BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF SEED MULTIPLICATION CAPACITY IN THE SYRIAN ARAB REPUBLIC

JANUARY 2001

JAPAN INTERNATIONAL COOPERATION AGENCY
SYSTEM SCIENCE CONSULTANTS INC.

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PREFACE

In response to a request from the Government of the Syrian Arab Republic, the Government of Japan decided to conduct a basic design study on the Project for the Improvement of Seed Multiplication Capacity and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Syria a study team from 15 July to 16 August, 2000.

The team held discussions with the officials concerned of the Government of Syria, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Syria in order to discuss a draft basic design, and as this result, the present report was 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 the Syrian Arab Republic for their close cooperation extended to the teams.

January, 2001

Saito Kunihiko
President
Japan International Cooperation Agency

January, 2001

LETTER OF TRANSMITTAL

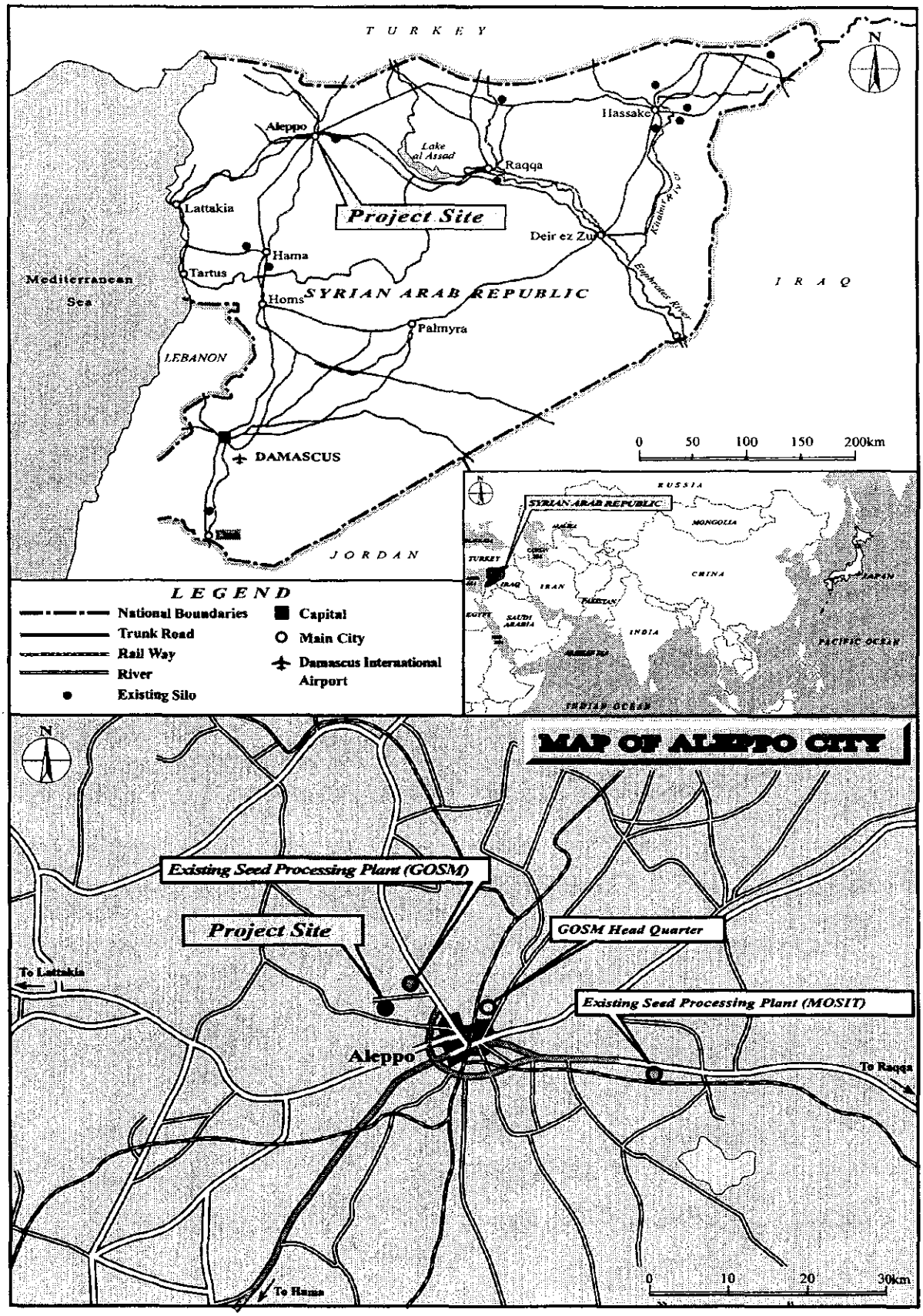
We are pleased to submit to you the basic design study report on the Project for the Improvement of Seed Multiplication Capacity.

This study was conducted by System Science Consultants Inc., under a contract to JICA, during the period from 30 June, 2000 to 2 February, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Syria 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,

Toshiharu Hata
Project manager,
Basic design study team on
the Project for the Improvement of Seed
Multiplication Capacity
System Science Consultants Inc.



Location Map of the Project Site

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Abbreviations

Organization

ACSAD	Arab Center for Study of Arid Zones and Dry Area
DASR	Directorate of Agricultural Science Research
GOSM	General Organization for Seed Multiplication
ICARDA	International Center for Agricultural Research in the Dry Area
JICA	Japan International Cooperation Agency

Others

E/N	Exchange of Notes
GNP	Gross National Product
OJT	On the Job Training

Summary

Summary

The Syrian Arab Republic (henceforth referred to as Syria) has an area of 185,000 km^2 and a population of about 17,460,000 people (as of January 1999). It is situated at the western end of the Asian Continent, constituting a mid-eastern strategic point close to Turkey, Iraq, Jordan, Lebanon, and the Mediterranean Sea. There are 3,000-meter-level mountain ranges on the western border of Lebanon and Mediterranean coasts, with the inland in the form of a plateau. The Mediterranean coasts and the mountainous areas surrounding them have a Mediterranean climate with a lot of greens and rainfalls in winter. But the area with the Syrian desert stretching from the middle to the southeastern part of the inland has a dry climate.

Of the total population of Syria, the people engaged in agricultural activities comprise about 24.2 percent, and the agricultural products make up about 32.3 percent of the country's GNP in 1998. Thus agriculture is the main industry of that country. Under its 8th five-year plan (1996~2000), too, agricultural development is the most important task for the promotion of its economy.

Increased production and supply of seeds of wheat, potatoes, etc., which are principal crops of the country, are carried out by the GOSM (General Organization for Seed Multiplication), which is attached to the Agricultural Reform Ministry and whose Headquarters is located in Aleppo province. The 12 seed processing centers in Syria select superior wheat seeds, and potato seeds are sold to the farmers in the entire country by three sales centers.

However, the wheat seed center established in 1975 has become too old for use because the facility has not been renewed nor improved since then, so it is unable to increase production satisfactorily. Thus the wheat seed supply is only 50 percent or so of the necessary volume, causing the farmers not fully supplied with seeds to use part of their own wheat as seeds. This situation, if allowed to continue, will inevitably bring about a decrease in the volume of crops. In the case of potato seeds, too, the cultivating facility is not fully consolidated despite the fact that technology has been established, and this is making it impossible to increase production adequately. Now the seed stock, which is the basis for the production of potato seeds, is dependent on imported seeds, causing the farmers to bear the heavy cost burden.

For such reasons, the Syrian Government is strengthening the structure for the production of superior whet seeds especially in Aleppo and Idleb provinces where the wheat seed supply ratio is low. For potato seed stock, too, it is working to consolidate the facility capable of independent production under a plan to construct a new seed center on the outskirts of Aleppo City in order to improve the

agricultural production in the enter country as well as in the said province. Syria has thus requested Japan to extend grant aid to supply seed processing plant equipment for the wheat seed production and tissue culture equipment for the potato seed production.

Because of such circumstances, the Japanese Government has decided to carry out a preliminary study for this project to grasp the actual states of seed supply and production in Syria and see whether the contents of its request was appropriate or not. The JICA (Japan International Cooperation Agency) dispatched a team for his purpose over the period from February 18 to March 9, 2000. Based on the result of this study the Japanese Government thereafter decided to investigate the basic design for this project, and the JICA dispatched a basic design team to carry out on-site survey for this purpose over the period from July 14 to August 17, 2000. In the survey of the basic design the JICA confirmed the background and contents of the request, and also grasped the state of activities by the investigation organ, the existing equipment, the current situations of seed demand and supply, the technical level, etc. At the same time, it knew the natural conditions of the site and the nature of activities by related facilities. After returning Japan the study team analyzed the data and information it had collected, and confirmed the necessity and adequacy of the project. In addition, it carried out a basic design related to the equipment having appropriate contents and scale as conditions for the Grant Aid, and provided a summary of the basic design. In order to obtain final confirmation together with the Syrian Government on the result of the basic design, The JICA dispatched Draft report explanation team to the actual scene to outline the basic design over the period from October 7 to 26, 2000.

Through the on-site investigation, the JICA confirmed Syria's development plan, the GOSM's role, the actual situation where the existing facilities and equipment were utilized, the technical level, the capability of maintenance and management, etc. and formulated an equipment plan with reference to the seed multiplication not responding to the Syrian demand, with the frameworks mentioned below:

① Demand for Seeds

Due to the advanced depreciation of the existing seed processing facility, it is unable to meet the national demand for seeds. Therefore, this project will provide equipment that will address this demand.

② Targeted Crops

The GOSM is responsible for the nationwide management and supply of a diverse variety of seeds for grains, raw cotton, beans, potatoes, vegetables, fruits, and others. However, since the project is unable to cover all the seeds handled by the GOSM, it will target wheat seeds,

the staple food of the country, and potato seeds, which are largely dependent on imported seeds, to enable potato seeds to be domestically produced. This will help alleviate the cost and provide a stable supply of healthy potato seeds.

