Department of Agriculture
Department of Horticulture
Land Resources, Soil and Water Conservation Department

State Government of Mizoram

Officers' Manual for Improving Agricultural Extension

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MizoCESAID
Project on Capacity Enhancement for Sustainable Agriculture and Irrigation Development in Mizoram

सत्यमेव जयते
State Government of Mizoram

JICA
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AKNOWLEDGEMENT

We would take this opportunity to express our deep gratitude and appreciation to our fellow colleagues from Irrigation & Water Resources Department, Land Resources, Soil & Water Conservation Department and Department of Horticulture working together in The Project on Capacity Enhancement for Sustainable Agriculture and Irrigation Development in Mizoram.

We would also take this opportunity to thank and applaud the JICA Project Team for their guidance and training through the project. It is through their hard work and dedication that The Officers' Manual for Improving Agriculture Extension is possible.

The Officers' Manual for Improving Agriculture Extension had been assembled and reviewed during the period of The Project on Capacity Enhancement for Sustainable Agriculture and Irrigation Development in Mizoram between 2017-2023.

Agriculture extension provides a critical support service for rural producers meeting new challenges confronting agriculture. The focus of agriculture in India is shifting from subsistence farming to agriculture for quality life through improvement livelihood scrutiny. It is in the process of transforming its agriculture extension system to become more demand driven and responsive to farmers' needs. Agricultural extension plays a crucial role in boosting agricultural productivity, increasing food security, improving rural livelihoods, and promoting agriculture as an engine of pro-poor economic growth.

This manual aims at guiding officers regarding activities involving extension services in terms of preparing activity plan, which is crucial for any extension services, improving the farmers' skills and rendering extension services to them as well as strengthening farmers' organization which plays a vital role in uplifting the farmers with practical examples. The manual has been prepared by a number of experts working together under the project.

It is through this manual that there might be a standardized method of extension services provided for the farmers and above all, it promotes responsible and sustainable agriculture in Mizoram.

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INTRODUCTION

STRUCTURE OF THE GUIDELINES AND MANUALS:

The development of the guidelines and manuals for sustainable agriculture and irrigation development is one of the outputs of the JICA Technical Cooperation Project (JICA TCP) on Capacity Enhancement for Sustainable Agriculture and Irrigation Development in Mizoram. The methods are composed of "Operational Guidelines for JICA Sustainable Farming System (JIFAS)" and "Officers' Manuals". This manual, "Officers' Manual for Improving Agricultural Extension" provides technical guidance on how to deliver appropriate services to farmers; whereas, the implementation guideline guides the overall procedures for planning, implementation, monitoring, and evaluation. The structure of the methods is depicted in the figure below.

Operational guidelines	**To guide the way of development through the following:** ● Village information including agriculture and land use; ● Development direction; ● The Block Agriculture and Irrigation Development Committee (BAIDC) annual activity plan; and ● Implementation, monitoring and evaluation
Officers' manual	**To develop capacity of officers using manuals on the agricultural extension and irrigation development.**

CONCEPT OF THE MANUAL

With regard to cultivation techniques, cropping calendar, and varietal information, there are a lot of existing manual and information prepared by official organizations such as Indian Council of Agricultural Research (ICAR), National Horticulture Board (NHB), International Rice Research Institute (IRRI). They are all well-developed and informative, and it is good to apply them for implementation and/or extension as it is. However, according to the farmers, it is not always fit to all places in Mizoram as agricultural environment including cultivation and marketing conditions varies from place to place. It means that there is a need for site-specific information and countermeasures when it comes to actual situation of village and farmers. Hence, it is very important for effective and efficient extension to reflect their needs. The manual shows the procedure to

establish site-specific agricultural extension for more production and profit, which can be applicable to specific environment.

During the implementation of the JICA TCP, the BAIDC members carried out agriculture extension activities in six (6) pilot villages. This manual is compiled based on weaknesses, strengths, and challenges observed among the BAIDC members and pilot farmers by the JICA Project Team (JPT). With utilization of this manual, it is expected that appropriate technologies will be developed by the BAIDC members for Mizoram farmers, considering Mizoram features and farmers' wisdom.

OBJECTIVES OF MANUAL FOR IMPROVING AGRICULTURAL EXTENSION

In order to ensure sustainable livelihoods, farmers need to improve their skills to increase crop productivity and profitability. In addition, extension practices focusing not only on the general farming practices but also strengthening farmers' ties are required for further development. The main objectives of this manual are to provide the way for:

- Establishment of appropriate farming techniques for more production;
- Implementation of market analysis for stable and profitable farming;
- Dissemination of technologies through planning, classroom lecture, and on-farm training; and
- Strengthening farmers organizations for further development.

TARGET USERS

The main users of the manual are the BAIDC officials who support the farmers at the village level. Officials at the state level are also required to learn the manual in order to disseminate the methods in the entire state.

EDITING OF THE MANUAL

The contents of the manual will be revised at least once a year at the time of the annual review meeting. The feedback from the officers of the BAIDC and trained farmers will be shared, and issues, findings, and lessons obtained from the pilot activities of the project will be clarified and discussed. The results of the discussion will be incorporated into the manual.

The following methods can be recommended to revise the manual periodically.

The Inter-departmental Committee (IDC) of the JIFAS will conduct seminars/ in-service

trainings for the BAIDC members at least once a year to review

the 'Manual for Improving Agricultural Extension'. It is therefore proposed that the manual could be revised according to the following procedures:

1) The IDC informs the BAIDC in advance via SAMETI about the revision of the manual.
2) The BAIDC members discuss the revision of the manual and submit proposals to the IDC.
3) The BAIDC organize the committee for the revision of the manual.
4) The IDC members and the manual Revision Committee members of the BAIDC work together to revise the manual.

CHAPTER I.
BEFORE PREPATION OF BAIDC ANNUAL ACTIVITY PLAN

101 UNDERSTANDING THE CURRENT FARMING

For better farm management, it is important to discuss the present agricultural practices. The discussion will be made on a group basis and the Block Agriculture and Irrigation Development Committee (BAIDC) member should facilitate the discussion. Through this exercise, farmers will recognize their present farming practices automatically, and understand their farming practices done by others. From the BAIDC side, they will understand more on the details of farming activities in the village and type of crops which farmers are interested in.

PROCEDURE

1. Enumerate the crops and varieties.

   At first, the participants raise all crops and varieties cultivated in each of the Jhum area, slope area, and WRC.

2. Write down the timing of farming practices.

   After all crops are listed on paper, sowing, transplanting, and harvesting time of the listed crops should also be marked. If information about the seed amount and production are available, it would be also written in the paper.

3. Gather the information on sales.

   When the cash crops are listed, sales volume, unit price, destination, and sales amount will also be written on paper as shown in Figure 101-1

Crop/Variety	Month												Sale Volume (kg/yr)	Unit Price (₹/kg)	Desti-nationa	Sales Amount (₹/yr)
	4	5	6	7	8	9	10	11	12	1	2	3				
	Rhabi	Kharif					Rhabi									
Paddy			△ Seed amount: 1 tin/acre	○			□ Production: 2,460 kg	□	□				Self-consumption			
Cabbage							△	○			□	□ □	10,000 qtl	10	Middle man	100 lakh
Ginger							△	○			□	□ □				
Broccoli							△	○			□	□ □				
Lady finger							△	○			□	□ □	40-50 qtl	70	Middle man	2.5-3.5 lakh
Beans							△	○			□	□ □				
Carrot							△	○			□	□ □				
Coriander							△	○			□	□ □				
Potatoes							△	○			□	□ □				
Mustard							△	○			□	□ □	10,000 qtl	30	Middle man	300 lakh
Brinjal							△	○			□	□ □	10,000 qtl	30	Middle man	300 lakh

△ Sowing ○ Transplanting □ Harvesting

Figure 101-1 Present cropping calendar in Serchhip II village, Serchhip, Mizoram

102 MARKET SURVEY FOR CASH CROPS

Introduction

The market survey aims to gather information about the actual and potential markets for the farmers' products. The best way to gather information about the market is to visit one or more markets or traders from other states.

After the market survey, the farmers will be able to answer the following three main questions:

- What is the demand for the products that the farmers are interested in?
- What are the buying conditions for these products?
- What other products are in high demand or scarce supply?

For many farmers, the market visit is an eye-opener. While all farmers have been going to a market to sell or buy something, few go there to gather information from traders with a view to improve their farming methods and businesses.

Table 102-1: Summary of Market Survey

Which markets to visit?	That depends on the priority of products the farmers have chosen for sale. Think about visiting the market nearest the village first, plus perhaps one or two other markets further away so you can compare information. Several agricultural products such as orange, areca nut and broom grass are directly traded to out-of-state traders, mainly from Assam. Therefore, the survey should be conducted at the base of those traders or place where they are dealing.
Who should take part?	It is not realistic for all farmers in a village to visit a market or base of traders, so ask the committee to select two or three farmers to act as their marketing representatives.
How many traders to interview?	Ask the same questions to two or three traders and see if they give the same answers. Remember always only interview one trader at a time. If the answers are the same, you can feel confidence about the information they have given you. If the traders all have very different answers, ask some more traders until you can see consistency in the information.
How long does it take?	This depends on the number of products, the number of markets to visit, and the distances between them. Typically, a visit to one market to study 2–3 products takes 1–2 hours, plus the traveling time. Allow time to analyze the findings and report back to the rest of the group.

102 MARKET SURVEY FOR CASH CROPS

A market survey is an important way for farmers to gather information about the markets for their products. A simple market survey focuses on a single product in one market. A more complex survey may cover several products in several different markets.

PREPARATION

1. Organize a team

   Ask the committee to choose a small number of farmers who know about the product to visit the market and collect information. At least one should be able to write, and one should have good communication skills as they will report their findings back to the group.

2. Decide what types of information to collect

   This will depend on the nature of the product and the market.

3. Decide where and when to visit

4. List the market sites to visit (village market, assembly market, town wholesale market, retail market, processing factory, shop), and the best dates and times to visit them.

5. Plan the number of interviews in each market

   Plan to interview several traders or buyers individually so you can compare their answers. Pairs of team members can conduct interviews, with one person asking questions and the other taking notes.

6. Prepare a questionnaire or checklist

   It is based on the types of information you want to collect. See Table 102-1 for an

example. You can plan to ask all these questions, or just the most essential items. Adapt the questionnaire by adding or deleting questions to suit your own needs.

7. Prepare an introduction

   It is explaining why you are doing the survey.

8. Rehearsal

   Discuss the interview procedure with the team members, and rehearse it with different farmers playing the roles of interviewer and interviewee.

9. Arrange interviews

   If necessary, contact the people you want to interview beforehand to arrange a suitable time.

10. Arrange transport

    If the market is a long way away, you may also need to arrange for the team to stay overnight.

SUGGESTED PROCEDURE

1. Visit the market with the team of farmers

   Make contact with some market officials, to tell them what you are planning to do in the market. If the place is unfamiliar, walk through it to find out where your products are traded and whom the team might interview.

2. Conduct interviews

   Approach the person you want to interview, introduce yourselves, and explain why you want to talk to him or her. Follow the interview plan you have worked out, and make sure you collect the information you need. But also explore interesting topics that you had not anticipated. At the end of the interview, thank the interviewee for their time and information. Make sure your notes are in order before going to interview the next person.

3. Compile the data

   Afterwards, collate the information you have collected so you can analyze it and present it (see Table 102-3 and 103. ANALYZING MARKET INFORMATION).

QUESTIONS TO STIMULATE DISCUSSION

- What do we need to know about the product and how it is marketed?
- What do we know already?
- What information do we need to check?
- How many people should we interview?
- What types of people - traders, managers, transporters, processors, consumers, etc.?
- What is the best way to approach people we want to interview?
- Should we take notes during the interview, or immediately afterwards?
- What sorts of information may be sensitive or difficult to get hold of?
- Can we find out this information from any other sources?

NOTES

- Some of the questions (e.g., about prices) may be sensitive, and interviewees may be reluctant to answer or give accurate responses. During an interview, start off with non-sensitive questions, then move on to the more difficult questions later. Ask about prices towards the end of your interview.
- Be sure that the person you are interviewing has time (if not, arrange to come back

at a better time). Don't takes more than 15–20 minutes with each person. Stop asking questions when the person is dealing with customers.

- Always thank the person you have interviewed for their time at the end of the interview.
- Adapt the interview guide or questionnaire as necessary. The survey team can ask all of these questions for each product, or only the most important questions.

