Paddy Seed Production Techniques Manual

District Agriculture Development Office, Sindhupalchwok

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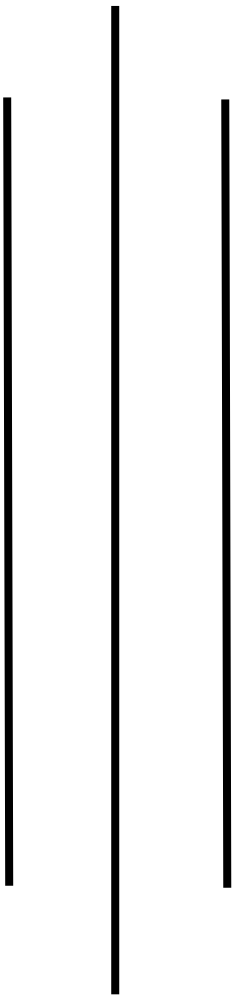

District Agriculture Development Office, Sindhupalchowk

Government of Nepal

Ministry of Agriculture Development

Regional Agriculture Directorate, central development Region

DISTRICT AGRICULTURE DEVELOPMENT OFIICE

Sindhupalchok, Chautara

Acknowledgement

Training Plays important role for the Change in behavior by improvement of knowledge, skill and ability of the farmers. To follow up and enhance more technically about the local methods, techniques, learning and experiences with current climatic requirement and technical needs are our major responsibility. Good Agricultural practices, traditional knowledge, skill and experience as well as research output techniques will be very helpful for successful Agriculture work. Successful Agriculture works refers to increment in the production of cereals, vegetables and cash crops as well as their marketing for raising the income. Management of the problems which arises during the farming like; disease pest occurrence, soil, Agro-materials also falls under the successive Agriculture work.

Regarding to the emerging context for commercialization, raising income and upliftment on livelihood of farmers by technical enhancement in simple way, we feel very happy by the preparation of this manual with very useful technical knowledge. This manual which is prepared under the JICA project on Rehabilitation and Recovery from Nepal Earthquake (RRNE) not only useful for rural Farmers, but also very useful for every technician related to Agriculture offices for the training material. It has been hoped that this manual, especially addressing the paddy seed production techniques will support for the increment of the productivity, improving in quality paddy seed production.

JICA/RRNE and Good Neighbors Nepal has helped much more for the preparation, correction, edition, all other related works and funding. I am also glad to assisting the preparation of this manual directly and indirectly by all persons, DADO technicians and technicians of Agriculture service center. I am hoping for this type of manual publication support by all readers and JICA Nepal in near future containing other precise and important training contents and materials.

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Table of Contents

PART I: DEFINITION AND IMPORTANCE OF QUALITY SEED

1. Background

Quality seed is very important to increase the production. It is necessary to maintain the varietal purity of seed, and control the seed borne disease for the production of high quality seed. Therefore, the major objective of this paddy seed production technique manual is to improve the knowledge to farmers about technical and management activities, including increment in production of quality seed of paddy. The technical and managerial farming activities will help to increase the knowledge on quality seed production as well as livelihood improvement of farmers living in mid-hill area of Nepal.

Fig. No. 1.1 Paddy cultivated land in hilly area

Source: JICA Project Team

2. Definition of Seed

- “Seed" means a matured ovule having embryonic plant, food substance and protective cover or seeds or germ which can be used in sowing or planting to produce crop by reproducing in sexual or asexual mode. (Seed Act, 1988).
- Seed is a live embryo in dormancy mode with or without cover, which can grow as a fully developed plant under a favorable environment.

3. Features of quality seed

Features of quality seed is as followings:

- Seed purity
  - It should have genetic purity.
  - It should have physical purity (no mix of other crop seed, weed seed and inert matter).
- It should have high germination vigor, germination rate and sprouting capacity.
- It should be free from seed borne disease and pests.
- It should have high growth and development capacity with germination capacity.
- It should be healthy and shining without any spot and weakness on looking.
- It should be in equal size and weight to produce healthy plants.
- It should have standard moisture level - with a maximum of 13% (as recommended by government) in paddy seed, which should clink while biting and shaking by hand.

4. Importance of Good Quality Seed

- Quality seed gives more production in comparison to normal seed.
- It also leads increment of production and income of farmers.
- Production from quality seed can be easily traded in the market.
- If high quality seed is produced in the mid-hill region of Nepal, the production of paddy will also be raised in that area.
- The variety selected from Nepal has higher adaptability and more resistant than the seed imported from foreign country.
- There are many pockets area for quality seed production in mid-hill region, which is also easily accessible to remote farmers.
- Quality seed production can also contribute to food security via increasing productivity.

PART II: METHOD OF PADDY SEED PRODUCTION

In techniques of quality seed production, there are the following points:

- Technical Aspect: it includes those activities, which help to produce quality and pure seed of improved variety.
- Management Aspect: in which, the individual farmers are managed through cooperatives for assurance of quality seed, and stable marketing of produced seed.

A) Technical Aspects for Quality Seed Production

5. Basic Knowledge for Paddy Seed Production

5.1General schedule for technique and technical work of paddy production

The general schedules for technical works of paddy cultivation are indicated in the following table:

Table No. 5.1.1:Paddy cropping calendar

Week	Plant stages	Activities			Farm works
		Field inspection	Use of fertilizers	Control of disease and pest	
3rd Week of May	Seed preparation and 1st ploughing		FYM (Farm Yard Manure) : 50-60 Doko (250-300 Kg) per Ropani	Seed borne disease: • Blast • Bacterial leaf blight • Foot rot	• Broadcast compost and first ploughing • Grading by salt water treatment • Seed treatment by fungicide
4th Week of May - 2nd Week of Jun.	Nursery stage	First field inspection		• Seed Bed beetle	• Uproot and remove diseased and off-type plants
3rd Week of Jun. Last Week of Jun.	2nd ploughing and transplantation		Initial stage: Urea: 4.8 Kg/ Ropani DAP: 3.12 Kg/ Ropani Potash: 2.5 Kg/ Ropani	• Mole cricket • Field cricket	• Second ploughing and apply chemical fertilizer, and then transplant paddy • Irrigation in the field 2-3 days before of transplanting
1st Week of Jul. – 2nd Week of Jul.	Tilling stage			• Rice Borer • Hoppers	• Make the field without water for 3-4 days in a 5-7 day interval if sufficient water is available
3rd Week of Jul - 1st Week of	Plant elongation stage	Second field	First top dressing Urea:	• Rice Hispa • Hoppers	• First weeding • Uproot and remove diseased and off-

Week	Plant stages	Activities			Farm works
		Field inspection	Use of fertilizers	Control of disease and pest	
Aug.		inspection	2.4 Kg/ Ropani	• Blast disease • Bacterial leaf blight • Foot rot	type plants
3rd Week of Aug.	Early heading stage		Second top dressing Urea: 2.4 kg/ Ropani	• Mealy bug • Sheath blight • Khaira Disease	• Second weeding
1st Week of Sep. - 2nd Week of Sep.	Late heading stage			• Mealy bug	
3rd Week of Sep. - 4th Week of Sep.	Flowering stage	Third field inspection		• Rice Borer	• Uproot and remove diseased and off-type plants
1st Week of Oct –2nd Week of Oct.	Grain(seed) formation stage	Forth field inspection		• Rice Gaundhi Bug	• Uproot and remove diseased and off-type plants
3rd Week of Oct. – 4th Week of	Grain(seed) maturation stage				• Start to make the field dry

Week	Plant stages	Activities			Farm works
		Field inspection	Use of fertilizers	Control of disease and pest	
Oct.					
1st Week of Nov. - 2ndWeekof Nov.	Grain(seed) ripening stage	Fifth field inspection			• Uproot and remove diseased and off-types plants
3rd Week of Nov. – 4th Week of Nov.	Harvesting stage	Sixth field inspection			• Uproot and remove diseased and off-types plants • Harvesting should be done on dry and sunny day

Source: JICA Project Team

5.2 Marketing plan

Before seed production, cooperative should prepare the plan of how much seeds that could be sold in the market, and how much quantity of seed can be stored in their storage. By considering this, the plan of land selection for seed production, and seed production should be done.

5.3 Land selection

Land selection should be done in coordination with seed production group/ cooperative.

Consider the following things while selecting plot for the seed production.