③ Targeted Area of the Seed Supply

The supply ratios of wheat seeds in Aleppo and Idleb provinces, the targeted project sites, are the lowest in the nation. Therefore, the project will contribute to improving the seed supply ratio in both these provinces. Presently, the supply of potato seeds is completely dependent on imported seeds. Therefore, the project will provide cooperation for potato seeds on a nationwide level.

④ Scope of the Project

The propagation of seeds during the initial growth stage is carried out at the GOSM farm and they are multiplied by contract farmers following this stage. However, due to the potential problems that exist in providing and managing equipment shared with the contract farmers, this project will be limited to assisting inside of the project site that is planned by GOSM.

⑤ Criteria for Equipment Selection

The equipment that will be selected by the project will be suited to the technical level of the current staff members. In addition, since the objective of the project is seed multiplication, production related equipment would be given priority in the selection process.

Consequently, the project is designed to furnish equipment for the processing of wheat seed and for the tissue culture of potato seed in order to produce wheat seed needed by farmers in Aleppo and Idleb provinces and seed potato which are dependent on imports, on the outskirts of Aleppo City where the site to be built up the facilities by the GOSM is located.

The equipment to be supplied under this project is shown next page:

Outline of Equipment

Item	Name of Equipment
A. Seed Processing Plant for Wheat	
Weighing Facility	Truck scale, etc.
Seed Processing Facility	Seed processing plant (15 tons/day), etc.
B. Quality Control Equipment for Wheat	
Laboratory Size Seed Processing Machine	Air screen cleaner, Gravity separator, indent cylinder, Auto weigher, etc.
Testing Equipment	Seed sample divider, Microscope, Moisture tester, Seed counter, Analytical balance, Illuminated magnifier, Seed sample pan, Grain dockage sieve, Sieve shaker, Grain shape tester, Bag sealer, Seed sample refrigerator, Seed germinator, etc.
C. Tissue Culture Equipment for Potato	
Water purification Room	Pure water system, etc.
Media Preparation Room	Autoclave, Refrigerator, pH meter, EC meter, Dispenser, Automatic pipette, Magnetic stirrer, etc.
Cultivation Room	Clean bench, Stereoscopic microscope, Universal microscope, Forceps, Scissors, Scalpel blade with handle and blade, test-tube rack, etc.
Growth Room	Illuminated incubator, Rotary shaker, Incubation growth room system, Recording unit, Lux meter, Air quality tester, etc.
Glassware Room	Plant test tube, Jar with lid, Graduated cylinder, Beaker, Flask, Pipette, Petri dish, etc.
Glassware Washing Room	Ultrasonic Pipette washer, Automatic glassware washing machine, Dry heat sterilize, Dry oven, etc.
Quality Control Room	ELISA reader system, Microscope for I.F. Test with photo system, Illuminated incubator, Fume hood, etc.
Green House	Green house of environment control type, heating system, cooling system, carbon dioxide equipment, Window system, water quality softener, Quality Control Room, etc.
Other	Standby Generator

As for the period of construction work for the project, it is presumed that about two months will be required for the implementation design, about 2.5 months for tender approval, and 8~10 months for the procurement and installation of the equipment. The operation and maintenance cost shouldered by Syrian side are estimated about 81.01 million Japanese yen.

The implementation of the project will result in the consolidation of the equipment for the plant needed by the GOSM to increase wheat and potato seed. The direct and indirect effects to be expected are as follows:

(1) Direct benefits

① Improved supply ratio of wheat seeds

The supply ratio of wheat seeds in the areas targeted by the project (presently 40 percent) will reach the national average level of about 57 percent.

② Improved wheat seed quality

The quality of wheat seeds will increase since the mixture of different varieties or immature seeds, crushed seeds, and others will be eliminated.

③ Domestic production of potato due a supply of basic potato seeds

A stable supply of potato seeds will be achieved due an increased domestic production volume of potato seeds, which is anticipated to reach 2,490 tons or about 35 percent of the current volume of 7,000 tons of imported potato seeds.

(2) Indirect benefits

① Increased production of wheat and potatoes

An increased production volume of potatoes and wheat is anticipated due to the distribution of cleaned wheat seeds and virus-free potato seeds to the farmers.

② Impact of the model facility on other seed processing facilities

The project will serve as a model for seed production in Syria with the introduction of new propagation methods and facilities; and its positive impact on other seed processing facilities is anticipated.

③ Improved living standards of farmers

The supply of superior seeds is expected to produce a stable yield and a higher income, that is expected to improve the living standards of farmers.

④ Contribute to balance of international payments

Due to the domestic production of seeds, the volume of imported seeds will decline, which in turn, will contribute to the balance of international payments.

The implementation of the project will enable wheat to be supplied to about 335,000 people in Aleppo district and potato seeds to be distributed to about 37,000 farmers nationwide. Therefore, in view of the management and operation capabilities of the project implementing agency, the number of beneficiaries, and subsequent improvements in the living standards of the farmers which the project is anticipated to produce, it has been concluded that the project will be implemented as a Japanese government grant-aid project.

When the project is implemented, the Syrian government must carry out the following countermeasures in order to effectively operate the equipment that will be provided by the project.

① The facilities and equipment that will be provided by the project will increase the volume of seeds that are processed and distributed to farmers. Therefore, a larger number of contract farmers should be procured to cope with the increased volume of seeds that will be produced.

② The wheat seed processing plant will produce seeds that will be distributed to farmers within its first year of operations. However, the tissue culture related facility for potato seeds will not be able to produce basic potato seeds for distribution for five years due to the propagation process. Therefore, this initial five-year period should be viewed as a long-term investment period and a planned budget must be procured.

③ Wheat seeds are generally stored in the open field and a large volume of seeds are lost due to damages incurred by rats and birds. Therefore, in order to prevent such losses, a storage facility for seeds must be built.

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Chapter 1 Background of the Project

1.1 Background of the Request

The Syrian Arab Republic (henceforth referred to as Syria) has a population of about 17,460,000 people (as of January 1999), of which approximately 24.2 percent of the population, is engaged in agricultural activities. In addition, agriculture is a major industry and agricultural products comprised about 32.2 percent of the GNP in 1998. Agricultural development has also been targeted in the Eighth Five-Year Development Plan, aimed at promoting the national economy.

However, the government has been able to supply only 50 percent of the volume of wheat seeds that are needed by farmers and subsequently, the farmers have been forced to independently secure the remaining volume of seeds that is needed by planting seeds for the following year. However, cleaning activities by farmers during the seed production process are inadequate. Moreover, the result is an increased volume of damaged seeds due to repeated propagation of impaired seeds. The germination ratio of such seeds and a lowered yield have become a growing concern and if the current situation is allowed to continue, Syria will no longer be able to produce an adequate volume of wheat, a principal crop of the country. Additionally, all basic potato seeds are imported, which has placed an enormous financial burden on the Syrian government.

The General Organization for Seed Multiplication (GOSM) based in Aleppo City is responsible for producing and supplying wheat and basic potato seeds. Superior wheat seeds are graded and sold to farmers by the twelve Seed Centers located throughout the country. The majority of the Seed Centers were built in 1975 and their facilities and equipment have depreciated and they have not been renewed or replaced. Subsequently, the centers have been unable to adequately conduct seed propagation activities. Potato seeds are cultivated and propagated at the GOSM culture facility and green house and are sold to farmers. However, the facility is incapable of meeting the seed volume demand of the entire nation and potato seeds are imported from abroad (mainly Europe) in order to meet the domestic demand.

In view of these circumstances, the Syrian government has plans to build a new seed center aimed at improving agricultural production, that will be capable of producing basic potato seeds and strengthening the production system of superior seeds in Aleppo and Idleb provinces, where the supply ratio of wheat seeds is especially low.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) Goal and project target

The area in Syria for the cultivation of wheat, which is the principal food in that country, comprises about 35 percent of the entire area of cultivation (about 4.8 million square hectares), and the volume of wheat production is about 4.1 million tons per year. Thus wheat is an important crop in Syria. However, 350,000 tons of wheat seeds is regarded as necessary and, with the existing seed processing facility (established in 1975) becoming too old for use, the volume of supply is no more than 190,000 tons (57%), making the country unable to meet its own demand. Especially in the areas covered by the seed supply project (Aleppo and Idleb provinces), there is only one seed processing facility (established in 1975). Therefore, the volume of supply in this area comprises only 40 percent, which is below the national level. Furthermore, about 490,000 tons of potatoes, which are representative crops next to tomatoes, are produced, and about 7,000 tons of seed potatoes are needed. In view of the productive capability of the existing facility, however, about 9.5 percent (approximately 670 tons) is all that can be produced in that country. Thus many seed potatoes are dependent on imported seeds, involving the problem of being swayed by a large amount of expenses and the crops on the part of exporting countries. It is therefore necessary to improve the situation promptly.

Thus Syria has made a plan to construct a new seed center on the outskirts of Aleppo, which is the second largest city in that country, and requested Japan to supply the equipment for this center by Grant Aid. This project is therefore designed to consolidate seed processing equipment, Tissue culture equipment and a greenhouse for the seed processing and tissue culture facilities which will be constructed by the GOSM, and thus to contribute to the multiplication of the seeds presently needed by Syria.

(2) Outline of the project

This project is aimed at consolidating the equipment related to the facilities for the seed processing of wheat and for the increased production of potato seed, and also at carrying out activities for seed production in order to attain the above-mentioned target. As a result, it is expected that the ratio of wheat seed renewal will be improved, and that domestic production of potatoes will become feasible. In this context, the project is designed to procure equipment related to wheat seed processing and potato seed producing facilities.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

In order to contribute to the propagation of seeds, the project will provide equipment for the seed processing facility under the following policy.

① Demand for Seeds

Due to the advanced depreciation of the existing seed processing facility, it is unable to meet the national demand for seeds. Therefore, this project will provide equipment that will address this demand.