TABLE 102-2 An Example of a Questionnaire for a Market Survey

THE INTERVIEW	
Place, date	
Type of product (e.g., maize)	
Interviewer(s)	
PERSON INTERVIEWED	
Name	
Type of activity in chain (e.g., trader)	
Position, name of company	
Phone number	
Address	
PURCHASES OF PRODUCT X	
How much of product X do you buy in all each day? Each week? Each year?	
How often do you buy product X?	
Who do you buy from?	
What is your main source of product X?	
TERMS OF PURCHASE	
What is the smallest amount of the product that you would buy? The largest amount?	
What varieties of the product do you need? How old or ripe? What size? What quality grade?	
How do you want sellers to pack the product?	
What are your terms of payment? (e.g., full or partial payment on delivery, payment after a delay, provision of credit)	
Would you be interested in buying from a farmers' group? What amounts? At what price?	
PRICES	
What unit price do you pay? (Per kilogram or sack)	
How does the price change from season to season?	
Do prices vary for different varieties, ripeness, size or class?	
THE VALUE CHAIN	
What do you do with the product after you buy it? e.g., do you sell it, process, package it, etc.?	
What price do you sell at?	
What are your main marketing costs?	
Whom do you sell it to?	
What do they do with it?	
Who are the end users?	

THE MARKET FOR PRODUCT X	
What is current of demand for the product, growing, stable, or declining? Are sales this year higher, the same, or lower than last year? Why the changes?	
How many other traders are there like you in the market?	
How much of product X is bought and sold at this market each day? In the peak season? In the low season?	
Who is the largest trader in this market for product X?	
OTHER PRODUCTS	
What product is in the highest demand?	
What products are very scarce?	
What new products are being sold in this market?	
What would you advise farmers to grow to earn more money?	

Source: Seven steps of marketing, CRS and MEAS, 2016

Table 102-3 An example of a survey result conducted by farmers in XYZ market, Mizoram

Target product	Tomato
Buyer	Ronald Hiatha
Telephone number	082-5888-xxxx
Products handled	Tomato, Cabbage, Lettuce, etc.
Demand	High in November-January
Type required	Hybrid varieties (Avinash-2, Rocky, PusaDivya)
Minimum volume purchased	1 tons
Collective marketing volume	One pick-up track offered INR 100 per bag, but he wants 20 tons.
Quality	Same size, Younger fruits, Without damages
Packaging requirement	15 kg bag
Frequency of delivery	Every two weeks
Purchase price	INR 40 / kg
Means of payment	Cash on delivery
Willing to buy from local farmers	If farmers are reliable

Source: JICA Project Team

103 ANALYZING THE SURVEY RESULTS

ANALYZING MARKET INFORMATION

After the market survey, JPT should write an analysis of the collected information, and report it to the concerned village members.

What was new for them? What did they learn? What did they find most interesting? Write the information gathered and invite the market team members to present it to the other farmers. Discuss the findings and their implications with all the concerned farmers. Help them identify what products and markets they are interested in exploring further.

PRICE DATA

Be careful specifically when reporting prices. Things to note are:

- What was the product?
- What quality or grade?
- For what volume or weight?
- Where (in which market) and when (when in the season)?

PRICES AT DIFFERENT SEASONS

Most products can be grown only at certain times of the year, so prices often go down at the main harvest time. Farmers can often get a better price by avoiding selling at this time. Do some ways to:

- Grow early maturing varieties
- Grow a product off-season (for example, using irrigation)
- Stagger planting and harvesting dates
- Store the produce until the price goes up

OTHER QUESTIONS

In addition to the market demand, the JPT also needs to answer more general questions that farmers want to know.

Examples:

- Where do we get the varieties that the buyers want?
- When should I expect my first payment?
- Is selling the product to one of traders more profitable than the trader I am already transacting?

ANALYZING PRODUCTION

Once farmers understand the market demand for one or more products, it is time for them to look at how they can produce and sell their products at a competitive price. As a field officer, these are the things to consider:

- Find out about the new varieties of a product that traders or processors want to buy.
- Ask farmers to provide you with information on their current production methods and yields per unit area (acre, hectare, etc.).
- Discuss your information with larger or more commercial farmers and find if they are using any new methods of production, or best practices to increase their yields.
- Talk to local agricultural experts, including researchers, traders, and extension workers, to get tips on how to increase the level of production and competitiveness of the product.
- Organize visits to other farmers who are already using advanced technologies in producing more. Such visits are particularly important if the farmers have no experience in growing a crop.

Some farmers produce more because they are doing several things right. They may not be doing anything that seems to be different from your farmers, but they get all the basics right, and they make the right investments, which are disciplined in their approach, and this makes them more competitive.

Help the team think of ways on how they might improve their productivity and the price of their products. Table 103-1 gives some suggestions on how they can do this for crop products.

Table 103-1 Possible Ways to Increase Productivity and Sales Prices of Crops

STRATEGY	EXPLANATION AND ADVANTAGES	POSSIBLE DISADVANTAGES
Before Planting		
Increase land areas	The most common way to raise production.	Suitable land may not be available.
Improved variety	The new variety or breed may yield more, be resistant to specific pests and diseases, grow quickly, mature early (so allowing farmers to sell before the main harvest),	Investment in new varieties is needed. New varieties may require technologies such as irrigation and fertilizer. If these are not available, the new variety may perform worse than the local alternative.
Staggering planting dates	Avoid harvest at peak periods, or spreads harvesting into early and late season. Generally, they are used for vegetables and fruits.	May depend on rainfall or irrigation.
Planting in rows	Increases crop density and makes weeding easier.	May increase labor costs and labor requirements of the family.

Seedling preparation	For some crops such as rice and vegetables, a farmer can improve germination and helps the crop to grow quickly by having a nursery for seedlings before planting into the main field.	Requires additional labor and investment in terms of time in order to learn new skills.
Seed dressing	Chemical treatment of seed to avoid losses through pests and diseases.	Availability of chemicals and cost of chemicals, and need to learn how to use chemicals properly.
After Planting		
Fertilizer	Organic or inorganic fertilizer can boost yields. A combination of new varieties and fertilizer has raised yields across the world.	Farmers need access to fertilizer and have to use them correctly.
Irrigation	Increases production and extends production season.	Costly, water may not be available.
Mulch or plastic covers	Works for high-value, fresh produce. It accelerates early growth, suppresses weeds, and takes advantage of early and late seasons' prices.	Labor and cost.
Regular weeding	Reduces yield losses due to weeds.	Laborious, high labor costs.
Chemical herbicides	Reduce weeds or allow zero tillage (which cuts soil erosion and costs of land preparation).	Cost of chemicals, health hazards.
After Harvest		
Drying floor	Reduces time for drying, and reduces trash in the final product.	Costly.
Sorting area	Allows for cleaning and sorting before sale.	Requires some investments and labor.
Grading	Makes it possible to sell best-quality grades at a higher price.	May soak up labor costs and not be rewarded in markets that do not provide quality premiums.
Bulking produce	Selling in bulk attracts premium prices from traders.	Many farmers may be needed to supply enough produce.
Processing	Increases the value of the product and often makes it less perishable. Examples: threshing, dehusking, boiling, drying, and fermenting.	May require special equipment.
Storing	Avoids peak sales time and takes advantage of rising prices when supply is short.	Requires suitable storage facilities. Not possible for some products.

Source: Seven Steps of Marketing, CRS and MEAS, 2016

104 AGRICULTURAL PRODUCE TRADERS IN OTHER STATE

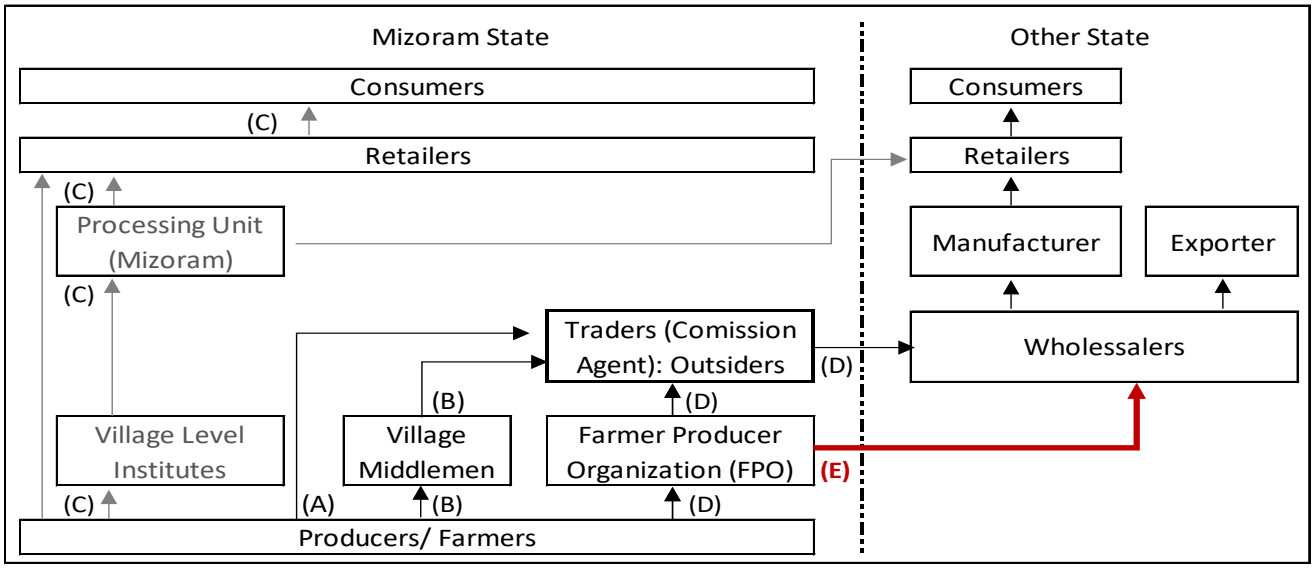
TRADERS COMING FROM OTHER STATES TO BUY FARM PRODUCT

Traders from other Indian states occupy a crucial part in marketing agricultural produce, especially broom grass, areca nuts, oranges, turmeric, gingers, and oilseeds (sesame, perilla, mustard, and rapeseed). These people are found throughout the year in the state, even in the interior areas, to procure surplus production of cash crops.

Farmers cannot easily collect broader information about traders' marketing systems without assistance from relevant departments. Therefore, for the agricultural products handled by these traders, the government agencies/ departments involved in the agriculture market and the BAIDC members had better meet with the relevant traders and gather reliable information needed by the farmers.

ANALYZING MARKETING CHANNELS AND PROBLEMS TO SOLVE

Figure 104-1 shows the main marketing channels for Broom grass as (A), (B), (C), (D) and (E). Details of each marketing channel are explained in Table 104-1.



Source: JICA Project Team

Figure 104-1 Marketing Channels of Broom Grass

A description of sales channels (A) to (E), shown in Figure 104-1 above, is given in Table 104-1.

Table 104-1 Description and Problems of Sales Channels in Figure 104-1

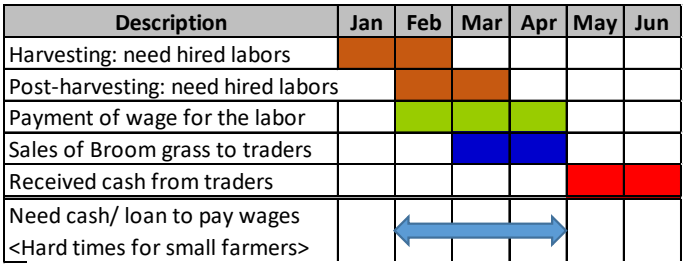
Each Channel	Description of the Marketing Channel and Problems
(A)	Each farmer sells products directly to traders privately. The proceeds from the sale are paid into each individual's bank account around one month later. In general, sales prices show a tendency to be lower for individual sales.
(B)	Farmers sell products to village middlemen (generally who are rich farmers). Farmers can receive cash payments on the spot from the middlemen, but the selling price is very low. However, many small farmers depend on this system because they need cash to pay hired laborers and for their own living expense.
(C)	NLUP assisted in organizing village-level institutes, Mizoram traders, and processing units in Mizoram. It aimed to improv' farmers' profitability, but it has been largely non-functional or has reduced their activities since the NLUP ended.
(D)	The Central Government of India aims to encourage small farmers through Farmer Producer Organizations (FPOs) to promote marketing and income-generating activities; FPOs can access bank loans and public funds to improve farmer income.
(E)	The market development of (E) is the next development step from (D). The FPO in Saipum Village, Kolasib District, commenced selling their products directly to significant trading companies/ manufacturers in 2022. The FPO buys farmers' products with cash and sells them to major trading companies/ manufacturers in bulk to increase the unit price per sale. Then, the farmers' income could increase.

Source: JICA Project Team

How BAIDC members can assist farmers

It is recommended that the BAIDC members should collect necessary information on sales channels with traders' marketing behavior about the previously-mentioned crops for farmers at the initial stage. Otherwise, it is difficult for farmers to obtain specific information comprehensively. Figure 104-1 and Table 104-1 describe the sales channels and concerned parties on broom grass marketing. Although the marketing channels/ system vary slightly from crop to crop, the four main points mentioned below can be applied to almost any crop.

