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稲栽培圃場作業指針

ANAMBRA RIVER BASIN AND RURAL DEVELOPMENT AUTHORITY

OPERATION MANUAL
PART III

GUIDELINE
FOR
MAIN FIELD WORKS ON RICE CULTIVATION

AUGUST, 1986

LOWER ANAMBRA IRRIGATION PROJECT

NIPPON KOEI CO., LTD.
CONSULTING ENGINEERS
OMOR

GUIDELINE
FOR
MAIN FIELD WORKS ON RICE PLANTATION

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GUIDELINE
FOR
MAIN FIELD WORKS ON RICE CULTIVATION

1. General

The guideline hereinunder prepared is the "Standard Works Schedule and Procedure of Rice Cultivation" which will be applicable to the rice plantation being on-scheduled in this Lower Anambra Irrigation Project.

As explained in the preceding guideline, Part II for the Nursery Preparation, two rice planting methods, namely "Transplantation of seedlings" and "Direct sowing of seeds" are familiarized and practised in the rice producing countries. The former method is applied extensively to the small holder-based rice cultivation, while the later method to the large scale rice plantation. The former method is generally accepted as the most effective and safety farming on rice cultivation. A high labour intensity is only the demelit of the transplantation method. As for the direct seeding method, high technology as well as highly consolidated rice field are always required so as to maintain reasonable production.

In attempt to minimize the production risks which would be arisen on field operation particularly at the initial stage of development, the transplantation method is selected and applied to the objective rice cultivation in this project area. Therefore, the standard schedule and procedure of rice plantation is hereby prepared upon the bases of following essential farming practies as listed below:-

1. Soil preparation
2. Up-rooting and transplantation of seedlings
3. Fertilization
4. Plant protection
5. Weeding
6. Water management, and
7. Harvesting and threshing

The rice plantation herein engisaged is in principle upon the bases of "Small Holder-Based Farm Operation" which will be established under the farmer participation programme. The size of operational unit varies from 0.5 ha to 4.0 and 1.0 ha/farm house-hold on an average. With medium and/or long term production contract, the participant should grow rice twice a year by fully using labour force, effectively. The farm mechanization will be scheduled on the soil preparation, plant protection, threshing work, etc. The machinery and equipment to be utilized for this farm mechanization will be leased by the Authority to the participant farmers.

Taking into account the basic consideration stated above, recommendation and/or suggestion to the farm operation are prepared with particular attention to the economic viability as well as technical feasibility on optimization of the rice production. Accordingly, these are fully incoporated herein the Standard Schedule and Procedure of Rice Cultivation.

2. Plant Physiological Characteristics of Rice at Each Essential Growing Stage

It is significantly essential that all the agricultural staff assigned in the project office as well as the participant farmers should understand the plant physiological characteristics of rice at each growing stage so as to manage crop water operation on field, efficiently and properly.

The growth of rice is characterized by two essential growing period, i.e. namely the "Vegetative Growth for Early Half Growing Period" and "Generative Growth for Later Hafl Growing Period". The vegetative growth period is generally divided into three growing stages, such as "Rooting Stage", "Active Tillering Stage" and "Maximum Tillering Stage". The generative growth period is divided into four growing stages, such as "Young Panicle Formation Stage", "Booting Stage", "Heading/Flowering Stages", and "Ripening Stage". The ripening stage could be sub-divided into "Milky Ripening Stage", "Dough Ripening Stage" and "Yellow-Ripening Stage". Each growing stage stated above is characterized by the plant physiological features as summarized below:-

PLANT PHYSIOLOGICAL FEATURES AND CHARACTERISTICS AT MAJOR GROWING STAGES

(in case of Rice Varity 130 Days for Maturation)

Growing Stages	Specific Growing Period	Plant Physiological Features
1. Vegetative Growth Period (after transplantation):		
a. Transplantation	95 to 110 days before heading of panicles	4 to 4.5 leaf stage or 21 to 25 days of nursery age
b. Rooting Stage	few to several days after transplantation	Seedlings are holding fast to ploughsole through newly rooting. The leaf colour changes to darker green from light or yellowish green. Start continuous leaving.
c. Tiller Initiation Stage	85 to 90 days before heading of panicles	Formation of tillers. Main stem (transplanted seedling) increases leaves to 6.5 to 8 stages
d. Active Tillering Stage	55 to 85 days before heading of panicles	Significant increase of tillers. Leaves keep dark green colour and erect under proper fertilization.
e. Maximum Tillering Stage	30 to 40 days before heading of panicles	The most luxuriant leaving while non-elongation of nodes at this stage.
2. Generative Growth Period:		
f. Young Panicle Formation Stage	24 to 28 days before heading of panicles	Leaf-colour changes to lighter or yellowish green from darker colour. Young panicles are formed through plant physiological process.
g. Reductive Division (Booting) Stage	12 to 18 days before heading of panicles	Blasting non-effective tillers and elongating nodes, gradually. Leaf-colour change again to darker colour.
h. Heading and Flowering Stage	Zero (0) day when start heading of panicles	Final leaving of flag-leaf, and starting the heading/flowering.
i. Ripening Stage	6 to 25 days after heading/flowering	Ripening of grains is proceeded through milking, dough-ripening and yellow ripening process.
j. Ripping Stage	30 to 35 days after heading/flowering	Grains on panicles are yellowed almost 70 % or more

3. Elemental Component for Determination of the Rice Yield

The growing conditions of rice are generally assessed according to the plant physiological features to be characterized specifically in each stage of the plant growth. The plant physiological features to be essential for the said assessment are as follows:-

1) Number of leaves
2) Colour of leaves
3) Plant height
4) Number of tillersper hill
5) Number of panicles per hill
6) Number of grains per panicles;
7. Total days for maturation

Besides, such rice cultivation effect as total days for full heading and/or flowering, ripening efficency, weight of 1,000 grains, etc. are also the important factor for the assessment of rice growing conditions.

Out of the circumstancial features stated above, the following four conditions are recognized/specified as the elemental components for determination of rice yield and/or assessment of the productive conditions of rice.

(1) Number of panicles in a unit extent (m^2)
   a. Number of panicles per hill, and
   b. Number of hills in a unit extent
(2) Number of grains per panicle (average conditions)
(3) Ripening efficiency (fully ripened grains/total grains x 100 = %)
(4) Weight of 1,000 grains

Practically, the rice yield could be calculated by the following formula applying four conditions stated in the preceding page.

(1) x (2) x (3) x (4) x 1/1,000 kg x 10,000 m^2 = Kg/ha

For instance:

100 grains/panicle on an average x (10 panicles/hill on an average x 22 hills/m^2) x 85% (or 0.85) x 1/1,000 kg x 10,000 m^2 = 5,610Kg/ha

The conditions of four elemental components are always and variabled pending on the rice cultivation circumstances and/or the outcomes to be attributed to the technical skillfulness on farming practices. A proper fertilization by use of the chemical fertilizers is directly effective for all the four conditions. While the plant physiological damages caused by insects/diseases obstruct those four conditions in notable extent. The plant space conditioned into b. of (2) is controled artificially according to the optimum plant spaceing specified. However, establishment of hills is, more or less, disturbed by the following causes:-

1) Physical damages on seedlings to be gotten at the up-rooting and/or transplanting times

2) Physical damages of seedlings at the initial growing stages due to deep submergency or drought hazard because of undulation of soil surface due to unsatisfactory land levelling conditions at the initial stage of development.

3) Damages by insects and/or diseases

Among three major problems stated above, damage of seedlings caused by insects and/or diseases is the most serious constraint for successful establishment of the hills. Therefore, the plant protection work is crucial to maintain the specific number of hills and hence to ensure number of panicles, effectively and successfully.

The rice grains are established during the specific period of young panicle formation stage to the booting stage. The number of grains is determined according to the substantiality of rice plant which would be destined and depended on the degree of fertilization made during the vegetative growth stages. The grain of each panicle varies notably, for instance; 145 grains for the panicles of main

stem, some 65 grains for the panicle of 15th tiller and 100 grains/panicle on an average of a hill.

In general, it is hardly expected to be ripened all the grains, successfully due to the plant physiological stress which would arise mainly because of imperfect fertilization. The physical damage caused by drought hazard during the ripening stage is also one of the serious issue on reduction of the ripening efficiency. The ripening efficiency which is expressed in the formular of "Number of fully ripened grains/ Total number of grains x 100 = % " would not exceed some 85% even in the most advanced cases. In normal cases, the efficiency is around 75% to 80%.