② Targeted Crops

The GOSM is responsible for the nationwide management and supply of a diverse variety of seeds for grains, raw cotton, beans, potatoes, vegetables, fruits, and others. However, since the project is unable to cover all the seeds handled by the GOSM, it will target wheat seeds, the staple food of the country, and potato seeds, which are largely dependent on imported seeds, to enable potato seeds to be domestically produced. This will help alleviate the cost and provide a stable supply of healthy potato seeds.

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⑤ Criteria for Equipment Selection

The equipment that will be selected by the project will be suited to the technical level of the current staff members. In addition, since the objective of the project is seed multiplication, production related equipment would be given priority in the selection process.

(2) Policy Pertaining to Natural Conditions

Generally, a westerly wind from the Mediterranean Sea is found at the project site, but the north wind blows during the winter season. Therefore, the planned location of the seed processing facility and the tissue culture building and greenhouse will take the wind direction into consideration, in order to prevent the dust discharged from the seed processing facility to accumulate in the greenhouse, which will be used for tissue culture.

In addition, heating and cooling systems will be installed in the greenhouse used for tissue culture to cope with summer temperatures over 35°C and 0°C in winter.

(3) Policy on Infrastructure Conditions

1) Electricity

Although Syria's electricity system has improved, extended periods of power failure continue to occur. Power failures in the summer or winter seasons will destroy the potato seed crop cultivated in the greenhouse due to the extremely high and low temperatures that prevail during these seasons. Additionally, a rise in the room temperature of the Growth Room due to a power failure will destroy the seeds that are under cultivation. Therefore, a standby generator will be installed to provide emergency power for the Growth Room and greenhouse in the event of a power failure.

2) Water Supply

The Euphrates River is the source of the tap water supplied by the city at the project site. Although the water supply volume is abundant, the water is hard and contains large amounts of coal, which tends to accumulate and encrust the water pipes. Therefore, a water softener will be installed for the water that will be used for the drip irrigation system, the boiler for the heating system supplying the greenhouse, for tissue culture activities, the water purification system, and the soil sterilizer.

3) Wastes Products

None of the wastes that are produced by the seed processing facility will have a major impact on the environment. However, since the culture medium, hormones, and chemicals will be used in

tissue culture, wastes that are discharged by the laboratory will be flushed into a settling tank and they will not be directly discharged into the sewer system. The accumulated wastes in the settling tank will be periodically pumped out, mixed with soil, and used as fertilizer.

4) Roads

The equipment provided by the project will be unloaded at either Lattakia or Tartus on the Mediterranean coast and transported by truck to the project site in the suburbs of Aleppo. The road from the Mediterranean coast to the suburbs of Aleppo is in excellent condition and the main road from the suburbs of Aleppo to the project site is paved. However, the last one-kilometer of this road leading directly to the site is unpaved, but it is level and capable of supporting the passage of trucks loaded with containers.

(4) Policy on Maintenance and Operation of the Equipment

1) Technical aspects

Presently, the seed processing facility owned by the GOSM has been in operation since 1997 and the staff members at this facility are fully experienced. Experiments and research in tissue culture have been conducted for ten years and a 1000m^2 greenhouse was built four years ago. The staff has accumulated experience in seed multiplication and in the operations and maintenance of the facility. Therefore, no problems are foreseen in the area of technology and expertise. The handling and operation of the equipment, that will be selected and installed under the project, will be within the scope of the current level of technical expertise at the facility. Care will be given to ensure that the specifications and grade of the selected equipment will not become a source of confusion. English language versions of the operating and maintenance manuals for the new equipment will be provided. In principle, the operations and mechanics of the new equipment will not differ greatly from the equipment presently in use, but some will utilize different operating methods. As a result, on-the-job-training (OJT) on the operations and maintenance methods of the new equipment will be provided by the party responsible for installing the equipment; and this will be a mandatory requirement. In particular, adjusting the equipment for the entire plant is detrimental to the operations of the wheat seed processing facility, which is responsible for producing high quality seeds. Therefore, sample wheat (2 to 3 tons) will be provided in the actual training sessions.

2) Budget

An adequate budget must be procured for consumables and spare parts of the new equipment since they will be in constant use. The majority of the new equipment is basic equipment and they will not require maintenance contracts or special maintenance work.

(5) Policy on Equipment Scope, Grade and Volume

1) Scope of the equipment

This project is largely divided into ①wheat seed processing plant and ②tissue culture of potato seeds. Its scope has been reviewed as follows.

【Review of the scope of the wheat seed processing plant】

The seed processing facility that will be equipped by this project is slated to commence in 2002. Hence, the scope of the project was based on FY2002.

A. Factors in the Aleppo and Idleb Districts in FY2002

The required processing volume, the existing potential processing capacity, the number of operating days, and other factors must be calculated in the design of the seed processing plant. The following factors are needed in the calculation.

①Estimated planting amount
②Targeted renewal ratio (%)
③Processing volume (ton/year) of the existing seed processing plant (1 plant)
④Number of operating months (month/year)
⑤Number of operating days (days/month)
⑥Operating hours (hours/day)
⑦Number of times seed variety is changed and cleaned (times/year)
⑧Number of required hours (day/times)
⑨Operation ratio (average number of idling hours per day)
⑩Product yield (%)

B. Formula Used to Calculate the Scope

Based on the factors listed above, the required processing scope was calculated according to the following formula.

$$\text{Required processing scope} = \frac{①\times②-③}{(④\times⑤-⑦\times⑧)\ \times\ (⑥-⑨)\ \times⑩}$$

C. Defining the Factors

① Estimated Planting Amount

The following has been estimated based on the transitions in the cultivation area for the past six years in the Aleppo district.

Irrigation area (250kg/ha): Excluding FY 1999 in Idleb, both districts have shown an increase over the past six years. Therefore, the average growth rate for the past six years for both districts (11.6% for Aleppo, 9.64% for Idleb) was used to estimate the annual growth. The cultivation area for FY2002 was estimated at 150,127ha.

Non-irrigation area (150kg/ha and 200kg/ha): Growth has ceased and the growth rate has remained stagnant for the past three years. Hence the cultivation area in FY2002 will be the same as FY1999 (150kg/ha: 176,988ha, 200kg/ha: 103,046ha).

Planting volume at irrigated area = 150,127 ha × 250 kg/ha = 37,531,750 kg

Planting volume at non-irrigated are = 176,988 ha × 150 kg/ha + 103,046 ha × 200 kg/ha

= 47,157,400 kg

Total Planting volume = 37,531,750 kg+ 47,157,400 kg= 84,689,150kg ≒ 84,689 tons

Based on the above, the sowing volume for both districts in FY2002 has been estimated at 84,689 tons. The planting area and sowing volume of national, Aleppo and Idleb area are shown blow.