- Most small farmers need cash to pay wages for hired laborers and their living costs, then almost all farmers sell their harvested broom grass to the middlemen (B) even at a low price.
- In addition, post-harvest management (drying and sorting) is essential to ensure high-quality products for selling at a high price. However, it is difficult for small farmers because they do not have the financial resources to afford it. Thus, the rate of return for small farmers continues to worsen (Figure 104-2).



Source: JICA Project Team

Figure 104-2 Hard Times for Small Farmers

- To solve the above problems, it is recommended for small farmers to organize a FPO. In addition, FPOs can receive low-interest/ group loans from banks, enable members to harvest timely and sell in a planned way to increase their income.
- FPOs can collectively negotiate with several traders about shipment to increase the unit sales price.

By organizing, producers/ small farmers gain the power to negotiate with traders. However, all the members need to be fully aware of the benefits of the organization and to organize spontaneously with members' will.

CHAPTER II.

IMPROVING OF FARMER'S SKILLS

201 CONDUCTING OF TRAINING

INTRODUCTION[1]

Trainings are designed to disseminate skills and knowledge necessary for the practical production of the target crops which the farmers have chosen. It is a demand-driven training.

The extension staff organizes training sessions where the target farmers learn skills, techniques, and knowledge necessary for the production of target crops. The training should be practical and conducted at the farmers' fields or in their vicinity with ample demonstrations and exercises.

KEY IMPLEMENTAION TIPS

- The training should address the needs of the farmers. Spend more time where farmers need more training and spend less time if the farmers are already familiar

[1] Source: SHEP Handbook for Extension Staff, A Practical Guide to the Implementation of the SHEP Approach, JICA, 2019

with the topics.

- The training should be conducted using easy-to-understand materials such as flip charts, posters, leaflets, and so on.
- If the training is conducted truly by a demand-driven approach, the farmers' adoption rate of the new techniques should be significantly high compared with that of supply-driven trainings.
- The extension staff should be well equipped with knowledge and skills necessary for teaching farmers. If they need more training, the implementers should organize Training of Trainers (TOT) for extension staff before training for farmers are conducted.
- The extension staff organizes training sessions composed of lectures, exercises, and demonstrations for each topic using effective teaching materials.
- The topics of the training should exactly match the needs of the target crop production and farmers' capacity development needs. Generally speaking, the training topics can be categorized into three areas: (1) general horticultural crops production and post-harvest handling techniques, (2) crop-specific production techniques, and (3) managerial skills such as bookkeeping, crop budgeting, and farm record keeping.

The table below shows an example of the module for in-field trainings for a village which has chosen two target crops.

Table 201-1 An example of training module

Session 1	First Target Crop Production: specific techniques on the first crop
Session 2	Second Target Crop Production: specific techniques on the second crop
Session 3	Pre-Cultivation Preparation: soil testing, composting, and quality planting materials
Session 4	Land Preparation: land preparation practices (solarization), incorporating crop residue and basal application
Session 5	Crop Establishment: raising seedlings, planting/transplanting spacing, fertilizer application rates
Session 6	Crop Management: managing weeds, top-dressing, integrated pest management practices, safe and effective use of pesticides
Session 7	Harvest and Post-harvest Handling: harvesting indices, containers/packaging materials

	and value addition techniques
Session 8	Managerial Skills: Bookkeeping, crop budgeting, farm record keeping

POINTS TO BE CONFIRMED AFTER THE TRAINING

- The target farmers understand and acquire technical knowledge and skills taught in the trainings.
- The target farmers do not face any technical, financial, or social difficulties applying techniques taught in the trainings. (If they do, identify the problems, consult them and give appropriate guidance to them)
- Male-female ratio of the participants is balanced.
- Participation of the members' spouses is encouraged.
- Gender stereotype and gender-insensitive training methods and materials are avoided.
- Sufficient consideration is given to illiterate and non-illiterate farmers in designing training methods.
- Labor-saving techniques or tools/ equipment, especially for women's benefit, are introduced.

The extension material will be prepared by the following procedure.

PREPARATION

- Ask the farmers' committee to nominate a small team to compile production technologies.
- Bring the list of priority crops products selected through the discussion between government officers and farmers.

SUGGESTED PROCEDURE

1. Ask farmers to state technical problems and enumerate them. To gather necessary information, conducting focus group discussions with farmers' organization or villagers' group is more appropriate than interview with individual farmer. Information from individual farmer may be more accurate, but it has a wide range of variation and it is not always applicable for the whole village of people. Hence, having consensus-based general information is more recommendable.
2. Ask the team to modify the technical guide compiled in the Attachment. Based on technical problems raised above, the contents in the prepared technical guide must be modified to fit to the farmers' needs. Items which are not included or fully described in the prepared technical guide are raised as their technical problem that needs to be improved, and those should be added to the guide, e.g., types of fertilizer, timing of application, and amount.

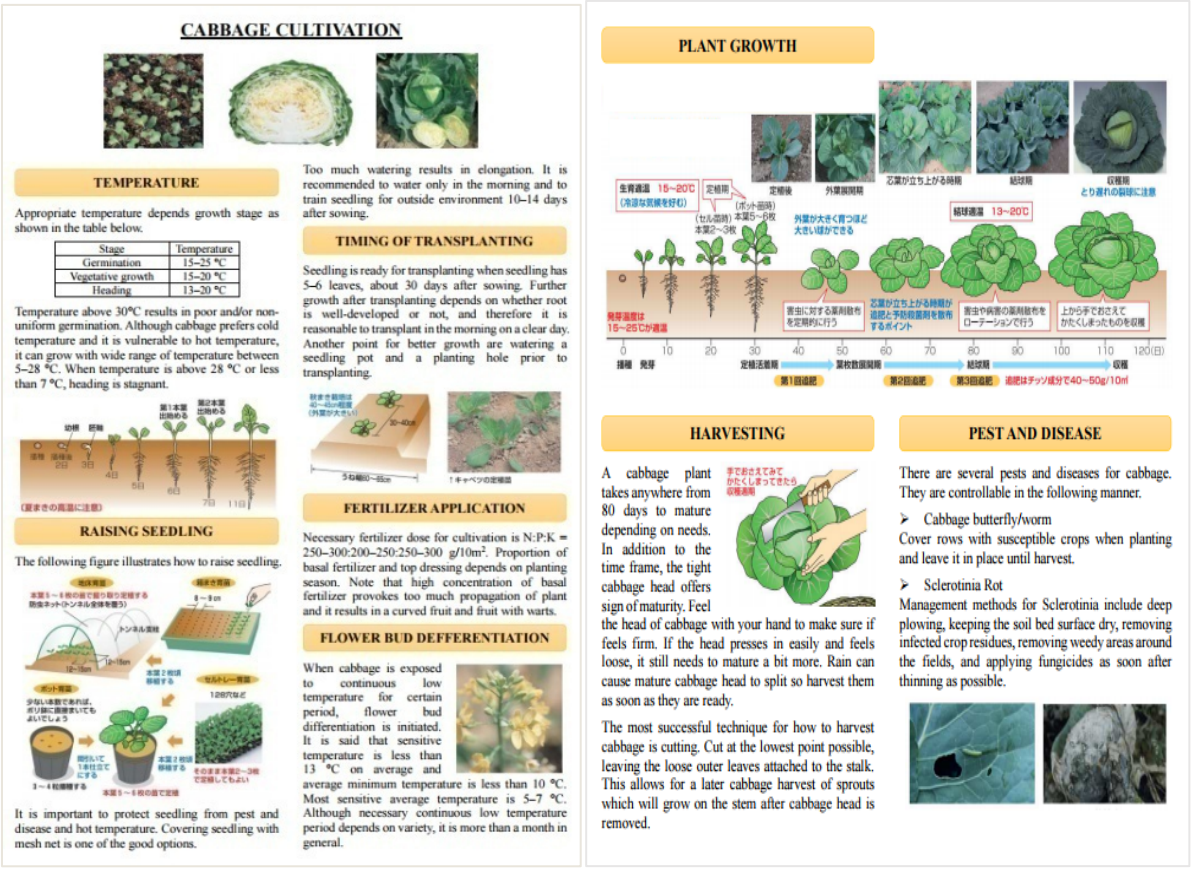
   Technical information can be collected in reference to available materials on a specific crop. For example, the "Handbook of Horticulture" published by the Indian Council of Agricultural Research (ICAR) describes basic technologies about horticulture crop production as shown in the table below.

Table 201-1 Items Covered in the Handbook of Horticulture by ICAR

I. General Horticulture	II. Fruit Crops	III. Vegetable Crops	IV. Potato
V. Tropical Tuber Crops	VI. Mushrooms	VII. Ornamental Plants	VIII. Medicinal Plants
IX. Aromatic Plants	X. Plantation Crops	XI. Spices	XII. Disease and Pest XII. Management
XIII. Postharvest Management	XIV. Revised Horticulture Data		

Source: Handbook of Horticulture, ICAR

3. Invite the team to present its results to the full group facilitate a discussion of findings.



Source: JICA Project Team

Figure 202-1 An example of "Village-wise technical guide for cabbage"

NOTES

- The BAIDC has to carefully facilitate farmers so that they can concentrate on the technical problems. For example, lack of water, lack of fertilizer, lack of seed, etc., are not technical problems and are instead considered as physical problems. So far, they are able to grow crops even if those are not available, although production may not be enough. Some examples of technical and non-technical problems are shown in the table below.

Table 201-2 Some Examples of Technical and Non-technical Problems

Technical Problem	Non-technical Problem
Lack of knowledge on required geoclimatic conditions depending on varieties	Lack of seed
Lack of knowledge on suitable variety	Lack of water
Do not know appropriate nursery period	Lack of machinery
Lack of knowledge on recommended fertilizer application rate and timing	Lack of fertilizer
Do not know recommended frequency and timing of weeding	Steep farmland

Source: JICA Project Team

- Information should not be more than two pages of A4 size paper for easy distribution and visual materials such as illustration and picture should be used to make farmers understand more easily. As too much information sometimes makes it more complicated for farmers, it is important to extract only critical information to be included in the guide. If the modified technical guide seems to be more than two pages of A4 size paper when adding more information, delete some information which are very common for farmers. Also, it is necessary to translate the modified technical guide into Mizo.
- Effectiveness or appropriateness of the modified technical guide will be confirmed through the trial plot implementation with farmers described in the following step. Although the modified technical guide may not work properly under the specific village conditions, BAIDC has to accept that fact. Actually, it is a trial-and-error method and lessons learned can be reflected into the technical guide to make it better. To do so, plant growth needs to be monitored carefully and information on farming practices and input should be properly recorded during the growth period.

203 ESTABLISHMENT OF TRIAL/DEMONSTRATION PLOT

Trial and/or demonstration plot is an important way for farmers to compare improved techniques with the conventional one. It also works as an information hub to disseminate the techniques.

PROCEDURE

1. Farmer selection

Farmers who will manage the trial plot shall be selected using the following criteria:

- The selected farmer should have experiences in cultivation of a specific crop.
- The selected farmer should be able to read and write for recording purposes.
- The selected farmer should be motivated to improve their production through cultivation techniques.

If there are other criteria that need to be included, it would also be added in consultation with the farmers.

In total, three to five farmers will be selected for close monitoring. It means that the same number of trial plots will be established.

2. Site selection

The following items are typical selection criteria for the plots:

- The selected land should be in a sunny location, flat landscape, and free from flooding.
- The selected land should not be in a location that makes inspection difficult for farmers. Another reason is that the farm needs to be visited frequently for general management and to avoid damage by animals, birds, and insects.
- It is better to have a small area of land for demonstration that is well managed than a large area that is poorly managed.

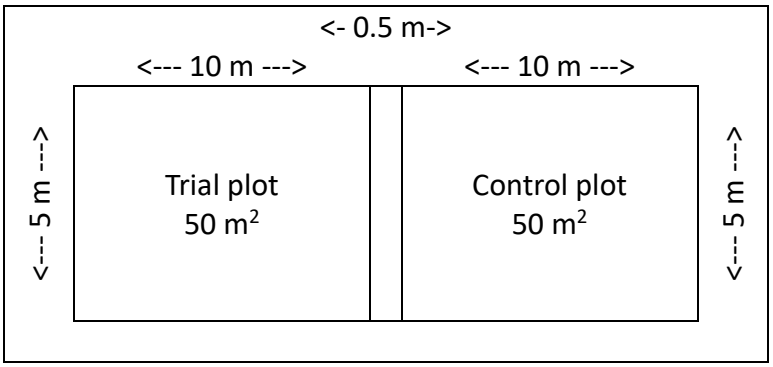
The same care mentioned above would also be applied here.