The weight of grain, which is generally expressed in "Weight of 1,000 grains gramme is specified, variety by variety, as one of the essential plant physiological features. The grain weight varies from 25 gramme/1,000 grains in case of fine size of grain to some 35 gramme in case of very course grain type. Of cause, the grain weight of each variety also varies according to the ripening conditions under various cultivation circumstances.

As briefed in the above, the rice yield would largely be affected by the various factors, and final yielding conditions is determined mostly by the four elemental components i.e. number of panicles, grains of each panicle, ripening efficiency and weight of grain. To optimize the rice yield, therefore, particular attention should be paid to the four essential factors and properly manage the crop-water operation especially of fertilization practice and plant protection measures.

The proposed farming practices for achieving the project target of 5 ton/ha is presented hereafter:-

4. Standard Schedule and Procedure of the Main Field Works on Rice Cultivation

The farming practices hereinunder demonstrated is the standard schedule on rice cultivation which will have to be regularized as the main production activities in the Lower Anambra Irrigation Project. The elemental works and those procedure/or manner included in the said demonstration are all scheduled upon the assumption that an achievement of target production would be 5 tons/ha on an average. It is, no doubt that the procedure/or manner of farming pracities herein primarily proposed will be flexible for change of enviornment and/or circumstances on the objective rice cultivation. While, the works on each elemental practices should be performed strictly according to the proposed time schedule on two season operation so as to ensure a successful optimization of rice production.

The standard schedule and work procedure are illustrated in Fig. III - 01 attached hereto. The detailed instruction on each work is given herebelow:-

4.1 Repair and Maintenance of On-Farm Facilities

In usual cases, the functional defects of the on-farm facilities will arise by various causes during the crop operation period. The major defects to be arisen are:-

1) Siltation in both irrigation and drainage canals
2) Erosion/scouring troubles on canal embankment and back-fill earth of the concrete structures, such as division boxes, curverts, drop-structures, etc.
3) Erosion/scouring trouble on farm ridges particularly at the inlet and/or outlet (cut-off of farm ridge for drainage work) of the farm plots.

The functional defects listed above obstruct the efficient operation of irrigation work as well as proper management of the drainage works. It is, therefore, essential and crucial to carry out the repair and maintenance of the trouble portions prior to commencement of the crop operation.

The de-siltation of both irrigation and drainage canals should be made to maintain the canal section and profile to the design conditions, satisfactorily. An imperfect de-siltatioh directly disturbe a favourable water discharge and its flow, and somewhat may give rise to serious troubles, such as over-flow of the canal embankment due to shallowed profile, further siltation due to disturbance of flow and/or abnormal water standing, etc.

The earth materials which are used for construction of the canal embankment as well as back-fill of the concrete structures have a very friable consistence when wet. An erosion/or scouring of said earth structures is the essential trouble during the operation period of irrigation. Therefore, particular attention should be paid to the protection measure and/or the maintenance of canal and its related facilities until those structural conditions are stabilized. Repair and maintenance of the eroded/or secoured portion should be performed as much as the damages are to be small at the early stage of trouble. For repairing of the erosion/scouring damages utilization of the earth and/or sand bags, which could be prepared by use of jute bags, plastic bags for fertilizers, etc., are quite effective even under submerged conditions.

Other than the above works, weeds in both canal and embankment should be slashed, time to time, and burn-out the slashed weeds when dry. Bush or young trees should also be cut-out within the green stage so far as to protect against a piping trouble and/or loosening of embankment to be attributed to the deep rooting.

The repair and maintenance of the on-farm facilities stated above should be undertaken by the participant farmers themselves under the technical guidance of the Authority staff. Each farmer should has the responsibility for up-keeping the on-farm facilities adjacent to his/her farm plots such as distribution canal, division boxes and stop-logs, farm road, farm access, field drain, etc. Besides, the participant farmers should organize them into the "Water Users Group"

in each rotational irrigation block as a unit of the "Water Users Association", and up-keep the common facilities, such as the tertiary canal, collector drain and those related structures, etc. through the communal work of the group farmers. In order to perform the above works, efficiently and satisfactorily, the Authority should provide the technical guidance as well as assistance in supply of such materials/ utilities as cement, sand, gravels, iron bars, laterites, clayey earth, etc. as required in the objective repair and maintenance of irrigation facilities and its related structures. The working capital to be required for these repair and maintenance works should be bourn by the participant farmers themselves as a part of the investment for rice production (i.e. production cost).

4.2 Soil Preparation

The soil preparation herein demonstrated is the specific work which preliminarily constitutes of the following practices:-

1) Ploughing of the surface soil in certain deep layer, and
2) Harrowing and/or puddling of soil surface of the ploughsol

This soil preparation is one of the most essential and basal practices for sustaining a high-yielding rice plantation, namely:-

1) A deep ploughing practice maintains the soil structure to be effective and/or favourable for rooting. Retaining capacity or water is also increases in certain extent.

2) Structural improvement of soil layer by ploughing work is effective for fertilization of crops by use of chemical fertilizers

3) Structural improvement of soil layer is also effective for the transplantation of seedlings as well as establishment of seedlings.

4) Puddling of soil surface is much effective for weed control particularly at the initial stage of rice growing. Majority of weeds and/or those seeds will be buried in deep soil layer by the puddling practice, and then recovery of weeds or germination of weeds' seeds are obstructed in certain extent.

Other than the above effects, preparation to a smooth and flat soil surface is much helpful for efficient operation and management of irrigation in each farm plot.

In this standard schedule on soil preparation, the ploughing and hence puddling practices should be regularized by using the farm tractors. Immediately after completion of the harvesting work on rice which has been grown in the prceding season, slashing of rice stubbles and weeds is carried out by use of slasher mounted to the farm tractor and directly succeed to the ploughing schedule. The ploughing of soil should be practiced by use of rotavator mounted to the farm tractor. Use of disc-plough is also accepted for this ploughing practice. Even the rotavator or disc-plough is used, the ploughing depth should be controlled around 15 cm of the soil surface. If the ploughing works is obstructed due to hard/firm soil consistences under dry conditions, the pre-irrigation with some 200m/m deep of water should be applied so far as to soften the surface soil.

The ploughsol (ploughed soil) should be dried uptil the clud is easy to break by harrowing practices. This drying of soil cluds is effective for promoting the wethering process of surface soil.

The harrowing of soil surface should be practiced therefore the ploughed soil is dried and weathered enough. In most cases, idling time between ploughing and harrowing works should keep, at least one week. In the course of harrowing work, the basal fertilizers should be applied and well mixed with the surface soil. The harrowing depth should adjust in and around 10 cm of surface soil. A deep harrowing, i.e. 15 cm at full depth of ploughed layer, is not accepted in view point of the technology on soil conservation/structural improvement of ploughsol layer. The soil surface should be prepared as smooth and flat as possible and soil clud be broken to small as much as the working efficiency of rotavator or disc-harrow could be sustained at reasonable range.

Following to the harrowing work, a puddling water should be supplied up to the ploughed soil is moistened/saturated enough and water is just standing in shallow depth whole over the farm plot. The puddling of soil could be performed when the ploughed soil become so friable under moistend/ saturated conditions. The puddling work is made by use of rotavator mounted to the farm tractor. In performance of this soil puddling practice, particular attention should be paid to the following points.

1) Puddling depth : only the surface soil layer at less than 10 cm

2) Puddling effect : mud-flat for easy transplantation of seedlings as well as for smoothly operating the henceforth irrigation

holding the fertilizers effectively in the shallow soil layer

sustaining a smooth rooting thereafter transplantation of seedlings.

This puddling work should be on-scheduled and completed few days before the transplantation of rice seedlings. During this few-day period, the puddling water, if excessively stand on soil surface, should be drained out so as to set off the puddled soil, satisfactorily.

4.3 Up-Rooting and Transplantation of Rice Seedlings

When rice seedlings grow-up to the 4 - 4.5 leaf stages or grow some 18 days to 21 days in the nursery bed in success, it is accepted to commence the transplantation of these seedlings to the main field. The rice seedlings at this stage are the most active on rooting as well as tillering initiation. The seedlings younger than that at 4 - 4.5 leaf stages are still weak plant, and then, be easy to get damages when up-rooting and/or transplanting works are practised. In contrast, the seedlings elder than that at 4 - 4.5 leaf stages grow strong enough for up-rooting and/or transplanting practices, while an activity on rooting/tillering initiation is weakened with time. Therefore, the transplantation of seedlings should be performed within the seedling age 4 - 4.5 leaf stages.