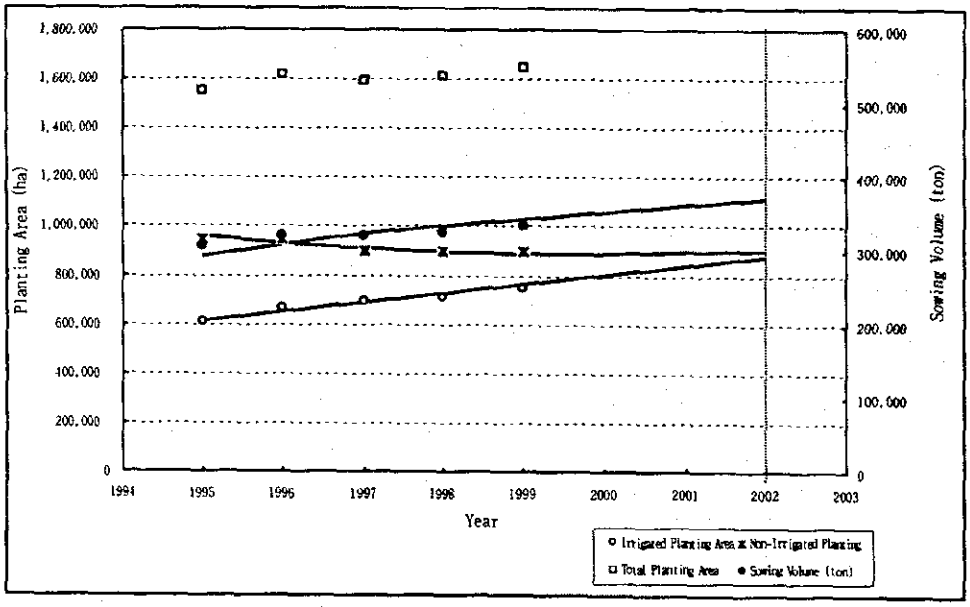

Fig. 2-1 National Planting Area/Sowing Volume

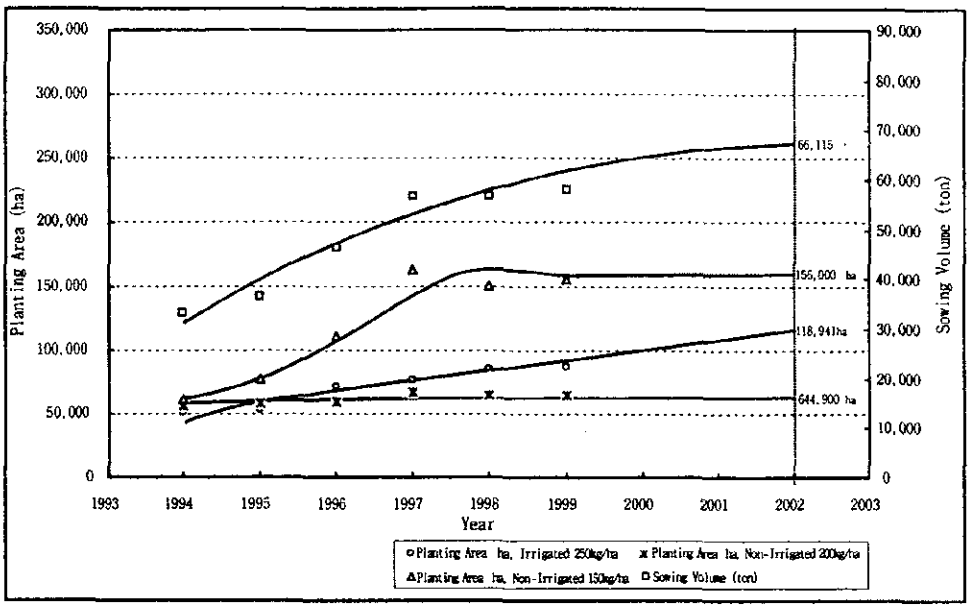

Fig. 2-2 Aleppo Planting Area/ Sowing Volume

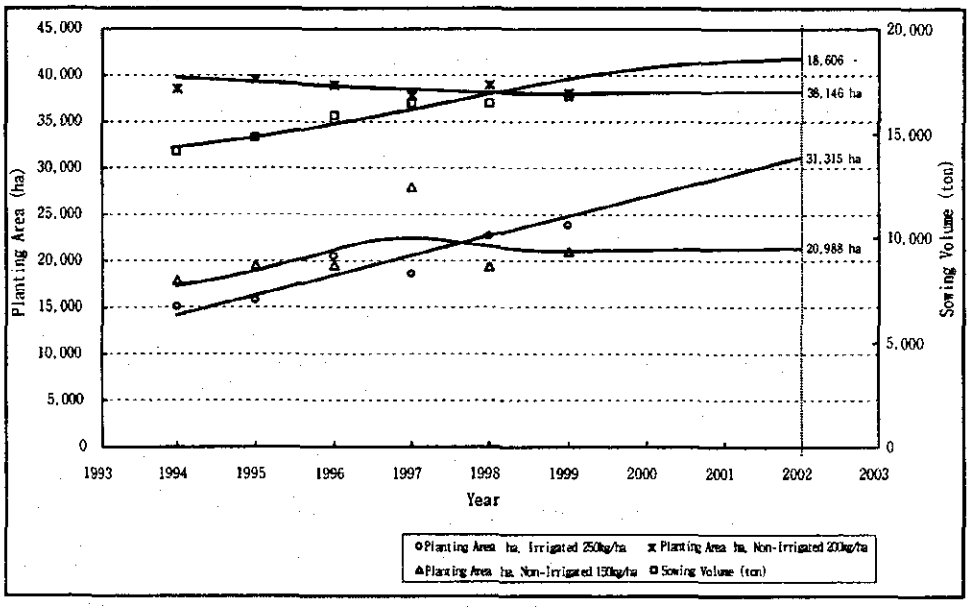

Fig. 2-3 Idleb Planting Area/ Sowing Volume

The population growth is shown under, it estimated that population of Aleppo and Idleb will be about 6,063,000.

Table 2-1 Population Growth in Aleppo and Idleb

×1,000

Year	1997	1998	1999	2000	2001	2002
Population	5,120	5,275	5,435	5,749	5,906	6,063

In 1998, the total consumption of wheat products in Syria ware 4,100,000 tons, the one person's consumption was 0.24 ton (including fodder). Therefore, the implementation year for this project in 2002, the consumption of wheat that is needed, estimated 6,063,000 × 0.24=1,450,000 tons.

The population growth ratio in Aleppo and Idleb is shown below. The population in FY 2002 is estimated about 6,063,000. Other hand, the planting volume ratio between product volumes in 1994 to 1999 FY are 16.3 (production volume in 1998 is excluded by unnatural whether condition).

Table2-2 Seed Volume Ratio between Product

F.Y.	1994	1995	1996	1997	1998	1999
Planting	47,394	51,408	62,229	73,251	73,241	74,722
Product	667,257	871,151	899,405	904,596	746,225	1,081,991
Ratio	—	18.38	17.50	14.54	10.19	14.77

The necessary planting volume for 1,450,000 tons products are 1,450,000 ton / 16.3 = 88,957 ton. The estimated planting volume pre-described is reviewed appropriate volume.

② Targeted Renewal Ratio

Both Aleppo and Idleb districts will achieve the national average seed renewal ratio by FY2002 when the project is commenced. The average renewal ratio was calculated at 56.8 percent based on the total national planting volume for the past five years and the GOSM data on supply volume. The renewal ratio of domestically produced wheat seeds in Japan was 64.7 percent in FY1999 (real ratio) and 65.0 percent for FY2000 (estimated ratio). Due to the high production target for good quality wheat after private wheat distribution was introduced (from FY2000), the renewal ratio is anticipated to rise further. Due to the large production scope in the United States and Australia, the largest wheat producing countries, the targeted seed renewal ratio of 57 percent will remained unchanged, since seed collection from the farmers' own crop is not practiced for safety reasons (see Appendix 2).

③ Processing Volume of the Existing Seed Processing Plant

Based on the most recent data collected from the interview survey on the capacity of the existing seed processing plant, the operating conditions of the plant for FY1999 is given below.

- Operating Period: 7 months, Number of operating days: 25 days/month, Average operating hours per day: 16 hours/day
- Cleaning During Seed Exchange: 5 times/year, 2 days/time
- Product Yield: 93%
- Operational Efficiency: (Idling time) 10 hours/week (average 1.7 hours/day)
- Annual Processing Volume: 19,539 tons: raw material base (18,171 tons: product base)

Based on the data above, the average processing volume is estimated at 8.9 tons/hour (59% of the initial design capacity of 15 tons/hour) and this volume is expected to remain the same for FY2002. If the capacity drops due to depreciation of the facility, the operating period (hours) will be increased.

④ and ⑤ Number of Operating Months and Days

The operating period of the seed processing plant is related to the planting and harvesting periods of six to seven months (average of 6.5 months), 25 days per month (in operation on all days, with the exception of Fridays). In addition to grain seeds, the GOSM also processes bean seeds. However, the cleaning and sorting structure and method employed for bean seeds differ from the seed processing facility of this project. Therefore, shared use of the facilities is not possible. In contrast, barley seeds can be processed, but the planting and harvesting period for barley is the same period as wheat. Therefore, utilizing the plant facilities during the non-operating period of five to 6 months for other grain seeds is difficult (see Appendix 2).

⑥ Operating hours

The cleaning and sorting activities of the existing plant is conducted 16 to 24 hours/day for four to five months of the six to seven month operating period. Therefore, the operating hours of the project will be set at 16 hours/day to be carried out in two shifts.

⑦ and ⑧ Frequency of Cleaning During Seed Exchange/Days

Cleaning is carried out about five times per year at the existing plant. One cleaning task averages two days or three days at maximum. According to the seed processing method adopted by the GOSM, the same variety of seed is continuously cleaned and after the task is completed, the cleaning process for the second variety of seed is started. Presently, five varieties of seed are processed by GOSM and the new processing plant will handle the same number of seed varieties. Therefore, cleaning will be carried out five times during the operating period at the new plant. The length of time required for the cleaning process will be two days, based on the average number of days utilized for cleaning at the existing plant.

⑨ Operational Ratio

According to the interview survey, the amount of idling time required for maintenance, repair, or the exchange of parts at the existing plant is about 10 hours in a six-day week. Therefore, based on this figure, the idling time estimated for the new plant is 1.7 hours per day.

⑩ Product Yield

According to data of the existing plant, the product ratio derived from the raw material, non-standard seeds are separated and eliminated averages 93 percent. Therefore, the product yield established for this project will be 93 percent.

D. Formula Used to Calculate the Appropriate Scope

Based on the factors explained above, the formula used to calculate the scope of the seed processing plant is shown below.

$$\frac{84{,}689 \times 0.57 - 18{,}171}{(6.5 \times 25 - 2 \times 5) \times (16 - 1.7) \times 0.93}$$

= 14.84 tons/hour

Therefore, a seed processing facility with a scope of 15 tons/hour will be provided by the project.

【Review of the scope of the tissue culture facility】

The objective of the Syrian government is to achieve the domestic production of potatoes. However, the country lacks the facilities that are needed to meet the domestic demand of 420,000 tons and imports 7,000 tons of potato seeds from Europe. The seeds are sent to contracted farms to multiply and 70,000 tons are distributed to general farms to produce 420,000 tons of potatoes. The objectives of the Syrian government is to multiply domestically produced virus-free seedlings to produce potato seeds and to prevent the spread of pest and disease from imported varieties of potato, to control the outflow of hard currency, and to secure a stable domestic supply of potatoes.

Of the tissue culture related equipment needed, the scope of the greenhouse and Growth Room will depend greatly on the production volume. Hence the scope will be determined based on the following calculation.

The potato plantlets are cultivated in vitro in the Growth Room. The matured plantlets are transplanted into plastic pots in the greenhouse and cultured into minitubers. The minitubers are

propagated in the net houses of the contracted farms to produce seed potatoes that are distributed to the general farms.

