Technical Recommendation Package for Vegetable Production

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Technical package for Vegetable Production Groups on chili (VPG)

Objective: To provide PAFOs and DAFOs with detailed requirements to start up Vegetable Production Group (VPG) who would request Matching Grants from the LACP Project and to establish a model procedure for technical support in the quality and safety vegetable production in adoption GAP techniques.

Learning experience from investment plan (IP) of Rice Seed Multiplication Group (SMG) and Rice Production Group (RPG) to make more understanding and sure to the Worldbank on technical recommendation, GAP adoption, postharvest, processing, packaging of rice seed, certification, marketing of rice seed and paddy rice of farmers. Consultant team of LACP has summarized this technical package to enhance comprehensive for both worldbank and farmers **to** understand how to implement this IP. Thus, Investment Plan for vegetable production also need to prepare technical package attaching to the IP of VPG and supporting PAFO and DAFO staff advise to farmers as below:

I.Enhance management capacity of the vegetable production group

For the VPG's management committees, an internal control committee (ICM) must be nominated or selected (ICS) to ensure that internal control is set up to maintain adherence of all group members to the commercial production protocols and standards. The ICM will check if vegetable producer farmers have passed/attended the producton training and the training of Vegetable GAP conducted by the DOA of PAFO. The ICM will provide support to the government staff in providing technical advice and inspection to the group on the recommended vegetable production techniques and GAP adoption.

2. Enhance the technical competency of the vegetable growers through training, experiential learning and extension support during the cropping season.

- Vegetable farmers will undergo a training on chili pepper production (at least 3 days training) to learn the recommended chili pepper production practices and good agricultural practice.
- The vegetable production farmers will be provided with the Chili Production Manual developed by HRC and NAFRI. This will serve as the quick reference guide of the farmers to properly implement the recommended practices for vegetable production.
- Farmers who complete the required vegetable production training and GAP training get an accredication as qualified vegetable producers from PAFO,

- Vegetable farmers should follow the recommended practices for vegetable production. Maintainance vegetable crop healthy, proper application organic fertilizer and chemical fertilizer followed technical recommendation rate, monitoring insect pest and disease regularly, proper use pesticide followed instruction to avoid resedue of pesticide in the product, in environment, and harm to human, animal and environment.
- The extension staff/ village's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed
- The extension staff/village's faciliator will teach the farmers to properly record their production practices
- During the crop production season, the farmers will undertake a field inspection (Seedling period, 2 weeks after transplanting, full growth and before harvest) by a deputized staff of the HRC/NAFRI/DOA, Technical staff from crop section under PAFO.
- Vegetable farmers will be processed (harvested,cleaned, sorted, packaged) accordingly before these are marketed,
- Farmers can only sell vegetable product that have received GAP certification from PAFO.
- The VPG will great a database or registry of their product that they sell. Information to be included in the registry will include the following: 1) Name of customer ; 2) Address and contact number: 3) Vegetable type; 4) Date, month and year, 5) Total amount of vegetables

3. **For the VPGs to properly implement their plans, the following activities will be undertaken:**
    - The PAFOs and DAFOs will conduct a 3-day GAP training for the farmer groups, The training will be conducted at the field level and implemented by technical staff of the PAFOs and back up by techncial staff from DTEAP, and NAFRI. The resource persons from the NAFRI/DTEAP should have a long and wide-breadth of experience on vegetble production and capable of teaching the farmers. The learning field during the training will be a Vegetable Production field at the VPGs.
    - The PAFOs will provide the farmers with a Manual for GAP of vegetable . That will guide the farmers on the good agricultural practices
    - During the cropping season, an extension staff from the DAFO/PAFO will be assigned to provide technical assistance and support to commercial vegetable farmers.
    - The extension staff/FPG's faciliator will hold regular visits and meetings with farmers at the critical growth stages The extension staff/ VPG's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed

- The extension staff/ FPG's faciliator will teach the farmers to properly record their production practices
- The extension staff/ FPG's faciliator will coordinate with the Crop section under PAFO for the field inspection of the vegetble production farms according to GAP's technical guideline, post-harvest technology and quality testing of the vegetable produced by the farmers
- The DAFO/PAFO will create a database or registry of accredited vegetable producer farmers and GAP farmers. The information to be included in the database/registry will include the following: 1) Name of farmer ; 2) Address: 3) Crop type and variety grown; 4) Month when vegetble is planted; 5) Farm area (in hectare/rai) and 6) Contact number. If possible, the GPS coordinates of the vegetable production farm is also taken

4. Summary of the Good Agricultural Practices

4.1. Pre-crop management

4.1-1 Farm location and facilities

Concern with commercialized vegetable production, farmers should follow criteria as below:

- Select flat land, good soil texture, chili is able to grow in almost all soil types, but sandy loam is more suitable, far from the forest of big tree,
- Available irrigated scheme or source of water in whole season
- Easy road access to the area of vegetable production
- Farm can be evaluated by a team of evaluators before croping
- The source of seed must be known from Horticulture Research Center, or buy from private shop or self produce. Use varieties recommended for the area. These have better growth performance, stable yields and preferred by farmers and consumers, obtain high-quality seeds from accredited or reputable seed sources
- Farm facilities are clean and well maintained.
- Farm supplies in stores are organized and labeled properly
- Farm equipment and machinery maintenance registry indicate that these are in good running condition

4.2. In-field Crop Management

4.2.1 Land preparation

- Apply organic fertilizer 18-24 t/ha before land preparation 1-2 weeks to provide soil nutrients for the vegetable plants and to support the soil healthy. Provide sufficient time for land preparation to decompose weeds and agriculture residues. The time needed to sufficiently decompose the weeds and crop residues is about three weeks
- Plow the field while soil is still dry in 20-30cm depth, let sun drying for 5-7days. Harrow the field twice. Allow a one-week interval for each operation.