Once the transplantation work is delayed by some causes, a successful rooting of seedlings is surely obstructed in certain extent since a rooting activity is weakened with the times where the growing stage of seedlings takes over 4 - 4.5 leaf stages. The conditions of rooting/tillering initiation thereafter the transplantation are demonstrated in Fig. III - 02 for better understanding on the mechanizum of seedlings establishment.

For smoothly and safely up-rooting the rice seedlings, the nursery beds should be submerged by applying the irrigation water at least one day before commencement of the up-rooting work so far as to soften the bed soil, enoughly. Application of the insecticides; for instance "Dimcron" at the dilution ratio at 1 : 1,000 should be performed few days before commencement of the up-rooting. It is also suggested that a long stock of up-rooted seedlings is not accepted so as to prevent a stuffing or withering troubles.

As for performance of the transplantation of rice seedlings to the main field, particular attention should be paid to the following conditions:-

1)	Plant space	:	The specific plant space herein recommended is at 30 cm x 15 cm or 21 hills per sqare-meter (m^2).
2)	Seedlings to be transplanted in each hill	:	Few sound seedlings be planted together for each hill
3)	Planting depth	:	Transplantation of rice seedlings be made as shallow depth as possible, preferably less than 2 cm of the soil surface. Deep plantation of seedlings is strictly prohibited so as to prevent mis-rooting due to suffocation trouble.

All the conditions would be applicable either for "regular transplanting" or "traditional random transplanting" methods.

As explained in the preceding section 3., the "number of panicles in a unit area " is one of the essential component factor for determination of the productive conditions of rice. The plant spaces are the primary bases to maintain the said "number of panicles". Taking into account the plant physiological characteristics, such as plant height, leafing form of plant, increase rate of tillers, size and heading position of panicles, etc., the plant space at 30 cm x 15 cm or 21 hills/m^2 is recommended as the most optimum rate for maintaining the vigorous growth at vegetative stages and faborable plant physiological formation at the generative stages.

A narrow planting space is the negative factor which will give the plant physiological stress particularly at the most active tillering stage, eventually, the number of tillers at the maximum tillering or young panicle initiation stages is limited to small extent. A narrow planting space causes a stuffing trouble on leaves especially for lower part of rice plant. Development of insects and diseases is also serious under such stuffing conditions of rice plant.

In contrast, a wide planting space will give favourable conditions for any activities on plant physiological formation; for instance maximization of tillers/hill, virgorous leafing-out, etc. In reality, however, it is difficult to maintain the optimum number of panicles/unit area due to smaller number hills in respective balance on successful formation of panicles.

The most applicable planting space should be determined according to the plant physiological characteristics of each rice variety and optimization test on plant spacing. In this Lower Anambra Irrigation Project Area, major rice varieties to be used for the plantation are all medium growing term variety and have the following specific characteristics:-

4.4. Fertilization

The fertilization of rice plant by means of fertilizer application is one of the most essential farming practices so as to maintain an optimum yield of rice product. The soils in the project area are not always fertile since the essential elements or nutritions have been leaching out through the laterization in soil forming process under the tropical monsoon climate. Besides, the top-soil in the arable land (or farm plots) has been removed in certain extent where the on-farm development/land consolidation works are performed, and consequently, un-weathered and/or in-fertile sub-soils have arisen in soil surface as the ploughsols for henceforth rice cultivation. Therefore, fertilization of said soil by utilization of the chemical fertilizers is very essential and crucial in order to amend the soil conditions effectively and satisfactorily, and to maintain growth of rice plant, favourably.

As shown in the Table III-01 and III-02, the practical field trials on crop-soil fertilization reveals that the soils in the project area highly response to the dressing by chemical fertilizers and bring high crop production by the reasonable dosage of fertilizers. According to the observation made through said field trials, the following dosages of fertilizers would be primarily acceptable so far as to attain the unit yield of 5 tons/ha/crop-season which has been presumably estimated as the target yield of this project.

Essential Elements	For Top-Soil Area	For Sub-Soil Area
1. Nitrogen (N)	80 to 100kg/ha	100 to 120kg/ha
2. Phosphate (P_2O_5)	35 to 45	45 to 55
3. Potass (K_2O)	-	-

Note: 1. An optimum dosage of phosphate would be corresponded to about 45% that of Nitrogen.

2. Fertilizations effect of potash did not observe so far. It is generally accepted that the said effect is limited to small in most cases according to the results of fertilizer dosage test performed by ADARICE during the initial development stage, 1976 to 1978.

It is well known that the field losses of nitrogen element are always serious because of the de-ammonification in soil reaction at the shallow soil layer which is proceeding with an oxidation/reduction in paddy-soil forming process under submerged/irrigated conditions. To minimize such field losses against the said soil reaction, the split application of fertilizers is generally accepted and practised in the advanced rice producing countries.

In due consideration of the soil conditions in the project area, the "one second split method" is recommended as the standard manner on the fertilizer application, as far as the nitrogenous fertilizers are concerned. Application of the phosphate and potash be made at once time preferably just before transplantation. In the split application method, the first one second of nitrogen be applied into soil during the period of the soil puddling and/or just after transplantation of seelings. This first application is hereunder called to the "Basal Application" and generally schedule on by the following manner.

1) The proposed dosage of phosphate and potash be applied all at once time preferably before soil puddling practice and mix with the ploughsol homoziniously when puddling, or

Those elemental fertilizers be applied just before transplantation of seedlings by means of the "Top-Dressing Method".

2) The same quantity of nitrogen be applied together with the above elemental fertilizers.

3) The rest of nitrogen be applied around one week after the transplantation work by means of the "Top-Dressing Method".

The second application (hereunder called to as the "Additional Application") be made at the young panicle initiation stage, more definitely, it should be made when young panicle in the main stem of seedlings is formed in 2 cm long. To this end, the remaining one second of proposed dosage of nitrogen be applied by means of the Top-Dressing Method.

In the small exception where the ploughsols constitute of course testure soils, such as lateritic sub-soils, loamy to sandy siliceous soils, etc., the application of fertilizers should be split into 3 to 4 times so as to maintain the crop-soil response to the fertilization practice as well as to minimize the field losses particularly due to leaching hazard on elemental nutrients under the irrigated conditions. The recommendable timing for split application is as follows:-

1)	Basal application;	N.P.K. K-elements just before or after the transplantation work
2)	First application of the Additional Fertilizers;	Nitrogen (N) at the most active tillering stage
3)	Second application of the Additional Fertilizers;	N and P-elements at the young panicle initiation stage
4)	Third application of the Additional Fertiizers;	Nitrogen (N) at just before heading of panicles.

To the above end, the proposed dosage for each timing/or rice growing stage is presumably estimated as follows:-

Schedule	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
1. Basal Application	30	50	50
2. First Addition	25	-	-
3. Second Addition	25	50	50
4. Third Addition	20	-	-

Note: The figures show the sharing ratio (%) on dosage of the elemental nutrients for each split.

As for the basal fertilization, the following chemical fertilizers which are available in the project office, will be utilized:-

- Nitrogen sources: NPK Compound (N:P:K = 15:15:15)
  Ammonium Sulphate (N = 21%)
  Urea (N = 46%)
- Phosphate sources: NPK Compound
- Potash sources: NPK Compound

Among the above fertilizers, NPK Compound is utilized as the basement for supplying three essential elements, such as nitrogen, phosphate and potash. A short balance of nitrogen in the said Compound should be supplemented by use of ammonium sulphate and/or urea. The dosage of each fertilizer which should be corresponded to the unit dosage of each essential element is as follows:-

Description	NPK Compound	Ammo-Sulphate	Urea
Basal Fertilization			
- Before Transplantation	230 kg/ha	- kg/ha	- kg/ha
- After Transplantation	-	70	(30)
Additional Fertilization	-	(140)	65

At the two essential rice growing stages mentioned above, application of insecticides should be arranged whole-over the rice plantation area so as to take the preventive measures against a serious development of insects. To maximize the treatment effect on the above measure, liquid type of in insecticides will be useful for the dry season operation, while the granule type is effective for the rainy season operation.

The chemical treatment against crop damages by insects should be locally performed, time to time and place by place, as one of the immergency measures by applying the insecticides. To this end, the liquid type of insecticides will be effectivel usefull for both dry and rainy season operation. The technical instruction and proposed dosage insecticides are given in the Tables attached hereto.