- Prevention of out crossing with other paddy variety, the isolation distance of the seed production field should be 3 meter; however, it is self-pollinated crop.
- Minimum area for declaration of seed production pocket should be one and half hector (10Ropani) according to policy of Nepal government.
- Seed production plot should be fertile land in sunny area.
- The seed production plot should have facility of irrigation and management of proper drainage system.

6. Works before Cultivation

6.1 Selection of variety

Seed production cooperative should select the variety in coordination with DADO. Variety of paddy recommended for the mid-hills are given below:

Table No. 6.1: Varieties of paddy

SN	Variety of paddy	Production in KG per Ropani	Harvesting day	Recommended area	Recommended year
1	Khumal-4	315	144	Mid-hills	2044
2	Makawanpur-1	215	150	Terai (Low hills)	2044
3	Taichung-176	395	144	Mid-hills and Valley	2024
4	Khumal-3	325	130	Mid-hills	2041
5	Khumal-8	385	158	Mid-hills and low-hills	2063
6	Khumal-11	425	144	Mid-hills	2058

SN	Variety of paddy	Production in KG per Ropani	Harvesting day	Recommended area	Recommended year
7	Khumal-6	390	155	Kathmandu Valley and Mid-hills	2056
8	Chainung-242	365	144	Mid-hills	2024
9	Khumal-10	239	136	Kathmandu Valley and Mid-hills	2068
10	Khumal-13	208	144	Kathmandu Valley and Mid-hills	2068

Source: Agriculture Diary, 2016

6.2 Conformation of purchased foundation seed

Among received foundation seeds from DADO or other relevant agencies or other seed companies, the warranty tag of the foundation seed should be checked whether this is the right or not.

6.3 Grading seeds by salt-water treatment

- It is necessary to use high quality paddy seed for increment of quality seed production.
- The un-matured, light and pest infected seeds have many bacterial diseases, which can be reduced by removing those seeds with salt water treatment.
- Process of salt water treatment:
  - Mix around 2 kg salt or 3 kg ammonium sulfate in 10 liters of water in a bucket for making specific density of water 1.14.
  - In case of no scale (hydrometer), egg can be used for making specific density of water.
  - Put egg into water, and keep adding salt with well mixing until

Fig. No. 6.3.1 Separation of paddy seeds floated in salt solution.

Source: JICA Project Team

half of egg floats. In this condition, density of water is 1.14.

- Now, put the paddy seed into the water.
- Remove the floated seed from the bucket. Floated seeds are mostly those seeds which are un-matured, damaged and pest infected.
- Collect the well-matured and healthy seeds, which are settled on the bottom of the bucket, and should be washed 2-3 times with clean water.

Separating paddy seeds floated in salt solution

Fig. No. 6.3.2 Preparation of bucket, seeds and salt for salt-water treatment

Source: JICA Project Team

Fig. No. 6.3.3. Dipping the egg into water

Source: JICA Project Team

Fig. No. 6.3.4 Egg dipped in clean water

Source: JICA Project Team

Fig. No. 6.3.5 Adding and mixing salt with water

Source: JICA Project Team

Fig. No. 6.3.6 Egg floating in salted water
Source: JICA Project Team

Fig. No. 6.3.7 Mixing the seeds in salt water and stir well
Source: JICA Project Team

Fig. No. 6.3.8 Floating light seeds on the surface of water for few minutes
Source: JICA Project Team

Fig. No. 6.3.9 Removing floating seeds from the surface of water
Source: JICA Project Team

Fig. No. 6.3.10 Settled heavy and matured seeds on bottom
Source: JICA Project Team

Fig. No. 6.3.11 Washing treated seeds 2-3 times with clean water
Source: JICA Project Team

Fig. No. 6.3.12 Spreading washed seeds for shade drying

Fig. No. 6.3.13 Seeds drying under shade
Source: JICA Project Team

6.4Germination test

Germination test of seeds should be tested in order to identify the vigor and germination rate of seed, which helps to identify the health quality of seed, future growth of seedlings and amount of future yield etc.

If the seed has good germination vigor, higher number of seeds germinates; and the required amount can be harvested. The methods of germination test of paddy seed are as followings:

- Dip the seeds for 24 hours in water before the germination test.
- Prepare the 2 cartoon box with plastic film inside it then put fine sand or sandy soil in it.
- Remove small stones or pebbles from the sand/sandy soil in each cartoon box.
- Plain the surface and make rows not deeper than an inch in each cartoon box.
- Take 200 seeds randomly from salt water treated seed.
- Sow 100 seeds in 10 rows (10 seeds for each row) in one carton box, and sow next 100 seeds similarly in next carton box.
- Water to each germination test boxes every day for making the soil wet.
- Start counting seedlings 5 days after sowing, and keep recording.
- The seedlings number of 5 days after sowing gives the vigor rate, and 8 days after sowing gives the germination rate.
- Average germination rate from two test boxes should be at least 80%.
- Based on germination test result, the amount of sowing seed can be decided to nursery bed.
- The temperature condition should be 25-30ºC during the time of germination test.

Methods of seed germination test

Fig. No. 6.4.1 Selected 100 seeds

Fig. No. 6.4.2 Soil prepared in a carton box

Fig. No. 6.4.3 Ten rows made with finger

Fig. No. 6.4.4 Ten seeds sown in each 10 rows

Fig. No. 6.4.5 Watering making sprinkler from water bottle

Fig. No. 6.4.6 Germinated seeds

Source: JICA Project Team

(Note: In above figure, one seed testing box have been shown, but we should do it for 200 seeds in separate cartoon box or do in big cartoon box for sowing 200 seeds)

6.5 Treatment of seeds before for sowing

(A)Hot water seed treatment

- Before seed sowing in nursery bed, the paddy seed should be made wet in normal water for 4 hours
- After that, seed should be immersed in hot water of 60 ºC for 10 minutes or of 58 ºC for 15 minutes, and put it out from hot water.
- Then, the seeds should be dried in shade, and treatment with fungicide.

(B)Seed treatment with fungicide

- As there might be several diseases in paddy seed like blast, bacterial leaf blight, false smut, brown spot, foot rot, etc., the seed should be treated to protect from these diseases and other pests.
- The seed has to be treated as followings for the protection from several fungal and bacterial diseases:
  - Make the solution by mixing 5 gm. Agrimycene per 20 liters of water.
  - Put 20-30 gm. of Bevistin powder in the solution.
  - Then, add the 10 kg of seeds in solution. If amount of seed is more or less, it shall also be prepared the proportional solution of water and fungicide.
  - In this way, the bacterial and fungal disease can be minimized.

The following things need to be considered while treating the seeds:

- Select non-airy place to treat seeds with fungicide so that air will not carry away the pesticide.
- Children, elderly people, pregnant women are vulnerable to poisonous effect of pesticide; hence, they should not be involved in treating the seeds with fungicide.
- Use mask, gloves, and goggles while treating seeds.
- Wear the clothes that cover whole body.
- Use only proper or prescribed amount of fungicide.
- Wash thoroughly with water when fungicide touches your skin directly.

7. Paddy Cultivation

7.1 Nursery bed

- Nursery bed should be prepared before seed sowing. Site for bed preparation should be selected near water source with a fertile soil. Nursery bed is prepared in valley of mid-hills region and river basin areas in the third to last week of May.

Based on availability of irrigation, the nursery bed can be prepared in two types: dry bed and muddy bed (wet bed).

- Muddy bed is suitable for blast appeared areas; whereas, dry bed is suitable for blight appeared areas and lack of irrigation areas. However; comparatively, in the dry bed, seedlings grow well and seem healthy.
- Seedlings become better and healthier if well fermented compost is applied before bed preparation.
- It takes 21 – 25 days to be prepared seedlings for early maturing variety; whereas, it takes 35 – 40 days for late maturity varieties for transplantation.
- About 2 kg of seeds required for a *Ropani* of land.
- Dimension of bed:
  - Length: as per required
  - Breadth: 1.2-1.5 meter

(A) Dry bed

- It should be well ploughed, and make soil soft.
- The nursery bed should be raised by soft soil up to 10 – 15 cm using spade.
- After sowing seeds, it has to be little covered with soil, and should be irrigated slightly by using sprinkle.

(B) Muddy bed

- To prepare this bed, the land is ploughed well and made muddy.
- After that, the seed is sown next day, when the water is clean.

