | |

c. Storage of Vegetables Seed

Due to the 2000 A.D. production plan for each crop not being released, the seed production in 2000 A.D. is set to be 3 tons (including buffer stock) based on the production over the past few years.

Additionally, for onions, carrots, cauliflower and radish it is planned to produce the necessary quantity of seeds for 3 years one time. The quantity of these seed is calculated to be 0.5 ton based on 1993 production data. Accordingly, the storage quantity of vegetable seed is adjusted to 4 tons.

d. Storage of Nucleus Seed

The quantity of seed production in 2000 A.D. is 6,045 kg including buffer stock. The storage quantity of nucleus seed is adjusted to be 10 tons in consideration of adding additional quantities because it becomes possible to store seeds for a few years production immediately after facilitating the low temperature storage in this Project.

3) Study of Storage Conditions

Regarding the storage temperature and humidity condition, the storage conditions are set after the object crop and purpose/duration of storage were studied based on the data related to the seed storage and the conditions of similar facilities. Then, in order to reduce the cost of electricity, the possibility of introducing moisture-proof containers is judged in consideration of the storage quantity and the work load of drying seed before packing into moisture-proof containers.

As a result of the study of the Project scale and its conditions, the storage facility plan is summarized as follows:

a. Nucleus Seed Storage Facility

| | |
|---|---|
| Capacity | :10 tons |
| Condition | :15° C, RH 30% |
| Container | :Paper Bag, Cloth Bag, Moisture-proof Film Bag (partial) |
| Max. Period | :approx. 3 years (vary for each crop) |

b. Breeder Seed Storage Facility

- Short-term storage

| | | |
|---|---|---|
| Capacity | : Wheat | 80 tons |
| | : Pulses / Oil Seeds | 30 tons |
| Condition | : Natural temperature (uncontrolled atmosphere) | |
| Container | : Cloth Bag | |
| Max. Period | : 6 - 7 months | |

- Storage of carry-over stock

| | | |
|---|---|---|
| Capacity | : Left Over Stock | 13 tons |
| | : Buffer Stock | 32 tons |
| Condition | : 20° C, RH 40% | |
| Container | : Cloth Bag | |
| Max. Period | : 1 year | |

- Vegetable seed storage

| | |
|---|---|
| Capacity | : 4 tons |
| Condition | : 15° C, RH 30% |
| Container | : Paper Bag, Cloth Bag, Moisture-proof Film Bag (partial) |
| Max. Period | : approx. 3 years (varies for each crop) |

(4) Study on Fumigation Plan at Regional Station Karnal

The purpose of utilizing a vacuum chamber for Methyl Bromide(CH3Br) fumigation requested in the Project is to exterminate Lesser Grain Borer which are resisting PH3 fumigant in increasing number. Procuring the fumigation equipment is deemed appropriate for the Project. The fumigation shall be conducted before shipping seed lots in which the insects failed to be exterminated in spite of several applications of PH3. Also, the quantity of seed to be fumigated is limited to 1.5 ton at one time.

The problems of storage insects occurring in Karnal Regional Station is closely related to the conditions of storage facilities. Therefore, it is necessary to take countermeasures throughout the steps of seed production, not only to exterminate insects by fumigation but also to prevent the infestation and reproduction of insects.

(5) Genetic Material Preservation Plan

The genetic material preservation plan which shall be conducted at DSST in New Delhi is as follows:

1) Active Breeding Stock

Presently, active samples for daily use are maintained and managed at each breeding unit in IARI. In this plan, the approximately 20 thousands active samples will be totally stored and managed by DSST under appropriate conditions in order to prevent deterioration of genetic purity due to seed reproduction, to prevent losses during storage due to improper management and to achieve efficient use of storage facilities.

2) Authentic Samples of Varieties

The government of India is in the process of installing the variety registration system which consists of an official list in order to protect breeders' right. The installation of this new system replaces the official notification system of variety which is presently in effect in order to protect breeders' right. When a new variety is registered, an official agency must test its distinguishing characteristics, uniformity and stability (DUS). IARI, including DSST, as an executing agency for these tests, will be responsible to conduct the test.

In the new system, breeders are assigned to keep authentic seed for 7 years after the registration of the variety for the future comparative growth test. DSST is scheduled to store and manage the authentic seed of variety which was bred by IARI.

As confirmed in the preliminary study, the Genetic Material Preservation Plan is deemed appropriate for the Project because its functions and purposes do not overlap the activity of NBPGR.

Table 2-3 Plan of Storing Quantity of Genetic Material

| Type of seed | Crop | Storing quantity | | |
|---|---|---|---|---|
| Active breeding stock | Wheat | 5,000accessions x 100g | 500 | kg |
| | Paddy | 2,000 x 100g | 200 | kg |
| | Maize | 4,000 x 250g | 1,000 | kg |
| | Sorghum | 50 x 100g | 5 | kg |
| | Pearl millet | 500 x 100g | 50 | kg |
| | Pulse | 6,000 x 250g | 1,500 | kg |
| | Vegetable | 1,100 x 10g | 11 | kg |
| | Oil crop | 1,000 x 50g | 50 | kg |
| | ( total ) | (19,650) | (3,316) | kg |
| Authentic Sample | Field crop | 300-500 x 1kg | 500 | kg |
| | Vegetable | varieties x 200g | 50 | kg |
| | Future Increase | 200-250 | 150 | kg |
| | (total) | (500-700) | (700) | kg |

3) Study of Storage Condition

Regarding the storage temperature and humidity condition requested for the Project, the storage conditions are set after the object crop and purpose/duration of storage were studied based on the data related to the seed storage and the conditions of similar facilities. Then, in order to reduce the cost of electricity, the possibility of introducing moisture-proof containers is judged by giving consideration to the storage quantity and the work load of drying seed before packing into moisture-proof containers.

As a result of the study of the Project scale and condition, the facility plan is summarized as follows:

a. Storage Facility for Active Breeding Stock

Capacity : 20,000 samples, 3,500 kg
Condition : 15°C, RH 30%
Container : Paper Bag, Cloth Bag
Max. Period : 5 - 7 years (varies for each crop)

b. Storage Facility for Authentic Samples of Varieties

| | |
|---|---|
| Capacity | : 700 samples, 700 kg |
| Condition | : 15° C |
| Container | : Moisture-proof Container |
| Max. Period | : 3 - 5 years (varies for each crop) |

(6) Study on Seed Research Program

DSST together with Regional Station Karnal shall conduct the research projects concerning quality seed production from 1995 ( details of each research project are shown in Appendix 5: Research Projects).

The title of the research projects are as follows :

**Research Project 1** : Characterization of varieties of wheat, rice, mustard, pearl millet, soybean, castor and mung bean.

**Research Project 2** : Improvement of storability of seeds of rice, soybean, sunflower, onion, maize and cole crops.

**Research Project 3** : Seed-borne diseases and their management in rice, wheat, pearl millet and soybean.

**Research Project 4** : Post-harvest handling and management of seeds of cereals, pulses, oil seeds and vegetables for efficient packaging, storage, treatment and sowing.

The necessary equipment shall be determined based on the conditions described below :

- Avoid duplication with existing workable equipment
- Purpose of equipment must match the objective of the research project

As confirmed in the preliminary study, the proposed equipment (not including the seed color sorter) is reconfirmed as being necessary for conducting the research project from the point of view of the conditions mentioned above.

### 2.3.3 Basic Design

#### (1) Site and Layout Plan

##### 1) DSST/New Delhi

The seed storage facility, controlled temperature glass house, and research equipment shall be installed at DSST. The layout plan is shown in the Fig 2.5 & Fig. 2.6.

##### 2) Regional Station Karnal

The seed storage facility, seed processing facility, research equipment, inspection equipment, and vacuum fumigation chamber shall be stationed at Regional Station Karnal. The layout plan is shown in the Fig.2.7 & Fig.2.8.

The layout for the seed storage facility and seed processing facility shall be planned in consideration of the following points :

- Secure the smooth movement of seed and workers through the practices of seed processing and storage (Function layout is shown in Fig. 2.9).
- Realize the functional connection between the new building and the existing building.
- Minimize the wall area faces on the outside of the building in low temperature storage building to reduce heat transmission.

(2) Architectural Design

1) Design Factors

a. Design standard

Architectural design and facility design follow the Indian standards.

b. Natural and geographic conditions

| | | |
|---|---|---|
| Temperature: | Outside air temperature | 35° C, DB |
| | Inside air temperature | 26° C, DB |
| Humidity: | Outside humidity | 65% RH |
| | Inside humidity | as presence |

As the project site is located in the southwest Asia monsoon region, the region has severe and prominent climatic conditions throughout the year, such as northeast and southwest monsoons with temperatures higher than 40° C and a large range of daily highest and lowest temperatures. Considering this, the following measures shall be taken:

- Northeast and southwest monsoon wind is convenient for taking natural ventilation, on the other hand, it brings rain water inside. To prevent it, deep eaves or louver type windows shall be provided.
- To minimize temperature changes in the seed storage, roof insulation will be installed once reinforced concrete having enough heat capacity is used as a roof structure.
- To absorb the expantion and contraction movements of the building as a resulf of temperature changes, an expansion joint shall be provided.
- To minimize maintenance costs, durable materials such, as aluminum or stainless steel, shall be used.