The damages by diseases are mainly of leaf-blight particularly at the maximum tillering stage, approximately 40 days after the transplantation. No serious dieases, such as rice blast, etc. are not occured yet, so far. Nevertheless the crop damages by diseases are limited to or negligible small, at present, it is very essential to take precaution against the infection of pest and dieases. The recommendable pesticides and fungicides as well as the specific dosages of each checmical are as given in the attached Tables/Figures hereto.

The plant protection mentioned above should be performed as one of the co-operative works of the participant farmers. On the other words, the chemicals utilized for this plant protection measures are always harmful though the reaction and/or specific characteristics of the active ingredients of those checmicals have been much amended recently into weak for humanbeing as well as the domestic animal, games and fishes. Therefore, to implement the plant protection works provision of the technical guidance and supervision to the farmers is very essential and crucial. The precautions

Note: - The above dosages are for top-soil reserved area.

- In case for fertilization of sub-soils, the dosage of each fertilizers such as NPK Compound, Ammo-Sulphate and Urea is 300 kg/ha, 120 kg/ha and 65 kg/ha, respectively.

- The figure in parenses is the dosage if the said fertilizer will be used instead of each objective fertilizer.

It is noted that the fertilizer application should be made strictly according to the standard schedule surely causes not only a reduction of fertilization effect but also upsetting of rice growing stages.

4.5. Plant Protection

The plant protection works herein scheduled are the chemical treatment of rice plant. The plant protection is generally taken two ways, namely:-

1) Precaution agains the infection of pest and diseases, and/or preventing measure against insect attacking

2) Treatment measures against crop damages by dieases and/or insects.

According to the crop damages observed in the past rice plantation, the insects especially of "stem-borers", "case-worms", "army-worms" and some caterpillers are the most serious troublesome in both dry and rainy season rice cultivation. Besides, it seems that the development and spread of those insects would be quite frequent and be habitual throughout the rice growing period. To control those insects, effectively, it should be scheduled the systematic/or area-wise plant protection works with attention to the following most essential rice growing stages:-

- The rooting to active tillering stages (approximately 5 to 20 days after the transplantation)

- The young panicle formation to booting stages (approximately 50 to 80 days after transplantation)

should be taken with attention to the following particulars:-

- To apply the chemicals precisely according to the technical instruction and recommendations, which are generally represented on label attach thereto
- In any cases, do not apply the chemicals under strong wid conditions
- To wash hands and exposed parts of body or clothing after the work.
- To keep the chemicals in their original container in a place which is out of reach of children and domestic animals, preferably in a place, which can be locked, as well as dry and sheltered from the sun.
- Do not leave empty containers lying about, and do not use them for other purposes.

Other than the above notice, it is also to suggest that renewal or new chemicals should be arranged in certain years interval, accordingly, so far as to take the counter-measure against a development of "anti-chemical-insects" to the respective insecticides.

4.6 Weeding and Purification of Rice Variety

The weed control and/or weeding works are one of the essential farming practices in rice cultivation to maximize the fertilization andplant protection effects, and then the production increase. To be highly response to an intensive farming practices and to secure a favourable growth of rice plant, the weed control or weeding should be performed, at least, three times during the crop season, i.e. the first weeding at the rooting to active tillering stages (approximately 10 to 15 days after the transplantation of rice seedlings), the second weeding at the maximum tillering to young panicle initiation stages (approximately 45 to 60 days after the transplantation) and the third weeding at the booting stage (around 80 days after the transplantation).

Under the present operation of rice cultivation, a large number of annual weeds, either graminaceous or dicotyledonous species are growing in the farm plots. These weeds have been widely spreaded and over-running in rice plantation area. Out of the graminaceous weeds, millet grass (i.e. Ischaemum Rugosum, Panicum Miliaceum, etc.) and sedges (i.e. Cyperus Esculentus, Cyperus Microira, Cyperus Difformis, etc.) are the predominant and the most serious troublesome in this project area. As for the dicotyledonous/broad leaf-weeds, starchytarpheta Cayennensis, a kind of Verbenaceae family is one of the stubborn weeds in the weeding and/or weed control works.

In the standard schedule herein envisaged, the first weeding/weed control will be made by utilization of the "herbicides", effectively and satisfactorily. Generally, efficiency of each herbicide is limited to narrow ranges and/or very selective on kind of weeds. In fact, the Stam - F is very useful for controlling the wide-leaf weeds, while no effect on graminaceous weeds. The Machete having "butachlor" in active ingredient is very effective for controlling the graminaceous weeds but selective on rice among others. Nevertheless, it is noted that the effect of herbicides could only be expected at the initial growing stage of weeds, and the treatment effect is hardly foreseenable when the weeds have been grown up in certain leaf-stages. The herbicides to be recommendable for controlling the trouble weeds are presumably selected among the products being available in the domestic market. Those are as listed in Table III-03. The technical instruction for utilization of those herbicides is also given in the same table.

The second and third weeding should be performed by hand using such farming implements as rotary-weeders, cutlass, sickles, etc. This weeding weeding work should be scheduled therebefore weeds are to be bearing the seeds or fruits.

In the course of weeding in farm plots, it is suggested to control the foreign varieties of rice which are, in most cases, brought from the field losses of the preceding production. This purification of rice variety is essential and crucial so far as to maintain the quality of production as well as to enable smooth and simultaneous harvesting of rice in each farm plot.

4.7 Water Management

In principle, the rainy season rice is grown under the rain-fed conditions. An artificial irrigation to this rice would be scheduled as the supplementary irrigation when certain drought is occured during the crop season. Accordingly, the full operation of artificial irrigation is scheduled on the dry season rice plantation.

The water management herein scheduled is practically the water control work at on-farm level either under artificial irrigation or rain-fed conditions. As for the irrigation to rice, it is generally accepted that the watering at just saturation to soil layer is the best conditions for maintaining a favourable growth of crop. However, this watering condition is also helpful for germination of weeds, eventually particular attention should be paid to the weed control. In contrast, deep irrigation obstructs weed germination in certain extent, while this practice is not always acceptable due to large operation losses and/or low efficiency of irrigation water. To minimize the operation losses of irrigation water as well as to sustain a favourable growth of crop, effectively, an application of irrigation water to rice cultivation should be managed according to the following schedule.

Proposed Schedule on Irrigation and/or Water Control for Each Growing Stage of Rice

Essential Growth Stages of Rice	Water Depth to be Applicable (m/m)	Remarks
Pre-irrigation for soil puddling	100	1 to 2 days before the soil puddling work. Pre-irrigation water be drained out most part before transplantation.
Transplantation	30 - 50	Immediately after transplantation, irrigation water be applied uptil water-logged in few cm.
Rooting to active tillering stages	50 - 100	During the days from 5 up to 30 days thereafter the transplantation.
Most active to maximum tillering stages	100	Maintaining the water depth at around 5 cm.
Young panicle initiation to drought tipe stages	100	Maintaining the stand water depth at maximum 10 cm.
Yellow ripening stage	-	Full stop of irrigation and draining out the standing water.

The detailed operation schedule on water management is given in Fig. III-03 attached hereto. Nevertheless, particular attention should be paid to the following schedule:

1) Before application of the basal fertilizers and/or additional fertilizers, standing water on farm plot be all drained out fully. Re-irrigation to the farm plot be made after few days of the fertilizer application. This schedule is very essential so as to prevent the water contermination trouble due to breeding of green-alga.

2) Before application of agro-chemicals, such as insecticides, pesticides, fungicides, etc, excessive water be drained out, as much as possible, so as to maintain an efficiency of chemicals.

3) If the irrigated water is conterminated by some causes, re-freshment be made without hesitation, accordingly.

Table III-01 PRODUCTION RESPONSE TO FERTILIZATION AND SOUNDNESS OF POTENTIAL MAXIMUM YIELD OF RICE

(1985/86 Dry Season)

(Unit: ton/ha)

DOSAGE OF FERTILIZERS (Dosage of Nitrogen)	REPLICATION I - Line	II - Line	III - Line	IV - Line
1. 30 Kg/ha + 30 Kg/ha = 60 Kg/ha	5.10	6.90	6.52	5.85
2. 40 Kg/ha + 40 Kg/ha = 80 Kg/ha	4.96	6.08	6.72	6.40
3. 45 Kg/ha + 45 Kg/ha = 90 Kg/ha	5.78	6.21	7.56	8.41
4. 50 Kg/ha + 50 Kg/ha = 100 Kg/ha	7.02	6.66	7.65	7.33
5. 60 Kg/ha + 60 Kg/ha = 120 Kg/ha	7.51	9.03	7.22	7.32
6. 70 Kg/ha + 70 Kg/ha = 140 Kg/ha	6.30	10.60	8.20	8.20
7. 80 Kg/ha + 80 Kg/ha = 160 Kg/ha	7.15	10.12	10.45	9.13
8. 100 Kg/ha + 100 Kg/ha = 200 Kg/ha	-	13.91	- (No plot)	-
9. 120 Kg/ha + 100 Kg/ha = 220 Kg/ha	-	9.33	-	-
10. 140 Kg/ha + 100 Kg/ha = 240 Kg/ha	-	9.00	-	-

Note:- 1. The fertilizers are applied twice times, i.e.
- The basal fertilization at just after transplantation, and
- The supplementary fertilization at young panicle initiation stage (young panicle just 2 cm long stage).