7.2 Land preparation

(A) Field sanitation

- The land for paddy cultivation should be cleaned or removed all crop and plant residues far from field before first ploughing.

(B) Application of FYM (Farm Yard Manure)

- Around 50-60 bamboo baskets of well-fermented FYM have to be applied in one Ropani of land during the land preparation or first ploughing.
- Use of unfermented FYM (farm yard manure) can increase pest such as white grubs, cut worms and other worms.
- In case of putting hips of FYM in the field for long time, the nutrients in the FYM will be lost, and insect may also lay eggs in the hips. So, it should be better spread the manure, and plough the field immediately.

(C) First ploughing

- Well-fermented FYM manure 50 – 60 bamboo basket (250-300 kg) per *Ropani* should be mixed in the soil, and have the first ploughing.

(D) Second ploughing

- The land should be ploughed second time before transplanting seedlings in the field.
- Second ploughing should be done immediately when rainy season starts.
- It would be better if the water is reserved for 2 – 3 days in the second ploughing of paddy transplanting field.
- The field should be leveled before transplantation of paddy seedlings.

Fig. No. 7.2.1 Farmer preparing the land for paddy transplantation

Source: Crop Development Directorate, Hariharbhawan, Lalitpur

Table No. 7.2.1: Amount of fertilizer to be applied

Fertilizers/ Manures	Basic dose (per Ropani)	Top dressing(kg/ Ropani)		Time
		1st	2nd	
Compost/FYM	50-60 bamboo basket (250-300 kg)	-	-	• First ploughing (Before one month of transplantation)
Urea	4.8 kg	2.4	2.4	• Second ploughing • First top dressing- first weeding • Second top dressing- second weeding
DAP	3.12 kg	-	-	• Second ploughing

Fertilizers/ Manures	Basic dose (per Ropani)	Top dressing(kg/ Ropani)		Time
		1st	2nd	
Potash	2.5 kg	-	-	• Second ploughing

Source: Paddy seed production technology, NARC

7.3 First field inspection in nursery bed

- Field inspection should be done 21-25 days after sowing for early maturity variety, and 25-30 days after sowing for late maturity variety.
- Before transplantation of paddy seedlings in the field, the diseased affected and off types seedlings should be removed. The off types seedlings are as followings:
  - Taller or shorter short compared to others
  - Leaves with more wide or narrow compared to others
  - Yellow leaves or with yellow spots on leaves

7.4 Paddy transplantation

- Nursery bed should be irrigated one day before for easy uprooting.
- While transplanting, about 2-3 seedlings should be transplanted at a place at 2-3 cm deep.
- The spacing between the rows should be maintained 20 cm; whereas, plant to plant distance should be 15 cm.

Fig. No. 7.4.1 Women transplanting paddy seedlings

Source: Source: Crop Development Directorate, Hariharbhawan, Lalitpur

7.5 Irrigation management

- After paddy transplantation, water level should be maintained 3-5 cm deep in the field for one month.
- At the time of development of the panicle in paddy plant, water is very important in field. So, there should not be less water in such period.
- At the time of seed ripening, there should not be water reserved in the paddy field, and water should be drained away if there is much water.
- While water is being collected in the field for long time, there is possibility of weed's growth.
- In the place having proper irrigation and drainage, make the field dry for 3-4 days, in the interval of 5 to 7 days multiplies the production.

7.6 Field Inspection

- It is necessary of field inspection even paddy seedlings are in bed. The diseases affected and off-types plants of paddy in the bed should be removed during field inspection.

  The following plants should be removed during field inspection:

  - Plants that are infected with disease and pest
  - Plants that are exceptionally taller or shorter compared to others
  - Plants with early maturity or late maturity
  - Plants with leaves that are exceptionally wider or narrower compared to others

- **Field inspection time and activities**: The following types of off-types plants and diseased pest infected plants should be removed during each field inspection:

(A) First field inspection: Nursery stage (within 20 – 30 days of seed sowing)

- Uproot disease infected and off-type plants

(B) Second field inspection: Plant elongation stage(after 25-30 days of paddy transplantation)

- Check plant height in the field, and remove plant with non-uniform height (so much taller and so much dwarf)
- Check plant in the field, and remove plant having leaves with non-uniform color or width.

(C) Third field inspection: Early heading stage (after 55-60 days of paddy transplantation)

- Check the situation of spike formation, and remove those plants having much early or late spike formation.

(D) Forth field inspection: Late heading stage (after 70-75 days of paddy transplantation)

- Check, and remove the plants having too early and too late spike formation.

(E) Fifth field inspection: Heading - Milking stage (after about 3 month of paddy transplantation)

- Check the plants in the field, and remove those having different husk color and size of the spikes.
- Remove plants having different or non-uniform spike length.

(F) Sixth field inspection: Harvesting stage (after about 4 month of paddy transplantation)

- Check the plants in the field, and remove those having different or non-uniform length and thickness of stalk (height- taller or shorter, thickness- thicker or thinner).
- Check, and remove the plants having different length, width and color of leaves among majority of plants.
- Remove the plants having different or non-uniform spike (less grain, small spike or bigger spike).
- Remove the plants with different color of spikes or having husks.

Fig. No. 7.6.1 Farmer inspecting the paddy seed field

Source: JICA Project Team

7.7 Weeding

After 25 to 30 days of paddy transplantation, the first weeding should be done, and there should be done second weeding after 25 to 30 days of first weeding again.

Fig. No. 7.7.1 Weeding in paddy field by farmers
Source: JICA Project Team

7.8 Top Dressing

The paddy plants should be top dressed at least two times with 2.4 kg urea per Ropani of land every time. The granules of urea shall be equally scattered into the paddy field. It is necessary to have the water in the field during the time of top dressing.

Table No. 7.8.1: Time and amount of top dressing

Top dressing	Amount	Time
First	2.4 kg per Ropani	Plant elongation stage (around 1 month after transplantation)
Second	2.4 kg per Ropani	Spike formation or early heading stage. (around two month after transplantation)

Source: Paddy seed production technology, NARC

8. Major Pests and Diseases

8.1 Major pests

(A) Zigzag Leaf hopper

- This kind of pest can be found in green, white and brown color that can jump easily.
- In case this insect attacks paddy, the plant dried, cannot grow well and died.
- From the attack of this pest, the spikes of plants cannot be grown up, and died from drying.
- The plants could not tiller and grow well. And, it gets dried as straw without any grains in paddy plant.

Fig. No. 8.1.1 Damage caused by Zigzag leaf hopper

Source: Crop Protection Directorate

- The insect problem is high in case of early planted, and early maturing variety than in late planted and late maturing variety.
- These hoppers carry the Rice orange-leaf virus or Rice dwarf virus.

Prevention and control

- Reduce the planting density of paddy during transplantation. While transplantation, not more than two or three seedlings have to be planted at one spot.
- There should be application of proper amount of urea (not more than recommended amounts).
- Increased and decrease the water level, and make the field dry for 3-4 days in a 5-7 day interval
- Make the solution of mixing1 ml. Imidacloprid into 4 liter of water, and apply 15-20 lt. of solution per Ropani of paddy field.

(B) Stem borer

- Its larva is of light yellowish or pink color with stripes on its coat, and mature one is seen as a butterfly.
- In case the pest attacks the paddy sapling in its immature stage, plant shoots appear dead.
- If the mature plant is attacked by this pest, spike changed into husky white ear.

Fig. No. 8.1.2 Larvae of stem borer

Source: Crop Protection Directorate

<u>Prevention and control</u>

- Plant after cutting the leaves of paddy seedlings along with insects' eggs, if it appeared.
- Use the light trap by putting 1-2 lights per Ropani of land. With the use of light trap, adult borer can be caught.
- Plant soybean in edge of the paddy field.
- Make solution of mixing 3gm. Bacillus Thuringiens (BT) is with per liter of water, and spray in paddy field.
- Remove and burn all the stump of paddy after its harvest.
- As a last alternative, chemical pesticide is applied when number of natural friendly pest is no or less, and more enemy pest occurred. Solution of 1 ml. Imidacloprid and 4 liters water is sprayed in the foot of the plant.

Fig. No. 8.1.3 Damage caused by rice stem borer

Source: JICA Project Team

(C) Mole cricket and ground cricket

- It is shiny black when it is adult, and its larva looks brown in color.
- Both of adult and larva live under the soil.
- Mole cricket has a thicker feet and stronger claws; whereas, ground cricket are generally jumping types.