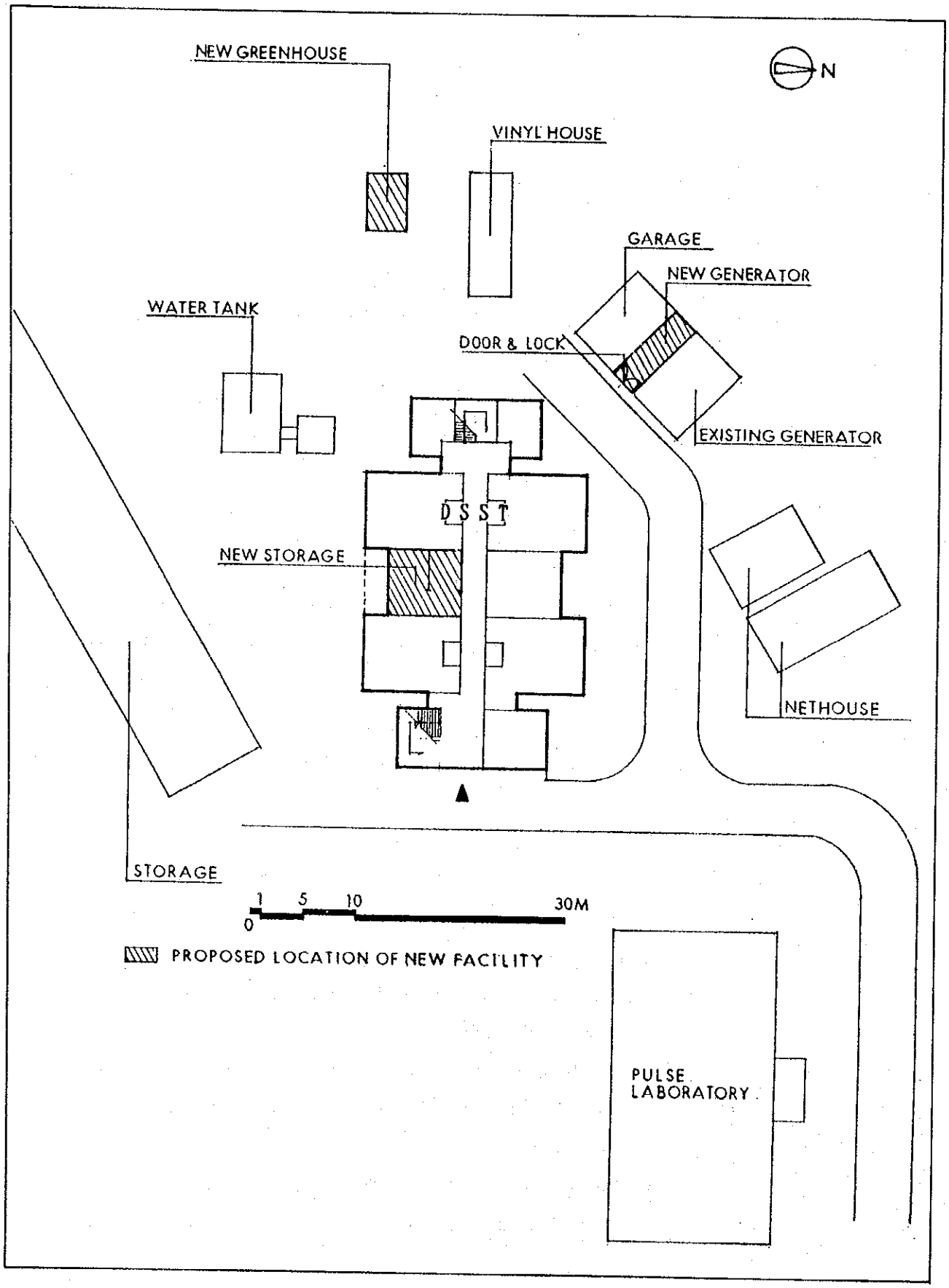



Fig. 2.5 Division of Seed Science and Technology - IARI, New Delhi

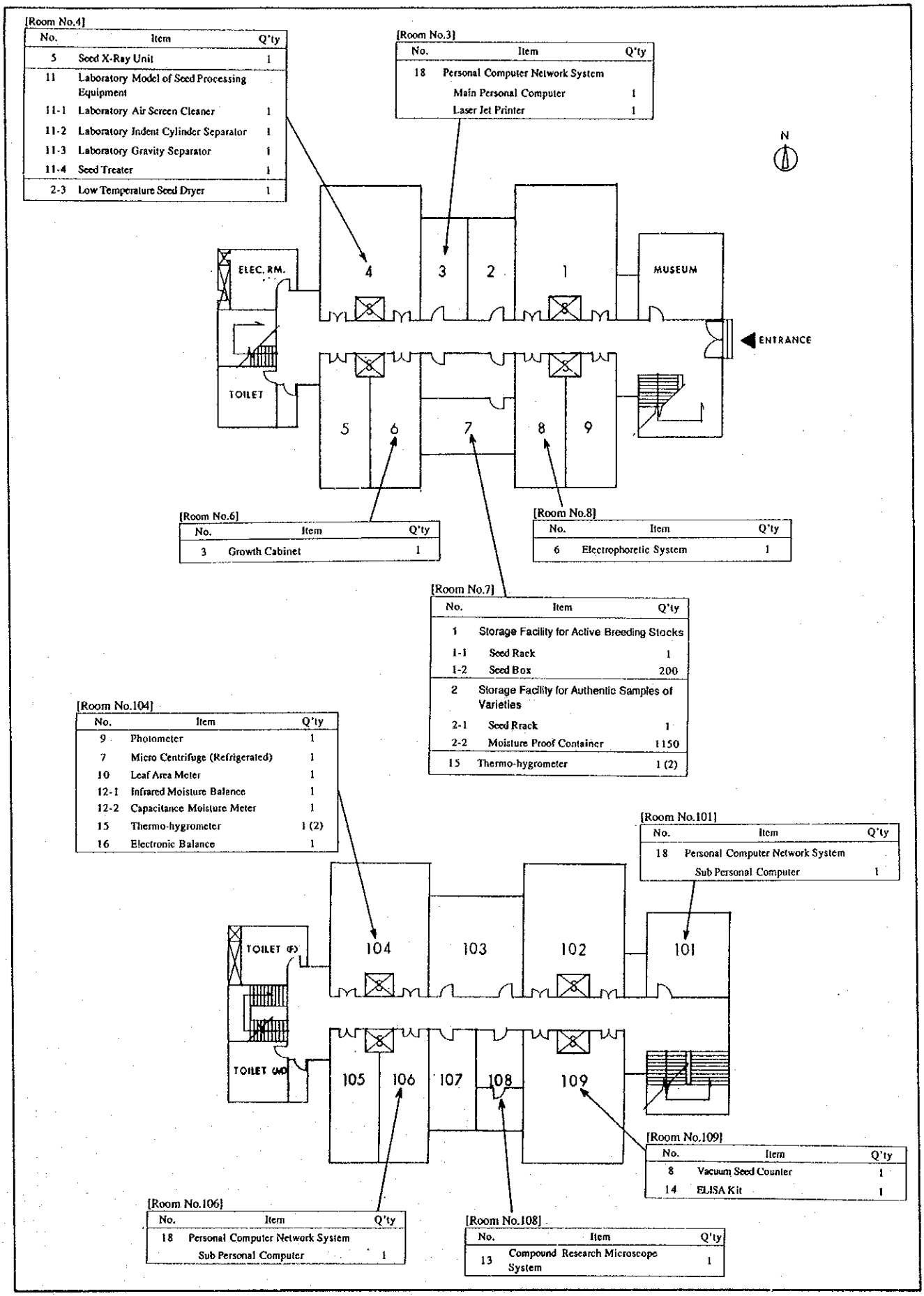



Fig. 2.6 Layout of Equipment

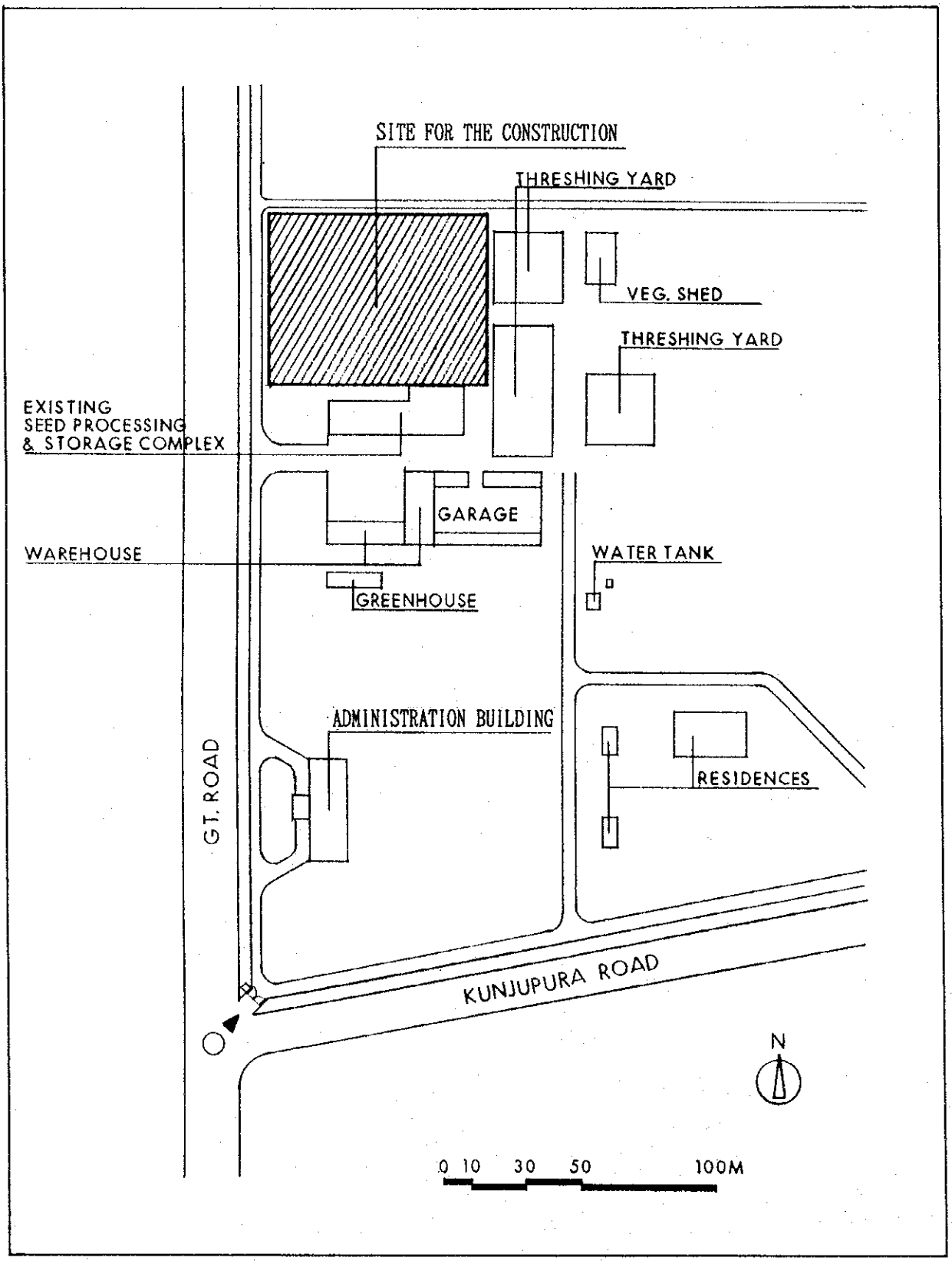



Fig. 2.7 IARI Regional Station, Karnal

| No. | Item | Q'ty | Figure No. |
|---|---|---|---|
| Laboratory Model of Seed Processing Equipment | | | |
| 24-1 | Screen Shaker | 1 | ① |
| 24-2 | Seed Blower | 1 | ② |
| 24-3 | Laboratory Aspirator | 1 | ③ |
| 24-4 | Laboratory Air Screen Cleaner | 1 | ④ |
| 24-5 | Thickness Separator | 1 | ⑤ |
| 24-6 | Laboratory Indent Cylinder Separator | 1 | ⑥ |
| 24-7 | Laboratory Indent Disc Separator | 1 | ⑦ |
| 24-8 | Laboratory Gravity Separator | 1 | ⑧ |
| 24-9 | Spiral Separator | 1 | ⑨ |
| 24-10 | Seed Treater | 1 | ⑩ |
| 24-11 | Rack | 1 | ⑪ |
| 24-12 | Working/Equipment Bench | 1 | ⑰ |
| Inspection Equipment | | | |
| 26 | Thermo-hygrometer | 2 | ⑫ |
| 27 | Sample Divider | 1 | ⑬ |
| 28 | Germination Chamber | 1 | ⑮ |
| 29-1 | Infrared Moisture Balance | 1 | ⑭-1 |
| 29-2 | Capacitance Moisture Meter | 1 | ⑭-2 |
| Equipment for Vegetables Seed Processing | | | |
| 23-6 | Color Sorter | 1 | ⑩ |