- The first harrowing should be done along the plowing direction and the second harrowing is along the crosswise direction and after that levelling the field

4.2.2 Seedling preparation

- Select a seed from a good source, high quality and healthy, germination is higher than 80%, popular in the local market. There are two methods for seedling preparation:
- **First method.** Seedling tray. Select a good soil for sowing seed, sun drying a soil then heating it into small particle, mix it with rotten cow dung by a proportion 2:1 or buy a moist seed compose from the shop, select the seed tray with 104 holes, add mistoire to the seed compost, fill it into a seedling tray and flatten dowm by sligth heating tray to the ground 2 times. Sow a chilli seed which soaked in 50c water for 24 hours. Wrap it with moist cloth or moist paper towel then stores it in water box for 1.5 or 2days. Use teech stick digs the soil making small hole then dropping a seed into each hole and cover by the seed compost sligtly, stir it by wood plate, keep it in nursery house, but it should contact with sunlight every day. Water it in every morning and evening. When the plant has 2 real leaves or around 2 weeks' old, apply fertilizer 15-15-15 for 100g/m^2. Seedling is able to transplant in 20-25 days'old.
- **Second methods:**

Seed sowing method. Prepare seed bed by plowing soil 25-30 cm dept, sun drying a soil for 5-7days. Prepare seed beds of 3m length and 1.2m wide are required. It should raise up10-15cm high from the ground. 100g/m^2 of 15-15-15 chemical fertilizer should be applied to the seed bed before sowing the seed, applied furadan 3g/m^2, then mulch the bed with 0,5-1cm rice husk or cow dung, spray water solution of Folathan 80 or Dithane M- 45 for 20g/20litres of water. Thin out the extra seedlings or unhealtly in 10days after germination . Seed rate is 1kg/ha, water seed bed regularly in every morning and afternoon, apply solution of urea for 100g/20 litres of water when seedling is 18 old age then water a seed bed suddently,

2.3 Planting

- **Flate land method:** 20-25 days old seedling is used to transplante in a line with row spacing 60-70cm and spacing between plan 50cm..
- **Raised up bed method**: for high moisture soil type only. A bed must be raised up for 20cm, 1 m witdh, a length up to a field large, row space 70-100cm.
- Cover the bed by black plastict film, then seal it by ground ice in between 1 meter apart or bured it edge in the soil. Drill plastic film by using a spade or PVC tube directly in each planting point. The prefer width of a bed is 100cm, planting in 2 rows with 70cm of row spacing and 50cm between plant.

2.4 Irrigation

- In the first 3 days, it is nessesary to water the plant 2 times, in the norning and evening. From day 4, it reduces only once per day. It does 3 times per week from week 2-4 and watering once a week from week 5 upto harvest.by using water flying system.

2.5 Crop management

Proper fertilizer application for chili depends on the soil quality. Generally, it recommends basal with compound fertilizer 15-15-15 before transplanting for 50kg/rai or 1 soup spoon per hole. Also apply urea for 25-30kg per rai in 14 days after transplanting by buring it in the soil around 10 cm apart from the plant. Then apply 15-15-15 in 1 month after planting for 25-30kg per rai by drilling a small hole and dropping a fertilizer into the soil around 10cm from the plant. After second fertilizer application, spray by liquid fertilizer of Bayfolan for 100-150cc/20litres of water. Then spray Bayfolan in after every harvest.

Pest management

- It should be regularly checked chili plantation to monitor pest and disease damage.
- Apply integrated pest management technique
- Use mechanical control, botanical pesticide,biological control method, when pest incident is observed or preventive measure by planting healthy crop, chemical application is permited the last chance while the other methods couldn't help only.
- The major insect pests of chili often found are: trips, spider mite, aphids and whitefly. It recommends alternately spraying with metarizium and buveria in every 5-7 days. Spraying with lennate20-30g/20litres water. Whitefly sprays with leptophos. However, major diseases are Cercospora leaf spot. It recommends to spray benomyl 80wp 12 cc/20liters water, Anthracnose sprays with mancozeb 75wp 50g/20litres water; bacterial wilt and fuzarium sprays quentozin+tridiazon 30-60ml/20litres water.
- Weed control is done in 30 days after transplanting by integrated method (good land preparation, herbicide use, hand weeding if nessecary)

2.6 Harvest technique

Harvest materials: Plastic cage, bamboo or plastic basket with 20kg size.

Green chili can be harvested in 60-70 days after transplanting. However, red chili can harvest in 90-100days after transplanting. Select dark green fruit, firm, or red color. The harvest time is once a week and should do in the early morning to avoid heating from hot sunlight.

2.7. Postharvest management

- Obtain chili fruit into the basket or cage then transfer to shading place and on top cover by plastic sheet or polyetelene. Then clean it, grading, packaging and storage in cool room.

Picture 1. Red chili production in Horticulture Research Center

Technical package for Vegetable Production Groups on coriander (VPG)

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2. Enhance the technical competency of the vegetable growers through training, experiential learning and extension support during the cropping season.