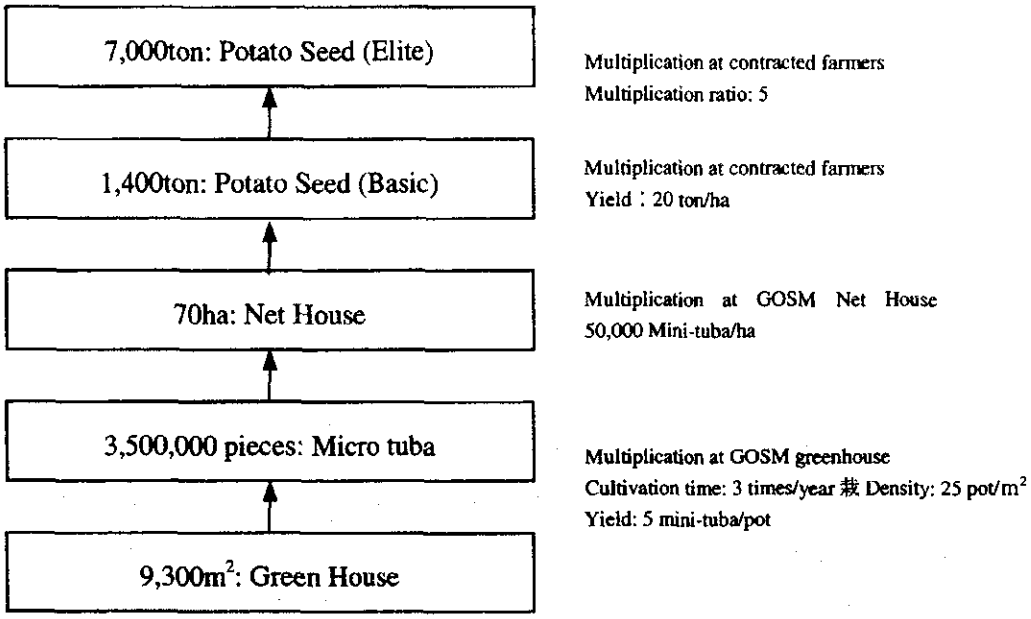

Fig. 2-4 Necessary Greenhouse Area for Potato Seed

Based on the calculation shown above, 9,300m^2 of cultivation area in the greenhouse will be required to propagate 7,000 tons of seed potato. However, in view of the experience and expertise of the GOSM at present, it was concluded that a greenhouse that encompassed such a large area was impractical in terms of maintenance because of the risk of disease, pests, and virus contamination of the potato seeds. The areas of the greenhouses built by the GOSM have gradually increased in area in conjunction with its accumulated experience (a 200m^2 greenhouse ten years ago and a 1000m^2 greenhouse four years ago). Moreover, about 3ha of land have been allocated for the project site. In addition, the expertise in culture and cultivation of the staff members have also increased. The number of staff members and their assigned work in tissue culture of potato seeds are shown in the table below.

Table 2-3 Staff of Tissue Culture Laboratory

Job Description	Work Content	Number of Staff Members
Researcher	Plant physiology research	4
Engineer	Virus, culture work	7
Technician	Cultivation, culture work	15
Worker	Greenhouse maintenance	5
Total		31

The task of replanting the plantlets cultivated in the Cultivation Room is carried out by 15 technicians.

The number of GOSM staff members, especially the number of staff members engaged in replanting the plantlets, is large for the scope of the existing greenhouse (1000m^2). Therefore, it was decided that the number of staff members will not be increased for the new greenhouse in order to control maintenance and operation costs. The scope of the greenhouse that will be provided in the project will be of a size that can be adequately maintained by the current number of staff members, their technical level, and expertise.

Conditions in Potato Production

A. Culture Method

The culture methods, which are employed, for potato seeds are propagation by stem cutting and propagation by microtuber (see Appendix). One of the major merits for cultivating microtubers in the Growth Room to propagate potato seeds is the ability to adjust the period when production starts in the greenhouse. Microtubers are shaped like a small potato and are easier to handle than plantlets; and special precautionary measures are not needed when transplanting them into the pots that are used in the greenhouse. However, when microtubers are grown in the Growth Room, they must be grown in dark conditions for a two-month period. Due to the need to grow plantlets in mid-growth and plantlets in dark conditions, a large Culture Room is needed. Although the GOSM plans to shift to the use of microtubers in future, it presently relies on the propagation method of stem cutting plantlets despite the handling problems.

B. Number of Cultivation Pots

Presently, the GOSM owns two greenhouses of 1,000m^2 and 200m^2 in scope. Potato seeds are propagated in the 1,000m^2 greenhouse. Each plantlet that has been grown in the Growth Room are replanted into plastic pots and are lined up on a bench 25 pots/m^2 in the greenhouse. Working areas and aisles also occupy the space within the greenhouse, in addition to the pots. Of the 1,000m^2 greenhouse presently in operation, the area occupied by the pots is about 850m^2 and 15 percent of the total area is used as working space and aisles. Therefore, the total number of pots that can be lined up on a culture bench is

$$850m^2 \times 25 \text{ pots}/m^2 = 21,250 \text{ pots.}$$

C. Propagation Method

Propagation by tissue culture begins with sorting the seed potato. The sorted seeds are disinfected and are prepared for germination under controlled temperature, humidity and light

conditions in the greenhouse. This is followed by a virus check according to the Elisa reader method and the head is cut removed and cultured for those seeds that have been ascertained as virus free. In meristem culture that is generally carried out, 0.2 to 0.3mm of the end of the growth point is removed and grown in a culture medium. However, to successfully grow the end of a growth point in culture medium requires highly skilled experience. The success rate has been low with the current level of technical skills at GOSM and this propagation method is impractical as yet. As a result, GOSM utilizes the stem cutting cultivation method (the growth point is removed and grown and the plantlet is used for propagation). A virus check is made at each stage. The propagation procedure employed at the current tissue culture facility is described below.

① About 100 terminal buds are cultivated in one month and when they have grown into a plantlet with 6 nodes, the nodes are removed, transplanted, and increased to 600.

② The 600 nodes are cultivated for one month and when they have grown into a plantlet with 6 nodes, they are removed, transplanted, and increased to

6 x 600=3,600.

③ The 3,600 nodes are cultivated for one month, the nodes removed, transplanted, and increased to

6 x 3,600=21,600 plantlets.

However, due to a 10 percent loss stemming from unsuccessful growth and handling errors, the actual numbers of plantlets that are successfully cultivated are about 23,000.

④ The plantlets are removed from the culture medium, washed, disinfected and transplanted to the plastic pots and are irrigated, fertilized, and controlled in the greenhouse for three months until they have grown into minitubers.

An important factor to ensure the uniform growth of the plantlets is to carry out the task of transplanting or replanting within an extremely short period of time. The number of nodes and plantlets that are handled during the task described in step ③ above is especially large and important. In order to accomplish the task in a short period of time, it is necessary to increase the number of highly trained workers. However, due to the difficulty in recruiting such workers, the task is actually carried out over a prolonged period of time. When this task is carried out over a prolonged period of time, the irrigation and fertilizing work in the greenhouse becomes complex and this develops into a cultivation management problem. The GOSM conducts the propagation of potato seeds according to the following pattern of rotation carried out three times

a year. The transplantation work described above in steps ① and ② does not become a cultivation management problem due to the limited number of plant test tubes. However, the number of plantlets and nodes that are handled in step ③ is the largest and the transplantation work will overlap into the work schedule of the greenhouse shown below. Therefore, the transplantation work that is carried out in step ③ must be completed within a one-month period.

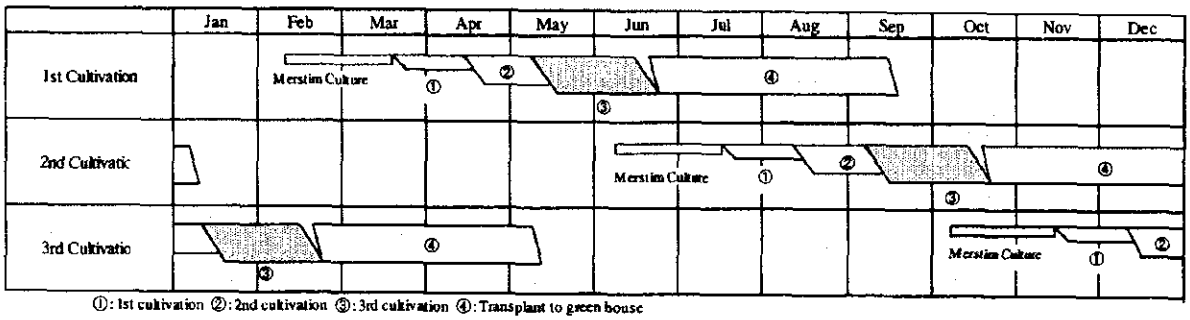

Fig. 2-5 Potato Seed Multiplication Patter

D. *Current Number of Workers Engaged in Transplantation Work*

As explained earlier, there are presently 15 workers employed by the GOSM facility who are engaged in the transplantation work. The existing greenhouse is 1000m^2 in area and the number of plantlets that is cultivated is less than the required number. Hence, there is only one work shift, excluding the busy period when the work is carried out in two shifts. It normally takes about 60 to 80 or an average of 70 seconds to transplant the plantlets from the plant test tube to the new culture medium. If one working day is six hours, the number of plantlets that are transplanted by one worker is

6 hours × 60 minutes × 60 seconds ÷ 70 seconds = 308 plantlets. The Media Preparation Room has five clean benches and

308 plantlets × 5 benches = 1,540 plantlets

that can be transplanted. To cultivate 23,000 plantlets in a 1,000m^2 area, it will require

23,000 plantlets ÷ 1,540 plantlets = 15 days.

E. Maximum Potential Volume of Transplantations of the New Media Preparation Room

As explained above, the number of plantlets that can be transplanted is limited due to the compact area of the present GOSM greenhouse. In view of the accumulated technical skills and capabilities of the current staff members, these skills are not fully utilized at present. Therefore, the number of staff members and workers will not be increased and the cultivation period will be set at one month for the following number of plantlets.

①Number of transplantations by one worker per day: 308 plantlets (the figure given above has been used)

②Work schedule: Two shifts (308 plantlets x 2 = 618 plantlets)

③Work period: One month, 25 days (618 x 25 days = 15,400 plantlets)

④Number of workers: Due to the concentration required to do the work, a work pattern based on the an appropriate number of consecutive working days and a working pattern based on a grouping of six workers will be adopted.

1,5450 plantlets/worker x 6 workers = 92,400 plantlets

F. Required Scope of the Greenhouse Based on the Number of Plantlets

Based on the calculation above, the 92,400 plantlings can be cultivated. If the 10 percent loss recorded by the existing greenhouse is included in the calculation, the number of successfully grown pots is 83,160. The GOSM greenhouse currently in use is $1000m^2$ in size, but the actual cultivation area is $856m^2$. The number of cultivated pots is

$856m^2 \times 25$ pots/$m^2 = 21,400$ pots.

Therefore, the following cultivation area will be adopted in this project.

83,160 pots – 21,400 pots = 61,760 pots (61,760 pots ÷ 25 pots/$m^2 \fallingdotseq 2,470m^2$)

Presently, the working space and aisles occupy an area of

$1,000m^2 - 856m^2 = 144m^2$

or about 15 percent of the total area of the greenhouse presently in use.