- In the adult stage, it eats the underground roots and stems of plant, and plants die.
- Mole cricket also makes the hole in the bunds, which also leaks the water from the field.

Prevention and control

- Maintain the standing water reservation in the field, which can remove the eggs of mole and ground crickets from the field.
- Plastic covering should be done for some days in the nursery bed for solar thermal treatment before sowing seeds.
- Seed selection by salted water.
- Make the solution of mixing Chloropyriphos, molasses and rice polish, and spray on nursery bed and near to paddy tiller.
- Make the solution of 2 ml. Chloropyriphos 205 EC and one liter water, and spray the solution at the rate of 15-20 liter per Ropani of pest infested field.

(D) Bugs (Rice bug and mealy bug)

Rice Bug

- Mature rice bug seems to be brown mixed with green color, and its baby is green.
- If it attacks to paddy leaf, the whole plant gets yellowish; whereas, if it attacks on panicles, it results into unfilled or empty grains.

Fig. No. 8.1.4 Adult Rice Bug

Mealy Bug

- A mature mealy bug is small, pink in color with a soft body and covered with wax like content. Some of these have the wings; whereas, some of these are wingless.
- The endemic of this kind of pest is found to be increasing.
- With its attack, the plant gets diseased; turns yellowish and plant cannot grow well and does not get a panicle.

Fig. No. 8.1.5 Plant infested with Mealy Bug

Source: JICA Project Team

Prevention and control

- Removing weeds from fields and surrounding areas, destroy the alternative shelter.
- Select and cultivate the uniform maturity paddy variety.
- Maintain the standing water reservation in the paddy field to control the mealy bug.
- Use the light trap by putting 1-2 lights per Ropani.
- Use the dirty trap. For this, dip torn pieces of clothes to the fresh urine of buffalo or cow, and tie up to a pole edge. After this, put this trap in the middle of the field. Rice bugs attract to the trap, and destroy them collecting the trapped insects in plastic bag.
- Use the solution made by Cypermethrin pesticide 2 ml. per liter of water, and spray in the pest infected field at the rate of 15-20 liters per Ropani.

8.2Major diseases

Bacterial diseases

A) Bacterial leaf blight

- Due to this disease, long yellow or brown lines from the edge of leaf are seen and later on, paddy plants dried from the tips of leaf.

Fig. No. 8.2.1 Paddy plants infected with Bacterial leaf blight

Source: Crop Protection Directorate

Prevention and control

- Cultivate disease resistant variety.
- Treated seed should be used for sowing after dipping in the solution made by mixing 0.25 gm. Agrimycin per liter of water. (for 1 Ropani of land: at least 1 gm. of Agrimycin required to make 4 liter of fungicide solution for treatment of 2 kg seed).
- In case the plants are affected by leaf blight, make the field dry for 2-3 days.
- Do not apply of urea in more amounts than recommended.
- Do the field sanitation and remove all crop debris during land preparation before plantation, and also clean the field after harvesting of paddy.

B) Foot Rot Disease

The main symptoms of this disease in the field are as follows;

- The plants in the field cannot grow well, and get short.
- Slowly plants become yellowish in color, and the foot or bottom parts of the plants start to rot.

Fig. No. 8.2.2Paddy plants infected with Food rot disease

Source: Crop Protection Directorate

Prevention and control

- Seed should not be collected from the field infected with this disease.
- The disease affected plant should be uprooted, and removed away from the field or buried in the soil.
- Treat the seed using Bevistin fungicide at the rate of 2 gm. per kg of seeds before sowing. (4-5 gm. Bevistin required for treatment of 2 kg seed for 1 Ropani of land)

Fungal diseases

(C) Blast Disease

Blast infected leaves show the following symptoms:

- In the beginning, small elliptical white to gray lesions or spots with small white mark in middle of each spot is shown on the leaves.
- The grey lesions are also seen in stem under the panicles or in node.

Fig. No. 8.2.3Blast diseased leaf of paddy

Source: Crop Protection Directorate

Prevention and control:

- Cultivate the disease resistant variety.
- Treat the seed with 2-3 gm. Bevistin per kg of seed before sowing (for 1 Ropani, use 4-6 gm. of Bevistin for 2 kg of seed).
- Apply the urea in recommendation amount only.
- Reserve the water in the field up to 5-7 days regularly.

- Spray the fungicide by making the solution with Hinosan 50 EC 2 -3 times in the field in the gap of 15 days at the rate of 1.5 ml. per lit. (mix 30 ml. of Hinosan fungicide for 20 liter of water for spraying in 1 Ropani of land)

(D) Sheath blight

- At the bottom (sheath) of the leaf joint, oval grayish spot are seen, which grows larger later, and convert into dark grey or blackish spot.
- Later it affects upper part of the plant also, and seems as dried.
- Sometimes, seed also gets infected showing some brown or dark spots.

Fig. No. 8.2.4Sheath blight of paddy

Source: Crop Protection Directorate

Prevention and control

- Do the field sanitation and remove all crop debris during land preparation before plantation, and also clean the field after harvesting of paddy.
- Apply the urea in recommendation amount only.
- Plant the paddy in proper distance.
- Mix 2 ml of Bevistin or Dorosal fungicide in a liter of water, and spraying it 2 times in a gap of 10-12 days.(For 1 Ropani land, use the solution made by 20 ml of Bevistin or Dorosal in 20 liter of water, and spray in disease infected field).

9. Harvesting

9.1Timing of harvesting

- When leaves and paddy grains became 80-90% yellow in color, the paddy can be harvested.
- Paddy should be harvested in sunny day. Paddy may germinate or rotten in case plant get wet by rainfall.
- Seeds should not be collected from lodged plants as they will have low quality.

9.2 Method of harvesting

The stalk should be cut about 10-15 cm above the ground or with a stalk length of about 60-70 cm, which helps for easy bundling and threshing.

Fig. No. 9.2.1 Farmers harvesting paddy

Source: JICA Project Team

9.3 Threshing

- The paddy can also be threshed by beating with stick to its stalk, losses of seeds is high by this method.
- Similarly, stalk of paddy can be dried for 2-3 days in the sun after cutting it, and threshed by beating its bundle on stone. From this method, there might be problem of high losses and remaining grains on stalk also.
- To reduce such problems, paddy can be threshed by pedal thresher. The working capacity of such threshers is threshing seed 40-50 kg per hours.

Fig. No. 9.3.1 Drying paddy stalk in sun before threshing

Source: JICA Project Team

Fig. No. 9.3.2 Threshing the paddy by pedal thresher machine
Source: JICA Project Team

10. Postharvest processing and storage

10.1Cleaning the seed

Seed cleaning refers to the separation of undesirable material, such as weeds, straw, chaff, panicle stems, empty grain, damaged grains, sand, rocks, stone, dust, plastic, even metal and greases particles from threshed seeds. We clean the seeds for following advantage.

- To get the quality seed, we need to clean it properly.
- The air fan or wind can be used while cleaning.

Fig. No. 10.1.1 Farmers cleaning seed by hand winnowing machine

Source: Crop Development Directorate

<u>Winnowing fans</u>

- The paddy should be cleaned by using hand operated and power operated winnowing fans

- Generally, such fans are available from agriculture machinery shops in urban areas.

10.2 Drying

- Paddy should be harvested with moisture contents of 21% to 26 % (higher in the rainy season- 26% lower in the dry season- 21%).
- Seeds with high moisture contents have high respiration rate, and are susceptible to attack by micro organisms, insects and other pests also. Therefore, there should be appropriate moisture for safe seed storage.
- The harvested paddy seeds with high moisture contents must be dried up to maximum 13% moisture for safe storage. For the temporary storage up to two weeks only, it can be dried up to 18% of moisture.

Fig. No. 10.1.1 Drying the paddy seed before storage

Source: JICA Project Team

- In the mid hill area, there might be no sun or raining while drying paddy after harvesting, which may difficult to maintain moisture in paddy seed.
- Due to less drying, there might be several problems in seed storage. Hence, to control the potential problem in seed storage, it should be dried well until the appropriate moisture get in seed.