3. Establish the trial plot according to village-wise cropping calendar

Items to be considered mainly are as follows:

- Plot size: as for horticulture crops, about 100 m2 of land is quite enough for the trial and control plots. However, the plot size can be adjusted in accordance with the purpose of the demonstration and/or the condition of the field. The selected land is divided into two plots by some isolation distance and each plot has 50 m2 at the maximum (Figure 203-1). In case of cereals, about 500 m2 of the total land is

reasonable. If farmers have their own measurement unit, it would be advisable to use them for better understanding.



Source: JICA Project Team

Figure 203-1 Example of Plot Layout for Demonstration and Control Plots

When the BAIDC establishes the trial plot, measurement of some numerical values such as right angle, gradient, and area are indispensable. Measurement methods for those plots are covered by training materials.

- Farming practices: Village-wise farming technique and conventional one are applied for trial plot and control plot, respectively. Conventional cropping calendar can be employed for both plots.
- Variety: one variety should be selected in consideration of varietal characteristics including growth duration, suitability for geoclimatic conditions, productivity, farmers' preference, market demand, and so forth.

As selected farmers are introduced to the improved cultivation techniques, some of

them may get confused as to why they have to practice the conventional method which needs to be improved or may not provide satisfactory production. Therefore, JPT has to carefully explain their intentions with objective and expected output at the beginning until farmers fully understand.

4. Maintaining of the trial plot

The trial and control plot must be maintained properly, according to village-wise technical guide and conventional way of cultivation. When special activities are to be made for the trial plot by using village-wise technical guide, participants should be well-informed prior to implementation. It is also a good timing for implementation of field visit which is described in 204.

204 FIELD VISIT (ON-SITE TRAINING AND GUIDANCE)

There is a proverb in Japan that says, “Seeing is believing”. And also, Chinese proverb says “If I hear it, I forget it. If I see it, I remember it. If I do it, I understand it. If I find it, I use it”. It indicates that we learn from what we have experienced. In case of farmers, once they have seen the field, practiced some activities, and realized the results, they will accept and utilize the newly-introduced extension packages.

PROCEDURE

1. Preparation of field visit plan

Schedule and frequency of visit should be confirmed prior to field visit. The main point to be observed here is whether the newly-introduced or improved technique written in the village-wise technical guide works properly for productivity enhancement. As mentioned in 203, when these techniques are applied, it is also a good timing for field

visit. Hence, frequency of field visit depends on the number of techniques, which are different from the conventional one. Field visit before harvesting is also important to see the difference between the trial plot and control plot.

2. Field visit and on-site practices

First of all, some technical guidance related to techniques to be introduced should be provided to the farmers. Then, let them practice those under the supervision of the BAIDC members. This is a type of on-the-job-training (OJT). When JPT conducts field visit before harvesting, let the farmer, who manages the land, states views on whether there are special attention, difficulties, advantages, and so on in cultivation as compared with the conventional one.

3. Exchange ideas on village-wise technical guide

After observation and field practices on site, ask farmers to state whether they understand the point to be followed and their impression, and so forth. Then, ask farmers to raise their hand based on the comparison sheet and count the number of farmers who raised their hands. The main points to be confirmed is shown in the following table. If many farmers answered, “Better than conventional” or “Same as conventional”, it seems to be feasible under village conditions. But JPT cannot neglect those who answered, “Worse than conventional” and may be able to find improved points from their opinion.

Table 204-1 Example of “Comparison Sheet”

Items	Better than Conventional	Same as Conventional	Worse than Conventional
Plant growth			
Workability			
Difficulties			
Other impression/comment			

Source: JICA Project Team

205 MONITORING AND RECORDING

WHAT ARE MONITORING

Monitoring means:

- Record-keeping: Keeping regular records of discussion, actions, and finances.
- Checking progress against plans: Checking that actions are taken according to the plan.
- Adjusting ongoing activities: To make sure they will achieve the development orientation in the village.

In the implementation, all farmers, who are participating in the activities, and government officers are responsible for monitoring. This will make it possible for farmers to solve their own problems.

WHAT TO MONITORING

The farmers and extension officers should decide by themselves what areas they will monitor. They should collect the data themselves, analyze the results, and use those results to improve their livelihood.

Many aspects of farm management can be monitored:

- Input procurement
- Farming practices
- Yield
- Issues and countermeasures
- Sales
- Financial record

It is best to keep records in a single record book so they do not get lost or get out of order.

KEEPING RECORDS

Records are important management tool. They show what has been done, what inputs have been used, how much has been sold, and what the results were. It is particularly important to keep records of work, money coming in and going out, inputs, and products produced and sold as shown below.

- Regular activities

A paddy production, for example, should have a list showing all farm activities including land preparation, sowing, transplanting, weeding, fertilizer application, chemical spraying, harvesting, and post-harvesting handlings.

- Handling expendable items

The farmer should keep track of expendable items such as fertilizer, seed, and chemicals. This helps prevent theft or misuse.

- Recoding money

It is important to keep records of how much money comes in and goes out. Financial records help keep people honest and make sure that farm management is well-run.

Table 205-1 an example of "Monitoring sheet"

10/06/2019, BAIDC Bilkhawthlir

Farming Record & Monitoring Sheet

on BU-03 "Increasing WRC farmers income"

Name of pilot farmer : _____

Address : _____

Phone no : _____

Number of Assam Labour employed : _____

Distribution of Input

Item	Date of distribution	Quantity	Cost
Gomati seeds			
Chemical fertilizers			
Herbicides			
Rapeseed TS-67			
Other crops (NFSM)			

1.Gomati

Date of Seed Treatment	Date of Soaking	Date of Incubation	Date of Ploughing
Date of Levelling	Date of Sowing	Date of applying Basal fertilizer	Germination %
Date of Transplanting	Date of Applying Herbicide	Date of 1st weeding	Date of 1st Top Dressing
Date of 2nd weeding	Date of 2nd Top Dressing	Date of Harvesting	Area of Demonstration plot
Average no of Hills	Average no of Tiller / Hill	Total Yield (kg)	Productivity (kg/ha)

2. Rapeseed TS-67 cultivation

Date of Sowing	Area of Planting	Germination %	Spacing
Date of 1st Weeding	Date of Thinning	Date of 2nd Weeding	Date of Harvesting
Income from Rapeseed	Total Yield (Kg)	Productivity (Ha)	

10/06/2019, BAIDC Bilkhawthlir

Monitoring Sheet No.1

on BU-03 "Increasing WRC farmers income"

Name of pilot farmer: _____

Date of monitoring: _____ Time: from _____:_____ to _____:_____

Name of Officer (s) who conducted a monitoring: _____

_____

Growth Situation, Problems (pest, disease, etc.) and Countermeasures:

Topic	Current situation/ Issues/ Problems		Control measures suggested/ Remarks
	Hearing from farmer	Observation by BAIDC	
Gomati			
Others			

CHAPTER III.
STRENGTHENING OF FARMER ORGANIZATIONS

301 THE ROLE OF EXTENSION IN FARMER ORGANIZATIONS

INTRODUCTION[2]

The role of extension will vary with the role of the organization, the sectors in which the organization operates, the services that it offers, and the organizational form used. In community-based organizations, extension is used as a supplementary or supportive activity to realize the objectives of the base function of the organization. In commodity-based organizations, extension is integrated with all the other aspects of the organization to maximize the returns on the investment of the collective enterprise. Extension is taken seriously by both the organization and its members because both derive direct and measurable benefits from it.

The following issues need to be considered when developing the extension role, especially for farmers organizations (FOs) which are set up to specialize in the extension function:

1. Is there an identifiable need for extension in specific commodities in the areas covered by the FO?
2. Would the FO be able to generate enough revenues from the extension activity alone (with farmers willing to pay for these services) to meet the FOs expenses and to provide satisfactory rewards to its members for their monetary and non-monetary contributions? It will be important to anticipate the high potential for unresolved conflict over the issues of equity and charges for extension services.
3. How sustainable will the extension activity be over time, and therefore how sustainable will the organization be? It is possible for an advice to be converted to freely transmittable knowledge which can be transferred to anyone without payment. The cost of the extension advice limits access to this knowledge. Therefore, the revenue earned from the extension activity could decline, especially with a client group which has a low resource base and is primarily concerned with a subsistence economy.
4. Can the advice given be actually put into practice and produce tangible benefits to the FO members? The FO would need to control or arrange for the supply of necessary inputs to ensure this; otherwise, the extension organization will fail, as it has happened in the past in many developing countries. This means that the extension function needs to be integrated backwards with research recommendations and forward with the supply of inputs.

[2] Source: Shankariah Chamala and P. M. Shingi, Establishing and strengthening farmer organizations, FAO (http://www.fao.org/3/w5830e/w5830e0n.htm)

5. The organization will need to provide specific information in addition to the general information available from research centers. To do this and to survive, the organization will need a research linkage with the government and university research institutions. It is beneficial if the FO can employ qualified and committed scientists who have active contacts in research organizations or who can act as consultants to member groups. This would increase the cost of extension advice to members if the FO is supposed to be financially self-supporting.
6. It is necessary to appreciate that "extension markets" are governed by factors such as agroclimatic variations, infrastructure development, and the strength of market forces. FOs operating in desert regions, single-crop rainfed areas, and predominantly irrigated areas will have different occupational and extension needs; therefore, variable response patterns to extension have to be anticipated (Gupta, 1981, 1985). Similarly, FOs operating in food-deficit and food-surplus stages will have different roles, expectations, and returns.

302 REVITALIZATION OF FARMER ORGANIZATION

A properly-nurtured FO would be a platform for efficient and effective extension activities. Although several FOs have been already formed in each village, almost all of them have been organized by government without proper institutional arrangement. It is important to study those respective FOs' organizational capability, and inter-organizational relationship in each village on how to reorganize or find model FOs in the village.

PROCEDURE

1. Collect necessary information and data about the existing FOs in the village.

- Understand basic community structure of village through interview and discussion with VC members, FOs leaders, and other key persons in the village.
- Collect basic data and information of the existing FOs in the village to check FOs' capacity and relationship (including power relation) among those FOs in the village.
- Categorize respective FOs in the village as shown in Table 302-1.

- Identify potential leaders in the community to be successful leaders of FOs.
- Identify young persons who can assist the FOs (especially support accounting, etc.)

Table 302-1 Community-type and Suitable FO-type

Community-type	Aspects	Suitable FO-type
Type A	• Village dwellers and cultivators are almost the same who belong to the same village community and living in the village. • Tenant farmers are small in numbers or nil.	Community-based FO for multi-purpose
Type B	• Many land owners of agricultural lands are living outside of the village or other district: do not belong to the same village community. • Many tenant farmers/ laborers are cultivating and do not belong to the same village community, but living in the village.	Commodity-based FO for single purpose

Source: JICA Project Team

2. Discuss and consider how to strengthen FO in the village in consideration of 'Village Community-type' and 'FO-type'.

- Review the type of 'Village Community-type' and 'FO-type' categorized in the previous step through the discussion and set a basic development direction on how to strengthen FO.
- Nominate potential leaders and young persons in the community.
- Prepare tentative schedule and implementation methods of workshop for the next step.

3. Implement the workshop.

- Implement workshop with VC leaders, existing FOs leaders, other key persons in the village and relevant important institutions.
- Report present conditions of the existing FOs in the village, and recommend suitable methods to strengthen FO for agricultural and marketing activities, and land use and resources management.
- Discuss with participants and finalize the way to strengthen FO in the village.
- Explain the next step and tentative schedule.

Note: In case of 'Community-type B', it is necessary to set up a kind of coordination committee; 'Federation for relevant FOs', and the federation will implement overall management concern to land use and resources management in the village as shown in Figure 302-1.

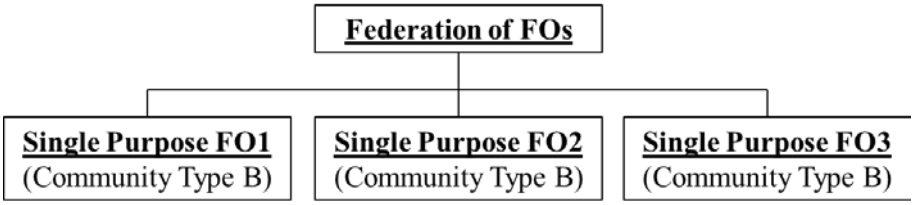


Figure 302-1 Federation of FOs for Community-type B

4. Prepare an implementation plan to strengthen FO.

- BAIDC members prepare an implementation plan in collaboration with Inter-Departmental Committee (IDC) and other necessary institutions such as Mizoram University.
- IDC members approve the implementation plan.