| No. | Item | Q'ty | Figure No. |
|---|---|---|---|
| Equipment for Vegetables Seed Processing | | | |
| 23-1 | Air Screen Cleaner | 1 | ① |
| 23-2 | Length Separator | 1 | ② |
| 23-3 | Gravity Separator | 1 | ③ |
| 23-4 | Spiral Separator | 1 | ④ |
| 23-5 | Seed Treater | 1 | ⑤ |
| 23-7 | Auto-weigher (10-100 g) | 1 | ⑥ |
| 23-8 | Auto-weigher (1-10 kg) | 1 | ⑦ |
| 23-9 | Bag Sewing Machine (portable type) | 1 | ⑧ |
| 23-10 | Heat Sealer | 1 | ⑨ |
| 23-11 | Low Temperature Dryer | 1 | ⑩ |
| 23-12 | Platform Scale (100 kg) | 1 | ⑫ |
| 23-13 | Electronic Balance (200g) | 1 | ⑪ |
| 23-14 | Rack | 1 | ⑱ |
| 23-15 | Working/Equipment Bench | 3 | ⑰-1,2,3 |

| No. | Item | Q'ty | Figure No. |
|---|---|---|---|
| Equipment for Cereal Seed Processing | | | |
| 22-1 | Receiving Hopper | 1 | ① |
| 22-2 | Pre-cleaner | 1 | ② |
| 22-3 | Screen Grader | 1 | ③ |
| 22-4 | Length Separator | 1 | ④ |
| 22-5 | Gravity Separator | 1 | ⑤ |
| 22-6 | Seed Treater | 1 | ⑥ |
| 22-7 | Auto-weigher (1-10kg) | 1 | ⑦-1 |
| 22-8 | Auto-weigher (10-100kg) | 1 | ⑦-2 |
| 22-9 | Product Tank | 1 | ⑦-3 |
| 22-10 | Bag Sewing Machine (conveyor type) | 1 | ⑧ |
| 22-11 | Bag Sewing Machine (portable type) | 1 | |
| 22-12 | De-awner | 1 | |
| 22-13 | Dryer | 2 | ⑨-1,2 |
| 22-14 | Dust Collecting System | 1 | |
| 22-15 | Control Panel | 1 | |
| 22-16 | Movable Bucket Elevator | 1 | |
| 22-17 | Movable Inclined Conveyor | 2 | |
| 22-18 | Movable Pneumatic Conveyor | 1 | |
| 22-19 | Carrying Cart (250kg) | 4 | |
| 22-20 | Carrying Cart (100kg) | 5 | |
| 22-21 | Carrying Cart (50kg) | 5 | |
| 22-22 | Bulk Seed Box Container (100 L) | 10 | |
| 22-23 | Bulk Seed Box Container (50 L) | 10 | |
| 22-24 | Platform Scale (100kg) | 1 | |
| 22-25 | Platform Scale (500kg) | 1 | |
| 22-26 | Vacuum Cleaner | 1 | |
| 22-27 | Air Compressor | 1 | |

Planned Facility

Normal Temperature Storage 1 (short term storage)

Normal Temperature Storage 2 (short term storgae)

Breeder Seed Storage (left over/buffer stock) 20℃, 40%RH

Low Temperature Storage

Vegetables Seed Storage 15℃, 30%RH

Nucleus Seed Storage 15℃, 30%RH

Research/ Inspection Room

Machine Room

Electric Room

Store Room

Dust Room

Lavatory

| No. | Item | Q'ty |
|---|---|---|
| Breeder / IARI Seed (short term) Storage Facility | | |
| 21-1 | Seed Rack | 1 |

| No. | Item | Q'ty |
|---|---|---|
| Nucleus & Vegetables Seed Storage Facility | | |
| 19-1 | Seed Rack | 1 |
| Breeder Seed (left over/buffer stock) Storage Facility | | |
| 20-1 | Seed Rack | 1 |

| No. | Item | Q'ty |
|---|---|---|
| 22-28 | Rack | 1 |
| 22-29 | Spare Screens | 1 |

Existing Facility

Normal Temperature Storage

Pre-processing Storage

| No. | Item | Q'ty |
|---|---|---|
| Fumigation Equipment | | |
| 25-1 | Vacuum Fumigation Chamber | 1 |
| 25-2 | Gas Mask | 3 |
| 25-3 | Gas Indicator | 1 |

Fig. 2.8 Layout of Facilities and Equipment

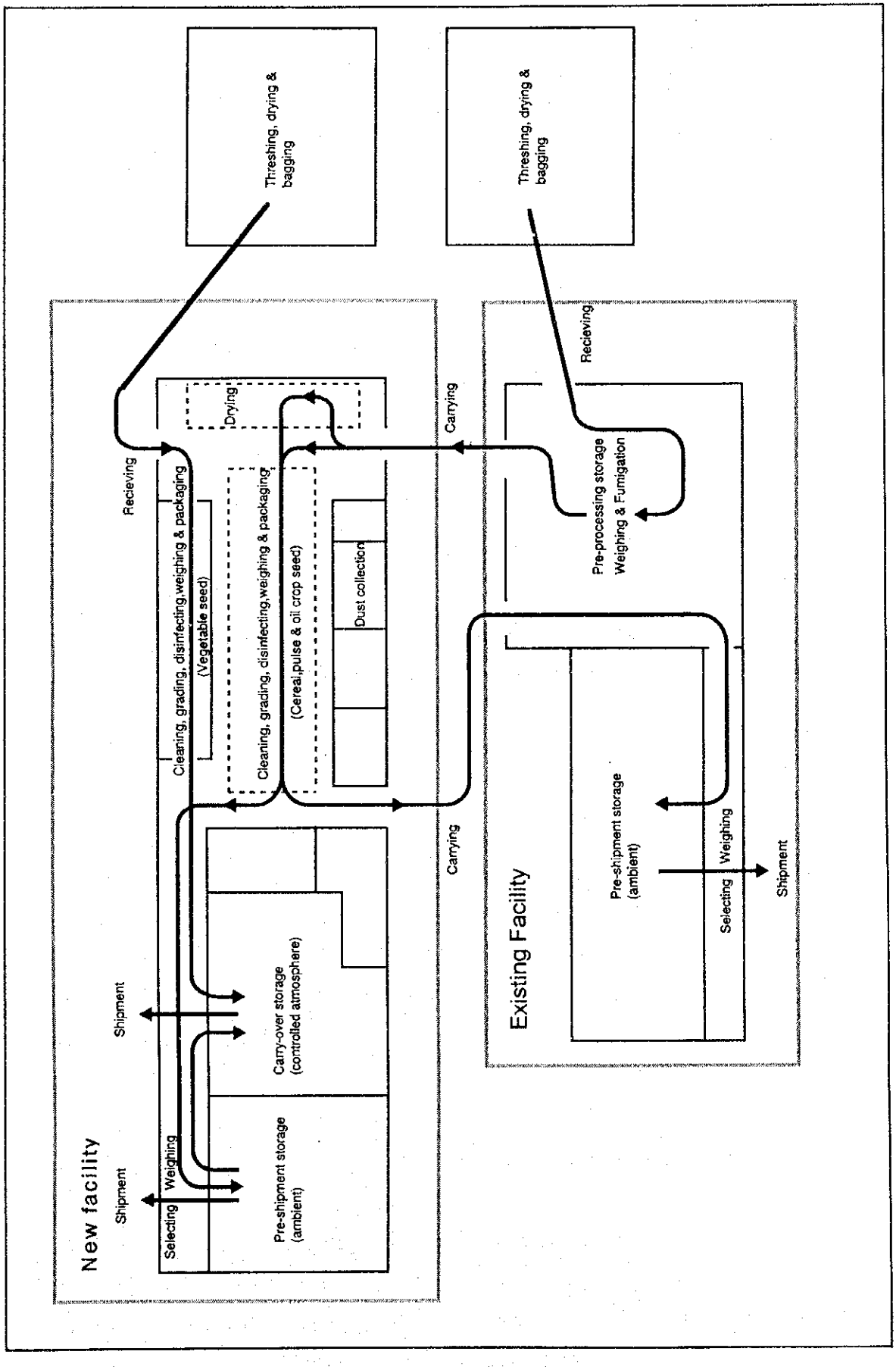



Fig. 2.9 Function Layout

c. Measures to protect the seed storage from heat and humidity.

- Place the storage between rooms.
- Lay a vinyl sheet under the slab.

d. Radiation and ventilation

As as a measure to prevent condensation in the space between the low temperature storage wall and building wall, a louver opening shall be provided to enhance inside ventilation.

e. Protection from harmful animals and insects

- Rat guards shall be provided around the building and screens shall be installed in each opening and drainage pipe.
- Install tightly fitted doors.

f. Cleaning

- To prevent the mixture of different varieties of seeds, the wall surfaces and the floor in the storage shall be smoothly finished for cleaning.
- To avoid the growth of harmful insects due to residual seeds in the storage, the surface of the floor shall be smoothly finished for cleaning.

g. Social and economic conditions

- Construction materials, such as cement, sand, gravel, reinforcing bar, brick, wood and stone shall be procured on the local market. Other materials, as much as possible, if the quality, quantity and prices are reasonable should also be procured locally.

- As a wide range of electrical fluctuation takes place, automatic voltage ballast shall be installed.

2) Layout Plan of the Facilities (For Regional Station, Karnal)

a. Seed processing block

The seed processing block receives seeds from the existing facility and/or directly from outside. After processing, the seed will be brought to the new storage or to the existing one. Hence, the seed processing block should be located next to the existing facility with a connection corridor. The entrance is located between the seed processing block and the seed storage block to minimize distance from both sides. Although the area of the entrance would be small because most of the workers will usually come from the existing facility, a proper entrance area is provided for occasional use by visitors and trainees.

As the vegetable processing room receives seeds only from outside, it is located in front of the unloading area and in a closest to the new seed storage. All vegetable seeds shall be stored there.

As the transformer is located between the existing facility and the new building, the electricity room shall be planned at the side of the existing facility so that power cable is kept to a minimum. Since the space for the office is limited in the processing block, it is planned to be located on the first floor above the electricity room in order to have a view of the processing work.

b. Seed storage block

The function of the seed storage block is to store seeds after processing for a certain period until shipping. The laboratory is located beside the

entrance, expecting an outside approach. Since the laboratory does not face the outside, it has a skylight to take indirect natural light and to proavide natural ventilation.

The normal temperature storage is located at the west side of the building and the low temperature storage is located in the middle of the block to minimize the influence of the ambient air. The security room is located at the end of the corridor in order to inspect loading and unloading work.

3) Seed Storage Facility Plan

a. Planning Factors

i. Structure of storage

Because of the following reasons, steel insulating panel shall be used to form the storage structure.