10.3Storing seeds in storage

- Seed storage refers act of keeping the seeds safe during the storage time until the seeds are sown or marketed.
- If the seed has extreme cold or extreme hot or extreme moisture, there might be problem of attacking by disease, pest and fungal in seed. Therefore, concerning all these aspect, seed storage should be constructed.
- The storage also should be constructed to fully protect the seeds from pests and rodents.

Fig. No. 10.3.1 Farmer storing the paddy seed

Source: JICA Project Team

- Seeds should be very carefully handled and stored without contamination from other variety and other crop seeds.

(A) Moisture management

If the moisture in seed is more than 13 % at the time of storage, the level of both heat and moisture increases due to intensified respiration in seeds. In this condition, the risk of fungus, pest and disease attack increases, and reduces the quality of seeds. Therefore, the seeds should be stored only after controlling the moisture in seeds. The following measures can be adopted to manage moisture in seeds:

- The seeds should be stored only after drying them in the sun for 4 – 5 times.
- The seeds should be cleaned well before loading into the store container/sacks.

Table No. 10.3.1: Moisture contents and storage duration

Moisture contents of seeds	Storage duration
10-13%	For 8-12 months
< 9%	For more than 1 year

Source: JICA Project Team

(B) Storage management

- There should be only one door or opening (not more doors or windows) in the seed storage to maintain the temperature and to protect from the rodents and robbery.
- While storing seeds in sack or metal container, such sacks or containers should be kept above the floor on a raised plank and without leaning the wall.
- The storage structure must protect the paddy seeds from extreme heat or cold and moisture which cause microbial and fungal growth. Therefore, these all should be managed in paddy seed storage.

(C) Pest and rodents control in storage

- The store should be cleaned properly before storing the seeds and after the seed are sold out, and fungicide has to be used.
- Use fumigants pesticide like Aluminum phosphate or Methyl bromide at the rate of 3 tablets of each 3 gm. per ton (1000 kg) of stored seed.
- Fumigation by pesticides in the storage is done by keeping the fumigants in the center of storage and let fumigation inside by closing all doors and windows for at least 24 hours during storage or before storage period.
- The place for storage should be clean and safe from pests and mice.
- Use mouse trap in the storage to protect seeds from mice attack.

- Inspect the storage regularly to ensure occurrence of pests.
- Do not keep door open of storage for a long time.
- For weevil control, one Selphas tablet can be used for 100 kg seeds by wrapping in cotton cloth and placing it in the center of the normal sack / metal bin filled with seed.

(D) Packing material and method

- Seed should be packed and stored on sunny day after well drying in sun for 4-5 times.
- To store the seeds, the seeds should be properly dried before the monsoon begins and stored in metal bin, hermetic bag or plastic sack. The bag or sack should be fastened air tight in order to protect seeds from possible moisture.
- Super-grain bag refers to the bag in which insects cannot enter that easily and it is air tight. Even if the insects enter into the bag, the insects and fungus die due to no chance or respiration in such bag. The following ways can be followed to use super-grain bags:
  - Squeeze the air out of the bag after placing the seeds inside the bag.
  - The bag should be fastened properly so that air could not pass.
  - The pests can be controlled without using any chemical pesticides in this way.

Fig. No. 10.3.2 Paddy stored in super grain bag

Source: JICA Project Team

B) Management Aspects for Quality Seed Production

11. Necessity of Management by Seed Production Cooperative

Production of seeds for commercial sales needs to be done in a certain scale in order to meet the demands of the buyers and to be able to provide stable supply. When a part of the production is affected by diseases or pests, this must be substituted by seeds produced in other plots; otherwise, the buyers will not be able to rely on the producers for stable supply. This may be quite difficult for a single farmer to manage; and therefore, it is encouraged that seed production should be done through seed production cooperatives.

12. Structure and Roles of Seed Production Cooperative

The prime objective of the seed production cooperatives shall be marketing and sales of the produced seeds, as well as its overall quality control. That's why, the cooperative should also function as a liaison body with external organizations such as DADO and Regional Seed Production Laboratory in order to request for technical support or official seed laboratory testing. Furthermore, the cooperative can also work on developing the capacity of its member farmers in order to further enhance the production and quality of seeds.

The major responsibilities of the cooperative in seed production are expected as follows:

- To bear the risk and accountability of produced seed and seed production work.
- To formulate rules and regulations, approve and implement them for quality seed production.
- To keep records of seed production works, and inform the group / members as per the need.
- To expand seed production selecting possible area for quality seed production.
- To supervise the routine works such as use of manure and pesticides, weeding and irrigation management, harvest time, drying out, cleaning, storing and treatment for seeds according to the advice from Technical/ District Agriculture Development Office.
- To observe crop, hold meetings and exchange information and initiate process to address the problems.
- To promote technical skill and knowledge of seed production.
- To coordinate and collaborate with District Agriculture Development Office, District Cooperative Association, and various other seed production organizations.

- To facilitate in laboratory testing, processing, storing, packaging, certification and marketing of the produced seeds.
- To work as a mediator among the District Agriculture Development Office/ Seed trader and seed production sub-group.
- To extend the seed production extending the potential seed production area.

Furthermore, seed production groups shall be formulated by dividing the member farmers by the location of their farmlands, in order to effectively manage the seed quality. Each group shall also select one coordinator to link the group members with the cooperative. The major roles and responsibilities of the group coordinator shall be as follows:

- To maintain regular communication, coordination and cooperation with cooperative.
- To work as a mediator between farmers and cooperative.
- To inspect crops time to time coordinating among inter-groups.
- To report problems seen in seed production to the cooperative, and take necessary initiative for solution.
- To treat all members equally.
- To inform all members about any information received from the cooperative or any other bodies or organizations.
- To participate or make arrangement for other members to participate in seminars in turn.
- To utilize received support or materials for the benefits of all, manage them properly or get them managed.
- To take mutual and consensual decisions, or help to that end.
- To get committed for producing quality seeds.

The organizational structure of the suggested seed production cooperative is indicated in the following figure

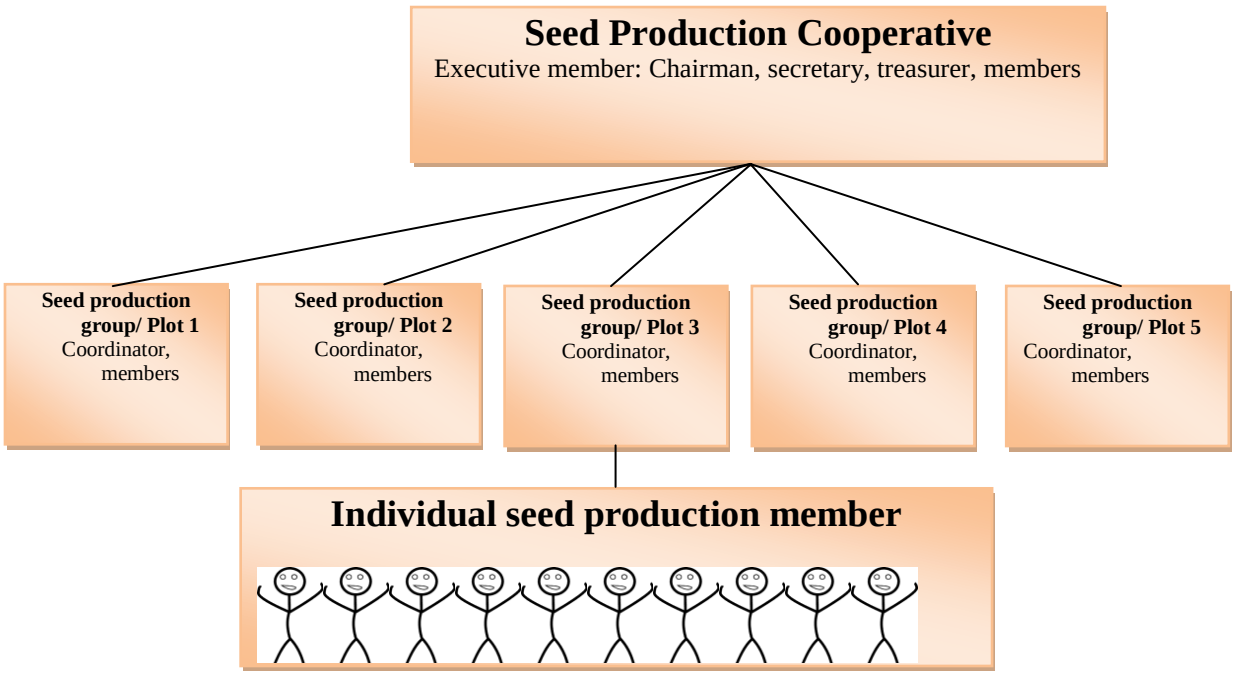

Fig. No. 12.1 Structure of suggested seed production cooperative

Source: JICA Project Team

13. Major Actions to Be Taken by Seed Production Cooperative

The followings indicate the major actions to be taken by the seed production cooperative.