5. Ratification meeting

- Conduct ratification meeting at the village and ratify the prepared implementation plan by village representatives (VC members, FO leaders, and other key persons in the village).
- Explain the next step and nominate suitable persons who can attend a series of workshops including young persons (persons who can support FO in the management of account, documentation, etc.)

6. Provide basic training for organized/ reorganized FO.

- Prepare training programs in collaboration with specialized institutions such as Mizoram University.
- Develop simple and easy materials for training and implementation especially accounting procedures.
- Select a suitable training institute for FO organization structure and function, operation and maintenance, account, etc.
- Implement a series of training.

7. Preparation of by-laws and other necessary documents

- Nominate representatives from villages for the preparation of by-laws and other rules and regulations.
- Prepare tentative visions/ objectives on FO through discussion.

- Prepare by-laws and other necessary documents related to the operation and management in collaboration with BAIDC.

8. Hold a general meeting to assent to by-laws and discuss monitoring and evaluation.

- Set the date and venue to hold a general meeting.
- Submit prepared tentative vision/objectives, by-laws, rules and regulations, and procedures of operation and management of the organization, etc.
- Explain further activities by the FO.
- Nominate members for participatory monitoring and evaluation.

9. Monitoring and evaluation

- Implement monitoring and evaluation of FO activities with the participation of representatives of the village.
- Prepare progress report by the members of monitoring and evaluation to FO and IDC.

10. Follow-up Training

- Provide training to members of FO in collaboration with a specialized institution.
- Improve operation and management system for further development.

303 REVIEWING PREFORMANCE

REVIEWING PERFORMANCE

The farmers should review the performance of their group members. Performance monitoring is a sensitive issue, but it should be discussed constructively. You should be sensitive to problems in group dynamics and find ways to suggest where changes may help. Election is one of the ways to ease change in positions and enable other members of the group to take on new responsibilities. It should be in a non-confrontational way for a group to change people who are not performing in key roles.

DISCISSING WITH YOUR TEAM

This is also good time to discuss your results with your colleagues, other field agents, and supervisor.

COMPARING GROUPS

- Are some groups doing better than the others?
- Why?
- What did you learn from them?
- What did you share from your own experience?
- What difficulties have you encountered, and how did you overcome these?

REVIEW THE APPROACH

- How successful has the approach been?
- Did it help farmers improve their livelihood?
- Did they learn new skills?
- Did the information gathering and processing help you assist the farmers?
- Does the approach reduce the time and costs of serving the farmers or increase it?
- Does it result in more and better impact at the farm level?
- What difficulties and challenges have you and your colleagues face in implementing the approach?

You can also compare productivity and profitability across farmers groups and products.

CHAPTER IV.
EVALUATION

401 EVALUATION OF TRIAL OR/AND DEMONSTRATION PLOT

The trial/demonstration activities have been conducted properly. It is time to discuss the results among stakeholders. Help them review both the qualitative and quantitative aspects.

PROCEDURE

1. Information sharing about production, input cost, and profitability

This is a comparison process between the trial plot and control plot. Here, information recorded in Chapter III is utilized. Calculation to be used for the comparison process is as follows (see also Table 401-1).

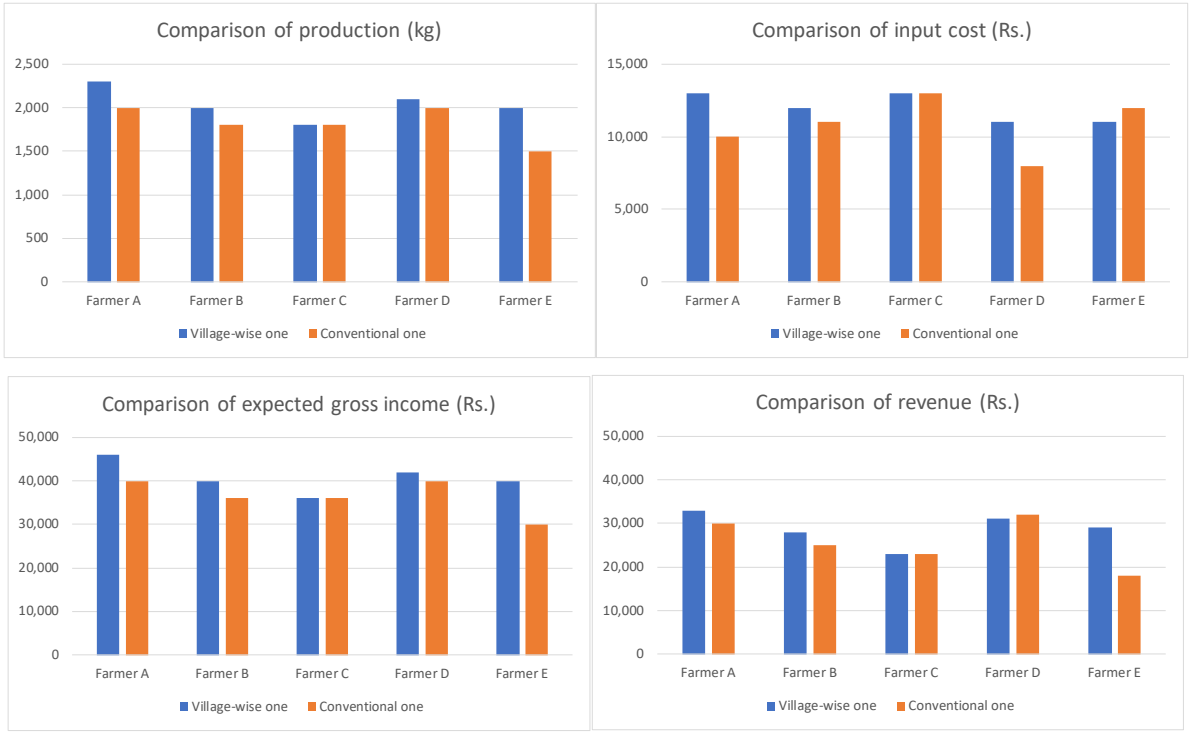
- Firstly, the harvest of each plot is compared after weighing. If farmers have their own measurement unit, it would be advisable to use them for better understanding.
- Then, calculate all the input costs between the trial plot and control plot from the record.
- Expected income is also evaluated by multiplying production amount by market price at the time of harvesting.
- Lastly, revenue is calculated by subtracting input from expected income.

These information are recommended to be described, as shown in Figure 401-1, for easy understanding.

Table 401-1 Calculation Formula for Evaluation

Item	Formula
Input cost	(Purchased item) + (Machinery cost) + (Hired labor), etc.
Expected gross income	(Production weight) x (market price)
Revenue	(Expected income)–(input)

Source: JICA Project Team



Source: JICA Project Team

Figure 401-1 An example of "production, input cost, gross income, and revenue comparison"

2. Information sharing about farming practice

Production may vary from farmer to farmer, although they are expected to apply the same techniques based on the village-wise technical guide. It is necessary to discuss why their production differs to one another to make the technical guide more village-wise one. There are several reasons for this, for instance, timing of certain farming practices, such as transplanting, fertilizer application, weeding, pest and disease management, may be different. If there are any points that need to be improved, they should be reflected into the guide.

3. Information sharing about cropping calendar with farming practices

In some cases, as shown above, harvested produce under the market-wise cropping calendar is lower than those under the conventional one. In contrast, revenue is higher in market-wise cropping calendar in any case. There may be a feasibility of newly-introduced market-wise cropping calendar, as its profitability is superior to the conventional one. But, as long as there is a gap between productions, there is room to improve productivity of market-wise cropping calendar for more profitability.

It is necessary to discuss why their production differs to one another and to make market-wise cropping calendar more profitable one from the technical aspect. There are several reasons for this, for instance, timing of certain farming practices, such as transplanting, fertilizer application, weeding, pest and disease management, may be different.

402 PLANNING THE NEXT SEASON

The farmers have reviewed the previous season. Now it is time to plan for the next season using the experiences that they have gained. You should help them do this well before the start of the next season so that they will have the time to explore markets, purchase inputs, and apply for any loans that they may need.

SAME PRODUCT AND MARKET

If they plan to target the same product and market, they probably will not need to gather a lot of new information. They can use the information and contacts that they already have. But farmers should still check whether any major changes have taken place, for example, in prices or market. Perhaps they can renew agreements or contracts with buyers and negotiate loan arrangements with financial institutions on similar terms to the previous season.

DIFFERENT PRODUCT OR MARKET

If the farmers decide to switch (or add) products or target a different market, they will probably need to do more work to gather and analyze information. You may need to help them do this.

SEEKING IMPROVEMENT

It is always possible to make improvements, even in the most successful season. Encourage the farmers to look for ways to cut costs, increase their output, obtain better prices, or invest money in a more effective way.

PROFITABILITY ANALYSIS

Help the farmers repeat the profitability analysis to estimate their costs, income, and profit for the crops to be cultivated in the next season.

INVESTING IN THE ENTERPRISE

Encourage the farmers to re-invest part of their profits in profitable ventures. They may do this as individuals (for example, by buying seed, fertilizer or equipment for their farms), or as a group (building a warehouse to store grains). The higher the farmer's savings to cover the costs of materials and labour, the more the farmer will keep the profit at the end of the year.

ATTACHMENT
TECHNICAL GUIDE
FOR BAIDC MEMBERS

TECHNICAL GUIDE
FOR
BAIDC MEMBERS

The followings are the list of the printed materials utilized for extension activities of the JICA TCP.

- Paddy seeds selection, and soaking and incubating of paddy seeds were drawn up as it was considered to be necessary to share similar skills among farmers in Champai, Aibawk and Kolasib areas as the skills are differed depending on areas.
- Then, since it was difficult to get labor for transplanting and weeding in most of the area, demand to utilize machines for the works was high as labor charges were expensive. Accordingly, the modified mat nursery, which could be utilized both for transplanting by hand or machine, was introduced.
- As it was considered necessary to make a systematic attempt to guide water management, weeding and leveling of paddy fields to land owners as a basic skill of paddy cultivation in Kolasib, a crop calendar was prepared. Officers and farmers shared the calendar, and checked by WhatsApp if necessary, operations were carried out by land owners or not. As a result, in the second year, many farmers turned to be able to harvest 4 – 6 t/ha of paddy.
- Further, it happened in a village that farmers got confused as 3 extension workers provided different technical guidance. This kind of the issue could be resolved by using printed materials.

It is considered that BAIDC members get together and have meetings for various issues to properly provide the extension services. In that occasion, it is required to prepare printed materials considering transfer methods of necessary knowledge and skills to farmers. Since Mizoram has one of the highest literacy rate in Indian, it should be maximized as a useful resource in Mizoram.

Table of Contents of the Technical Guide for BAIDC Members

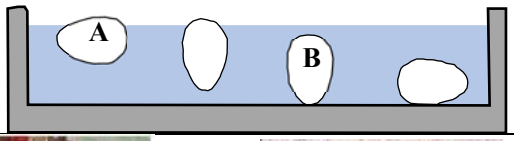
[Explanatory note]
Farmers' knowledge and techniques in Mizoram are mostly based on Jhum cultivation, and many WRC farmers prepare a nursery bed similar to the Jhum method. For example, one farmer in Champai prepared a nursery bed with the seed paddy just scattered on the ground and covered with fallen leaves without any treatment. Unfortunately, this technique makes it difficult to control highly contagious diseases. Farmers also want to obtain rice transplanter machines, and it is essential to use this kind of opportunity to promote new and better methods of nursery preparations. Here, to introduce IRRI's modified mat nursery, introduce several basic techniques.

Since many cultivation materials are available through websites, it is advisable to closely observe the situation in Mizoram and prepare a practical farmers' manual for Mizo.