- construction work is easier making the building airtight and heat insulated.
- it will be possible to change the size and shape of the storage in a future renewal.

ii. Type of dehumidifier

A chemical dehumidifier (dry cell type) shall be selected because of simplicity of its principle and maintenance, and because it is easy to realize low humidity conditions.

iii. Method of cooling

Considering the capacity of each storage facility, the duct type shall be

selected for the storage at Regional Station Karnal, and unit cooler type shall be selected for DSST in New Delhi.

iv. To reduce running costs, the following measures shall be taken :

- The doors for nucleus seed storage and vegetable seed storage (15℃, RH30%) shall be located inside the breeder (carry over) seed storage (20℃, RH40%) to minimize the inflow of ambient air.
- The double door shall be used for breeder (carry over) seed storage, to reduce the inflow of ambient air. A vinyl curtain shall be installed at the door.
- The duct shall be installed inside the storage to minimize heat transmission to controlled air, and to protect the duct from rust corrosion caused by moisture condensation.

v. In addition to the above, the following points shall be applied to the storage facility at DSST in New Delhi :

- Install the stand-by generator for emergency use.
- Utilize moisture-proof seed containers only for authentic samples.
- Secure pre-room space inside the storage to reduce the inflow of ambient air.

b. Determination of Appropriate Size of Storage ( for Regional Station Karnal )

The floor area of the seed storage shall be calculated using the following factors :

- Apparent specific gravity :
  Wheat /0.7, Pulses and oil seeds /0.6, Vegetables /0.5
- Height of stack of bags :
  inside normal temperature storage (wheat, pulses, oil seeds) / 2 m
  inside low temperature storage (wheat) / 1.5 m
- Space for handling and carrying :

occupancy space with (stack of bagged seed + seed rack) x 100%

- Seed rack :
  seed lot with less than 500 kg per variety shall be stored in the rack

The floor area of each storage is summarized as follows:

i. Low Temperature Storage

- Nucleus seed storage / capacity 10 tons
  5.2 tons of wheat seed (1.5 m stack of 40 kg bag) :10 $m^2$
  4.8 tons of other seed ( stored in rack ) :20 $m^2$
  total :30 $m^2$

- Breeder seed (carry over stock) storage / capacity 45 tons
  30 tons of wheat seed (1.5 m stack of 40 kg bag) :57 $m^2$
  1 ton of wheat and13 tons of pulse and oil seeds (stored in rack ) :41 $m^2$
  total :98 $m^2$

- Vegetable seed storage / capacity 4 tons
  all seed ( stored in rack ) :20 $m^2$

ii. Normal Temperature Storage / capacity 110 tons

80 tons of wheat seed ( 2 m stack of 40 kg bag ) :114 $m^2$
30 tons of pulse and oil seeds (2 m stack of 40 kg bag ): 50 $m^2$
total :164 $m^2$

remark : 1) Though only a small quantity of seed shall be stored in the rack in the normal temperature storage, the floor space is calculated considering the stacking of all seed.

2) The above floor area shall be adjusted according to architectural factors, such as the layout with other rooms in the building, to match the standard size of insulating panel, etc.

c. Design Factors for Low Temperature Storage

Based on the natural conditions ,operational customs, insulation materials etc., the following are set as the design factors :

Table 2.4 Design Factors for Low Temperature Storage

| Design factors | | DSST / New Delhi | | Regional Station Karnal | | Remarks |
|---|---|---|---|---|---|---|
| | | Active breeding stock storage | Authentic seed storage | Breeder (carry over) seed storage | Nucleus & vegetables seed storage | |
| a. Heat load transmitted through wall | | | | | | |
| thermal conductivity of insulating panel | [w/(m2•℃)] | 0.0174 | 0.0174 | 0.0174 | 0.0174 | urethane foam 42 mm, |
| thermal transmittance | [w/(m2•℃)] | 0.3488 | 0.3488 | 0.3488 | 0.3488 | steel board |
| outside air temperature | [℃] | 35 | 35 | 35 | 35 | maximum average temp. |
| inside air temperature | [℃] | 15 | 15 | 20 | 15 | in July |
| wall surface area | [m2] | 42.91 | 32.85 | 124.20 | 86.40 | |
| b. Cooling load for seed | | | | | | |
| specific heat of seed | [kcal/kg•℃] | 0.95 | 0.95 | 0.95 | 0.95 | max. seed quantity x |
| receiving quantity per day | [kg] | 20 | 4.6 | 300 | 93.3 | 0.66% |
| seed temperature | [℃] | 35 | 35 | 35 | 35 | maximum average temp. |
| maximum cooling hours | | 24 | 24 | 24 | 24 | in July |
| c. Heat load by seed respiration | | --- | --- | --- | --- | No consideration |
| d. Heat load by air inflow | | | | | | |
| enthalpy | [kj/m3] | 3.53 | 3.53 | 2.88 | 3.53 | |
| storage capacity | [m3] | 34.2 | 27.7 | 320.7 | 131.2 | |
| volume of air inflow per day | [m3] | 480 | 480 | 816 | 672 | |
| e. Heat load by lighting fittings | | | | | | |
| lighting hours per day | | 1 | 1 | 1 | 1 | |
| wattage per m2 | [w] | 5 | 5 | 5 | 5 | |
| f. Heat load by laborers | | | | | | |
| working hours per day in the storage | | 1 | 1 | 1 | 1 | |
| no. of laborers | | 1 | 1 | 2 | 2 | |
| heat generation rate per hour | [w] | 117 | 117 | 235 | 235 | |
| g. Other heat load | | -- | --- | --- | --- | No consideration |
| h. Moisture inflow | | | | | | |
| volume of air inflow per day | [m3] | 480 | 480 | 816 | 672 | |
| outside air relative humidity | [%] | 56 | 56 | 56 | 56 | maximum average RH in |
| moisture amount | [kg/day] | 9.68 | 9.68 | 11.59 | 11.29 | July |
| i. Moisture generation from seed | | -- | --- | --- | --- | No consideration |

## d. Specification of Low Temperature Seed Storage

Table 2.5 Specification of Low Temperature Seed Storage

| | | Regional Station Karnal | | | DSST/New Delhi | |
|---|---|---|---|---|---|---|
| | | Breeder seed | Nucleus seed | Vegetable seed | Breeding stock | Authentic seed |
| Storage Conditions | | 20°C, RH40% | 15°C, RH30% | | 15°C, RH30% | 15°C, |
| Storage | material | Steel plated insulating board (urethane foam 42 mm) | | | | |
| | floor area($m^2$) | 106.90 | 29.16 | 19.44 | 13.7 | 11.1 |
| | Capacity($m^3$) | 320.7 | 87.5 | 58.3 | 34.25 | 27.75 |
| Cooling unit (kcal/h) | | 7,000 | 4,000 | | 1,400 | 550 |
| Dehumidifier unit (kg/h) | | 1.48 | 0.90 | | 0.56 | - |
| Lighting (w) | | 40w x 14 | 40w x 4 | 40w x 3 | 40w x 2 | 40w x 1 |
| No. of outlet socket | | 1 | 1 | 1 | 1 | 1 |

4) Floor Area Schedule for Regional Station Karnal

The necessary floor areas for the cereal seed processing room, vegetable seed processing room, dust room, store and laboratory are calculated in accordance with their functions and the scale of installing equipment. The floor area of each room is summarized as follows:

| | | |
|---|---|---|
| a. | Cereal seed processing room | : 357m$^2$ |
| b. | Vegetable seed processing room | : 72m$^2$ |
| c. | Dust room | : 24m$^2$ |
| d. | laboratory | : 35m$^2$ |
| e. | Low Temperature Storage | : |
| | Nucleus Seed | : 30 m$^2$ |
| | Breeder Seed | : 98 m$^2$ |
| | Vegetable Seed | : 20 m$^2$ |
| f. | Normal Temperature Storage | : 156 m$^2$ |
| g. | Machine Room | : 40m$^2$ |

h. Security room

| | | |
|---|---|---|
| Required area(m$^2$/person) | = 6 | |
| Number of security | 1: | 6m$^2$ |
| Number of visitor | 1: | 3m$^2$ |
| Total | : | 9m$^2$ |

i. Electric room

The maximum demand (TMD Kw)

= load x demand factor x floor area / inequality factor
= 0.16 x 0.6 x 1,125 / 1.1 = 98.18(100Kw)

Required floor area (m$^2$)=0.98 x 100[TMD (kW)]$^{0.7}$= 24.76 (24m$^2$)

j. Office

| | |
|---|---|
| Required area | = 6 m$^2$/person |
| Number of staff | 3: 18m$^2$ |

k. Toilet

Minimum area for urinal x 2 sets, lavatory x 1 set is
2.25m x 4.0m = 9m$^2$

l. Corridor

Considering space required for weighing and loading/unloading works, a 3 m wide corridor is provided.

m. Connecting corridor

The existing facilities and the new building are connected to the corridor and, according to the processing and storage flow, it is an important place for transporting seeds from the pre-storage of unprocessed seeds to the storage of processed seeds. Taking into consideration these functions and the maximum utilization of both buildings, the connecting corridor is arranged to have enough space as an intersection.

Connecting corridor : 120 $m^2$

5) Section plan

In order to link and to provide good workability between the new and the existing buildings, the elevation of the new building floor shall be designed one meter above the ground level once the floor level of the existing building is also one meter above the ground level. For protection against rat intrusion, a concrete flange shall be provided.

In the seed processing block, an 8 meters high piece of equipment is installed. To provide clearance between the equipment and the roof, the story height of the block shall be 8 meters high and a gable shaped roof shall be employed. The other part of the block is 4 meters high. A part of the block shall be provided with a ceiling to reduce radiant heat from outside.

6) Structure design

The construction site is to be used as a seed/production farm. The soil is loose silt with sand. The soil bearing test was carried out during the basic design survey, and the bearing capacity at 1.2 meter below ground level is

7.5ton/$m^2$(mean). Information from Regional Station Karnal indicates that the bearing capacity of said site is 6.5ton/$m^2$ . For the safety of the structure design the same bearing capacity is used.

a. Type of structure

Judging from the layout plan, site conditions, scale of building, economic aspects and local conditions, reinforced concrete frame structures are employed for the processing and storage building.

b. Load

Live and dead load with actual load shall be calculated to design the seed processing block and the seed storage block.

c. Others

From the point of view of structural design, attention must be paid to the effects of seismic forces and the expansion and contraction movements of the building caused by the daily temperature difference which exceed 20°C in the hot season.

Regarding seismic forces, the Aravelli earthquake zone, as one of the earthquake belts in the subcontinent, shall be taken into account once it is relatively near to the construction site. Consequently, the seismic factor Co=0.1 shall be adopted as a standard share coefficient against the seismic force.

Due to the expansion and contraction activities of the building caused by temperature changes, an expansion joint shall be provided at points between the seed processing block and the seed storage block.

d. Architectural drawings

Architectural drawings for the new seed processing and storage buildings at Regional Station Karnal are shown in the Appendix 6 "Drawings".

7) Architectural Utilities

a. Electrical installation

i. Electric power

An existing 11Kv service drop, which is connected to the existing facilities, shall be used for the new building.

The work undertaken by the Indian side is to provide a new 11Kv 3ph 3wire service drop and to install a new transformer of 165Kva due to the increased electricity consumption by the installation of new facilities through this project.