- Vegetable farmers will undergo a training on coriander production (at least 3 days training) to learn the recommended coriander production practices and good agricultural practice.
- The coriander production farmers will be provided with the Coriander Production Manual developed by HRC and NAFRI. This will serve as the quick reference guide of the farmers to properly implement the recommended practices for coriander production.
- Farmers who complete the required vegetable production training and GAP training get an accredication as qualified vegetable producers from PAFO,

- Vegetable farmers should follow the recommended practices for vegetable production. Maintainance vegetable crop healthy, proper application organic fertilizer and chemical fertilizer followed technical recommendation rate, monitoring insect pest and disease regularly, proper use pesticide followed instruction to avoid resedue of pesticide in the product, in environment, and harm to human, animal and environment.
- The extension staff/ village's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed
- The extension staff/village's faciliator will teach the farmers to properly record their production practices
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- Vegetable farmers will be processed (harvested,cleaned, sorted, packaged) accordingly before these are marketed,
- Farmers can only sell coriander product that have received GAP certification from PAFO.
- The VPG will great a database or registry of their product that they sell. Information to be included in the registry will include the following: 1) Name of customer ; 2) Address and contact number: 3) Vegetable type; 4) Date, month and year, 5) Total amount of vegetable

3. **For the VPGs to properly implement their plans, the following activities will be undertaken:**
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4. Summary of the Good Agricultural Practices

4.1. Pre-crop management

4.1-1 Farm location and facilities

Concern with commercialized coriander production, farmers should follow criteria as below:

- Select flat land, good soil condition, coriander is able to grow in all soil type, but sandy loam is more suitable, far from the forest of big tree,
- Available irrigated scheme or source of water in whole season
- Easy road access to the area of vegetable production
- Farm can be evaluated by a team of evaluators before croping
- The source of seed must be known from Horticulture Research Center, or buy from private shop or self produce. Use varieties recommended for the area. These have better growth performance, stable yields and preferred by farmers and consumers, obtain high-quality seeds from accredited or reputable seed sources
- Farm facilities are clean and well maintained.
- Farm supplies in stores are organized and labeled properly
- Farm equipment and machinery maintenance registry indicate that these are in good running condition
- Select the suitable variety for each season: In dry season, use local varieties with short duration, good smell and good market price. In wet season, use african varieties with fast grow and rain tolerant,

4.2. In-field Crop Management

4.2.1 Land preparation

- Coriander has shadow root, so soil plough is sufficient only15-20cm dept,then sundrying for 5-7 days.

- Harrow the field after second ploughing. Raise up the bed 10-15cm in dry season, 1m width, the length of the bed is followed the field length. Applying cow dung or compost 2,5-3kg/m2 or 4-5tones per rai then incorporate it in the soil by harrowing. If soil PH is lower than 5,5, lime should apply 200-400kg/rai before harrowing.
- In wet season, seed bed must be raised up to 20-25cm high, 1m width and 30cm a space between bed.

4.2.3 Planting

- Coriander is able to grow in all year round, but the most suitable period is October to February; it is difficult to grow in hot period and in wet season. It needs more take care and management.
- Break a seed before sowing by pouring out the seed on the rice pan or tray, rolling by bottle or round wood, clean seed with clean water. Wrap it by cloth and soacking in neem solution for 24hours.
- Water a seed bed before sowing a seed throughout a bed then mulch by rice straw or rice husk and water it. However, in wet season after bed mulching by rice straw, cover the bed by black net or coconut stalk. It is removed after seed germination. Then make a shade for the bed by black net in 1 metre high up from the ground by support stake. However, it needs to open to the sun in every morning.

4.2.4 Irrigation

- Water flying system is used, laying a water supply tube in the middle and straigh to the another end of the bed.
- Crop must be watered every morning and evening during first month. Then, in the second month water a crop in every2-3days in the morning and evening. Watering should reduce in 1 week before harvest by watering once for 3-4 days in morning and evening.

4.2.5 Crop management

Application fertilizer to coriander right amount and right time

- Except organic fertilizer or cowdung application in headline 4.2.1 above, chemical fertilizer also recommended, but mostly it depends on the soil quality. Generally, compound fertilizer of NPK is recommended for 20-11-11 or 13-8-8 for 50 kg/rai. First application is basal for 25kg/rai, second application when crop is 15days'old for12,5kg/rai and mixed with urea 46.00.00 in 8kg/rai then water crop suddenly, third application is done when crop age is 30 days'old for 30kg per rai.

Pest management

- It should regular check coriander production to monitor pest and disease damage.
- Application integrated pest management technique
- Use mechanical control, botanical pesticide,biological control method, when pest incident is observed or preventive measure by planting healthy crop, chemical application is alowed the last chance while the other methods don't help only.

- Insect pest of coriander is rarely found as a problem
- Only diseases are the major problem such are: Leaf brigth disease recommends spray Captan50WP in 30-40 g/20litres of water, fuzarium and alternaria spray with Dithane M45 Harvest period is 10days after spraying.
- Weed control is done in 30 days after transplanting by integrated method (good land preparation, herbicide use, hand weeding if nessesary)

2.6 Postharvest technique

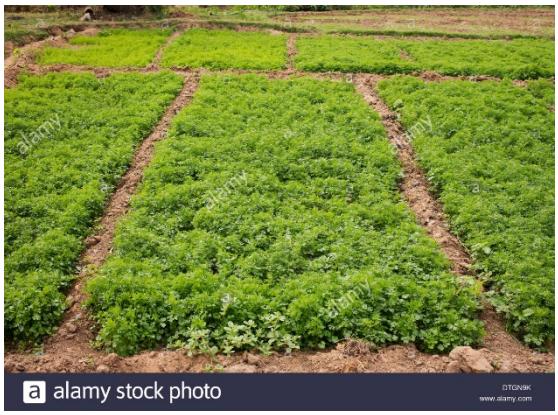
Harvest materials: Plastic cage, bamboo or plastic basket with 20kg size.