Agricultural Technical Note Based on Experiences in Mizoram – JICA TCP

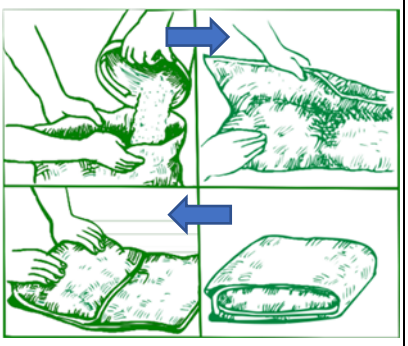
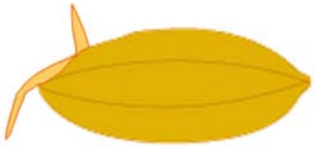
Technical Guidance:	Paddy seed selection
Target Area:	Sailam village (Jhum based traditional village)
ID. No.:	WRC-1
Date Created:	2018/06/03, Revised 2020/05/12
Reference Materials:	**IRRI Rice Knowledge Bank, http://www.knowledgebank.irri.org/ and** Improved Rice Production Technology, NICRA India, Farmers' Guide, Extension Bulletin No 78 www.nicra-icar.in
Purpose/ Background:	 Most farmers prepare seed bed in the slope or flat land close to paddy field by simply clearing weeds with hand hoe as shown in photo, and then farmers sow paddy seeds there directly without seed selection or seed treatment etc. Some farmers soak seed while others do not. This type of method is usually practiced when farmers need transplanting in the Jhum land. This type of seed bed can be observed at various places in Mizoram except plain land area and most farmers have no doubt about their traditional method that is not easy to readily change . Therefore, proper and sustainable training for farmers to acquire basic agricultural knowledge and skills is indispensable for further agricultural development in Mizoram. As mentioned above, careful observation on farmers' agriculture practice in the field by officers is very important to provide proper and stepwise practical assistance to farmers. Farmers in Sailam village cultivate rice for self-consumption without use of chemical fertilizer and plant protection chemicals. Therefore, it is important to improve basic skill such as seed selection and farmers' habitual activity to avoid risk at initial stage of rice cultivation.
Expected Outcome:	To avoid Jhum style nursery for WRC

Contents	**Technical Guide**
How to ensure seed quality	Seed is a base of paddy cultivation. It must be cultivated, harvested, and processed correctly for the best results of yield and quality. Good seed is pure of a single variety. Purity and viability test of seed include (1) look, (2) germination rate (3), not mixing with other varieties, (4) not mixing with weed seeds and other crop seeds, (5) check of foreign material (stones, soil, etc.), and (6) moisture content. Many varieties have a dormancy period after harvest. When stored under traditional open systems, the germination rate of most of rice seeds begins to deteriorate rapidly after 6 months. To test seed germination: 1) Select a number of small random samples from the seed to be planted and select a subset (e.g., 200 seeds) of the ample. Soak the seed in water for 24 hours. 2) Arrange 100 soaked seeds in a grid pattern on a wet paper towel. - Place the paper in a closed container or - Cover the seeds with another moist paper towel and roll together and place the moist paper with seeds on a tray. 3) Ensure paper remains moist. 4) Count the germinated seeds after 3 and 5 days and record the number seeds germinated. 5) Compute the germination rate using the following formula:

	$$\text{Germination rate} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds on the tray}} \times 100$$ At least 80 seeds should be germinated to be considered to be "good seed" (80% germination).
Moisture content	Moisture content influences the life and vigour of the seed. The amount of moisture should be less than 14%, and preferably less than 12% for extended storage times. For measuring moisture content during harvesting, the most practical option is to use a resistance-type moisture meter that gives quick results and it is applicable for small samples.
How to obtain good seed	• Buy certified seed that is pure and guaranteed by DOA. • Get farmer-produced good seed, or • Select your own good seed (suitable for remote area in Mizoram). Ref.: Seednet India Portal: https://seednet.gov.in/
Discoloration	Fungi, bacteria, and environmental conditions such as high humidity and temperature (i.e. 27−35°) cause discoloration. Other rice diseases do not produce consistent discoloration. Any seed having more than 0.5% differently coloured or spotted seed surface is considered discoloured. Discoloration can occur on fully or partially filled or empty grains. There are two types of discoloration on rice seeds: 1) Spotting, which is caused by certain diseases (brown spot) or insects (vermiculate damage by rice bug) 2) Discoloration on a portion or portions of rice seeds can be caused by black kernel fungus, stack-burn disease, or sheath rot on certain occasions.
Seed Selection	• Selecting good quality seed has many advantages and will help to: 1) Improve yield, 2) Improve germination by more than 80%, 3) Reduce bacterial diseases etc. (by removing infected seeds such as the un-matured, light and pest infected seeds), 4) Maintain uniformity in plant size • Selecting healthy and viable seeds are important work for raising healthy seedlings. After bringing out from the store, seeds should be dried in the sun for 1 day, and then cleaned manually by air-flow. • Seed selection using salt solution (urea, mud soil can be used instead of salt) 2) Dissolve 2.5 kg salt in 10 litters of water for non-glutinous rice, 1.45kg salt in 10 litter of water for glutinous/ sticky rice. 3) Soaked seeds in the salt solution and stir. 4) Remove floating seeds by hand or with a sieve. 5) Wash seeds properly 3-4 times with clean water. 6) Dry in the shade thoroughly before sowing.
	• The specific gravity of liquid is able to understand in the float condition of a raw egg as shown in the following figure; A: 1.13 SG for non-glutinous. B: 1.08 SG for sticky rice. Note: SG is liquid Specific Gravity 
 Seed soaking  Stirring  Cleaning out unfilled seeds  Good filled seed under water	
Fungicide Seed Treatment	Dissolve 3 g fungicide (e.g., Benlate + Mancozeb or Arazone red alone) per kg of seed in 5 ml water inside a plastic bag or plastic bottle. Distribute fungicide slurry about the walls of the container. Place seed in container, seal, and shake to coat seed uniformly with fungicide slurry. Wear protective equipment and follow appropriate safety procedures. *Please refer to Improved Rice Production Technology, NICRA, Farmers' Guide also
N fixation	Use 1 g of 'Azospirillum sp.' inoculant (as a powder) per kg of seed and mix with primed wet seed just before sowing.

Agricultural Technical Note Based on Experiences in Mizoram – JICA TCP

Technical Guidance:	Soaking and incubating paddy seeds
ID. No.:	WRC-2
Date Created:	2018/06/03. Revised 2020/05/12
Reference Materials:	IRRI Rice Knowledge Bank, http://www.knowledgebank.irri.org/
Purpose/ Background:	It is observed that incubation period of stimulation for germination of paddy seed adopted by most of farmers is too long, and root of incubation seeds has grown by more than 1cm in Hnahlan and Buhchangphai. In this case, roots are easily damaged before and during sowing time. In addition, many farmers are sowing seeds without soaking. At least, farmers had better to know several methods to improve their farming for increasing yield.
Expected Outcome:	Jhum farmers in particular should acquire the necessary basic skills for WRC

Contents	**Technical Guide**
Soaking and Incubating Paddy Seeds **Materials required:** ▪ rice seeds ▪ bucket, @12 litre ▪ water ▪ pot label ▪ balance ▪ pencil	Soaking and incubating paddy seeds are two (2) steps in pre-germination. Pre-germinated seeds sown in the field or seedbed shall be less affected by birds and other pests because they require healthy growth. **Steps in soaking paddy seeds**. 1) Calculate the required quantity of seeds. Data needed in calculation: a) seeding rate (wet-bed/dry-bed: 40-50 kg/ha), b) area (ha) to be planted, c) germination rate The formula is: Quantity of seeds = seeding rate (kg/ha) x ha required / germination rate (%) 2) Weigh the seeds and place them in a container 3) Pour water into the container and raise the water level up to about 10 cm above the seeds as seeds are not floating. 4) Stir for at least 1 minute and remove the floating seeds. Poorly filled or damaged seeds are light and therefore they will float. Use your hand or a strainer to remove and discard floating seeds. 5) Wash the good seeds with fresh water. 6) Soak the seeds in fresh water in a bucket or drum for 24 hours. Keep the water level 10 cm above the seeds. If possible, change the water every 5-6 hours during the 24 hours soaking period. Keep the container at normal room temperature (27 degree Celsius or a little higher). 7) Label the seeds using the pot label indicating the name of variety and date & time soaked 8) Wash the soaked seeds by rinsing them with clean water.
Incubating rice seeds **Materials required:** ▪ Soaked seed for 24 hrs ▪ pot label ▪ Gunny sack ▪ Pencil ▪ Water ▪ sprinkler	 1) Wet the bag or sack to be used in incubating the seeds. It should be free from other variety seeds. 2) Place the seeds in an appropriate container. For a small quantity of seeds, use a cloth bag or gunny sack. Pour the seeds into the bag and fold it tightly. For a larger quantity of seeds, a large tray or the cement floor can be used. Spread the seed on the floor in a layer of 10-15 cm depth and keep them covered with moist sacks. 3) Label the seeds: Use a wooden label, as in the soaking operation. Add the date of incubation. Put the label on top of the incubating seeds. Let the seeds germinate: Keep the bag of seeds in a shaded place. Turn the bag twice a day at 12 hr intervals to improve aeration. Keep it moist by sprinkling water each time you turn it. If the seeds are on the cement floor, mix them by hand every 12 hour: Sprinkle water on the seeds while mixing. Keep the sacks moist and keep the seeds from becoming too hot throughout the incubation period. Seeds must be incubated for 24-48 hours. A 2–3-millimetre radicle will grow from each germinated seed.
	No Good Exceeding appropriate time  **Good**  

Modified mat nursery (No. WRC-3E)

http://www.knowledgebank.irri.org/training/fact-sheets/crop-establishment/modified-mat-nursery

What is a modified mat nursery?

A modified mat nursery establishes seedlings in a layer of soil mix on a firm surface. Seedlings are ready for planting within 15–20 days after seeding (DAS).

Why use a modified mat nursery?

The modified mat nursery uses less land, can be installed closer to the house than traditional field nurseries, and uses less labor for both transporting seedling mats and replanting. As a result, root damage is minimal while separating seedlings.

How to establish a modified mat nursery?

1. **Seed:** To plant 1 ha (with 2 seedlings/hill at 20 X 20 cm spacing), use 18–25 kg good quality seeds (i.e., >80% germination and establishment). Note: Good seeds result in lower seed rate, more uniform germination, vigorous seedlings, less replanting, fewer weeds, and 5–20% increase in yields.
2. **Nursery area:** Prepare 100 m^2 nursery for each 1 ha to be planted. Select a level area near the house and/or a water source. If the area is not sufficiently compacted, then spread a plastic sheet or banana leaves on the marked area to prevent roots growing into soil.
3. **Soil mixture:** Four (4) m^3 of soil mix is needed for each 100 m^2 of nursery. Mix 70–80% soil + 15–20% well-decomposed organic manure + 5–10% rice hull or rice hull ash. Incorporate around 20 kg N/ha (1.5 kg powdered diammonium phosphate or 2.0 kg 15-15-15 powdered NPK fertilizer for every 100 m^2 of nursery area).

4. **Pre-germinating seed:** Soak the seeds for 24 h (some varieties may need longer to bud). Drain and incubate (cover and keep moist) the soaked seeds for another 24 h. At this time, the seeds sprout (bud) and the first seed root grows to 2–3 mm long.
5. **Laying the soil mixture:** Place a wooden frame of 0.5 m long, 1 m wide and 4 cm deep divided into 4 equal segments on the plastic sheet or banana leaves. Fill the frame almost to the top with the soil mixture.
6. **Sowing:** Sow the pre-germinated seeds uniformly and cover them with a thin layer of dry soil. (Approximately 1 seed/cm^2)
7. **Soaking the seedbed:** (a) Sprinkle water immediately to soak the bed. (b) Remove the wooden frame and continue the process (i.e., fill soil mix-sow seed-cover seed-water) until the required nursery area is completed.
8. **Watering:** Water the nursery as needed to keep the soil moist. Protect the nursery from heavy rains for the first 5 days after seeding (DAS). If the nursery can be flooded then at 7 DAS, maintain a 1 cm water level around the mats. Drain the water two days before removing the seedling mats for transplanting.
9. **Fertilizer topdressing (optional):** If the temperature and water are adequate, but the seedlings show yellowing (N deficiency), then sprinkle seedlings with 0.5% urea (1.5 kg Urea in 300 l water/100 m^2).
10. **Lifting seedling mats:** Seedlings reach sufficient height for planting in 15–20 DAS. Lift the seedling mats and transport them to the main field.

Limitations

The system is best suited for irrigated areas. If transplanting is delayed, seedlings can be damaged when separated for planting.