13.1 Land and variety selection

The variety and amount of seed have to be planed and produced in consultation with DADO, in consideration of market demand.

(A) Cooperative needs to select appropriate seed variety based on the climatic and geographical conditions in coordination with the respective District Agriculture Development Office.

(B) The cooperative shall not change the seed variety every year in the production area to avoid contamination with other previous variety.

(C) Land plot has to be selected through discussion with member farmers and respective DADO in consideration of the following points:

i) If seeds of different variety have to be produced under a single cooperative, the production area should be divided into separate plots to minimize

chances of getting mixed different seed varieties, while producing quality seeds.

ii) Trustworthy farmers and separate fields with isolation distance should be selected by coordinating with the concerned farmers to produce quality seed by cooperative.

iii) Separation of plots for food crop and seed crop can be done on the basis of trail/ roads, water cannel or forest, etc.

iv) In case, seed crop and food crop are to be grown at the same area at the same period, the crop variety should be same.

13.2 Quality control and record keeping

(A) Record keeping

- To ensure the seed quality, it is very important to record the process of seed production management (field inspection form) of production area, every stage of crop development, and keep all records of produced seeds including laboratory certificates.
- Also, keep complete records of seed produced by all farmer members after the harvest.

(B) Preserve seed from mixing and infection

- Preserve seed from getting crossed with other variety while harvesting and storing. Even for cultivating food crop around seed production area, same variety of crop should be cultivated. However, such crops would be better to cultivate at the difference of 1 month.

(C) Prediction of disease and pest attack

Predicting the possible attack from disease and pest at the early stage of crops, in consultation with the District Agriculture Development office or related governmental offices, the outbreak of disease and pest attack can be easily and effectively controlled using necessary pesticide at the right time.

(D) Regular inspection of field

It is very important for the farmers, seed production group and cooperative to pay attention and keep records of genetic quality of crop, condition of weeds, and infection from disease and pests, etc., during regular field inspection and management of crop. The frequency and contents of regular inspection are indicated in the following table.

Table No. 13.2.1Frequency and contents of field inspection by Cooperative and Group

Responsible sides for seed production	Inspection Time	Inspection Work
Seed production Cooperative	At least twice a month	Inspect of proper spacing, crossing with other varieties, outbreak of disease and pest, weeds and height situation etc., and provide necessary advices to farmers accordingly for controlling measures, and keeping records of it.
Seed production sub-group	At least fourth a month	Weeds, equal height, outbreak of disease and pest, and provide necessary advices to farmers and cooperative accordingly for controlling measures, and keeping records of it.

(E) Coordination with DADO/Regional Seed Production Laboratory or other related governmental authorities for field inspection

Coordination shall be made with DADO/Regional Seed Production Laboratory or other related governmental authorities to conduct official field inspections as indicated in the following:

Table No. 13.2.2 Timing of official field inspection

Crop name	Field inspection Time		Activities
	First	Second	
Paddy	Time of spike formation or after spike formation	Spike ripening time but before harvesting or after physical maturity	Uproot and Remove: • disease plants • Early or late spike formatted plant • Plant with different spike, color, size, length, grain numbers etc.

Source**:** Seed production and management training booklet, 2069 B.S., www.sqcc.gov.np

The acceptable standards for official field inspection are as follows:

Table No. 13.2.3: Minimum standard of certified seed crop to be checked during official field inspection

Name of Crop	Minimum Isolation distance (in meter)	Maximum Off-type plants percentage	Maximum diseased plant in percentage	Restricted disease
Paddy	300	0.20	0.50	Neck Blast

Source: Seed production and management training booklet, 2069 B.S., www.sqcc.gov.np

Fig. No. 13.2.1 Crop Protection Officer from DADO Sindhupalchowk, inspecting the paddy seed production field

Source: JICA Project Team

13.3 Collection of produced seeds and storage

(A) Germination test

- After harvesting the seeds about 2 to 3 months, conduct germination test as indicated in **"6.4 Germination test".**
- The coordinator of each group shall collect samples from individual farmer, and conduct germination test based on the procedures indicated in **"6.4 Germination test".**
- If the result of the germination test is below 85%, the seeds will be returned to the respective famer. The farmer shall once again clean the seeds and submit it to the coordinator. This process shall be continued until the germination rate becomes 85% or above. If the germination rate does not reach 85% after several times of cleaning, the coordinator shall reject the seeds, and the farmer shall use them for self-consumption or sales as food-crop.
- It should also be noted that germination of seeds is affected by low temperature. Therefore, when conducting germination test, temperature of the container should be 25-30 ^{o}c.
- This process should be conducted with extra care; because if the reliability of the germination test at this point is low, it will affect the seed quality of the entire lot, which will lead to lower the income of the whole seed production group.
- After confirming that the seeds have germination rate of 85% or above, the coordinator shall submit the record of final germination tests for each farmer to the cooperative. The record shall consist of; name of farmer, type and variety of crop, period of germination test, and germination rate.

(B) Collection of produced seeds and storage

- After receiving the final result of the germination tests from the group coordinator, the cooperative shall collect the seeds from the group.
- The certificate provided by regional lab is mandatory before marketing of seeds.
- The seeds collected from the individual subgroups shall be managed as one "lot", which should not be mixed with seeds from other sub-groups.
- The seeds should be mixed together with same lot in clean and open space. But, it should be ensured that the place is clean before and after mixing the seed to each other, so that it should be protected to mix with dust and other seeds.
- After mixing, the seeds shall be packed in super grain bags or tight metal bins with one Selphas tablet for 100kg seeds wrapped in cotton cloth in the centre of the bag/bin. An identical tag indicating the lot number, name of crop, variety of seed, production year and date of packing shall be placed in a visible location on each bag/bin.

- The bags/bins shall be stored as described **in "10.3 Storing seed in storage"** with due attention that it will not be mixed with seeds from other lots.

(C) Coordination for official germination test

- The cooperative shall collect samples from each lot, and submit them to DADO or Regional Seed Production Laboratory for official lab testing.
- The standards for certified seeds are as indicated in the following table.

13.4 Standard for seed certification

Table No. 13.4.1 Acceptable and unacceptable standard in seed inspection for certified seed

Crop name	Min. Physical Purity (%)	Max. next mater (%)	Max. other crop seed(grains per Kg)	Max. seeds of restricted weeds (grain per kg)	Max. identifiable other variety seeds (grains per Kg)	Min. germination rate (%)	Max. Moisture percentage (%)
Paddy	98	2	20	5	20	80	13

Source: Seed production and management training booklet, 2069 B.S., www.sqcc.gov.np

After receiving the results of the official germination test, the result should be recorded together with the amount of seed collected in each lot. Furthermore, the following information should be additionally indicated on the bag/bin of seed for each lot.

- Purity Percentage
- Germinating percentage
- Month of seed testing

13.5 Packaging

After receiving the certificate, seeds should be kept in clean and attractive bags. According to consumers' choice, seeds can be packed in plastic bags or sacks of different sizes and sent to the market.

13.6 Warranty tag

In the form received from Agriculture Development Office required details should be carefully filled up on the basis of laboratory testing certificate.

- Name of Crop
- Name of variety
- Tag number

- Lot number
- Production Year
- Physical Purity Percentage
- Moisture percentage
- Germinating percentage
- Seed weight
- Date of seed testing
- Name of cooperative
- Address of cooperative
- Treated chemical name

- Validity period of seed laboratory testing results provided by seed testing laboratories is only up to six months from the time of testing, and retesting is required if entrepreneurs want to sell that seed after six month duration (Seed Act, 1988).
- Warranty tag should be kept inside plastic, and it should be stitched placing visible in middle part of the open end of the bag.
- While stitching bag together with the form, details of the form should be visible.