- Crop should be watered before harvest or collect coriander from the bed. It helps easely to pull coriander with root. Because, coriander is needed to have root. Crop will be harvested in 40-45days after sowing. Harvest it should do in early morning and keep it in the shading place to ovoid sunburn or heating.

2.7. Postharvest management

- Obtain coriander into the basket or cage then transfer to shading place and on top cover by plastic sheet or polyetelene. Then cleaning to take out the yellow leaves, rice straw, other residues. Then wash with clean water, grading, weigth, packaging and storage in cool room.

Picture2. Coriander plantation in opened field and greenhouse



Technical package for Vegetable Production Groups on tomato (VPG)

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2. Enhance the technical competency of the vegetable growers through training, experiential learning and extension support during the cropping season.

- Vegetable farmers will undergo a training on tomato production (at least 3 days training) to learn the recommended tomato production practices and good agricultural practice.
- The tomato production farmers will be provided with the Tomato Production Manual developed by HRC and NAFRI. This will serve as the quick reference guide of the farmers to properly implement the recommended practices for tomato production.
- Farmers who complete the required vegetable production training and GAP training get an accredication as qualified vegetable producers from PAFO,
- Vegetable farmers should follow the recommended practices for vegetable production. Maintainance vegetable crop healthy, proper application organic fertilizer and chemical fertilizer followed technical recommendation rate, monitoring insect pest and disease regularly, proper use pesticide followed instruction to avoid resedue of pesticide in the product, in environment, and harm to human, animal and environment.
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deputized staff of the HRC/NAFRI/DOA, Technical staff from crop section under PAFO.

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- The DAFO/PAFO will create a database or registry of accredited vegetble producer farmers and GAP farmers. The information to be included in the databse/registry will include the following: 1) Name of farmer ; 2) Address: 3) Crop type and variety grown; 4) Month when vegetble is planted; 5) Farm area (in hectare/rai) and 6) Contact number. If possible, the GPS coordinates of the vegetble production farm is also taken

4. Summary of the Good Agricultural Practices

4.1. Pre-crop management

4.1-1 Farm location and facilities

Concern with commercialized tomato production, farmers should follow criteria as below:

- Select flat land, good soil texture and structure, tomato is able to grow in almost all soil type, but loamy is more suitable, high organic metter, good evaposity, PH 6-6,8, enough sunshine in whole day, far from the forest of big tree,
- Available irrigated scheme or source of water in whole season
- Easy road access to the area of vegetable production
- Farm can be evaluated by a team of evaluators before croping
- The source of seed must be known from Horticulture Research Center, or buy from private shop or self produce. Use varieties recommended for the area. These have better growth performance, stable yields and preferred by farmers and consumers, obtain high-quality seeds from accredited or reputable seed sources
- Farm facilities are clean and well maintained.
- Farm supplies in stores are organized and labeled properly
- Farm equipment and machinery maintenance registry indicate that these are in good running condition

4.2. In-field Crop Management

4.2.1 Land preparation

- Plow the field while it is still dry in 20-30cm depth, sun drying for 5-7days. Apply animal manure or compost for 3-4tones/rai or 18-24 tones/ha after second ploughing.
- Then practise first harrowing followed by land leveling. Finally, seed bed preparation. Ithe soil PH is lower than 5,5 lime should be applied 200-400kg/rai.

4.2.2 Seedling preparation

- Use a seed from a good source, high quality and healthy, germination is higher 80%, popular growing in the local area or local market.
- Soak a seed in normal water for 20 minute, pour out a water, prepare a cloth which makes its moist then it wraps a seed, put it in a plastic bag, seal a bag by plastic or string,then keep it in the water box with 28-30·c for 24 hours.
- Select the seed tray with 104 holes, fill in a tray by pit moss or seed compost by select a good soil, dry it, and hit into small particle, mix with animal dung 2:1 then add mistoire to seed compost and flatten dowm by sligth heating a tray to the ground 2 times. Sow a tomato seed which soaked in 50c water for 24 hours. Use teech stick dips the soil making small hole then dropping a seed into each hole and mulch by the seed compost slitly, stir it by wood plate, keep it in nursery house, but it should contact with sunlight every day. Water every morning and evening. When the plant has 2 real leaves or around 2 weeks applying fertilizer with 15-15-15 for 100g/m^2. Seedling is able to transplant in 30 days'old.

2.3 Planting

- The appropriated planting season is from October to February. Because tomonto likes cool weather and will be harvested in January next year.
- A bed must be raised up for 20cm, 1 m witdh, a length up to a field size, planting with two row method, planting space 40x 70cm.
- Cover the bed by black plastict film, then seal it by ground ice in between 1 meter apart or bured it in the soil. Drill plastic film by using a spade or PVC tube directly at each planting point. Watering a plant suddendly after planting.

2.4 Irrigation

- Use water flying sytem. Connect water tube to the main supply tube then laying in the middle of the bed and straight to the end of the bed. It is done after covering the bed by plastic film. If drop irrigation it used It is done before covering a bed by plastic film. In the first three days after planting, water must be done every morning and evening, from day 4 after planting, water must be done once a day. Tomato prefers constant moisture, thus irrigation must be done regularly untill harvest. Then after, it is recuded twice a week with flying sysstem is better. Because it saves a labour and production cost.