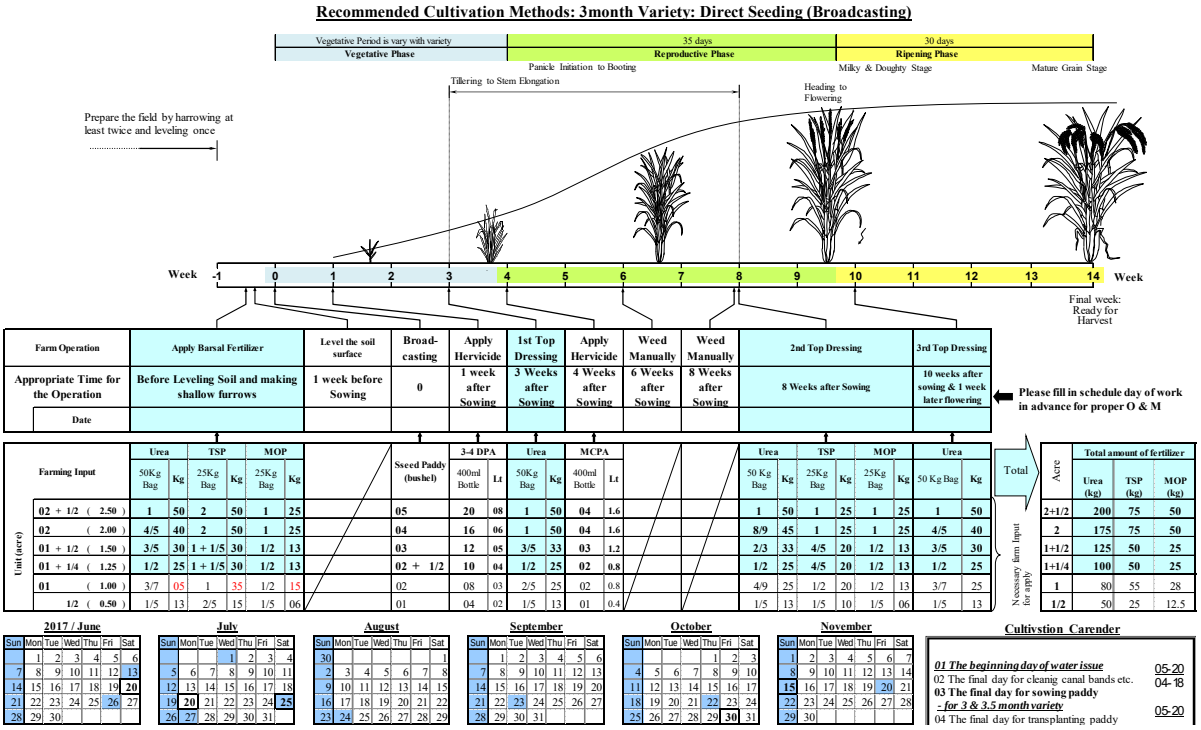
Developed with input from V Balasubramanian, MA Bell, and JF Rickman.

Technical Guide How to Make & Use Crop Calendar for Farmers

1. Use a Crop Calendar for Rice and Other Crops as Technical Guide

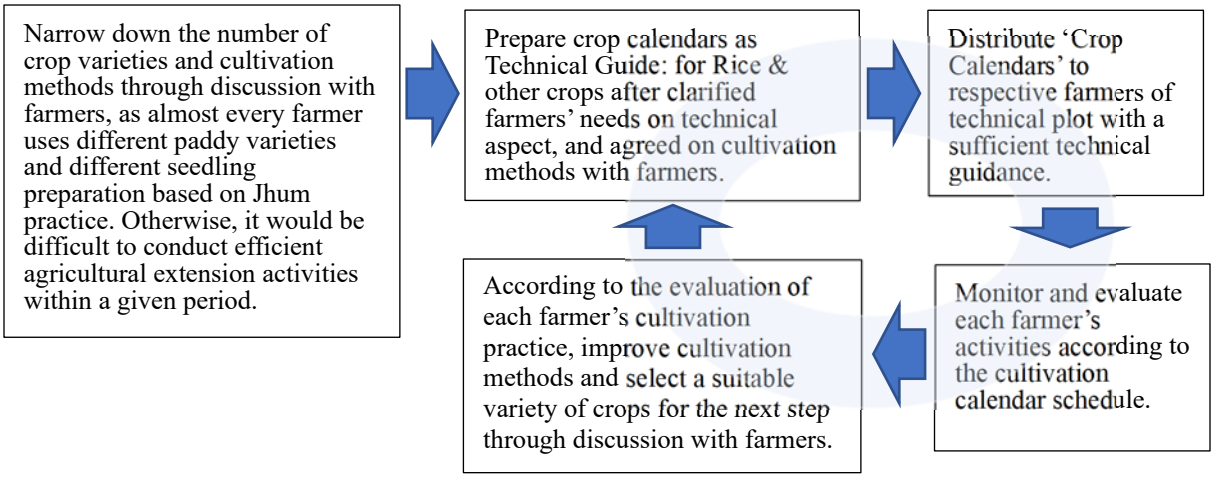
A crop calendar is a pictorial explanation of rice growing process and other crops with necessary cultivation management and technical guide. It is better that agriculture activities and farming management are planned and implemented at right time by using a crop calendar as technical guide. It is also easier to manage step-wise arrangement of farming process in advance for labour arrangement and procurement of inputs such as seed and fertilizer. Better and advanced arrangement for cultivation result in increase in yield and income.

Technical guidance for farmers on the cultivation of rice and other crop such as soya bean, maize etc. should be implemented by using a crop calendar to improve the production. Therefore, a crop calendar should be prepared with the study of cultivation practice in each village or place, especially in Mizoram.



How to utilize a crop calendar

Crop calendar will be a main tool to improve cultivation techniques and productivity of crops by distributing crop calendar to farmers with adequate technical guidance as following cycle process.



Capacity building of both officers and farmers will be implemented through this **cycle** process, and extension system also expected to improve step by step. Therefore, technical guidance for farmers, periodical monitoring and evaluation activities with farmers are very much important.

How to make a crop calendar

1) Check and decide variety of paddy with farmers and cultivation methods and determine a period for sowing/ planting to harvest depending on variety.

   - Number of crop calendar is determinable by number of rice variety and cultivation methods.
   - Methods of cultivation: The sowing method is determined by the paddy land condition, costs and farmers' degree of technical skills.
   - For the effective and efficient utilization of crop calendar to improve rice cultivation, select few varieties in number and select same methods of cultivation as much as possible through the discussion with farmers. Otherwise, it is necessary to prepare many different type of crop calendar and technical guidance for farmers will be complicated.

2) The period of vegetative phase differs with variety, and that of the reproductive and ripening phases are fairly constant for most varieties. The reproductive phase lasts about 35 days; the ripening phase lasts about 30 days. Based on this reproductive and ripening phase, entire growth duration including land preparation period is drawn in the crop calendar as shown in Annex 1 (1), (2) & (4).

3) Based on the growth duration of selected rice variety, time of sowing, transplanting, panicle initiation stage, heading to flowering, flowering, milky doughy stage and mature grain stage are marked with explanation note in the crop calendar as shown in Annex 1 (3).

4) Prepare table in the crop calendar to fill each farm operation item by indicating suitable work time as shown in Annex 1 (5).

5) Make blank table under each farm operation item in order that respective farmers are able to fill scheduled date on each of sowing, planting and other works such as ploughing, levelling, weeding, fertilizing, and harvesting, etc. as shown in Annex 1 (6).

6) Make a table of farming input as shown in Annex 1 (7). The said farming inputs are fertilizer, insecticide, agrichemical, weedicide and compost. Officers shall calculate adequate amount of those inputs and show proper time to apply. In addition, since farmers do not have proper equipment of measuring scale, amount of those inputs had better indicate by bag or cup which is exiting everywhere with farmers.

7) Make a calendar of the year for filling out the date according to above farm operation schedule as shown in Annex 1 (8).

8) Especially it is necessary for efficient operation and management of irrigation water by preparing an agreed-upon schedule for irrigation and farm activities by WUA or FO as shown in Annex 1 (9).

9) Mentione important overall managements such as effective application methods of fertilizer, weed management and water management for getting high yield as shown in Annex 1 (10).

   Note: It is important that farmers stick the crop calendar in a house or any other place to check when each work needs to be done. Meanwhile, the BAIDC shall contact each farmer or farmer group leader over the phone or WhatsApp to ensure that farmers are carrying out their farming activities according to the calendar schedule.

Reference:

1. Steps to successful rice cultivation, IRRI, ISBN 978-971-22-0313-8
2. Status Paper on Rice in North East India, Dr. S. V. Ngachan, Dr. A. K. Mohanty & Dr. A. Pattanayak, Director, ICAR Research Complex for NEH Region, Umiam-793193, Meghalaya, Principal Scientist & Head, Division of Plant Breeding & Genetics, ICAR Research Complex, Umiam, Meghalaya. Landraces and varieties of rice of NE India

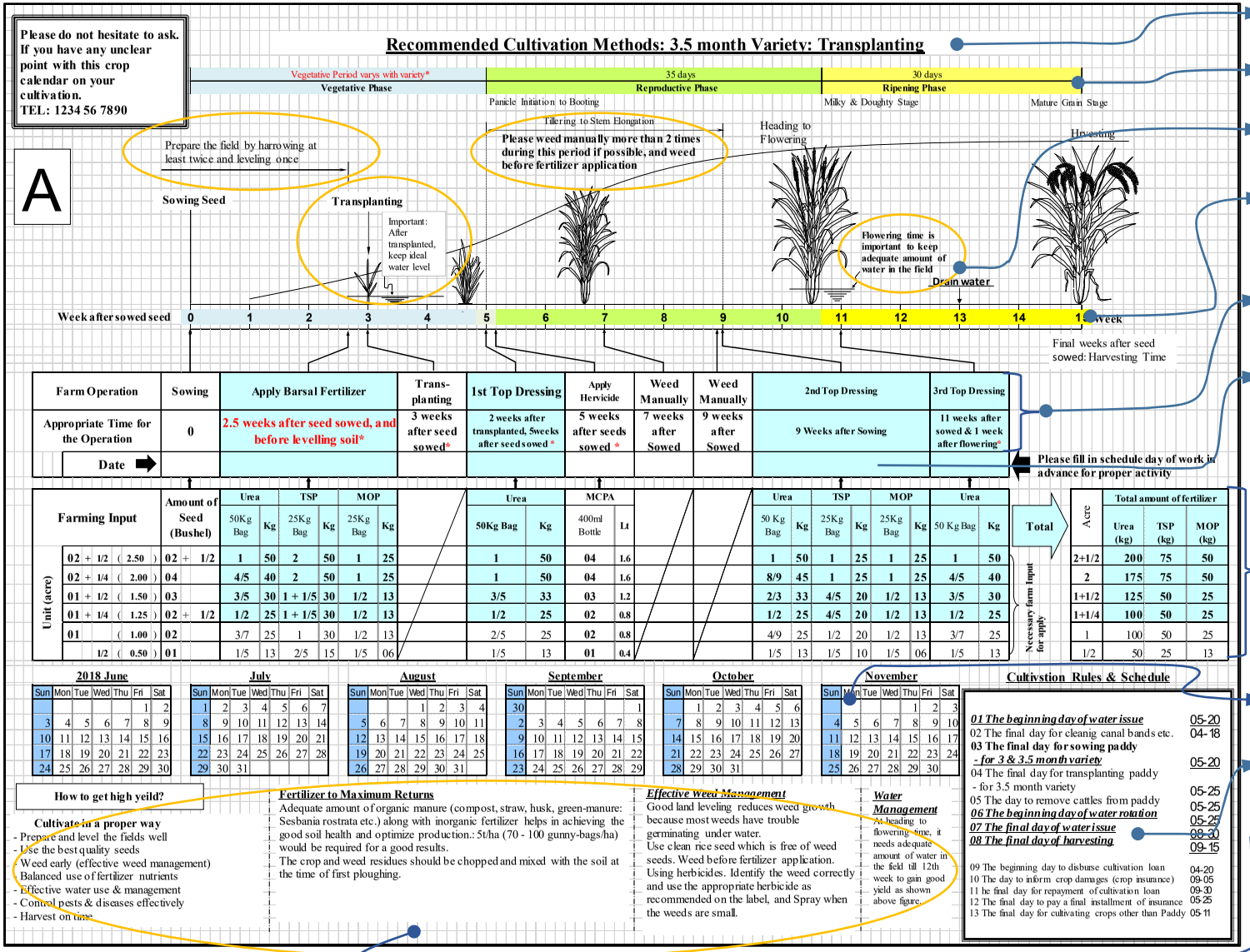
Some landraces, breeding lines and varieties of NE India are mentioned below:

1) Mizoram:
Tangate, Zichum, Batetype, Ugemap,Taisanghar, Thlanchhuab, Matani, Kangpui, Idaw, America, Mizo, Buhtial, Taiklawngh, Farate, Mizo (big), Maibasa, Maibring, Rungteinn, Buhtui, Bahbite, Releng, Buhskhi, Ringteii, Bangbow, Taikouwn, Nagatai, Taikawnpui, Veipheitai, Taifarete, Lengpui, Kawinglawntawi, Thawkmawh, Relengwi, Rungfei, Maibasapui, Mawbuh, Farel, Maotai, Tai, Rungtai, Birichuk, Kawnlong Taikarlang, Lawngtlai, Lawngtalawai, Chinairi, MP 2, LP 8, Horipui, Baitarisno, Pawnbuh, Sihletma, Ngarempaoo, Mang, Champhai, Tui, Rangoon, Manbuh, Bu, Fazaitai, Trai, Traivuban,Buhchi, Idaw, Boban, Buhbantharam, Buhpui, Puthalama, Mangbuh, Zorambuh, Fangsang, Fangsin, Zotawuh, Buhbawn, Tialte, Zerusalem, Ngokawi, Rengkoi, Americabuh, Nonglwai, Majhera, LT 4, LT 2, LT 3, LP 9, LT 9, LP 6, LP 5, Bapnah, Lakang, LP 7, Lumum, Heijong, Midokru, Mantai, Chinairi, Manusal, Leiletbuh, Maibiring, Thalnchhuah, Buhte, Kangpui, Taisanghar, Farete, Pumphir, Phulbuh, Taibialbuh, Maibiring