The rolling bench system is currently used in the greenhouse in order to maximize the area used for cultivation. The rolling bench system is shown in the figure below.

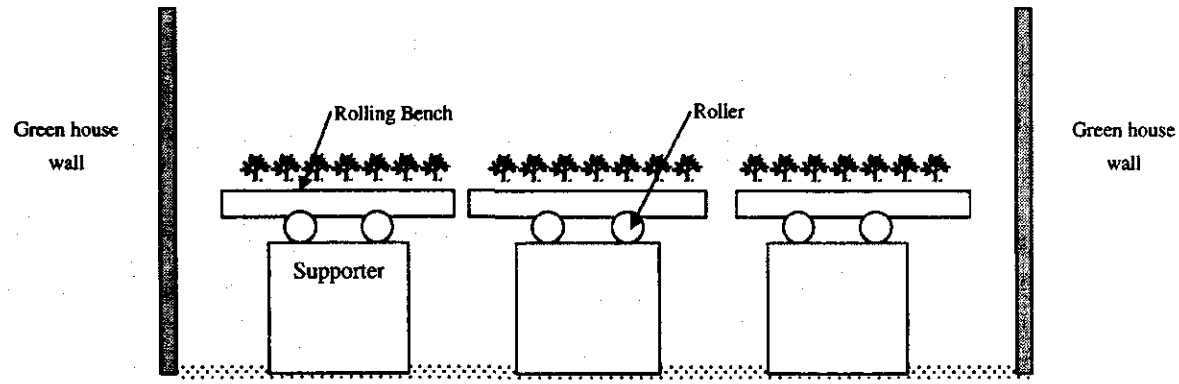

Fig. 2-6 Rolling Bench in Growth Step

Rolling Bench System

In order to maximize work efficiency, aisles must be created between each bench. However, in such cases, the area for the aisles must be procured for each bench which reduces the cultivation area. In order to minimize the space occupied by the aisles, the rolling bench system enables aisle space to be created whenever it is needed by moving the bench, which is installed in the plant of each stand.

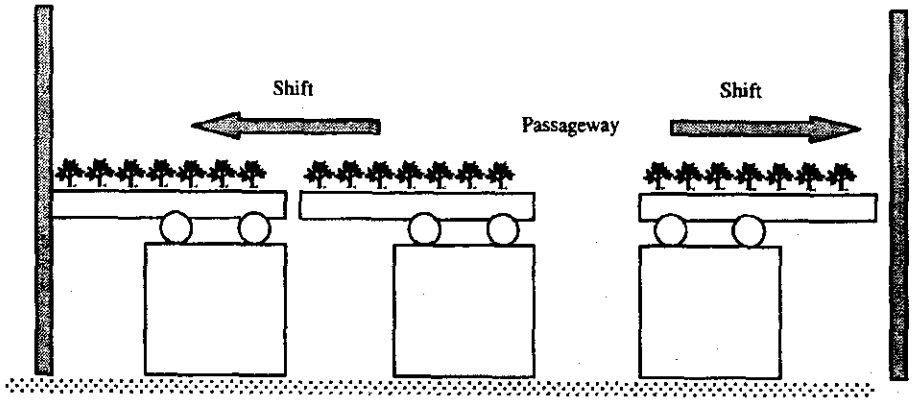

Fig. 2-7 Rolling Bench in Working Time

But in the case of the existing greenhouse, the length of the bench has been overextended and the end of the bench is close too the wall. Subsequently, there is no passageway to the back of the greenhouse. The workers work are forced to work in an inefficiently arranged work environment by working to the back end of the bench, temporarily stop their work, go back up the aisle, move the bench, and resume their work.

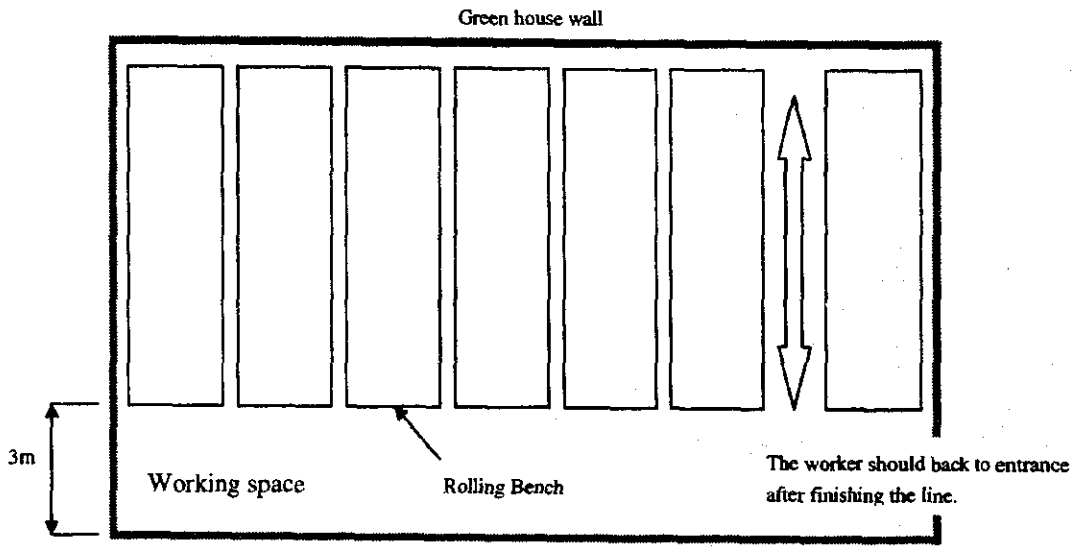

Fig. 2-8 Existing Green House Plan

Therefore, the pass way will be prepared in the end of bench for effective works.

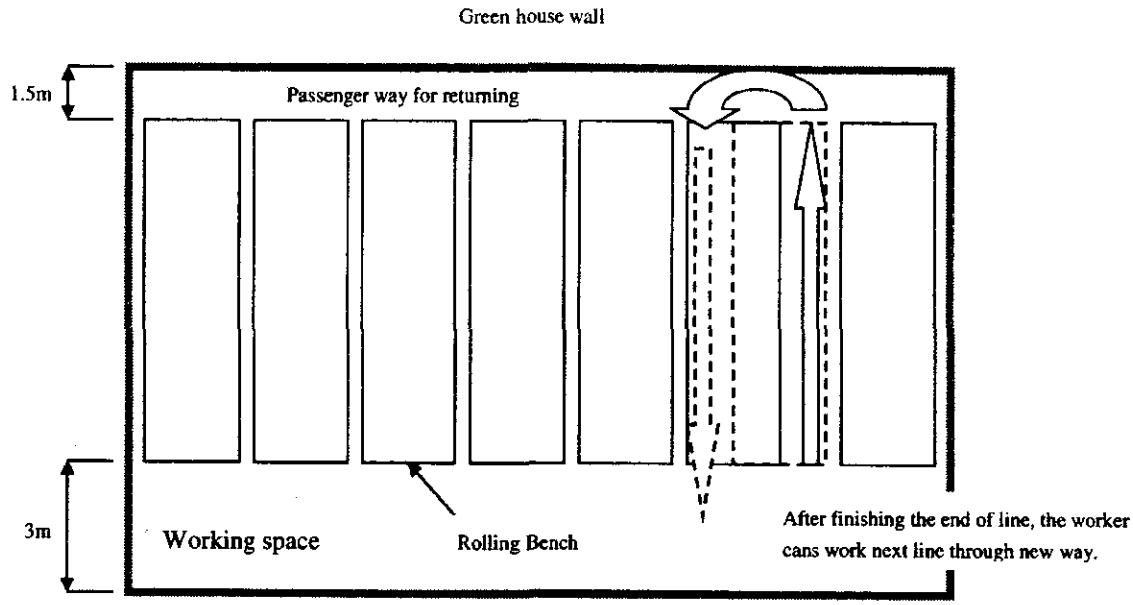

Fig. 2-9 Green House Plan

In order to improve work efficiency and increase the number of aisles, the ratio of work space and aisles of the total area of the greenhouse will be

3m : 15%=3m + 1.5m : X from X=22.5%.

Therefore, the total area A of the greenhouse described above (2,470m^2), that includes work space and an aisle ratio of 22.5 percent, is calculated as

$$\frac{A - 2{,}470m^2}{A} = \text{from } 22.5\%,\ A = 3{,}187m^2$$

In the case of the large roofed greenhouse that has been requested for the project, the work space and aisles will occupy 20 to 30 percent of the total area of the greenhouse.

However, the construction of a 3,187m^2 greenhouse in one building is anticipated to exceed the maintenance capabilities of the current GOSM staff members and to become the source of increased losses stemming from pest and disease. Therefore, three buildings, each containing a 1,000m^2 greenhouse, will be constructed in order to reduce the risks and to ensure adequate maintenance of the facilities.

If the area of 3,187m^2 is divided between three buildings, the area of one greenhouse will be

3,187m^2 ÷ 3=1062.3m^2.

Therefore, the project will design a greenhouse with an area of about 1062.3m^2 with adequate space for the required number of pots.

Generally, iron-manufacturing companies will manufacture 3m or 6m channel steel or aluminium steel frames for greenhouses and greenhouse manufacturers will utilize these frames in their designs. With a few exceptions, the span of a large greenhouse is generally

12m or 12m × 2 = 24m (connecting span)

However, in the case of a 12m span, the depth becomes 90m and long (12m × 90m=1,080m^2). As a result, the effect of the pad and fan cooling system (a cooling unit that utilizes water evaporation heat) is lowered producing uneven temperatures throughout the facility during the hot summer season. Therefore, the span for three greenhouse buildings will be 24m with a depth of 45m (24m × 45m=1,080m^2) for a total area of 3,240m^2 for the project.