2.5 Crop management

Application fertilizer to tomato right amount and right time

- Extension stakes: In case tomato is planting in two rows, extension stakes need to be used to reach good yield. It is practised after second fertilizer application. The support post with 1,80m high is setting in every 4 metres apart along the length of the bed. Long stick is tighten from first post to second post, fasten it to the post by string or wine in 1,50 cm high from the ground. Then extension stakes are sticked into the soil beside each tomato plant and leaning its on the long stick in 45degree from both sides then extension stakes are fastened it to the long stick.
- Pruning a plant: It is quite important to ecelerate tomato plant fast grow and healthy, prevent disease, larger fruit, market popular and simultaneous ripen. Pruning is started when tomato is 39 days old or flower initiation. The lower branches which is under the first flower bunch is cuted, the above first flower bunch is maintained. All branches are under the two separated branches need to prun for vine varieties. Then branches are holded by rope vertically to the long stick. When tomato fruit is mature, the yellow leaves in the lower part and also upper leaves close to the first bunch should be pruned.
- Fertilizer application depends on the soil fertility. Generally, basal application before transplanting by compound fertilizer 15-15-15 for 20g/plant or 50kg/rai (1600m^2) is recommended. Then 3 applications will be done at 7, 22 and 40 days after transplanting. If clay soil, high phosphorus needs to be used likes 15-30-15 for 50kg/rai. If loamy or sandy soil,high potasium is recommended likes 13-13-21 by burring in the soil in 20 cm far from the plant.

Pest management

- It should be regularly checked tomato plantation to monitor pest and disease damage.
- Apply integrated pest management technique
- Use mechanical control, botanical pesticide,biological control method, when pest incident is observed or preventive measure by planting healthy crop, chemical application is allowed the last chance while the other methods don't help only.
- Tomato doesn't like to grow in water retention area, diseases will be occurred. When it is raining and having water retaintion, it needs to drain it out quickly
- The major insect pests of tomato are sucking group such are: aphids and white fly;chewing group as worms. To control these pests recommend alternately spray with Metharizium and Boveria in every5-7days or use furadan 3% for 1 g per hole before planting, or spray with lenate20-35g/20 litres of water,

- The major diseases of tomato are late bright, recommend spay with Difolatan 80% in every 7 days, leaf spot spray with Mancozeb 75 WP 50g/20 litres of water, Fuzarium wilt should apply lime before planting, apply more organic fertilizer and minimize chemical fertilizer. Weeding must be done in 30 days after planting.
- Concentrate on integrated weed management(good soil preparation, herbicide use, additional hand weeding if needed)

4. Crop harvest management

Essential harvested equipment:

- Plastic cage, bamboo or plastic basket with 20kg size,
- Tomato is first harvest during 70-90 days after transplanting. It depands on the varieties. The harvest will finize in 4-5months after planting date. Select harvesting a fruit with pink color, it is done once a week in the morning hours to avoice heating from hot sunlight.

5. Post harvest mangement

- Obtain harvested product in cage or basket fully, then transport them to the shading place suddenly and cover with cloth or other materials. Transport them to packing house or storage for cleaning and grading, packaging, labeling and storage in cool room.

Remark: the source of photo is from Horticulture Research Center of NAFRI and www.trueplookpanya.com/knowledge/content/57339/-blo-agragr-agr-

Picture3. Preparing tomato seed in seedling tray Picture4. Irrigation tomato with spkrinker system

Technical package for Vegetable Production Groups on onion (VPG)

Objective: To provide PAFOs and DAFOs with detailed requirements to start up Vegetable Production Group (VPG) who would request Matching Grants from the LACP Project and to establish a model procedure for technical support in safety vegetable production in adoption GAP techniques.

Learning experience from investment plan (IP) of Rice Seed Multiplication Group (SMG) and Rice Production Group (RPG) to make more understanding and sure to the Worldbank on technical recommendation, GAP adoption, postharvest, processing, packaging of rice seed, certification, marketing of rice seed and paddy rice of farmers. Consultant team of LACP has summarized this technical package to enhance comprehensive for both worldbank and farmers **to** understand how to implement this IP. Thus, Investment Plan for vegetable production also need to prepare technical package attaching to the IP of VPG and supporting PAFO and DAFO staff advise to farmers as below:

I. Enhance management capacity of the vegetable production group

For the VPG's management committees, an internal control committee (ICM) must be nominated or selected (ICS) to ensure that internal control is set up to maintain adherence of all group members to the commercial production protocols and standards. The ICM will check if vegetable producer farmers have passed/attended the producton training and the training of Vegetable GAP conducted by the DOA of PAFO. The ICM will provide support to the government staff in providing technical advice and inspection to the group on the recommended vegetable production techniques and GAP adoption.

2. Enhance the technical competency of the vegetable growers through training, experiential learning and extension support during the cropping season.

- Vegetable farmers will undergo a training on onion production (at least 3 days training) to learn the recommended onion production practices and good agricultural practice.