Taking into consideration the wide fluctuation range, especially during summer seasons, voltage regulators shall be provided after the transformer. However, static voltage regulators shall be provided only for precise research equipment.

ii. Electric outlets

Three-pole outlets of the Indian Standard are installed as the power source for the seed processing and research equipment.

iii. Lighting fixtures

Fluorescent lamps are the main lighting fixtures. The illuminance for each room is shown in the following table:

| Room | Illuminance (Lx) |
|---|---|
| Seed Processing Room | 150 – 250 |
| Office | 200 – 300 |
| Laboratory | 300 – 400 |
| Seed Storage | 150 – 250 |

b. Telephone

There are two telephone lines from DTM. For the new processing and storage building, an extension line to the office from one of those lines is provided. In the new building, an inter-phone shall be provided for inter-communication between the office, the laboratory and the security room.

c. Fire prevention equipment

Heat detectors shall be installed at the seed storage, the electric room, the machine room and the dust room, and monitored at the office of the new building.

d. Lightning arrester equipment

Lightning arrester equipment shall be provided.

e. Air conditioning equipment

Natural air ventilation is generally introduced for air circulation in the new building by roof fans and windows. For the office, which is expected to receive visitors and trainees, a mechanical air conditioner with a heat pump shall be installed. The electric room, the dust room, the toilet and the machine room shall be equipped with exhaust fans according to their requirements.

f. Plumbing system

i. Water supply system

The water supply for the toilet shall be connected to the existing 50mm diameter supply line which runs 50 meters to the northern part of the construction site from the elevated water tank.

ii. Drainage system

Sewage from the toilet shall be drained through the existing line by connecting it to the sewage pump. Rain water shall be drained through a

gutter about 10 meters away from the new building.

iii. Sanitary fixtures

The lavatory is of Asian style. The booth has a tap for washing at the right hand.

g. Fire extinguishing equipment

In accordance with an instruction from the Municipality corporation in Haryana, fire extinguishers shall be provided for the building.

8) Schedule of Materials for the Construction

Durable materials selected for the construction of the building shall be suitable and adequate to fulfill requirements. Careful consideration shall be given to material selection because of the severe local environment. It is also very important to consider easy maintenance using locally obtainable materials.

The scheduled materials and the reasons for selection are as follows:

a. Main structural materials

Table 2 .6 Main Structural Materials

| Part | Material | Reason For The Selection |
|---|---|---|
| Column & Girder | Reinforced concrete | Durable and is a typical construction material |
| Interior wall | Reinforced concrete block | It's advantageous for short time work and has a reasonable price |
| Floor | Reinforced concrete | Durable and is a typical construction material |

b. External materials

Table 2.7 External Materials

| Part | Material | Reasons for the selection |
|---|---|---|
| Roof | Color coated metal sheet roofing | Only for long spans in the processing room / it's advantageous for short time work and light dead loads |
| Exterior wall | Sand texture spray coating | Durable as an exterior finish<br>Relatively dirt free rather than other materials |
| Fixtures | Window: aluminum sash | Durable and light for fittings |
| | Door: steel sash | Durable for fittings |

c. Interior finishing materials

Table 2.8 Interior Finishing Materials

| Room | Floor | Wall | Ceiling |
|---|---|---|---|
| Security room. | Cement mortar | Emulsion paint | Decorative gypsum board |
| Normal temperature storage | Cement mortar | Emulsion paint | Emulsion paint on gypsum board |
| Low temperature storage | Cement mortar | — | — |
| Laboratory | Terrazzo tile | Emulsion paint | Decorative gypsum board |
| Machine room | Cement mortar | Emulsion paint | Emulsion paint |
| Vegetable seed processing room. | Cement mortar | Emulsion paint | Emulsion paint |
| Cereal seed processing room. | Cement mortar | Emulsion paint | Emulsion paint |
| Electric room | Cement mortar | Emulsion paint | Emulsion paint |
| Dust room | Cement mortar | Emulsion paint | Emulsion paint |
| Store | Cement mortar | Emulsion paint | Emulsion paint |
| Office | Terrazzo tile | Emulsion paint | Decorative gypsum board |
| Toilet | Mosaic tile | Semi-vitreous tile | Emulsion paint on gypsum board |
| Corridor | Cement mortar | Emulsion paint | Decorative gypsum board |

(3) Equipment Plan

1) Equipment Plan for DSST/New Delhi

a. Equipment for Seed Research

The following equipment plan guidelines are common for research items.

- equipment shall match with present level of technology
- supplies, such as reagents, shall be available locally
- grade of equipment shall match usage purpose

The equipment plan for each research item considered in this project is shown below :

i. Research project 1 : Characterization of varieties

Function :

- Control the environmental conditions, such as temperature, humidity and illumination, to research the response of plants under specific conditions.
- Measure the morphological and biochemical characteristics of varieties, such as leaf area, zymogram of seed protein and DNA .

Primary equipment :

- Growth Cabinet
- Controlled Temperature Glass House
- Electrophoretic System
- Micro Centrifuge (refrigerated)
- Photometer
- Leaf Area Meter
- Thermo-hygrometer

Location : in the existing research facility

ii. Research project 2 : Improvement of storability of seeds

Function :

- Measure the seed storage conditions.
- Measure the seed moisture content.

Primary equipment :

- Infrared Moisture Balance
- Capacitance Moisture Meter
- Thermo-hygrometer
- Electronic Balance

Location : in the existing research facility

iii. Research project 3 : Seed-borne diseases and their management

Function :

- Detect / identify seed-borne fungi, bacteria and viruses.

Primary equipment :

- Compound Research Microscope System
- Elisa Kit

Location : in the existing research facility

iv. Research project 4 : Post-harvest handling and management of seeds

Function :

- Detect damage inside of seed.
- Test and identify the appropriate aperture shape and size for grading of seeds

Primary equipment :

- Seed X-ray Unit
- Vacuum Seed Counter
- Laboratory Air Screen Cleaner
- Laboratory Indent Cylinder Separator
- Seed Treater (mist-o-matic)

Location : in the existing research facility

b. Data Processing Equipment

Function :

- Generate the data base for stored seed and for varieties characterization of different crop varieties.
- Analyze research data generated from the different research projects and utilize the information.
- Publish various research information.

Primary equipment :

- Personal Computer Net Work System ( with laser jet printer )

Location : in the existing research facilities

2) Equipment Plan for Regional Station Karnal

a. Equipment for Cereal Seed Processing

Function : to conduct the following processing of cereal seeds, pulse and oil seeds:

- pre-cleaning
- separation & grading
- treating with chemical agents
- weighing
- packaging
- drying and etc.

Primary equipment :

- Pre-Cleaner
- Screen Grader (separator with shifting sieve)
- Gravity Separator
- Length Separator
- Automatic Weigher
- Seed Treater
- Drier
- Dust Collecting System
- Transporting Equipment

- Cleaning Equipment and etc.

Location : in the new building (Cereal Seed Processing Room)

Guidelines for selection:

- to match the present technological level and grade of equipment
- to match the the seed production plan in 2000 A.D.
- to facilitate the following in order to match the equipment plan with the present operating customs, post harvest conditions of seed, etc. (seed flow of the processing line is shown in Figure 2.10 and the layout plan of seed processing equipment is shown in Figure 2.11)

  i . facilitate multiple dumping pits :

  3 locations ( pre-cleaner, screen grader, seed treater )

  ii. facilitate switching valve :

  screen grader ----> gravity separator / length separator

  gravity separator ----> seed treater / automatic weigher

- to retain safety during maintenance and inspections by providing handrails in the inspection corridor.
- to plan facilities and equipment so that they are easy to clean

b. Equipment for Vegetable Seed Processing

Function : to conduct the following processes for vegetable seed :

- separation
- treating with chemical agents
- weighing
- packaging
- drying and etc.