G. Area of the Media Preparation Room

The GOSM plans to utilize the existing 1,000m^2 greenhouse and the greenhouse that will be provided by the project for cultivating potato seeds. Therefore, the area of the existing greenhouse and the facility provided by the project will be used to cultivate plantlets. The area of the media preparation room for the project has been calculated as shown below.

H. Number of Planting

As mentioned before, the GOSM has capability to plant 92,400 plants. The plantlet which growth in growth room are copied by under-mentioned flow char, and transplant to green house.

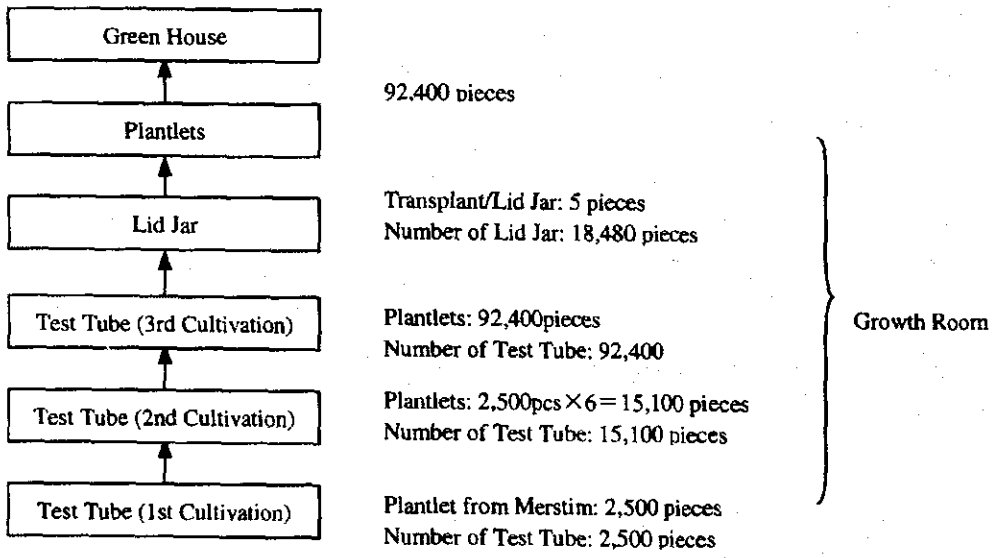

Fig. 2-10 Flow Chart for Plantlet Growth

J. Installation Area of Plant Test Tubes

The tissue culture process is concerned with growing plantlets from stage 1 culture to the transfer to the greenhouse. The number of plantlets that are cultivated in plant test tubes is

2,500 + 15,100 + 92,400=110,000 plantlets

A test tube rack has been installed in the raw cotton area of the existing Growth Room and this method will also be adopted in the project. The test tube rack accommodates 50 test tubes. The number of test tube racks that are needed to accommodate 110,000 plantlets is

110,000 ÷ 50 = 2,200 racks

One test tube rack occupies an area of about $0.05m^2$ and the total area needed to install 2,200 racks is

$0.05m^2 \times 2{,}200$ racks = $110m^2$

In addition, 10 percent spacing between the racks are needed to enable the racks to be carried in and out. Therefore, in order to enable the work to be carried out quickly and safely, the total area needed to install the racks has been set at

$110m^2 \times 1.1 \fallingdotseq 121m^2$

K. Area Required for the Plant Jars

Plant jars with a diameter of 10cm and a capacity to contain five plantlets are utilized in the existing Growth Room. Hence the number of plant jars that are needed to accommodate 92,400 plantlets that will be transplanted from the test tubes is

92,400 ÷ 5 = 18,480 plant jars

The area occupied by one plant jar is $0.01m^2$. As in the case of the test tube rack explained above, the total installation area needed to promote work efficiency for plant jars has been set at

$184.8m^2 \times 1/1 \fallingdotseq 203m^2$

Based on the calculation above, the total area that will be allocated for the test tube racks and plant jars in the Growth Room is

$121m^2 + 203 = 324m^2$

L. Installation Area of the Growth Room

The Growth Room is generally surrounded by a high insulation panel and shelves for the plant test tubes and plant jars are installed. The Growth Room that is planned by the GOSM has a floor area of $50m^2$ with six rooms. However, if factors such as an effective floor area, number of shelves (four shelves in the existing facility), and working space are considered, one growth room will encompass an area of $105.6m^2$. Working tables will be installed in the growth room as shown in the figure next.

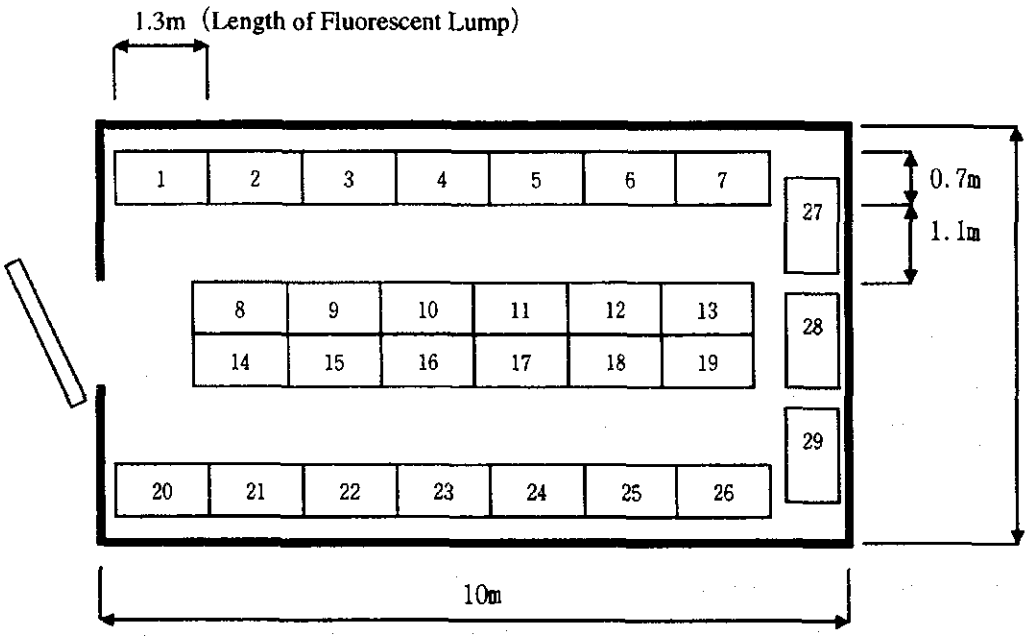

Fig. 2-11 Layout Plan for Growth Tables

Area of one table: $1.3m \times 0.7m = 0.91m^2$
Total area of tables with one shelf : $0.91m^2 \times 29$ tables $= 26.39m^2$
Total area of tables with four shelves: $26.39m^2 \times 4 \fallingdotseq 105.6m^2$

Based on the installation area of one growth room and the installation area required for plant test tubes and plant jars, the number of required growth rooms are

$324m^2 \div 105.6m^2 = 3.06$ rooms

Therefore, three (3) growth rooms will be provided by this project.

2) Equipment selection criteria

The policy on equipment selection that was explained in the section on project content has been summarized as follows.

①The equipment must be essential to seed propagation activities and must be equipment that will not be used for research purposes.

②The equipment will not require highly advanced technical skills to maintain and will not generate excessive maintenance costs.

③The equipment will not require excessively high installation costs.

④The equipment will have superior cost performance.

3) Criteria pertaining to specifications and grade of the equipment

The specifications and grade of the equipment will be able to cope with the volume of seed multiplication produced by the plat and the grade will be within the technical expertise and experience of the existing facility.

①The specifications and grade must be suited to seed multiplication.

②The grade of the equipment will be equivalent to the grade of the equipment at the existing facility.

③The equipment will be durable and easy to inspect.

④The equipment must have superior cleaning capabilities, in order to cope with several varieties of seed production.

4) Criteria for Determining Quantity

In accordance with the review findings on the scope of the facilities explained earlier, the quantity will reflect the production scope of wheat and potato seeds. A minimum number of equipment for quality control inspections will be provided.

(6) Policy on Equipment Procurement

None of the equipment that will be provided by the project will be procured locally in Syria and the majority will be purchased in Japan or a third country. The supply of parts and consumables and after-service are important in order to effectively maintain the new equipment. However, sales offices of large manufacturers do not exist in Syria and GOSM purchases parts and consumables for the equipment at the existing facility through sales offices in Europe. Therefore, in view of these circumstances, the equipment procurement plan will target the equipment of manufacturers in Japan or a third country with sales offices in Europe.

(7) Policy on Spare Parts and Consumables

A supply of spare parts and consumables is essential to the uninterrupted operation of the equipment, especially in the event of damaged parts due to accidents or damages sustained from operational errors. The need for parts replacement can be effectively anticipated through regular maintenance by the facility. Therefore, the project will provide only those spare parts and consumables that are difficult to ascertain when they need to be replaced.

(8) Policy on Work Schedule

This project is concerned with providing equipment for facilities that will be funded and constructed by the Syrian government. Hence the implementation schedule of the project must be coordinated adequately with the construction schedule of the facilities. Therefore, the project will be implemented in two phases. Phase 1 of the project will be carried out during the short construction period for the seed processing facility and phase 2 will be implemented during the long construction period for the tissue culture facility.

2-2-2 Basic Plan

(1) Policy on Equipment Selection

Problems stemming from the technical skills and experience of the GOSM staff in operating, handling, or procuring the equipment, that will be provided by the project, are not foreseen. Therefore, in reviewing the requested list of equipment, meetings with the technicians and personnel relevant to the tissue culture and the seed processing facilities were held to confirm the purpose, usage, function, specifications, and other details about the equipment. Based on these discussions, the following points will be considered and data obtained from the survey on similar or related facilities will be reflected in the selection process.

Table 2-4 Criteria for Equipment Selection

①The equipment will be essential to the task of seed multiplication.
②Research equipment will not be provided by the project since the focus is on seed propagation.
③Equipment with simple mechanism and high cost performance will be selected.
④The equipment will be suited to the level of the existing facilities, will not require advanced technical skills or numerous technicians and workers to operate, and will not generate high maintenance costs.
⑤The equipment will not require excessive installation work.
⑥The equipment will not require advanced technical skills or excessive investments to maintain.