- The onion production farmers will be provided with the Onion Production Manual developed by HRC and NAFRI. This will serve as the quick reference guide of the farmers to properly implement the recommended practices for onion production.
- Farmers who complete the required vegetable production training and GAP training get an accredication as qualified vegetable producers from PAFO,
- Vegetable farmers should follow the recommended practices for vegetable production. Maintainance vegetable crop healthy, proper application organic fertilizer and chemical fertilizer followed technical recommendation rate, monitoring insect pest and disease regularly, proper use pesticide followed instruction to avoid resedue of pesticide in the product, in environment, and harm to human, animal and environment.
- The extension staff/ village's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed
- The extension staff/village's faciliator will teach the farmers to properly record their production practices
- During the crop production season, the farmers will undertake a field inspection (Seedling period, 2 weeks after transplanting, full growth and before harvest) by a deputized staff of the HRC/NAFRI/DOA, Technical staff from crop section under PAFO.
- Vegetable farmers will be processed (harvested,cleaned, sorted, packaged) accordingly before these are marketed,
- Farmers can only sell vegetable product that have received GAP certification from PAFO.
- The VPG will great a database or registry of their product that they sell. Information to be included in the registry will include the following: 1) Name of customer ; 2) Address and contact number: 3) Vegetable type; 4) Date, month and year, 5) Total amount of vegetable

3. For the VPGs to properly implement their plans, the following activities will be undertaken:

- The PAFOs and DAFOs will conduct a 3-day GAP training for the farmer groups, The training will be conducted at the Field level and implemented by technical staff of the PAFOs and back up by techncial staff from DTEAP, and NAFRI. The resource persons from the NAFRI/DTEAP should have a long and wide-breadth of experience on vegetble production and capable of teaching the farmers. The learning field during the training will be a Vegetable Production field at the VPGs.
- The PAFOs will provide the farmers with a Manual for GAP of vegetable . That will guide the farmers on the good agricultural practices
- During the cropping season, an extension staff from the DAFO/PAFO will be assigned to provide technical assistance and support to commercial vegetble farmers.

- The extension staff/FPG's faciliator will hold regular visits and meetings with farmers at the critical growth stages The extension staff/ VPG's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed
- The extension staff/ FPG's faciliator will teach the farmers to properly record their production practices
- The extension staff/ FPG's faciliator will coordinate with the Crop section under PAFO for the field inspection of the vegetble production farms according to GAP's technical guideline, post-harvest technology and quality testing of the vegetble produced by the farmers
- The DAFO/PAFO will create a database or registry of accredited vegetble producer farmers and GAP farmers. The information to be included in the databse/registry will include the following: 1) Name of farmer ; 2) Address: 3) Crop type and variety grown; 4) Month when vegetable is planted; 5) Farm area (in hectare/rai) and 6) Contact number. If possible, the GPS coordinates of the vegetble production farm is also taken

4. Summary of the Good Agricultural Practices

4.1. Pre-crop management

4.1-1 Farm location and facilities

Concern with commercialized onion production, farmers should follow criteria as below:

- Select flat land, good soil texture and structure, onion likes to grow in almost all soil type, but sandy-loam is more suitable, soil PH 5,8-6,5, get full sun in whole day, far from the forest of big tree. Because, onion doesn't like to grow in under shading place.
- Available irrigated scheme or source of water in whole season
- Easy road access to the area of vegetable production
- Farm can be evaluated by a team of evaluators before croping
- The source of seed must be known from Horticulture Research Center, or buy from private shop or self produce. Use varieties recommended for the area. These have better growth performance, stable yields and preferred by farmers and consumers, obtain high-quality seeds from accredited or reputable seed sources
- Farm facilities are clean and well maintained.
- Farm supplies in stores are organized and labeled properly
- Farm equipment and machinery maintenance registry indicate that these are in good running condition

In-field Crop Management

4.2.1 Land preparation

- Plow the field while soil is still dry in 20-30cm depth, sun drying for 10-15days. If soil is acidic, lime should apply for 200kg/rai. Apply animal manure or compost for 3-4tones/rai or 18-24 tones/ha after second plaughing.
- Then practise first harrowing followed by land leveling.

2.2 Seed prepation

- Clean a dry bulb by cutting of the tip and the root part. Then separated into a sections. Put them in a bowl and cover by moisture cloth. Keep it in cool place such as toilet for 1-2 days. The seed rate is about 400kg/rai.

2.3 Planting

- After harrowing, raised bed is to be done in 1 m width, leveling and watering a bed. Then bure a bulb into the soil, or it is better to compost a soil for 5-7 days and then water it to add in a moisture. Mulch a bed by ice straw or rice husk to retain a soil moisture.

2.4 Irrigation

- Water every morning and every evening in two week periods. Then, water once per day untill harvest, but it is not too wet. It will be born a disease.

2.5 Crop management

Right amount and right time of fertilizer application to onion

- Fertilizer application depends on the soil fertility. Generally, basal application before transplanting by compound fertilizer 15-15-15 or 20-11-11 for 25kg/rai (1600m^2) is recommended, first top dressing in 14days after planting of urea 25-30kg/rai by broadcasting througout the bed and watering suddendly. Then one month after apply 15-15-15 for 25kg/rai by sowing throughout the bed and follow by watering.

Pest management

- It should be regularly checked onion garden to monitor pest and disease damage.
- Apply integrated pest management technique
- Use mechanical control, botanical pesticide,biological control method, when pest incident is observed or preventive measure by planting healthy crop, chemical application is alowed the last chance while the other methods don’t help only.
- There are several important pests that attack onions and garlic. Thrips are a major pest. The main disease of spring onions is downy mildew (Peronospora destructor). However, it is good practice to rotate spring onions with other crops not in the onion family to minimize the risk of root diseases likes 'pink root'. Onions are also very prone to foliar diseases and bulb

rots, a bacterial disease that significantly reduces onion bulb quality. Fungal diseases such as neck rot, mildew, rust and leaf rot, are frequent too. Fungicidal control is required on these cases.

- Concentrate on integrated weed management at 30 days after (good soil preparation, herbicide use, additional hand weeding if needed)

2.6 Crop harvest management

Essential harvested equipment:

- Plastic cage, bamboo or plastic basket with 20kg size,
- Onion recommends to harvest manually in 45-55 days after planting. It should water the crop before harvest. Should shake out or remove a soil and wastes from onion while harvest.