2. Dosage and variety of fertilizers are as follows:-
- Basal fertilization: The first 30 Kg/ha of nitrogen is applied by use of NPK-compound (15:15:15). The nitrogen dosage exceeded more than 30 Kg/ha but up to 50 Kg/ha level (total dosage up to 80 Kg/ha) is by use of urea (46 %). Total dosage over than 100 Kg/ha is made by NPK-compound for 50 Kg/ha and urea for remaining.
- Supplementary fertilization:- All bu use of urea.

3. Method of application:- Top-dressing method for both stages. Two days after application, the inner-tillage is practiced by use of rotary-weeders.

4. Variety of rice:- ITA - 306

GENERAL DESCRIPTION AND PLANT PHYSIOLOGICAL CHARACTERISTICS
OF
MAJOR RICE VARIETIES UTILIZED

LOWER ANAMBRA IRRIGATION PROJECT

Rice Varieties Being Utilized for Current Rice Production Programme

Descriptions	BG - 90/2	IR - 14/16	ITA 212	ITA 306
1. Place of Origin	Sri Lanka	IRRI (Philippines)/1	IITA (Naigeria)/2	IITA (Naigeria)
2. Growing Terms (seeding to maturity)	130 days	125 days	135 to 140 days	130 to 135 days
3. Photoperiodic Sensitivity	not sensitive	not sensitive	not sensitive	not sensitive
4. Specific Characteristics of Plant				
- Plant Height	100 cm	95 cm	105 cm	105 cm
- Plant Type	semi-dwarf, erect, stiff	semi-dwarf, erect, stiff	semi-dwarf, erect	semi-dwarf, slightly spreading
- Tillering Ability	very good	very good	very good	very good
- Lodging	resistant	resistant	resistant	resistant
- Type of Leaf	erect, stiff, dark-green	medium, erect, green	erect,	erect, rather wide, dark green
- Response to Fertilization	very good (high)	very good (high)	very good (high)	very good (high)
- Growth	slow growing	quick growing	quick growing	quick growing
5. Specific Characteristics of Grain				
- Length	9.2 mm	7.9 mm	9.3 mm	9.3 mm
- Wideth	2.7 mm	2.7 mm	2.7 mm	2.7 mm
- 1,000 Grains Weight	28 grm.	25 grm.	30 grm.	30 grm.
- Colour	straw	straw	light straw	light straw
- Shattering	resistant	resistible	resistant	resistant
- Awn	awnless	awnless	awnless	awnless
- Dormancy	5 to 6 weeks	less than 4 weeks	5 to 6 weeks	5 to 6 weeks
- Milled Rice	medium size, white	medium size, white	medium size, very white	medium size, very white
6. Ptential Yielding (N:P:K = 60 -80:30 - 45: 0 -30)	6 to 8 ton/ha	5 to 7 ton/ha	6 to 8 ton/ha	6 to 8 ton/ha
7. Resistance				
- Blast (Pyricularia)	moderately resistant	resistant	resistant	resistant
- Leaf Scald (Rynchosporium)	moderately resistant	resistant	resistant	resistant
- Stem-Borers	moderately susceptible	resistant	moderately resistant	moderately resistant
- Iron Toxicity	resistant	moderately resistant	moderately resistant	rather weak

Remarks: /1: IRRI: The International Rice Research Institute, Philippines
/2: IITA: The International Institute of Tropical Agriculture, Ibadan, Naigeria

Table III - 02

SUMMARY OF PRODUCTIVE CONDITIONS OF EACH VARIETY

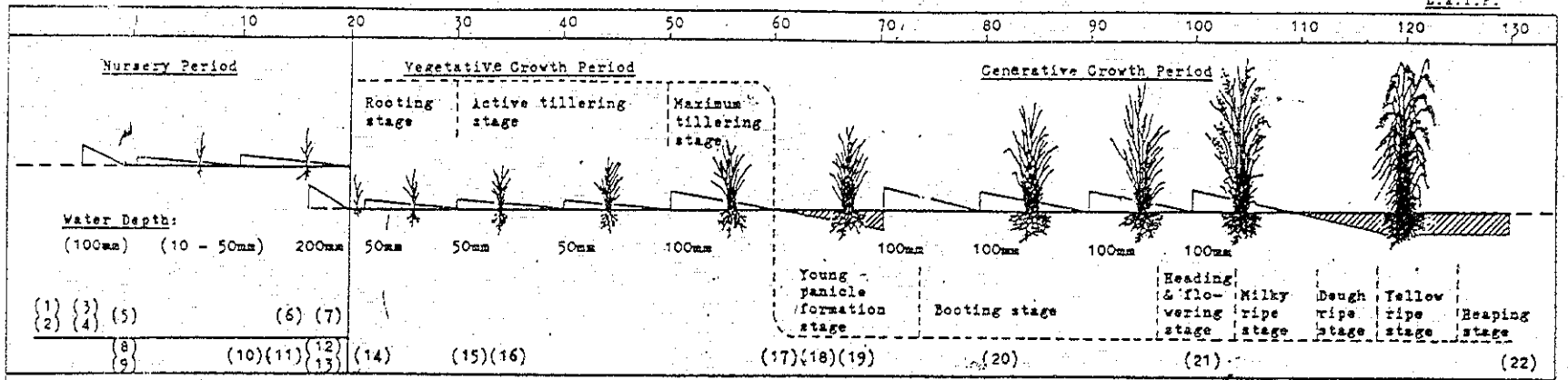
Name of Variety	I - line	II - line	III- line	Average Yield
BG - 90 - 2	6,193	5,342	4,922	6,152
BG - 400 - 1	6,979	5,913	7,635	6,843
BOUAKE - 189	3,991	5,439	4,669	4,699
BR - 51 - 282 - 8	6,630	7,155	6,357	6,714
IET - 6279	3,863	6,320	4,387	4,856
IR - 2042 - 178 - 1	6,281	2,765	6,474	5,173
IR - 36	4,077	4,389	3,971	4,145
IR - 42	4,229	7,428	6,273	5,976
IR - 4422 - 98 - 3 - 6 - 1	8,159	7,440	4,813	6,804
IR - 46	6,231	6,306	5,837	6,124
IR - 54	6,094	4,988	3,045	4,709
ITA - 212	6,505	6,655	7,628	6,929
ITA - 222	6,383	7,823	7,687	7,297
ITA - 231	5,151	6,415	6,681	6,082
ITA - 249	5,237	5,359	6,053	5,549
ITA - 306	6,530	7,524	4,275	6,109
LOCAL (Ochanja)	4,953	4,378	4,620	4,650
				(5,812)

Remarks:

1) Unit yield..... Gr./ 10 m^2,(2 m x 5 m)
2) Setting of test plots ... three replication with random selection method
3) Planting density ... 20 cm x 20 cm or 250 hills per 10 m^2 with regular planting method
4) Transplantation .... one seedling per hill
   The nursery is prepared by use of seedling boxes.
5) Dosage of fertilizers ... N : P : K = 60 : 30 : 30
   Basal fertilization by use of NPK compound (15:15:15) 200 kg/ha
   Additional fertilization by use of urea (46%) 65 Kg/ ha
6) No application of agro-chemicals in accordance with the operational conditions specified in the programme.