(2) **Review of the Equipment Requested**

The equipment requested for the project has been reviewed according to its role, function, and current conditions as well as for the relevancy and need for each item. The results of the review are given below.

1) Processing equipment for wheat seeds

① Wheat seed processing plant

The processing procedure at the wheat seed plant begins with receiving the raw material or seeds, followed by cleaning and grading of the seeds, disinfect ion, and the bagging of the final product. Therefore, the equipment that will be provided is relevant and essential. A review of the attachments that have been requested (belt conveyor, forklift, and standby generator) is given below.

A-3-5 Belt Conveyor

The belt conveyor is used to transport the final bagged product from the plant to the adjacently located warehouse. However, due to the far distance from the plant to the warehouse and the various storage areas of the bag used to package the final product, the priority for a belt conveyor has been rated as low. The belt conveyor has been categorized as supplementary equipment.

A-4-9 Forklift

The forklift is used to transport the packaged product from the plant to the warehouse or to transport products of different specifications to other areas of the plant compound. It is useful in transporting parts and heavy items such as motors used in repair and maintenance activities. In comparison to other types of transport equipment, it rotates easily and does not occupy a large amount of space. Therefore, the use and relevancy of the forklift has been rated as high and it will be included in the project.

A-4-8 Standby Generator

Although the power supply system of Syria has improved, power failures continue to occur periodically. These power failures reduce operating hours and incur time loss stemming from inspections of the facilities after power is resumed. Therefore, there is a need for a power generator. However, such problems that are caused by power failures can be resolved by administrative measures such as extending operating hours, inspecting only the selected, important facilities, and others. Therefore, a standby power generator will exclude from the project.

② Quality Control Facility for Wheat Seeds

Prior to the start of the actual processing, seeds are graded using a grading machine or cleaning and grading machine to produce only high quality seeds as the final product. The seed processing facility must utilize a air-screen cleaner or gravity separator to decide the mesh size of the cleaning and grading machine before the start of the main processing operation. As a result, these machines maintain quality control and are essential to producing a high quality product and product yield. Therefore, they will be provided by the project.

③ Testing Equipment

The seeds that are received from the contracted farms are checked for moisture content, size, specific gravity, and other properties, as well as for pest and diseases. Microscopes and magnifying glass are used to check for pest and diseases and if the seeds are found to be contaminated by an infectious disease, the entire seed volumes are returned to the contracted farm. Further, in order to handle any claims by the contracted farms that may arise after the product has been shipped and sold, a portion of the product is stored according to its product lot number. Testing equipment is used from the initial stage when the seeds are received as raw materials to the stage of product guarantee after the product is shipped. Therefore, the testing equipment will be provided by the project.

2) Tissue culture related equipment for potato seeds

Tissue culture of potato seeds will be carried out according to the following procedure.

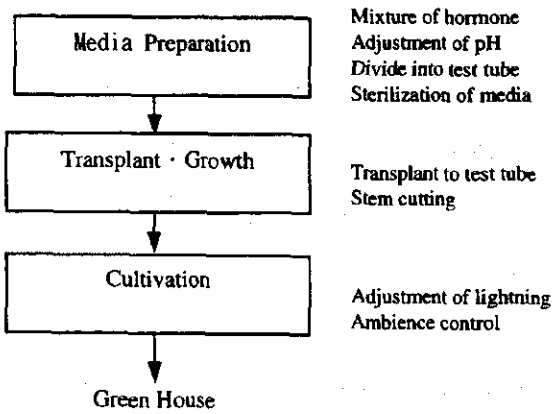

Fig. 2-12 Procedure for PotatoTissue Culture

According to the GOSM plan, the implementing agency, the tasks listed above will be conducted in each room. Therefore, a review of the tissue culture related equipment for potato seeds that have been requested for the project must be made for each room.

① Water Purification Room

Producing good quality tissue media is one of the most essential criteria to growing high quality seeds. Much of the culture medium is comprised of water and a high degree of purified water is required. Therefore, it has been concluded that the pure water system is an essential item of equipment in tissue culture and it will be provided by the project.

② Media Preparation Room

The hormones and nutrients in the culture medium are adjusted using a pH meter and the mixture undergoes heat sterilization. It is then transferred to a plant test tube or plant jar. Therefore, the equipment requested for the Media Preparation Room will be provided by the project.

③ Cultivation Room

In the Cultivation Room, the heads of the buds are extracted, sterilized, and planted in the culture medium. The mature seedlings are divided and transplanted to plant test tubes or plant jars or replanted to a different culture medium. Following the transplantation, they are cultivated for a fixed period of time in the Cultivation Room. It is necessary to protect the transplantation process from fungus or bacterial contamination and a clean bench must be installed. In addition, the tasks of dividing the seedlings or examining the seedlings for viral contamination requires the use of microscopes. Therefore, the equipment requested for the Cultivation Room will be provided by the Project.

④ Growth Room

The buds and seedlings that were planted in test tubes and bottles in the Cultivation Room, as explained above, must be cultured under uniform temperatures, humidity and light conditions. The Growth Room will maintain these uniform environmental conditions. Therefore, the equipment requested for the Growth Room is essential to the tissue culture process and will be provided by the project.

⑤ Glassware Room

Glass instruments such as beakers, volumetric flasks are essential items in tissue culture, in addition to test tubes, which are utilized when the culture medium is divided or plants are cultured. These types of glassware are needed in producing culture medium and in the culture process. Therefore, they will be provided by the project.

⑥ Glassware Washing Room

As explained in the above, glassware is essential items of equipment in tissue culture and the volume of glassware that is utilized is large. In addition, the number of glassware that is used in the daily planting process is also large and the work of washing all of this glassware is a major task. Therefore, the automatic glassware washing machine will be provided by the project. However, the requested dryer has been classified as supplementary equipment for the following reasons.

C-7-4 Hot Air Dryer for Glassware

During the winter season when low temperatures and high humidity conditions prevail, it is difficult for moisture in the triangular flasks and other glassware with narrow apertures to evaporate after they have been washed. This leads to the potential growth of fungus and bacteria. Therefore, in order to dry out the remaining moisture in these containers, hot air is blown into the glassware using a nozzle.

However, only a compact version of this type of equipment is presently utilized in the school science laboratory. In order to meet the needs of the tissue culture facility, where the focus is on productivity, the capacity of this type of equipment is problematic. Therefore, a dry heat sterilize oven, which is more suited to the demands of the Washing Room, has been classified as supplementary equipment in the project.

⑦ Quality Control Room

The foremost condition in tissue culture is to keep the cultured plants virus-free. It is especially vital to ascertain that the potato seeds are virus-free during the initial stage, as well as to ensure that each stage of the propagation culture remains uncontaminated. Therefore, the Elisa reader system and microscope with photo system will be provided by the project. However, the vacuum cleaner and knapsack sprayer, which were also requested, will be excluded from the project for the following reasons.

C-8-5 Vacuum Cleaner

Although a vacuum cleaner is important to keep the entire laboratory clean, it is not specifically related to the objectives of the project, which is seed multiplication and maintaining the quality of seeds. Therefore, it has been excluded from the project.

C-8-6 Knapsack Sprayer

The knapsack sprayer is used to fumigate the Quality Control Room against pest and diseases, but it has been excluded from the project since its frequency of use is surmised to be low.

⑧ Greenhouse

A greenhouse is required to produce minitubers from virus-free seedlings cultured in the Culture Room and transplanted to a net house. During the summer season, the temperatures in Aleppo, the project site, exceed 35°C and drop to near freezing point during the winters. Therefore, in order cope with these extreme seasonal temperatures, a pad and fan cooling system and a steam boiler heating system will be installed. In addition, a water softener will also be installed for filtering the water used for the heating system, due to the high calcium content of the water. Indicator plants that are used in checking for viral contamination must also be cultivated for quality control purposes. Therefore, a small quality control room for growing virus test indicator plants and tubers for post-harvest tests will be additionally installed. The soil sterilizer, which has been requested as supplementary equipment, has been scaled down in scope for the reasons explained below.

C-9-1 Soil Sterilizer

The soil sterilizer is used to disinfect the culture soil of the greenhouse where steam will be utilized. However, the specification of the soil sterilizer that was requested is excessively large (steam capacity of 2,000kg/hr). It is surmised that this specification covers usage in the net house as well as the soil disinfect ion for potato seed contract farms. Therefore, the scope of the specifications will be reviewed and a soil sterilizer adequate in scope for use in the greenhouse will be provided.

⑨ Others

An emergency power generator has also been requested. As explained earlier, the power supply conditions in Syria are poor and power failures occur frequently. It is especially vital that the Culture Room and the greenhouse maintain uniform temperature and humidity levels.

A power failure has the potential to completely destroy the seedlings or cause seed damage. Therefore, an emergency generator for the Growth Room and the greenhouse will be provided by the Project as a countermeasure against sudden power failures.

(3) Overall Plan

The equipment that will be provided by the project will be installed in the facilities that will be constructed by the Syrian government. The construction site is located northwest of Aleppo city and the soil composition of the site foundation is a mixture of lime, sand, gravel, and rock. The soil bearing is about 40 tons/m^2 and problems are not anticipated in the construction of the seed processing and the tissue culture facilities. In addition, the site is located in the industrial area of Aleppo city and electricity, water, and other infrastructure are available.

The area of the GOSM construction site is about 10ha, which is sufficiently adequate for the facilities that are planned. The site is largely divided into two sections—the seed processing facility will be constructed on the north side and the tissue culture facility will be constructed on the south side. The north side will also contain a storage area and the total area containing all of these facilities is about 6.8ha. The remaining 3.2ha will be utilized for tissue culture.

(4) Equipment Plan

A summary of the equipment name, specifications, quantity, etc. of the equipment is given in next page, in accordance with the review of the review of requested equipment and design policy.