2.7. Postharvest management

- Obtain harvested product in cage or basket fully, then transport its to the shading place suddenly and cover with cloth or other materials. Transport them to packing house or storage for cleaning and grading, packaging, labeling and storaging in cool room.

Technical package for Vegetable Production Groups on lettuce (VPG)

Objective: To provide PAFOs and DAFOs with detailed requirements to start up Vegetable Production Group (VPG) who would request Matching Grants from the LACP Project and to establish a model procedure for technical support in safety vegetable production in adoption GAP techniques.

Learning experience from investment plan (IP) of Rice Seed Multiplication Group (SMG) and Rice Production Group (RPG) to make more understanding and sure to the Worldbank on technical recommendation, GAP adoption, postharvest, processing, packaging of rice seed, certification, marketing of rice seed and paddy rice of farmers. Consultant team of LACP has summarized this technical package to enhance comprehensive for both worldbank and farmers **to** understand how to implement this IP. Thus, Investment Plan for vegetable production also need to prepare technical package attaching to the IP of VPG and supporting PAFO and DAFO staff advise to farmers as below:

II. Enhance management capacity of the vegetable production group

For the VPG's management committees, an internal control committee (ICM) must be nominated or selected (ICS) to ensure that internal control is set up to maintain adherence of all group members to the commercial production protocols and standards. The ICM will check if vegetable producer farmers have passed/attended the producton training and the training of Vegetable GAP conducted by the DOA of PAFO. The ICM will provide support to the government staff in providing technical advice and inspection to the group on the recommended vegetable production techniques and GAP adoption.

2. Enhance the technical competency of the vegetable growers through training, experiential learning and extension support during the cropping season.

- Vegetable farmers will undergo a training on lettuce production (at least 3 days training) to learn the recommended onion production practices and good agricultural practice.
- The lettuce production farmers will be provided with the Lettuce Production Manual developed by HRC and NAFRI. This will serve as the quick reference guide of the farmers to properly implement the recommended practices for onion production.
- Farmers who complete the required vegetable production training and GAP training get an accredication as qualified vegetable producers from PAFO,
- Vegetable farmers should follow the recommended practices for vegetable production. Maintainance vegetable crop healthy, proper application organic fertilizer and chemical fertilizer followed technical recommendation rate, monitoring insect pest and disease regularly, proper use pesticide followed instruction to avoid resedue of pesticide in the product, in environment, and harm to human, animal and environment.
- The extension staff/ village's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed
- The extension staff/village's faciliator will teach the farmers to properly record their production practices
- During the crop production season, the farmers will undertake a field inspection (Seedling period, 2 weeks after transplanting, full growth and before harvest) by a deputized staff of the HRC/NAFRI/DOA, Technical staff from crop section under PAFO.
- Vegetable farmers will be processed (harvested,cleaned, sorted, packaged) accordingly before these are marketed,
- Farmers can only sell lettuce product that have received GAP certification from PAFO.
- The VPG will great a database or registry of their product that they sell. Information to be included in the registry will include the following: 1) Name of customer ; 2) Address and contact number: 3) Vegetable type; 4) Date, month and year, 5) Total amount of vegetable

3. For the VPGs to properly implement their plans, the following activities will be undertaken:

- The PAFOs and DAFOs will conduct a 3-day GAP training for the farmer groups, The training will be conducted at the Field level and implemented by technical staff of the PAFOs and back up by techncial staff from DTEAP, and NAFRI. The resource persons from the NAFRI/DTEAP should have a long and wide-breadth of experience

on vegetble production and capable of teaching the farmers. The learning field during the training will be a Vegetable Production field at the VPGs.

- The PAFOs will provide the farmers with a Manual for GAP of vegetable . That will guide the farmers on the good agricultural practices
- During the cropping season, an extension staff from the DAFO/PAFO will be assigned to provide technical assistance and support to commercial vegetble farmers.
- The extension staff/FPG's faciliator will hold regular visits and meetings with farmers at the critical growth stages The extension staff/ VPG's faciliator will monitor the implementation of the GAP by the farmers during the cropping season and provide technical advice as needed
- The extension staff/ FPG's faciliator will teach the farmers to properly record their production practices
- The extension staff/ FPG's faciliator will coordinate with the Crop section under PAFO for the field inspection of the vegetble production farms according to GAP's technical guideline, post-harvest technology and quality testing of the vegetble produced by the farmers
- The DAFO/PAFO will create a database or registry of accredited vegetble producer farmers and GAP farmers. The information to be included in the databse/registry will include the following: 1) Name of farmer ; 2) Address: 3) Crop type and variety grown; 4) Month when vegetable is planted; 5) Farm area (in hectare/rai) and 6) Contact number. If possible, the GPS coordinates of the vegetble production farm is also taken

4. Summary of the Good Agricultural Practices

4.1. Pre-crop management

4.1-1 Farm location and facilities

Concern with commercialized lettuce production, farmers should follow criteria as below:

- Select flat land, good soil texture and structure, lettuce is able to grow in all soil type, but most suitale is loamy soil, soil PH is 6-6,8**,** good moisture**,** get full sun in whole day and suitable temperature for leavely variety is 21-23cc and 15,5-21c for a headed variety. Because, lettuce doesn't like to grow in under shading place.
- Available irrigated scheme or source of water in whole season
- Easy road access to the area of vegetable production
- Farm can be evaluated by a team of evaluators before croping
- The source of seed must be known from Horticulture Research Center, or buy from private shop or self produce. Use varieties recommended for the area. These have better growth performance, stable yields and preferred by farmers and consumers, obtain high-quality seeds from accredited or reputable seed sources
- Farm facilities are clean and well maintained.
- Farm supplies in stores are organized and labeled properly