Fig. No. 13.6.1 Sample tag

Source: JICA Project Team

Fig. No. 13.6.2 Stitched sample tag in seed bag

Source: JICA Project Team

13.7 Advertisement and sales

- Promotion can be done disseminating information about quality seeds through the local medias such as local newspapers, Radio, etc. which help in the sale of seeds in the local market itself.
- Marketing for seeds can be done in collaboration with District Agriculture Development Office and Private companies for selling seeds or signing an agreement with them.

- After Marketing of seeds, the benefit shall be distributed to the individual farmers after retaining a certain amount for logistic costs for the seed production group / cooperative. The amount to be retained shall be decided and agreed by the members prior to the handing over to the seed production group / cooperative.

14. Skilled Human Resource Development under Seed Production Group and Cooperatives for the Quality Seed Production

In order to further enhance the amount and quality of seeds produced by its members, the cooperative shall further coordinate with DADO and its Service Centers to receive technical information and trainings for its core members including the coordinators of each group. The knowledge gained shall be further disseminated to all members through the coordinators.

Compost

PART 1: Farm Yard Manure (FYM)

1. Introduction

Generally Nepalese farmers have the practice of collecting FYM from their livestock shed as an organic fertilizer for their crop fields.

Farm Yard Manure is the manure prepared in decomposed from by collecting dung and urine of farm animals along with wastes feeds, fodder, and the bedding materials. FYM is the main organic manure used in Nepal.

However, Nepalese farmers have the practice of applying immature (un-decomposed) FYM in their field. Immature manure FYM can cause the generation of harmful gas ammonia and wilting, and disturb for well germination of seeds. And, also the immature (un-decomposed) manure does not improve soil conditioning capacity of increasing water holding and fertilizer holding ability. Weed seeds can also survive inside manure and as a result, weeds problems occur in the field.

Well decomposed FYM can solve many crop growth problems in the fields.

2. Advantages of Well Decomposed Farm Yard Manure (FYM)

2.1 Improvement of soil productivity

- Application of well decomposed FYM in soil act as a soil conditioner which is capable of improving moisture holding, fertilizers holding and air passing capacity; as well as it helps the capacity of drainage to soil in good balance. This type of soil is very useful for good growth and development of plants.
- By the application of well decomposed FYM, some portions of nutrients are available directly to the plants and remaining nutrients in soil is released to plants for long time.
- The materials that soak urine should be used as bedding materials in animal shed which can help to minimize the loss of urine. Otherwise, we can also make the urine collecting place separately with plastic or cemented structure, and use urine as fertilizers.
- By using well decomposed FYM in field, fewer amounts of chemical fertilizers are also enough for crop, which can also save the money.

Table No. 2.1: Composition of FYM

Materials	Nitrogen (%)	Phosphorus (%)	Potash (%)
Paddy straw	0.42	0.20	0.45
Cow dung	0.71	0.70	0.74
Pig faeces	1.35	1.94	1.05

Source: Ministry of Agriculture, Forestry and Fisheries, Japan 2000

2.2 Healthy for plants

- Well decomposed FYM is free from weed seeds; plant pathogenic Fungi, bacteria and parasites.
- Around temperatures of 55 °C to 65 °C during decomposition, many microorganisms, plant pathogenic fungi, bacteria and parasites are destroyed.

2.3 Good means of breakdown of organic matter

- FYM is the good means of breakdown of organic matter in simpler form
- During decomposition of FYM, high temperature inside is accelerated, which helps to breakdown of structural molecules of bedding materials (straw, weed, grasses of feed, etc.) into simpler nutrient form which can be easily uptake by plant after its application.

3. Material Required for Making FYM

- Animal excreta: Dung, Urine
- Bedding materials: Straw, saw dust, dry leaves etc.

4. The Place for Making FYM

Place for collecting and making decomposed FYM should be as followings:

- The nearer place to animal shed
- Elevated and well drained place
- Place of easy care and observation

- It is recommended two places for the preparation of well decomposed FYM manure. Therefore total two place should be selected as mentioned below:
  - First storage place
  - Second storage place

(A) First storage place

- Every day animal dung, urine and bedding materials should be collected on the surface near the animal shed.
- Usually pits of 8 meters length x 2 meters wide x 1 meter depth dimensions should be prepared nearby the animal shed, but the dimension may varies according to the land availability and number of animals.

Fig. No. 4.1 Taking out Farm Yard Manure

Source: JICA Project Team

- After putting the manure (Dung together with bedding materials) from animals shed in first place up to 2 months, let it remain further up to 2 months without putting other manures over it. And at that time of collecting the manure to be done in the second storage place.

(B) Second storage place for preparation of decomposed FYM

- After 2 months of manure collection in first place, use second place to collect manures from animal shed.
- Collect the manure in second place daily up to 2 months as first one. And, let it remain for next 2 months without collecting the manures over that for further decomposing.

Fig. No. 4.2 FYM with roofing

Source: JICA Project Team

- The size of second storage place can be varied according to the land availability
- If possible, storage place for collecting manure should be walled and roofed with stone, wood, or hay, which protects manure from direct sunlight and rain. It is important to protect manure from sunlight and rain to protect micronutrients; otherwise the micronutrients in the manure will be lost.

(C) Actual Procedure for collecting and using FYM

- The fresh dung together with bedding materials should be collected daily from animal sheds to the first storage place up to 2 months properly, and let it remains for next 2 month by covering it with dry leaves, straw or plastic sheet.
- After fulfilling the manure in first storage place, the manures should be collected daily to the next storage place.
- Put the manure in next storage up to 2 months and cover it like as in first place, and let it remains for next two months.
- The manure already becomes fermented in first place up to two months, when we are collecting dung in second place. So, we can apply the manure from first place to the field, and the first place will become empty and we can collect the dung again on first place. This cycle continue on every two month period on first and second places. This way, we can get well fermented FYM.

5. Condition Required for Well Decomposition of FYM

Well decomposition of manure is required for making good FYM. For making well decomposed manure, the following things should be considered well during its preparation:

- After piled up the fresh FYM, moisture content of the FYM should be managed 50-65%. It can be known by squeezing the manure in palm of hand, if it is wet. If moisture is less, water should be sprayed, and if moisture is high, the manures should be dried in shadow by removing cover for 1-2 days.
- The fresh FYM temperature rises up to 70 degrees Celsius within 2 to 3 weeks (1 week in summer) after deposition, which is not good for well decomposition of

FYM. Therefore, we should be careful for turning over at every 60 ºC for two to three times. It can be known by putting hand inside the manure and feel hot.

- The manure has to be covered with a plastic sheet or straw or dried leaves or mud to protect rain and direct sunlight.
- FYM will be ready to use from first place after 2 months of filling it.

6. Collection of Animal Urine and Its Advantages

6.1 Collection of urine

- Urine can also be collected and preserved for separate use or for mixing in manure by following method:
  - The floor of cattle shed should be cemented to collect urine.
  - To collect the urine, cemented tank should be constructed at first; and then urine could be collected in plastic tank.
  - By making a pit in a corner of the shed, urine can also be collected

Fig. No. 6.1.1 Cattle urine collection through pipe from shed

Source: JICA Project Team

Fig. No. 6.1.2 Cattle urine collection through drain

Source: JICA Project Team

6.2 Advantage of collecting urine

- The urine can be collected separately, and used as fertilizer since it has three times more nitrogen than in dung.
- Urine also can be used to control the disease and pests in crops. This can be sprayed in 5 to 7 days gap by mixing 1 part of urine with 4-5 parts of water.
- It also helps to reduce the application of chemical fertilizer and pesticide, which leads to reducing production cost.
- Separate collection of urine will help to sanitize and dry animal shed.
- The urine can be used together with water as fertilizer.

7. Things to Be Considered While Making Farm Yard Manure (FYM)

- The FYM should not be dried under the sun to decrease its weight, which will cause the loss of nutrients.
- The FYM should not be left on field in small heaps for long time as the nutrients will be lost.
- Instead of leaving the FYM in individual heaps, it would be better 4 to 5 bamboo baskets of manure collection in one heap, and covered with straw, dried leaves, plastic, etc., which will help to protect the nutrients.