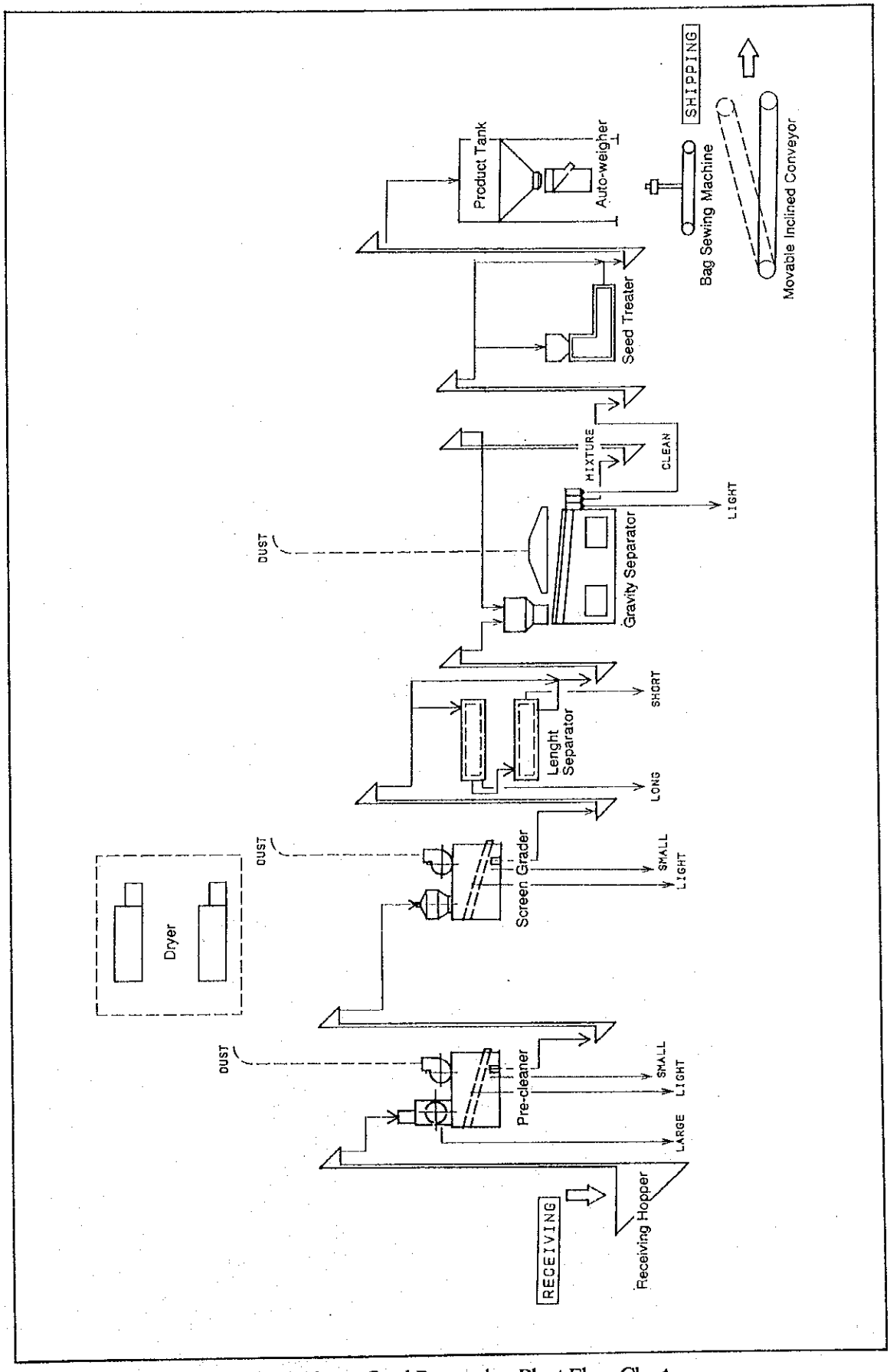



Fig. 2.10 Seed Processing Plant Flow Chart

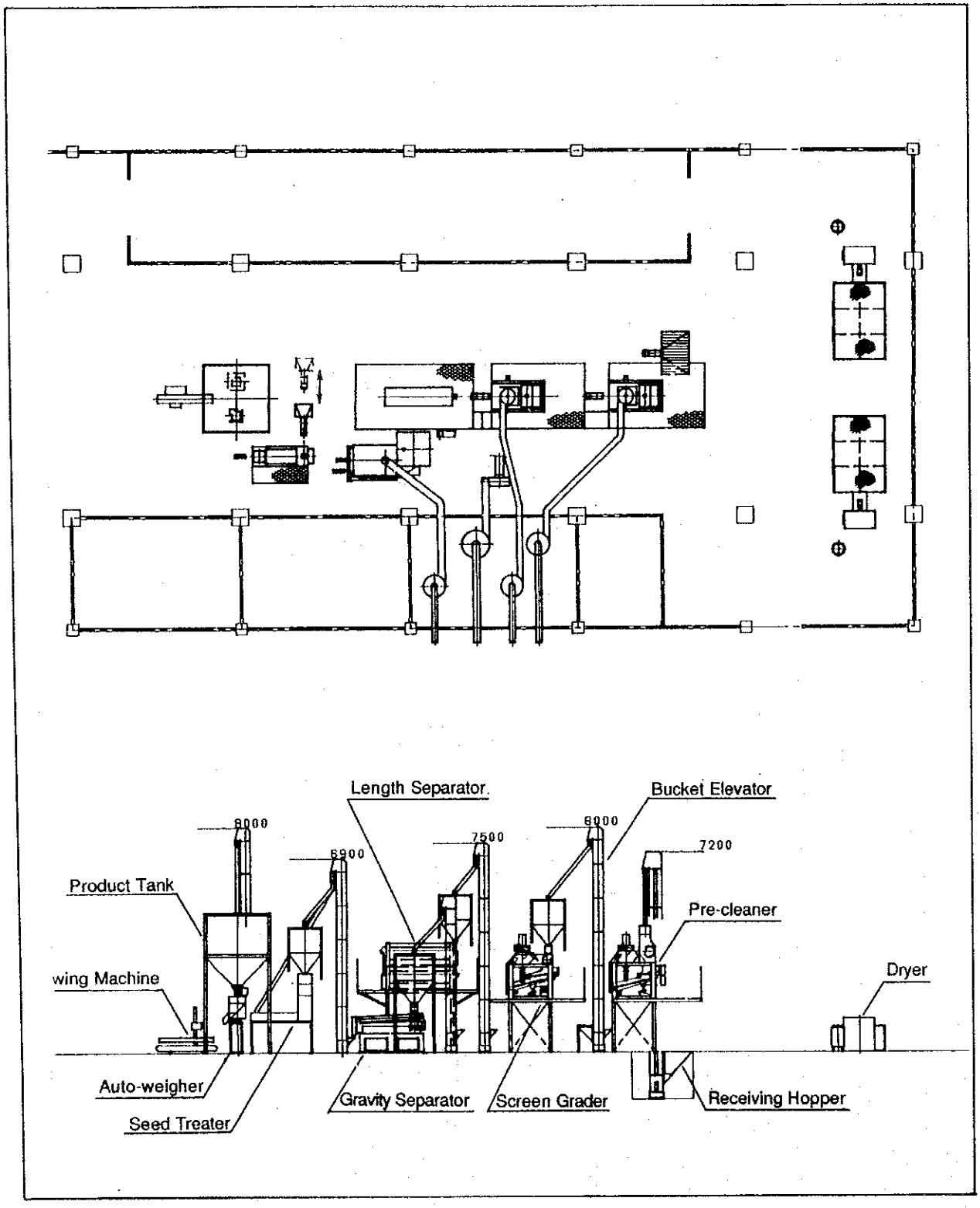



Fig. 2.11 Layout of Cereal Seed Processing Equipment

Primary equipment :

- Air Screen Cleaner
- Length Separator
- Gravity Separator
- Color Sorter
- Automatic Weigher
- Bag Closer
- Heat Sealer
- Seed Treater
- Low Temperature Drier
- Platform Scale and etc.

Location : in the new building (Vegetable Seed Processing Room)

Guidelines for selection :

- to match the present technological level and grade of equipment
- to match the the seed production plan in 2000 A.D.
- to plan each function as independent units and to utilize and select units according to the purpose of operation and the quantity of seed to be processed
- to select equipment that is easy to handle and operate

c. Laboratory Model of Seed Processing Equipment

Function : to conduct practical research for efficient seed processing, such as selection of separating screen according to amount of dockage and other crop seed in harvested seed, setting of air volume, amount of seed flow and setting degree of sieves, etc.

Primary equipment :

- Laboratory Air Screen Cleaner
- Thickness Separator
- Laboratory Gravity Separator
- Seed Treater (mist-o-matic)
- Laboratory Aspirator, etc.

Location : in the new building (Research and Inspection Room)

Guidelines for selection :

- to match the practical seed processing equipment in use in order to utilize collected data promptly for the improvement of the seed processing operation of cereal and vegetable seed
- to select equipment easy to handle and corresponds to the research of standard grading/separation adopting physiological characteristics
- to select equipment with giving consideration to its compatibility with research data obtained in New Delhi/DSST

d. Inspection Equipment

Function : to conduct seed quality control inspection including germination, moisture content, storage condition, etc.

Primary equipment :

- Infrared Moisture Balance
- Capacitance Moisture Meter
- Germination Chamber
- Thermo-hygrometer
- Seed Divider

Location : in the new building (Research and Inspection Room)

Guidelines for selection :

- to match the present technological level and grade of equipment
- to select equipment that is easy to maintain
- to select the same type as the one used in New Delhi/DSST
- to select equipment that is easy to handle and operate

e. Fumigation Equipment

Function : to conduct fumigation in order to eliminate pests which have developed a resistance to PH3 fumigant

Primary equipment :

- Vacuum Fumigation Chamber
- Gas Indicator
- Gas Mask

Location : in the existing facilities (Pre-processing Storage Room prior to processing)

Guidelines for selection :

- to follow Japanese standards for the fumigation chamber in order to maintain safety

Specification outlines of both planned and requested project equipment are listed in Table 2.9.

Table 2.9 List of Facilities and Equipment (requested/planned)

| REQUEST | | | | PLAN | | | |
|---|---|---|---|---|---|---|---|
| NO. | Facility & Equipment | Spec. / Component / Remarks | Q'ty | NO. | Facility & Equipment | Spec. / Component / Remarks | Q'ty |
| New Dehli / DSST | | | | *Remark : facilities are shown in italic* | | | |
| *1* | *Germ Plasm Storage Facility* | | | | | | |
| | *Storage Facility for Active Breeding Stocks* | 15℃, 35~40%RH<br>3 tons | | *1* | *Storage Facility for Active Breeding Stocks* | 15℃、30%RH、3.5 tons<br>steel insulating board (urethane form,42 mm)<br>chemical dehumidifier、duct cooling | 1 |
| | | | | 1-1 | Seed Rack | | 1 |
| | | | | 1-2 | Seed Box | | 200 |
| | *Storage Facility for Authentic Samples of Varieties* | 5℃, 35~40%RH<br>1.5 tons | | *2* | *Storage Facility for Authentic Samples of Varieties* | 15℃、0.7 ton<br>steel insulating board (urethane form,42 mm)<br>duct cooling | 1 |
| | | | | 2-1 | Seed Rack | | 1 |
| | | | | 2-2 | Moisture Proof Container | 1.5 L x 400, 1.0 L x 250, 0.5 Lx 250, 0.3 L x 250 | 1150 |
| | | | | 2-3 | Low Temperature Seed Dryer | forced air type, drying temp. : below 35℃ | 1 |
| 2 | Growth Cabinet | 300 L, 5~50℃,50~90%RH, 23,000lux | | 3 | Growth Cabinet | 300 L, 10~50℃, 50~90%RH, 0-33,000lux | 1 |
| 3 | Controlled Temperature Glass House | 8' X 18', ambient temp.-5℃(fan & pat system)、heater、day length control、movable cart | | 4 | Controlled Temperature Glass House | 12' X 16' X 8', Galvanized light-gauge steel with aluminum sash , sliding/roof window, hailstone protection net, fan & pat system, electric fan heating, lighting (max. 35,000 lux)、humidifier (70-90%RH), movable plant bench ( 9 pcs.) | 1 |
| 4 | Seed X-Ray Unit | | | 5 | Seed X-Ray Unit | super soft x-ray(25kvp), resolution 25 micron, 10-12 inch TV monitor, video graphic printer | 1 |
| 5 | Electrophoretic System | slab gel, 4 gels/chamber | | 6 | Electrophoretic System | protein (polyacrylamide gel/horizontal type):<br>gel platform(160 x 200 mm), gel maker, circulation cooling unit (each 1 pc.)<br>DNA (agarose gel/horizontal type) :<br>gel platform(200 x 200-250 mm), gel maker (each 1 pc.)<br>power unit ( 1 pc.) | 1 |
| 6 | Micro Centrifuge (Refrigerated) | table top、-20℃、 rotor: 1.5ml x 24, 15ml x12, 50ml x 8 | | 7 | Micro Centrifuge (Refrigerated) | 2,000-15,000 rpm, automatic control, timer, refrigerator capacity : -10~30℃, rotor :1.5 ml x 36, 0.5 ml x 36、analog display, sample tube (2000pcs) | 1 |
| 7 | Vacuum Seed Counter | | | 8 | Vacuum Seed Counter | relief valve, filter, pressure gauge, foot switch, counting head :000,00,0,2,3 | 1 |
| 8 | Photometer | | | 9 | Photometer | 0-35,000 lux /1 lux, portable type, digital display | 1 |
| 9 | Leaf Area Meter | | | 10 | Leaf Area Meter | measuring range : max.100,000cm2/0.01cm2、digital display | 1 |
| 10 | Laboratory Model of Seed Processing Machine | | | 11 | Laboratory Model of Seed Processing Equipment | | |
| | | Screen grader-cum-indented cylinder | 1 | 11-1 | Laboratory Air Screen Cleaner | | 1 |
| | | | | 11-2 | Laboratory Indent Cylinder Separator | | 1 |
| | | gravity separator | 1 | 11-3 | Laboratory Gravity Separator | | 1 |
| | | seed treater | 1 | 11-4 | Seed Treater | mist-o-matic | 1 |
| | | spiral separator | 1 | | | | |
| | | thickness separator | 1 | | | | |
| | | seed pellet maker | 1 | | | | |
| 11 | Digital Moisture Meter | 6~14%, for cereal, pulse, oil crop & vegetable seeds | | 12-1 | Infrared Moisture Balance | heated drying & weight measurement method, 0 - 100 %/±0.1%, digital display | 1 |
| | | | | 12-2 | Capcitance Moisture Meter | indirect measurement method (non-destructive), portable type, digital display | 1 |
| 12 | Compound Research Microscope with Photoautomat, color Monitor and CCTV | universal condenser, with photoautomat, color monitor and CCTV | | 13 | Compound Research Microscope System | observation method : bright field, DIC, phase contrast<br>eyepiece : 10X, micrometer<br>objective : DIC/ 20X,40X,100X<br>: phase contrast/10X,20X,40X<br>universal condenser, halogen lamp<br>TV system (14-15inch monitor、CCD color camera, PAL)<br>photo system(35mm full auto, spot exposure measurement) | 1 |
| 13 | ELISA Kit | elisa reader<br>plate washer<br>micro plate<br>micro pipette<br>auto dispenser<br>homogenizer, shaker, etc. | | 14 | ELISA Kit | elisa reader (400~700nm, with printer) x 1<br>plate washer x1<br>micro plate (96 wells,nunc-immuno plate) x 1,000<br>8-channel digital micro pipette x 1, micro pipette / 2-10ul X1, 10-100ul X 1, 100-1,000ul X 1 (with 1000 tips / each pipette)<br>micro pipette washer x 1 | 1 |