- Farm equipment and machinery maintenance registry indicate that these are in good running condition

4.1.2 In-field Crop Management

4.1.3 Seed sowing

Plow or dig a soil in 10-15cm depth, let sun dry for 5-7days, harrowing after second plough , raise up a bed in 15-20cm and 1m width, collect all wastes or residues from the field, apply manure or compost about 3kg/m^2 then practise harrow again to incorporate it with the soil. Broadcast a seed through a seed bed, cover slightly with rice husk about 0,5cm or mulch by rice straw slightly, water every morning and evening in 2 week periods. Then apply it once per day in afterward. Seedling can be transplanted in 20-25 days' old. It needs to water a seedling before removing for transplanting.

4.1.4 Land preparation

Lettuce root is shallow, so ploughing should 20-30cm depth and let sun dry for 7-10 days. harrowing after second plough , raised up a bed in 15-20cm high and 1m width in dry season. The bed length depends on a field large. Apply manure or compost in 2,5-3kg/m^2 or 4-5tones per rai follow by harrowing smoothly. If the soil PH is lower than 5,5 lime must be applied in 200-400kg/rai. In dry season a bed should raise up to 20-25cm, 1m width, a bed length depends on the field large, a space between bed is 30cm.

4.1.5 Transplanting

- Lettuce is able to grow in all year round,but the most suitable season is cool period of the year from December to March next year. If growing in hot and rainy season, it needs more intensification technology and select appropriated variety.
- Lettuce can be grown in two methods: 1. Seed broadcasting 2. transplanting.
  Seed broacasting:
  After completion seed bed preparation in above mentioned, use a sand mixe with a seed by 2:1 then broadcast throughout the bed, mulch by rice straw slightly or rice husk in 0,5cm. watering verery morning and evening. When seedling has 2-3 real leaves, thin out unhealty seedlings.
  Transplanting.
  When a seedling is 20-25 old age or has 3-4 real leaves, wartering a seedling before remove a seedling. Select only healty seedling to transplant with spacing2 5x30cm.

4.1.6 Irrigation

- Use water flying sytem. Connect water tube to the main supply tube then laying in the middle of the bed and straight to the end of the bed.
- Two water applications per day to be done in the morning and evering until 1 month after transplanting. The seed will not germinate, if it isn't enough soil moisture and water application will reduce in 2-3 days period for 2 applications per day in the morning and

evening from 1 month after transplanting. Also it practises 2 applications per day in 3-4 days period in one week before harvest.

4.1.7 Crop management

Application fertilizer to lettuce right amount and right time:
Except organic fertilizer or manure application in headline 4.1.4 above, chemical fertilizer also recommended, but mostly it depends on the soil quality. Generally, compound fertilizer is recommended for NPK 15-15-15 for leafy lettuce and 13-13-21 for headed variety in **50**kg/rai**.** It splits in two applications: first application is basal after seed sowing or transplanting in 25kg/rai and second application is done in 15-20 days after transplanting in 25kg/rai and mixes with 10kg of urea. However, it should water suddenly after fertilization.

3.2.6 Pest management

- It should be regularly checked lettuce garden to monitor pest and disease damage.
- Apply integrated pest management technique
- Use mechanical control, botanical pesticide,biological control methods, when pest incident is observed or preventive measure by planting healthy crop, chemical application is allowed the last chance while the other methods don't help only.
- There are very litle insect pests problem found in lettuce. However, some problems from diseases. Because, lettuce plant is short and closed with soil surface. Therefore, it is infected by fungal diseases when the soil moisture is high.
- Some major diseases are often found likes: leaf spot, root rot, and leaf bright. The control measure is improving soil health and soil nutrient, minimize soil moisture and regulate soil PH in 6.5, apply Trichofula. Waiting period is 10days after spraying.

4. Harvest management

Essential harvest equipment:

- Plastic cage, bamboo or plastic basket with 20kg size,
- Tettuce is able to harvest in 45-70 days after transplanting. It depends on the varieties. It should harvest in the morning hours to avoid sun heating. Use sharp knife cut at the bottom root part and remove all yellow leaves. Then transport it to the shading place or cover by material.

5. Post harvest management

- When the crop reaches home or packing house, the yellow leaves, residues and rice straw are remove out, then wash with clean water, display to the air and package for marketing.

Remark: The source of picture from Horticulture Research Center

Picture 5. Lettuce production in protected system in Horticulture Research Center

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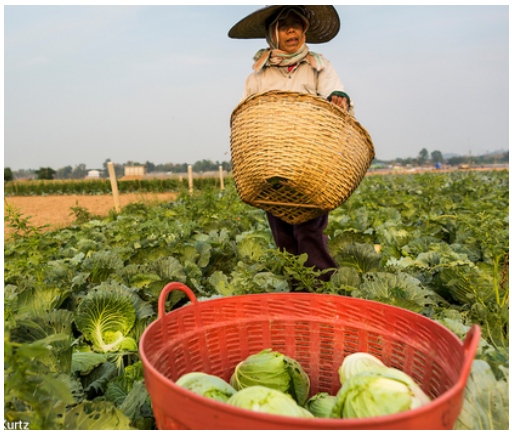
Technical Recommendation Package For Vegetable



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