Some photographs of wrong and good practices

Fig. No. 7.1 Manure dried in the sun
(Bad practice)
Source: JICA Project Team

Fig. No. 7.2 Small heap of manure in the field
(Bad practice)
Source: JICA Project Team

Fig. No 7.3 Collection of 4-5 bamboo baskets of FYM in one place, and covered by dried leaves (Good practice)

Source: JICA Project Team

PART 2: COMPOST MANURE

8. Introduction

- Compost manure can be prepared as alternative to FYM.
- Compost making is the best option for the farmers who don't rear the animals or cattle's with them.
- Compost manure is decomposed mixture of straws, grasses, fodder, ash, leaves and other parts of trees, farm waste, kitchen waste and similar material, together with dung if possible.
- Compost manure is generally prepared in pit or heap by making different layers of raw materials covering with mud or plastic. One wooden stake or bamboo is put in the middle for well development of bacteria and to be decomposed.
- The temperature inside the manure should be felt hot. While we put our hand inside the manures, the temperature is up to 50-60 ºC at that time.
- Emulsifying concentrate (E. M.) should be sprayed in each layer of the grasses or straw or other raw materials during the preparation of manure for quick decomposition of the manure.

9. The Advantages of the Compost Manure

- It provides necessary nutrients to the soil for improving its fertility.
- Increases the water absorbing capacity of soil.
- Improves the physical, chemical and biological quality of soil.
- Increase air aeration and water movement in the soil.
- Manure can be kept in soil for long time.
- Increases the microbial activity in the soil; due to which soil become soft, and increase fertility status in the soil.
- Compost manure can be prepared in own accessible places, so that it will be easy for carrying manure in the field.

10. The Materials Required for Making Compost Manure

- Waste straws and grasses.
- Weeds, leaves fallen from trees.
- Roots and stems of young plants.
- Dung and urine of animals.
- Organic kitchen product (vegetable, food wastes)
- Limestone, ash, urea, etc.

11. The Place for Making Compost Manure

- The near place from farm.
- Elevated and well drained place
- Place of easy care and observation.

12. Methods of Preparing Compost Manure

12.1 Methods of preparing compost in pit

(A) Digging pit

- It is better to dig a pit on winter season than in summer season due to which the chance of drying out of material is less.
- The length of the pit should be as per need, but depth should not be more than one meter.

(B) Filling pit

- The collected raw materials for making compost manure should be kept arranging in layers inside the pit.
- Wooden stick or a bamboo should be put in the middle of the pit during filling materials inside the pit.
- Spraying water in each layer of compost during its preparation will help for making good compost manure.
- It is better to make each layer up to15-20 cm (1 to 1.5 hand span).

- We can also use dried leaves, green fodder, dung, water (2-3 liter of water in each layer), lime powder (100-200 gm. in each layer), E. M. liquid (Mixture of 1 liter E.M. and 10-15 liter water, and spray nearly 1 liter in each layer) and forest soil (2-3 kg. in each layer) between each layer which help to decompose the manure well.
- E.M. liquid, Dung, Urine, lime powder is not mandatory, but it is better to apply for producing well decomposed FYM.
- Lime powder preserves the manure from its acidity and increases the bacterial activities. Likewise, forest soil increases the bacterial numbers.
- The use of dung and urine between the raw materials will increase the quality of the compost.
- The raw materials should be forcefully pressed inside the pit so that it decays soon.

(C) Using bamboo or wood stake for manure ventilation

- During the winter and dry summer, the compost should be prepared by pit method due to which the moisture can be preserved inside the pit.
- In case the temperature inside the compost become so much hot (over than 70 ºC), bacteria cannot be survived and that will damage the compost, which will give the less quality of compost. Therefore, to maintain the temperature only up to 60 ºC, bamboo or wooden stake should be put during the time of compost preparation.
- The bamboo or wooden stake should be swing or stirred round by hand in every week for maintaining the temperature and passing air inside the manure, which will give well decomposed compost manure after 3-4 month.

(D) Covering by mud or plastic

- After filling up the materials the pit should be covered with mud.
- Covering the pit with mud stops the spread of bad smell and preserves manure from rain, direct sun-light and from nutrient loss.

Methods of producing compost by digging pit have been presented as followings:

Fig. No. 12.1.1 Digging a pit for preparing Compost Manure

Fig. No. 12.1.2 Taking out soil from pit

Fig. No. 12.1.3 Pit ready for putting compost making materials

Fig. No. 12.1.4 Putting raw materials for compost making

Fig. No. 12.1.5 Pressing the raw materials with staking in the middle part to prepare manure

Fig. No. 12.1.6 Spraying the water for compost making

Fig. No 12.1.7 Covering with plastic to decompose the materials for compost manure

Fig. No. 12.1.8 Observing well decomposed compost manure

Fig. No. 12.1.9 Observing the condition of manure while turn-over of compost

Fig. No 12.1.10 Farmer applying well decomposed compost manure in rows

Source: JICA Project Team

12.2 Heap method

(A) Methods of making compost in heap

- Compost manure also can be produced by making heap on earth surface without digging a pit. The heap method of compost making is done in rainy season due to which the manure cannot be damaged by excessive moisture.
- It is better to make a heap in slightly elevated, and drainage facilitated site.

- This method of making compost is better in the area where shortage of labor and time.

(B) Methods of making heaps on earth surface to produce compost manure

The following methods should be applied for making the compost by heap method:

- Put fodder, weeds, grasses, straws, hey and leaves on earth surface in different layer by making heap.
- Make the different layers of straw, leaves, branches, fodders or grasses by putting dung or lime or soil in between each layer, and spray water together with E.M. liquid.
- The materials in heap should be tightly pressed so that it gets decomposed earlier.

(C) Use of wooden or Bamboo frame for making compost on heap

- Heaps of material can be put inside the wooden frame or covering around by wooden stakes or bamboo stakes.
- The wooden or bamboo frame can be made as per desire, but the height should be 1-1.3 meter height.

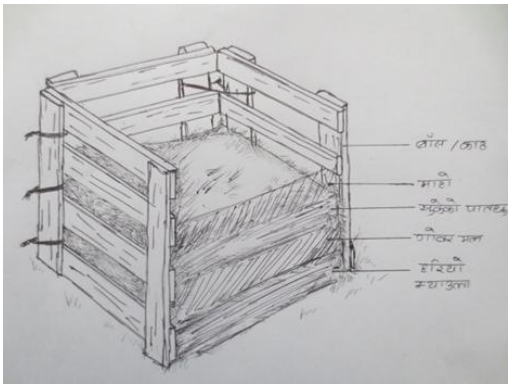

Fig. No. 12.2.1 Wooden or bamboo frame for making compost by heap method

Source: JICA Project Team

(D) Turn-over in heap method for compost making

- Generally, the turn-over of compost should be done when the temperature inside the compost is 60-65 ºC, which is identified by feeling very hot while we put hand up to 20 cm inside the compost.
- In case the temperature inside the compost become so much hot (over than 70 ºC), bacteria cannot be survived, and that will damage the compost, which will give the less quality compost. Therefore turn-over should be done on-time.

- Making another frame near the main frame will help to exchange the manure for controlling the excessive heat inside the compost, and for turnover of compost for obtaining well decomposed manure.

(E) The timing of turn-over

Compost manure should be turned over when its temperature becomes near 60 ºC, which can be identified by putting your hand inside, and feels very hot. Thus, temperature should be checked every week.

13. Identifying the Well Decomposed Compost and FYM

- The manure is decayed and appears black.
- The used materials loses its original form, and cannot be distinguished
- The manure does not stick in hand.
- The bad smell of manure is less.

References

राष्ट्रिय बीउ बिजन नीति, २०५६ । हरिहरभवन, काठमाण्डौ ।

मानन्धर, पौड्याल, चौधरी र दंगाल । धान बीउ उत्पादन प्रविधी । नेपाल कृषि अनुसन्धान परिषद् । तरहरा, सुन्सरी ।

कृषि सुचना तथा संचार केन्द्र । बीउ विजन उत्पादन तथा तालिम पुस्तिका । हरिहरभवन, काठमाण्डौ ।

कृषि सुचना तथा संचार केन्द्र, २०७३ । कृषि डायरी । हरिहरभवन, काठमाण्डौ ।

SQCC, 2014.Notified varieties of crops in Nepal. Seed quality control centre (SQCC), Ministry of Agriculture Development (MoAD), Pulchowk, Lalitpur

SQCC, 2045 B.S. Seed Acts- 1988. Seed Quality Control Centre (SQCC), Hariharbhawan , Kathmandu.

www.google.com