Table 2.9 List of Facilities and Equipment (requested/planned)

| REQUEST | | | | PLAN | | | |
|---|---|---|---|---|---|---|---|
| NO. | Facility & Equipment | Spec. / Component / Remarks | Q'ty | NO. | Facility & Equipment | Spec. / Component / Remarks | Q'ty |
| 14 | Temperature and Humidity Meter | 0~50℃, 0~100%, digital display | | 15 | Thermo-hygrometer | -10~60℃/±0.5℃, 20~100%RH/±2.0-3.0%, digital display, portable type, auto recording, printer | 2 |
| 15 | Electronic Balance | 100g/0.1mg, digital display, automatic taring | | 16 | Electronic Balance | 180g/0.1mg, digital display, automatic taring | 1 |
| 16 | Electronic Color Sorter | | | | | | |
| 17 | Generator | to support seed storage facility | | 17 | Diesel Generator | 10-15kva,3 phase, 415V, 50HZ, diesel engine, automatic starting | 1 |
| 18 | Computer with Laser Printer | IBM compatible,14inch color monitor + key board x 4, laser jet color printer, projection display system | | 18 | Personal Computer Network System | main PC(pentium 60MHZ) x 1, sub PC(486DX2 66MHZ) x 1, laser printer (black) x 1, software(10 kinds) | 1 |
| Regional Station Karnal | | | | | | | |
| 1 | *Storage Facility for Nucleus Seed* | 20℃, 45~50%RH<br>5 tons | | *19* | *Nucleus & Vegetables Seed Storage Facility* | 15℃,30%RH, nucleus seed /10 tons, vegetables seed /4 tons<br>steel insulating board (urethane form,42 mm)<br>chemical dehumidifier, duct cooling | 1 |
| | | | | 19-1 | Seed Rack | | 1 |
| 2 | *Storage Facility for Breeder Seed* | 20℃<br>65 tons | | *20* | *Breeder Seed (left over/buffer stock) Storage Facility* | 20℃,40%RH, cereals,pulses & oil crops seed /45 tons<br>steel insulating board (urethane form,42 mm)<br>chemical dehumidifier, duct cooling | 1 |
| | | | | 20-1 | Seed Rack | | 1 |
| | | | | *21* | *Breeder / IARI Seed (short term) Storage Facility* | ambient temperature, cereals, pulses & oil crops seed /110 tons | 1 |
| | | | | 21-1 | Seed Rack | | 1 |
| 3 | Seed Processing and Packing Facility for Cereals | ability : 1 ton/ hr | | 22 | Equipment for Cereals Seed Processing | | |
| | | | | 22-1 | Receiving Hopper | holding capacity 1.5-2 tons, bucket elevator 1-2 tons | 1 |
| | | Pre-cleaner | | 22-2 | Pre-cleaner | scalping reel x 1, vibrating screen x 2, aspirator x 1, capacity 1-2 tons, bucket elevator 1-2 tons | 1 |
| | | Cleaner | | 22-3 | Screen Grader | vibrating screen x 2, aspirator x 1, capacity 1-1.5 tons, bucket elevator 1-2 tons with 2-way change valve, surge bin 0.5 ton | 1 |
| | | Indent Cylinder Separator | | 22-4 | Length Separator | indent cylinder x 2, capacity 1-1.5 tons, bucket elevator 1 ton, surge bin 0.5ton | 1 |
| | | Gravity Separator | | 22-5 | Gravity Separator | capacity 1-2 tons, bucket elevator 1-2 tons with 2-way change valve, surge bin 1-1.5 tons | 1 |
| | | Spiral Separator | | | | | |
| | | Seed Treater | | 22-6 | Seed Treater | mist-o-matic type, capacity 1-2 tons, bucket elevator 1-2 tons, surge bin 1-1.5 tons | 1 |
| | | Auto-weigher & packer | | 22-7 | Auto-weigher (1-10kg) | | 1 |
| | | | | 22-8 | Auto-weigher (10-100kg) | | 1 |
| | | Control Tank | | 22-9 | Product Tank | holding capacity 2 tons | 1 |
| | | Conveyor Bag Sewing Machine | | 22-10 | Bag Sewing Machine (conveyor type) | | 1 |
| | | | | 22-11 | Bag Sewing Machine (portable type) | | 1 |
| | | | | 22-12 | De-awner | capacity 1-1.5 tons | 1 |
| | | Dryer (circulation type) | | 22-13 | Dryer | box type, holding capacity 1 ton, diesel fuel | 2 |
| | | | | 22-14 | Dust Collecting System | | 1 |
| | | | | 22-15 | Electric / Control Panel | | 8 |
| | | | | 22-16 | Movable Bucket Elevator | | 1 |
| | | | | 22-17 | Movable Inclined Conveyor | | 2 |
| | | | | 22-18 | Movable Pneumatic Conveyor | | 1 |
| | | | | 22-19 | Carrying Cart (250kg) | | 4 |
| | | | | 22-20 | Carrying Cart (100kg) | | 5 |
| | | | | 22-21 | Carrying Cart (50kg) | | 5 |
| | | | | 22-22 | Bulk Seed Box Container (100 L) | durable plastic | 10 |
| | | | | 22-23 | Bulk Seed Box Container (50 L) | durable plastic | 10 |
| | | | | 22-24 | Platform Scale (100kg) | Electric type, 100 kg/100g | 1 |
| | | | | 22-25 | Platform Scale (500kg) | mechanical type, 500 kg/500g | 1 |
| | | | | 22-26 | Vacuum Cleaner | | 1 |
| | | | | 22-27 | Air Compressor | | 1 |
| | | | | 22-28 | Rack | | 1 |
| | | | | 22-29 | Spare Screens | | 1 |

Table 2.9 List of Facilities and Equipment (requested/planned)

| REQUEST | | | | PLAN | | | |
|---|---|---|---|---|---|---|---|
| NO. | Facility & Equipment | Spec. / Component / Remarks | Q'ty | NO. | Facility & Equipment | Spec. / Component / Remarks | Q'ty |
| 4 | Seed Processing and | | | 23 | Equipment for Vegetables Seed Processing | | |
| | Packing Facility for | | | 23-1 | Air Screen Cleaner | vibrating screen x 2, aspirator x 1, capacity 100kg | 1 |
| | Vegetables | Indent Cylinder Separator | | 23-2 | Length Separator | indent cylinder x 1, capacity 100kg | 1 |
| | | | | 23-3 | Gravity Separator | capacity 100kg | 1 |
| | | | | 23-4 | Spiral Separator | open type, ht/83" | 1 |
| | | Seed Treater | | 23-5 | Seed Treater | mist-o-matic, capacity 100kg | 1 |
| | | Color Sorter | | 23-6 | Color Sorter | for okura, cariflower seed, built-in oscilloscope | 1 |
| | | Auto-weigher & packer (10-100g, for film bag) | | 23-7 | Auto-weigher (10-100 g) | | 1 |
| | | Auto-weigher & packer (1-10kg, for cloth bag) | | 23-8 | Auto-weigher (1-10 kg) | | 1 |
| | | | | 23-9 | Bag Sewing Machine (portable type) | for cloth bag | 1 |
| | | | | 23-10 | Heat Sealer | for moisture-proof film bag | 1 |
| | | Seed Extractor (for eggplant) | | | | | |
| | | Low Temperature Dryer | | 23-11 | Low Temperature Dryer | forced air type, holding capacity 50 kg | 1 |
| | | | | 23-12 | Platform Scale (100 kg) | electric type, 100 kg/100g | 1 |
| | | | | 23-13 | Electronic Balance (200g) | top pan type, 200 g/0.1g | 1 |
| | | | | 23-14 | Rack | | 1 |
| | | | | 23-15 | Working/Equipment Bench | | 3 |
| 5 | Laboratory Model of Seed | | | 24 | Laboratory Model of Seed Processing Equipment | | |
| | Processing Machine | | | 24-1 | Screen Shaker | | 1 |
| | | | | 24-2 | Seed Blower | | 1 |
| | | | | 24-3 | Laboratory Aspirator | | 1 |
| | | Screen Cleaner | 1 | 24-4 | Laboratory Air Screen Cleaner | | 1 |
| | | | | 24-5 | Thickness Separator | roller type | 1 |
| | | Indent Cylinder Separator | 1 | 24-6 | Laboratory Indent Cylinder Separator | | 1 |
| | | Indent Disk Separator | 1 | 24-7 | Laboratory Indent Disc Separator | | 1 |
| | | Gravity Separator | 1 | 24-8 | Laboratory Gravity Separator | | 1 |
| | | Spiral Separator | 1 | 24-9 | Spiral Separator | | 1 |
| | | | | 24-10 | Seed Treater | | 1 |
| | | | | 24-11 | Rack | | 1 |
| | | | | 24-12 | Working/Equipment Bench | for 24-1,2,3,7 | 1 |
| 6 | Vacuum Fumigation Chamber | capacity :2 tons | | 25 | Fumigation Equipment | | |
| | | | | 25-1 | Vacuum Fumigation Chamber | holding capacity 1.5 tons, chamber volume 6m3 | 1 |
| | | | | 25-2 | Gas Mask | side mounted type, canisters for CH3Br/PH3 gas | 3 |
| | | | | 25-3 | Gas Indicator | for CH3Br/PH3 gas | 1 |
| 7 | Temperature and Humidity meter | 0～50℃, RH0～100%, digital display | | 26 | Thermo-hygrometer | -10～60℃/±0.5℃, 20～100%RH/±2.0-3.0%, digital display, portable type, auto recording, printer | 2 |
| 8 | Sample Divider | capacity : 2 kg | | 27 | Sample Divider | precision type | 1 |
| 9 | Germination Chamber | 200～250L, illumination control | | 28 | Germination Chamber | 300 L,15～30℃, above RH90%,0 -15,000lux | 1 |
| 10 | Moisture Meter | infrared type | | 29-1 | Infrared Moisture Balance | heated drying & weight measurement method, 0 - 100 %/±0.1%, digital display | 1 |
| | | | | 29-2 | Capacitance Moisture Meter | indirect measurement method (non-destructive), portable type, digital display | 1 |

# CHAPTER 3 IMPLEMENTATION PLAN

# CHAPTER 3: IMPLEMENTATION PLAN

## 3.1 Implementation Plan

### 3.1.1 Implementation Concept

The responsible organization for the project is the Indian Council of Agricultural Research, but the real administration will be done by the Indian Agricultural Research Institute (ICAR). The project will be carried out by the Japanese Grant Aid Program, and after the decision is made by the Japanese Government to execute the project, the Indian Agricultural Research Institute in collaboration with other concerned agencies will prepare and arrange for the Exchange of Notes to be signed by both governments. They will also make banking arrangements, and will follow the tax exemption procedures for importing project equipment and materials and for Japanese engineers and technicians.

The Indian Council of Agricultural Research, after the signing of the Exchange of Notes has to arrange necessary number of employees by self expenses, to hire a consultant company for the preparation of the detailed design and for construction supervision and to select and enter contract agreements with a contractor and a trader for project building construction and equipment supply.