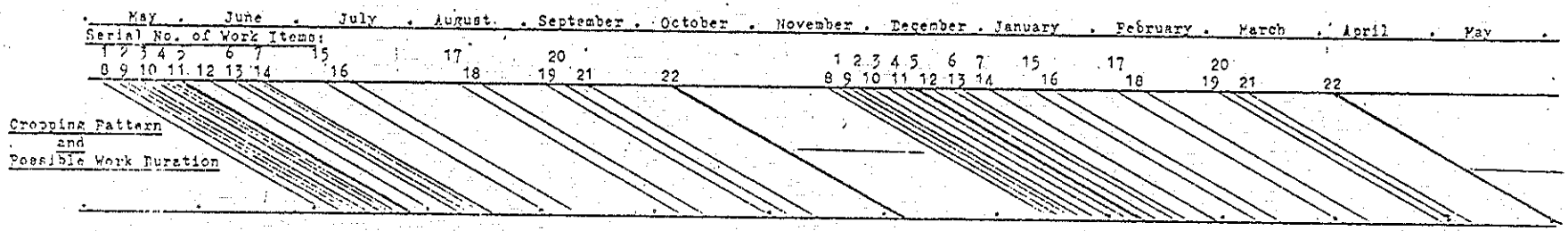
Fig. I₁-01 STANDARD SCHEDULE AND PROCEDURE OF RICE CULTIVATION

L.A.I.P.



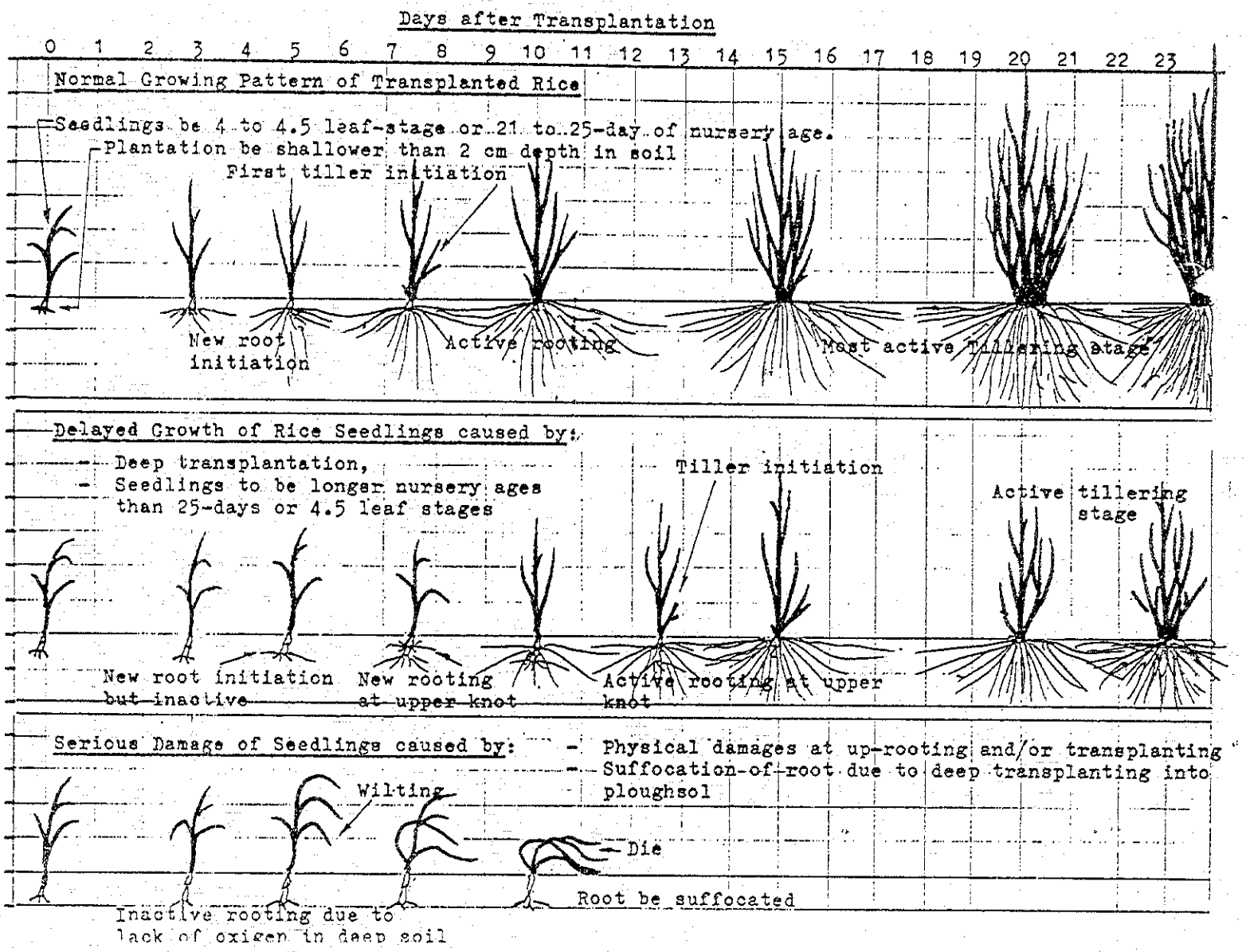
Work Items:	Equipment Required:	Farm Inputs:	Days: (before/after transplanting)	Remarks:
A. Nursery works;				
(1) Soil preparation	Disc plough/rotavator	-	- 30	Nursery: 200 m^2/ha
(2) Basal fertilizer application		65 kg/ha of NPK compound	- 30	(2 m x 25 m, 4 seed
(3) Preparation of seeds	Soaking tank	30 kg/ha of rice seeds,	- 25	beds per ha)
(4) Pre-irrigation		90 g of Benlate/45 lit. of water	- 25	
(5) Seeding		(30 kg/200 m^2 of rice seeds)	- 21	
(6) Weeding/Plant protection	Sprayer	10ml/200m^2 of Dimecron	- 3	
(7) Up-rooting of seedling		-	0	
B. Main field works;				
(8) Maintenance of farm facilities		-	- 20	Farm facilities;
(9) Cleaning of farm plot	Rotary slasher	-	- 20	irrigation/drainage canal, farm ridges,
(10) Ploughing	Disc plough/rotavator	-	- 10	division box, farm approach
(11) Pre-irrigation		(stop-logs if necessary)	- 5	
(12) Harrowing/puddling	Disc harrow/rotavator	-	- 3	
(13) Basal fertilizer application		200 kg/ha of NPK compound and 70 kg/ha of Ammonium Sulphate	- 3	
(14) Transplanting of seedlings		3 to 4 seedlings per hill	0	Plant space; 30 cm x 15 cm
(15) 1st insecticide application	Knapsack sprayer	1 lit./ha of Dimecron (1 : 1,000)	+ 10	
(16) 1st weeding	Knapsack sprayer	or 25 kg/ha of Furadan	+ 15	
(17) Fungicide application	Knapsack sprayer	5 lit./ha of Stem-F/Casaprin	+ 40	
(18) 2nd weeding		1 kg/ha of Benlate (1 : 1,000)	+ 45	
(19) Additional fertilizer application		-	+ 45	Both basal and additional fertilization be made by means "top-dressing method"
(20) 2nd insecticide application		65 kg/ha of Urea or 140 kg/ha of Ammonium Sulphate	+ 60	
(21) 3rd weeding		25 kg/ha of Furadan	+ 80	
(22) Harvesting/threshing/bagging	Combine harvester/threshing machine	Jute-bags	+110	

Fig. III - 01 (2) STANDARD SCHEDULE OF FARM OPERATION
(Twice Cropping a Year)

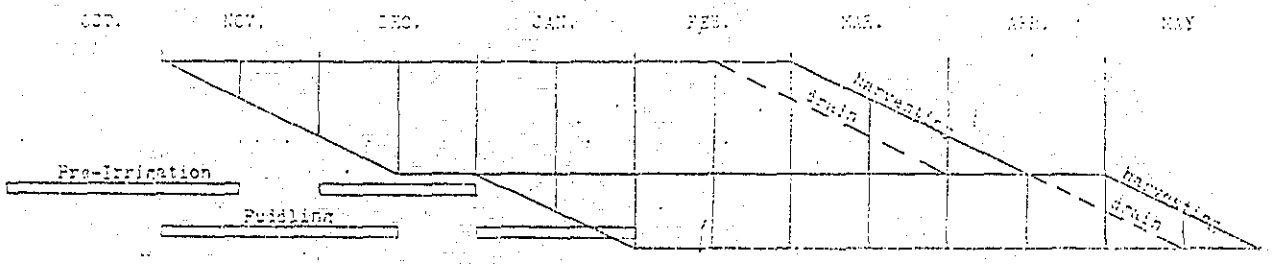


	Work Items	Working Force	Equipment and Implements	Regular Working Efficiency	Farm Inputs to be Required
A.	Nursery Works:				
1.	Soil preparation	60 PS farm tractor	Rotavator	0.25 ha/hr.	-
2.	Basal fertilizer application	Labour	Bucket or basins	0.5 ha/M.D	65 Kg/10,000 m^2(ha) of NPK compound
3.	Preparation of seeds	Labour	Buckets or basins	250 Kg of seeds/M.D	30 Kg/ha of clean and dryed seeds
4.	Pre-irrigation to nursery beds	Labour	-	2 ha (4 plots)/10 hr.	-
5.	Seeding to nursery beds	Labour	Buckets or basins	400 m^2 in net/M.D	-
6.	Weeding/plant protection	Labour	Knapsack sprayer	0.2 ha/hr.	1 lit./ha of dimecron with dilusion ratio at 1/1,500
7.	Up-rooting of seedlings	Labour	-	50 m^2in net/M.D	-
B.	Main Field Works:				
8.	Repair and maintenance of farm facilities (canal, farm ridges)	Labour	Local hoes, cutlass, etc.	-	-
9.	Slashing of weeds and stubbles	60 PS farm tractor	Rotary-slasher	0.5 ha/hr.	-
10.	Ploughing	60 PS farm tractor	Rotavator	0.25 ha/hr.	-
11.	Pre-irrigation to ploughed plot	Labour	-	2 ha(4 plots)/12 hr.	-
12.	Harrowing cum Puddling	60 PS farm tractor	Rotavator	0.3 ha/hr.	-
13.	Basal fertilizer application	Labour	Buckets or basins	0.5 ha/M.D	200 Kg/ha of NPK compound and 70 Kg/ha of ammonium-sulphate
14.	Transplanting of seedlings	Labour	-	400 m^2/M.D	-
15.	1st application of insecticides	Labour	Knapsack sprayer	0.25 ha/hr.	1 lit of dimecron/ha (1:1,000)
16.	1st weeding	Labour	Knapsack sprayer	0.25 ha/hr.	5 lit/ha of stam-F mixt with 5 lit/ha of machet or 6 lit/ha of ronster, etc.
17.	Fungicides application	Labour	Knapsack sprayer	0.25 ha/hr.	1 Kg/ha of benlate (1:1,000)
18.	2nd weeding	Labour	Cutlass, rotary-weeder	400 m^2/M.D	-
19.	Additional fertilizer application	Labour	Buckets or basins	0.5 ha/M.D	65 Kg/ha of Urea or 140 Kg/ha of ammonium-sulphate
20.	2nd insecticides application	Labour	Knapsack sprayer	0.25 ha/hr.	25 Kg of furadan or 1 lit/ha of dimecron
21.	3rd weeding/purification	Labour	Cutlass, etc.	400 m^2/M.D	-
22.	Harvesting/threshing	Labour	Thresher motorized	1,000Kg/hr.	Jute bags, etc.

Fig. III-02 INITIAL GROWING (ROOTING/TILLER INITIATION) OF RICE THEREAFTER TRANSPLANTATION



Appx. III-09 Standard Schedule of Irrigation for Dry Season Cropping (Case 1)
(In case of 2,500 ha Operation)

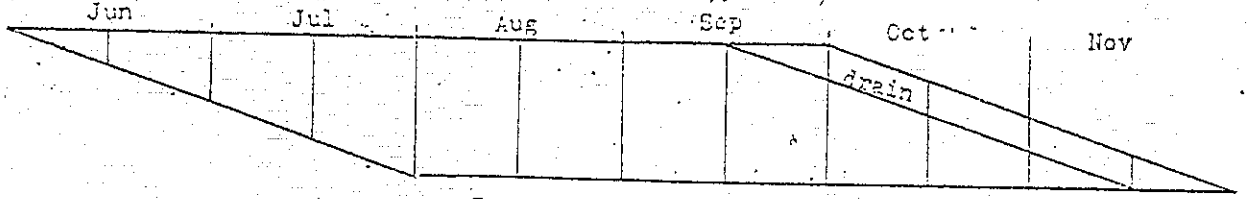


(1)	Crop Co-efficient(Kc)			1.02	1.28 1.02	1.58 1.28 1.02	1.83 1.58 1.28 1.02	1.95 1.83 1.58 1.28 1.02	1.93 1.95 1.83 1.58 1.28 1.02	1.73 1.93 1.95 1.83 1.58 1.28 1.02	1.73 1.93 1.95 1.83 1.58 1.28	1.73 1.93 1.95 1.83 1.58	1.73 1.93 1.95 1.83	1.73 1.93 1.95	1.73 1.93	1.73
(2)	Average Kc			1.02	1.15	1.29	1.43	1.53	1.60	1.62	1.72	1.80	1.86	1.87	1.83	1.73
(3)	Rpt. (mm)			63	63	67	67	73	73	69	68	73	73	66	66	66
(4)	Consumptive Use of Water (mm)			64	72	86	96	112	117	112	117	131	136	123	121	114
(5)	Effective Rainfall (mm)			0	0	0	0	0	0	0	0	13	13	28	28	45
(6)	(4) -(5)			64	72	86	96	112	117	112	117	118	123	95	93	69
(7)	Crop Intensity to Total Area			1/10	3/10	5/10	6/10	7/10	9/10	1	9/10	7/10	5/10	4/10	3/10	1/10
(8)	Nursery Requirement	3	3	5	2	4	4	2	1							
(9)	Pre-Irrigation Requirement	40	40	40		40	40									
(10)	Puddling Requirement			20	20	20		20	20							
(11)	Net Irrigation (mm) (6)x(7)x(9)x(10)	43	43	71	44	107	102	100	126	112	105	83	62	38	33	7
(12)	Net Irrig. Water Req. ($10^3 m^3$) (11)x2500 ha	1,075	1,075	1,775	1,100	2,675	2,550	2,500	3,150	2,800	2,625	2,075	1,550	950	700	175
(13)	Diversion Water Req. (3) ÷ 0.64 ($10^3 m^3$)	1,680	1,680	2,773	1,719	4,180	3,984	3,906	4,922	4,375	4,102	3,242	2,422	1,484	1,094	273
(14)	Pump Operation Hour (hr.)	233	233	385	239	581	553	543	684	608	570	450	336	206	152	38
(15)	Fuel Consumption ($10^3 l$)	59	59	97	60	147	140	137	173	154	144	114	85	52	38	10

Total: 5,611 hrs. / 1,469,000 l

Fig. III-03 Standard Schedule of Irrigation for Rainy Season Cropping (03 - 2)

(Supplementary Irrigation in case of 2,500 ha)



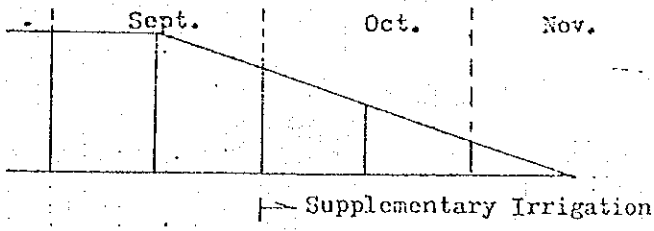
Proposed Cropping Pattern

(1) Crop Co-efficient (kc)	0.96	1.11	1.31	1.56	1.72	1.69	1.49				
		0.96	1.11	1.31	1.56	1.72	1.69	1.49			
			0.96	1.11	1.31	1.56	1.72	1.69	1.49		
				0.96	1.11	1.31	1.56	1.72	1.69	1.49	
					0.96	1.11	1.31	1.56	1.72	1.69	1.49
(2) Average kc	0.96	1.04	1.13	1.24	1.33	1.48	1.55	1.62	1.63	1.59	1.49
(3) Max. kc	0.96	1.11	1.31	1.56	1.72	1.72	1.72	1.72	1.72	1.69	1.49
(4) Ept. (mm)	57	57	56	56	55	55	54	54	56	56	63
(5) Cons. Use of water (Avrg.)	55	59	63	69	73	81	84	87	91	89	94
(6) " (max.)	55	63	73	87	95	95	93	93	96	95	94
(7) Rainfall (mean)	107	107	81	81	108	108	111	111	75	75	12
(8) Effective Rainfall (Avrg.)	81	81	59	59	81	81	81	81	57	57	8
(9) " (20% drought)	52	52	27	27	38	38	49	49	40	40	0
(10) Net Water Requirement (mm)			Negligible /*						Supplementary Irrigation		
① (5) - (8)	-	-	4	10	-	-	3	6	34	32	86
reference ② (5) - (9) (20% drought)	3	7	36	42	35	43	35	38	51	49	94
③ (6) - (8) (partial drought)	-	-	14	28	14	14	12	12	39	38	86