As the facilities and equipment provided by the project are required to have high level technique and accuracy, Japanese engineers and technicians will be dispatched to supervise the field work. The field works for the construction and installation of facilities and equipment will be implemented by the Indian contractor and its personnel, and considering the future operation and maintenance of the project, it will be necessary to place priority on the transfer of technology during the execution of the work.

Concepts for the building construction and installation of equipment are summarized as follows:

(1) All personnel responsible for building construction must recognize their duties and do their best work in constructing the quality buildings required by the Project.

(2) All personnel responsible for building construction should attempt to transfer technology of building construction and equipment installation to the Indian personnel.

(3) For the smooth implementation of the project, all personnel should communicate frequently with the project related Japanese and Indian agencies.

(4) Cooperation between Indian Governmental agencies, the consultant, and construction contractors must be maintained at a high level to carry out the project smoothly.

(5) Utmost effort should be made to complete project construction on schedule.

(6) Japanese engineers and technicians specializing in the following fields should be dispatched for the project:

- Active breeding stock storage, nucleus seeds and breeder seeds storage.
  Supervision and technical transfer of panel fabrication and air conditioning unit installation.

- Controlled temperature glass room.
  Supervision and technical transfer of steel frame and its fabrication and control system.

- Seeds processing equipment.
  Supervision and technical transfer of installation and operation of equipment.

- Major research equipment.

Supervision and technical transfer of equipment installation.

### 3.1.2 Implementation Condition

Matters pertaining to the project construction requiring special attention are as follows:

(1) The limits of the construction work to be borne by the Indian Government and financed by the Japanese Grant Aid Program must be clarified. Both parties must cooperate fully to perform the construction work.

(2) To expedite the utility installation work, such as the connection of power lines, any agreements made with responsible Indian agencies should be arrived at carefully.

(3) Since the project construction will take place at two different sites, the construction methods and the capabilities of the contractors should be studied carefully.

(4) Coordinate wall and floor construction work with power facility, water supply and drainage facility installation work.

### 3.1.3 Scope of Work

For project construction, the work items to be undertaken by the governments of Japan and India are summarized as follows:

(1) Work Items to be Undertaken by the Japanese Government:

1) Construction and procurement of building facilities and equipment for the project.

2) Dispatching the engineers and specialists necessary for installing the Japanese supplied equipment and facilities.

3) The transportation and insurance costs for shipping the equipment and materials from Japan to the project sites in India.

4) Detailed design and construction work supervision necessary for the Grant Aid Program.

(2) Work Items to be Undertaken by the India Government:

1) Removal of the partition wall from the room to be changed into a low temperature storage room and reform the existing generator house.

2) Secure the building construction site at Karnal Station and install an adequate transformer for the increase of electricity consumption.

3) Procurement of furniture and utensils.

4) Provide tax exemption for import duties and incidental expenses and take necessary measures for obtaining customs clearance for the materials, equipment, and spare parts to be brought into India by the Japanese consultant and contractors for use in the implementation of the project.

5) Facilitate convenience for the Japanese nationals whose services may be required in connection with the project to enter India and remain in the country to perform their assigned tasks.

6) Payment of bank arrangement commission.

7) Perform all the other work not covered by the Grant Aid Cooperation Program of the Japanese Government but are necessary for project implementation.

### 3.1.4 Consultant Supervision

(1) The most important facet of construction supervision is to coordinate the technical, administrative, and construction work between the concerned Indian and Japanese parties. Therefore, the resident engineer who is sent to and will remain in India during the entire project construction period should possess managerial skills and be qualified and capable of providing technical guidance.

(2) The resident engineer must be an experienced construction supervisor who can evaluate construction site conditions and make accurate decisions for accomplishing the construction work.

(3) The resident engineer must judge the construction work being performed at the project site and act as the coordinator between project related Indian agencies and Japanese and Indian contractors in all construction matters. The resident engineer must maintain close contact with Indian agencies, the Japanese embassy and JICA office in India to ensure that construction work progresses smoothly.

(4) Important duties of the resident engineer include erecting buildings that are of a quality sufficient to meet the needs of the project, completing the project on schedule, and providing technical transfer to local contractors.

(5) The major duties of the resident engineer are listed below:

- Prepare monthly reports;
- Decide the location and elevation of the building to be constructed;
- Being witness to project site ground bearing capacity determinations;
- Check and approve shop drawings, inspect reinforcement bar setting work, and supervise concrete placing work;
- Witness and inspect the procurement of domestic materials and equipment;
- Check and approve detailed finish-work drawings and supervise the finish work;
- Hold periodic meetings and monitor , manage the construction schedule;
- Inspect and examine the completed construction work (witness the inspection and

examination of completed construction work by the consultants and Indian agencies);

(6) One resident engineer will be required for building construction.

3.1.5 Procurement Plan

The basic policy is to procure the necessary equipment and materials in India to the greatest extent possible, so that it will allow the use of local construction methods and will contribute to Indian social and economic improvement.

Equipment and materials that are neither available in India, nor required to be extremely accurate and of high performance, or are simply more expensive in India than in Japan, should be procured in Japan. If possible, domestic construction materials should be procured in the vicinity of the project sites. Building finish materials should be procured in New Delhi and transported by trucks to the site.

Equipment and materials procured in Japan will be unloaded at the Port of Bombay and transported to the Inner Container Depot-Tughlakabad, Delhi by train. After custom clearance at the depot, equipment and materials will be transported to the site in containers, so that their security and weather proofing will be maintained.

(1) Major Equipment and Materials to be procured in India

1) Building Materials:
Cement, sand, coarse aggregate, concrete block, shaped steel, reinforcement bars, form materials, corrugated slate, tile, window glass, wood product for base and finish work, paint, terrazzo blocks, caulking materials, gypsum board, and plastic sheet.

2) Electrical equipment and materials:
Emergency generator, wire, cable, conduits, switching units, electrical wall outlets,

lighting fixtures, air conditioning units, roof and ventilation fans, aluminum window frames and exterior doors

3) Equipment

Computers, automatic voltage regulator and uninterrupted power supply units.

(2) Equipment and materials to be procured in Japan

1) Building Materials:

Color coated metal sheet roofing, fittings, interior doors and low temperature storages.

2) Electrical Equipment:

Induction automatic voltage regulator and distribution panels.

3) Controlled Temperature Glass House :

4) Equipment:

Equipment for seed research, seed processing and packing facilities for cereals and vegetables, and vacuum fumigation chamber.

3.1.6 Implementation Schedule

The Project will be under the auspices of the Government of Japan's Grant Aid Cooperation Program and will be carried out in accordance with the following schedule:

(1) The Exchange of Notes (E/N) concerned with the objectives and the contents of the project, and with the amount of grant aid required for the project will be signed by representatives of the Government of India and Japan.

(2) The Government of India will make banking arrangements with a Japanese foreign exchange bank for transferring the money covered by Grant Aid Cooperation in accordance with the E/N.

(3) The Government of India will enter a contract agreement with a consultant firm for the project-use equipment and materials, and for facility construction work needed to fulfill the objectives of the project.

(4) The consultant shall carry out the field survey and prepare the detailed design and tender documents, and obtain the approval of documents by the Governments of both sides.

(5) The pre-qualification, in which only Japanese nationals tenderers can participate, for the construction of the building will be carried out.

(6) The successful tender shall procure the equipment and materials required by the contract and deliver them to DSST. It is expected that the construction and installation of equipment will take twelve months.

(7) The construction work is expected to be completed before the rainy season starts.

| Item \ Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Detailed Design | | | | | | | | | | | | |
| 1. Site Survey | | | | | | | | | | | | |
| 2. Design Work | | | | | | | | (Total 3.0 Months) | | | | |
| B. Construction & Procurement | | | | | | | | | | | | |
| 1. Building | | | | | | | | | | | | |
| 1) Preparatory Works | | | | | | | | | | | | |
| 2) Foundation Works | | | | | | | | | | | | |
| 3) Structural Works | | | | | | | | | | | | |
| 4) Low Temperature Storage Work | | | | | | | | | | | | |
| 5) Exterior Works | | | | | | | | | | | | |
| 2. Procurement of Equipment | | | | | | | | | | | | |
| 1) Manufacture & Procurement | | | | | | | | | | | | |
| 2) Transportation of Equipment | | | | | | | | | | | | |
| 3) Installation & Adjustment | | | | | | | | | | | | |
| 3. Completion & Delivery | | | (Total 12.0 Months) | | | | | | | | | |

Fig . 3.1 Implementation Schedule

## 3.2 Project Cost Estimation

### 3.2.1 Project Cost

Project cost as borne by the Indian Government, is estimated to be Rs 462,000.

The foreign exchange rate used for estimating the cost was US$1.00 =97.00 yen (Rs 1.00 = 3.08 yen, March 1995)

(1) The construction work items and their cost that will be bone by the Indian Government are as follows:

| | | |
|---|---|---|
| 1) | Site reclamation and preparation work | Rs 150,000 |
| 2) | Building modification cost (DSST, New Delhi) | Rs 10,000 |
| 3) | Building modification cost (Regional Sta. Karnal) | Rs 50,000 |
| 4) | Power line connection work | Rs 37,000 |
| 5) | Banking service | Rs 215,000 |
| | Total | Rs 462,000 |

### 3.2.2 Operation and Maintenance Cost

DSST shall be responsible for the operation and maintenance of the facilities and equipment procured and delivered under the project. Maintenance and repairing of equipment, tools and management of spare parts supplied under the project shall be carried out properly. After the spare parts supplied under the project are consumed, additional procurement will have to be borne by DSST.

The yearly operational expenses for the operation and maintenance of Regional Station Karnal and DSST New Delhi are estimated be of (Expenses for existing staffs are not included because they have already been budgeted for the research activities of each sector):

1) Personnel

Personnel costs are as follows;

| | | | | |
|---|---|---|---|---|
| a. | DSST New Delhi | Rs 3,600 | x 12 | 43,000 |
| b. | Regional Station Karnal | Rs 4,500 | x 12 | 54,000 |
| | Total: | | | Rs 97,000 |

2) Charges for Electricity

Unite Electricity Rates:

Basic rate : Rs 114.00

Surcharge rate : Rs 1.84/kw • h

DSST New Delhi (Yearly Consumption Volume : 1,080 kwh)

Electricity fee = (1.84 x 1,080) + 114 = Rs 2,101

Regional Station Karnal (Yearly Consumption Volume : 17,220 kwh)

Electricity fee = (1.84 x 17,220) + 114 = Rs 31,799

Total = Rs 33,900

3) Fuel Costs

Fuel for dryer at Regional Station Karnal is estimated as follows:

Rs 6.78/*l* x 1,555*l* /year = Rs 10,270

4) Annual Operation and Maintenance Cost

a. DSST New Delhi

The annual operation cost for the Seed Storage Facilities for Breeding Stocks and Authentic Samples of Varieties are estimate to be Rs 11,915

b. Regional Station Karnal

The annual operation costs are estimate as follows:

| | | |
|---|---|---|
| Seed processing equipment | : | Rs 52,498 |
| Buildings | : | Rs 53,936 |
| Low temperature storage facility: | | Rs 26,800 |
| Total | | Rs 133,234 |

5) Total Operation and Maintenance Costs

Annual expenses for each center are as follows:

| | | |
|---|---|---|
| DSST New Delhi | : | Rs 57,216 |
| Regional Station Karnal | : | Rs 229,304 |
| Total | : | Rs 286,520 |