Note: /* Supplementary irrigation is to be started if required according to the field condition

Fig. III-03 Standard Schedule of Supplementary Irrigation for Rainy Season Cropping (in case of 2,500 ha Operation) (03 -3)

Condition : Average Effective Rainfall is expected

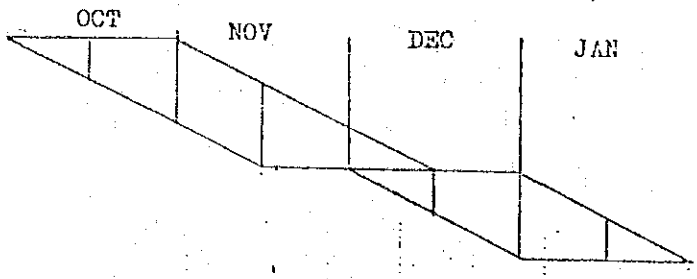


(1)	Net Water Req. (mm)	34	32	86	
(2)	Crop Intensity	5/8	3/8	1/8	
(3)	Net Irrigation Water Req. (1)x(2)x2,500 ha (10^3 m^3)	531	300	294	
(4)	Division Water Req. (Pump Discharge) (3) ÷ 0.64 (10^3 m^3)	830	469	420	
(5)	Pump Operation Hour (hr.)	115	65	58	Total 233 hrs.
(6)	Fuel Consumption (10^3 ℓ)	29	16	15	Total 60,000 ℓ

Reference (to be assumed that no Effective Rainfall is expected)

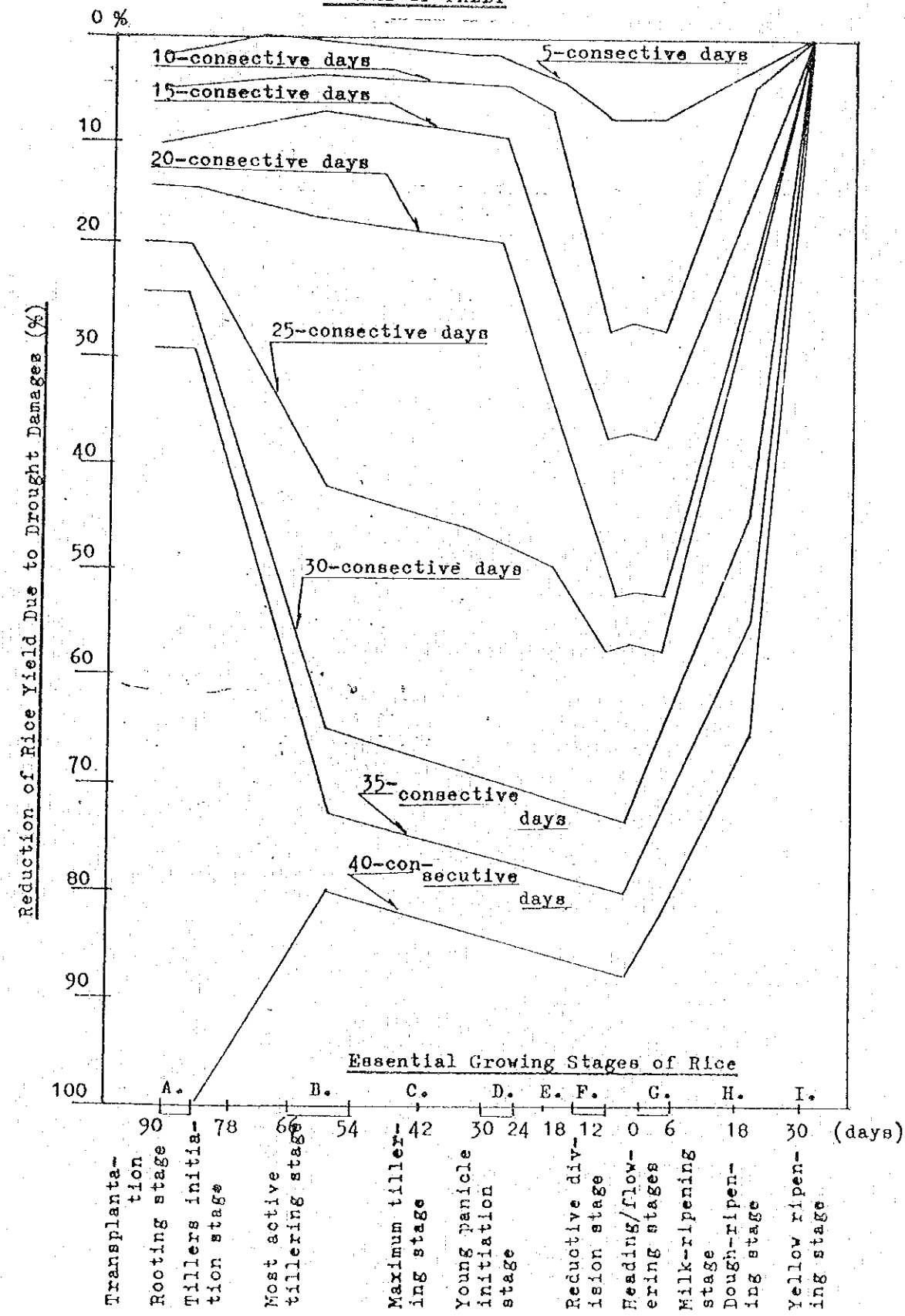
(1)	Net Water Req. (mm)	91	89	94	
(2)	Crop Intensity	5/8	3/8	1/8	
(3)	Net Irrigation Water Req. (1) x (2) x 2,500 ha (10^3 m^3)	1,421	834	294	
(4)	Division Water Req. (Pump discharge) (3) ÷ 0.64 (10^3 m^3)	2,220	1,303	459	
(5)	Pump Operation Hour (hr.)	308	181	91	Total 580 hrs.
(6)	Fuel Consumption (10^3 ℓ)	78	46	23	Total 147,000ℓ

Fig. III-03 Standard Schedule of Irrigation to Nursery (03 - 4)
(in case of 2,500 ha Dry Season Operation)



(1)	Consumptive Use of Water	109	109	105	109	109	109	109	109
(2)	Effective Rainfall	40	40	0	0	0	0	0	0
(3)	Nursery Area	1/10	3/10	4/10	3/10	2/10	3/10	3/10	1/10
(4)	((1)-(2))x(3)	6	18	42	32	22	33	33	11
(5)	Puddling for Bed	40	40	40		40	40		
(6)	Crop Intensity to total Area	1/20	1/20	1/20	1/20	1/20	1/20	1/20	1/20
(7)	Net Water Req. ((4)+(5))x(6)	3	3	5	2	4	4	2	1

Fig. III-04 REDUCTION OF RICE YIELD DUE TO DROUGHT DAMAGES AFFECTED AT DIFFERENT GROWING STAGES OF PADDY



..... Fig. III-04 Reduction of Rice Yield due to Drought Damages affected at Different Growing Stages of Paddy

Remarks:

1. The figure shows the decrease rate of rice yield which would be attributed to the drought damages occured at the essential stages of rice growth.

   The figures are practically the "Imerge curve" which has been drawn in attempt to represent a degree of damage due to the consecutive drought spell. These curves are drawn by means of the "compound process" of the respective field data. To this end, more than 85 sample data, which have been obtained from both Japan and South-Asian countries during the past 25 years, are applied.

2. The imarge curves reveal that the young seedlings at the rooting to active tillering stages are rather resistible to the drought hazard. Moreover, it can be expected that the tiller initiation and then tillerings would be much activated under certain dry conditions (the soil moisture condition range at less than that for saturation but higher than that of field capacity).

   In most case, the damages of young seedlings would be so serious if the drought spell is extended to more than two consecutive weeks.

3. The rice plant at later stage of tillering (uptil the maximum tillering stage) is highly susceptible to the drought hazard. Therefore, the irrigation to rice at these growing stages is very essential and crucial so as to maintain the favorable growth and then to ensure a production at reasonable level.

   If the rice plant is affected by drought damages at these stages, it is hardly to expect to recover the growing conditions as ever before.

4. The drought damages at the young panicle initiation to milking stages are always so serious eventhough the drought spell is short. Therefore, the irrigation at these growing stages is the most essential practices for maintaining the productive conditions of rice.

5. When the rice plant has been approaching to the dough-ripening stage, the rice plant is never affected by drought damages. Practically, the drainage work is essential practice at this growing stage so far as to maintain not only the productive conditions but also the quality of production.