2) Manipur
Breeding Lines
Manipur: RCM6, RCM5

3) Rice varieties developed/ identified by ICAR Research Complex for NEH Region
Khonorullo, NEH Megha Rice 1, NEH Megha Rice 2 , Ngoba, RC Manipbou 4, RC Manipbou 5, RC Manipbou 6, RC Manipbou 7, TRC-Borodhan-1, Bhalum1 & 2, Lumpnah 1, Sahsarang1, Lungniaphou

ANNEX 1



(1) Growth duration & Cultivation Methods

(2) Growth phase (Vegetative, Reproductive, Ripening)

(3) Important technical guidance in each stage is mentioned

(4) Weeks: from land preparation work to harvesting time

(5) Each farm operation items and suitable work time are mentioned

(6) Fill out scheduled date of each farm operation by each farmer

(7) Since appropriate application time and adequate amount of fertilizer, herbicide and insecticide are mentioned according to the land area, farmers apply those materials in the right quantity at the right time by check this calendar

(8) Calendar of the year for filling out the above mentioned schedule of farm operation

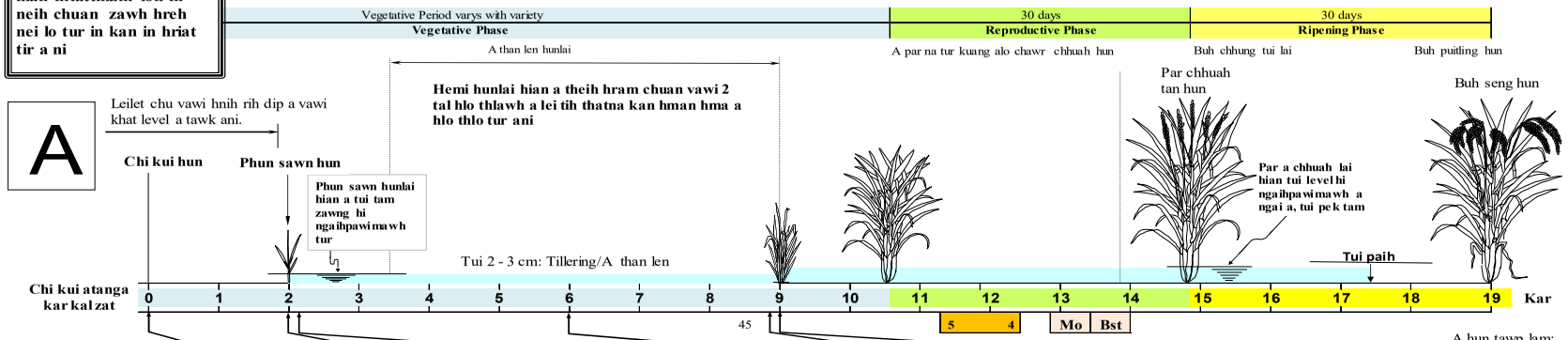
(9) An agreed-upon schedule for irrigation and farm activities by WUA or FO.

(10) Important overall managements are mentioned such as weed, water management

Sample of Crop calendar of Gomati variety for Farmers (Mizo)

Khawngaih in he mi thlai calendar chungchang ah hian hriatthiam loh in neih chuan zawh hreh nei lo tur in kan in hriat tir a ni

CROP Calendar for GOMATI: Phun Sawn Hun



Lo Enkawl Hna	Buh chi kui	Basal fertilizer pek hun	Phun sawn hun	Apply Hervicide	Kut a hlo thlo	Kut a hlo thlo	Top Dressing
Hna Thawh hun tur tha ber	0	Buh Phunsawa hma ni khat emaw ni hnih hnu ah leitha kan hmang ang. Lei let level hma atih tur.	Chi kui atanga kar 2 na	5 weeks after sowing	Chi kui atanga kar 6 na	Chi kui atanga kar 9 na	Buh kui atanga thla 9 na
Ni ➡							

In hnahthawh ni apiang in in lo ziak thla thin dawn nia

Leilet/huan sian nan a mamawh dan		Buh chi hman zat (Kg)		Urea		DAP		MOP		MCPA 400ml Bottle	MCPA Lt	Urea		DAP		MOP	
Unit (Bigha)	3 (1 acre)	20	Kg	15	Kg	15	Kg	10	Kg	04	1.6	20	Kg	23	Kg	16	Kg
	2.5 (0.8 ac)	16	Kg	12	Kg	8	Kg	8	Kg	04	1.6	16	Kg	18	Kg	13	Kg
	2 (0.7 ac)	14	Kg	10	Kg	7	Kg	7	Kg	03	1.2	14	Kg	16	Kg	11	Kg
	1.5 (0.5 ac)	10	Kg	7	Kg	5	Kg	5	Kg	02	0.8	10	Kg	12	Kg	8	Kg
	1 (0.3 ac)	06	Kg	4	Kg	3	Kg	3	Kg	02	0.8	6	Kg	7	Kg	5	Kg
	0.5 (0.15 ac)	03	Kg	2	Kg	1.5	Kg	1.5	Kg	01	0.4	3	Kg	3.5	Kg	2.5	Kg

Total

huan siam nan a mamawh tul kn hman te

Bigha	lietha hman zat		
	Urea (kg)	DAP (kg)	MOP (kg)
3	35	38	26
2.5	28	26	21
2	24	23	18
1.5	17	17	13
1	10	10	8
0.5	5	5	4

2018 June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September

Sun	Mon	Tue	Wed	Thu	Fri	Sat
30						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

October

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

November

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Engtin nge buh seng tur kan tih pun ang?

A chin dan dik tak a chin

- uluk tak a ahmun buatsaih leh tih zawl dap
- Achi tha thei ang ber hman tur
- Hlo thlo hma (Sawt taka thawh)
- Lei tih thatna in tluk tlang taka hman
- Tui tha tak leh sawt taka hmang
- Buh tichhe tu leh natna te lak atanga inven that
- A hun tak a Buh seng

Lei tih thatna hmanga thar chhuah tih tam

Organic manure tam tawk ve tak (compost, straw, husk, green-manure: Sesbania rostrata etc.) inorganic fertilizer hman dawn chuan lei hrisel takin kan chhuah theih mai baka thlai thar tha tak kan nei thei ang.: 5t/ha (70 - 100 sai ip bag/ha) thlai thar tha tur in a tawk viau ang.
Kan thlai leh hnim kuangbang te chu lei kan leh hmasa berin lei nen a tha tak chawhpawlh a tha.
Chemical fertilizers ai chuan Oil cake te, favai te, ar ek te, compost te, Bokashi, Bamboo/ wood ash, hnim hring leh thlai hring atanga lei tha te, etc. chu organic agriculture atan hman tangkai theih vek anni. Amaherawhchu hun a mamawh deuh dawn ani a chhan chu thiamna leh hriatna neih ve a ngaih dawn

Sawttaka Hlo thlo

Uluk tak a ahmun tih zawl a tui dah hian hnim to tur atibuai/veng ani
Buh chi fai tak hnim chi emaw bawlhhlawh dang nen in pawlh te chu hmang loh tur ani. Lei tih thatna kan hman hma in hlo thlo tur ani.
Hlo tur kn hman dawn reng reng in eng hlo nge a nih th kn chian hmasa tur a ni a chuan a hman zat tur dik tak a abur /bawm a a inziah dan a hman tur ani,hnim chu a la tet lai a hlo tur a kah tur ani

Tui pek dan tur

Buh in par a chhuah dawn hunlai hi tui a mamawh hunlai ber ani a, hemi hunlai hian tha taka tui pek tur ani. Tui pek that hunlai hi a kar 12 na thleng vel a awh ani.A lem ah khian

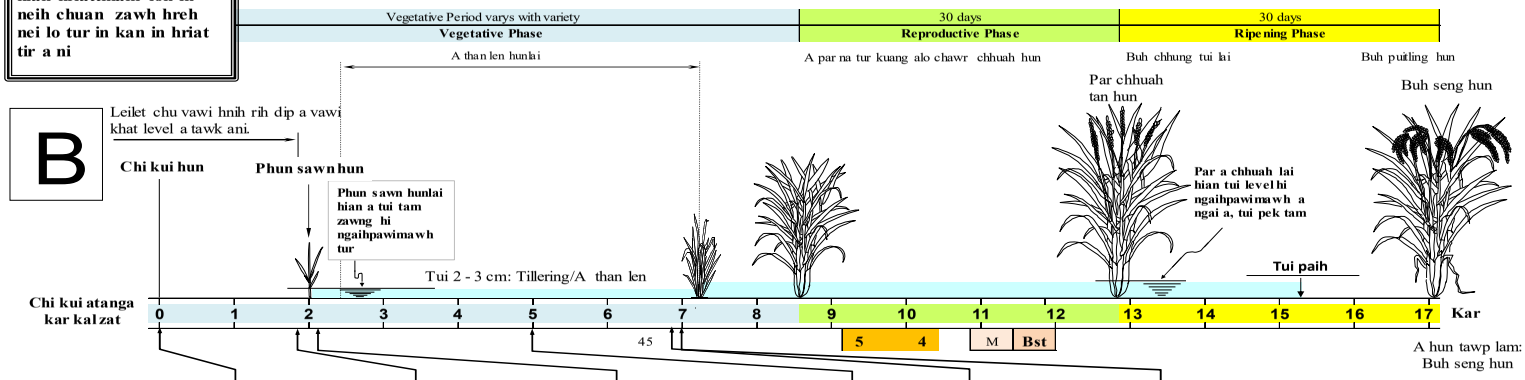
Cultivation Rules & Schedule

01 The beginning day of water issue	05-20
02 The final day for cleaning canal bands etc.	04-18
03 The final day for sowing paddy - for 3 & 3.5 month variety	05-20
04 The final day for transplanting paddy - for 3.5 month variety	
05 The day to remove cattle from paddy	05-25
06 The beginning day of water rotation	
07 The final day of water issue	05-25
08 The final day of harvesting	

Sample of Crop calendar of Tripura-Nirogi variety for Farmers (Mizo)

Khawngaih in he mi thlai calendar chungchang ah hian hriatthiam loh in neih chuan zawh hreh nei lo tur in kan in hriat tir a ni

Crop Calendar for Tripura-Nirogi: Transplanting



Lo Enkawl Hna	Buh chi kui	Basal fertilizer pek hun	Phun sawn hun	Apply Hervicide	Kut a hlo thlo	Kut a hlo thlo	Top Dressing
Hna Thawh hun tur tha ber	0	Buh Phunsawa hma ni khat emaw ni hnih hnu ah leitha kan hmang ang. Lei let level hma atih tur.	Chi kui atanga kar 2 na	5 weeks after sowing	Chi kui atanga kar 7 na	Chi kui atanga kar 7 na	Buh kui atanga thla 7 na
Ni ➡							

In hnahthawh ni apiang in in lo ziak thla thin dawn nia

Leilet/huan sian nan a mamawh dan	Buh chi hman zat (Kg)	Urea	DAP	MOP	MCPA 400ml Bottle	MCPA Lt	Urea	DAP	MOP	Total
Unit (Bigha)										
3 (1 acre)	20 Kg	15 Kg	15 Kg	10 Kg	04	1.6	20 Kg	23 Kg	16 Kg	
2.5 (0.8 ac)	16 Kg	12 Kg	8 Kg	8 Kg	04	1.6	16 Kg	18 Kg	13 Kg	
2 (0.7 ac)	14 Kg	10 Kg	7 Kg	7 Kg	03	1.2	14 Kg	16 Kg	11 Kg	
1.5 (0.5 ac)	10 Kg	7 Kg	5 Kg	5 Kg	02	0.8	10 Kg	12 Kg	8 Kg	
1 (0.3 ac)	06 Kg	4 Kg	3 Kg	3 Kg	02	0.8	6 Kg	7 Kg	5 Kg	
0.5 (0.15 ac)	03 Kg	2 Kg	1.5 Kg	1.5 Kg	01	0.4	3 Kg	3.5 Kg	2.5 Kg	

huan siam nan a mamawh tul kn hman te

Bigha	lietha hman zat Urea (kg)	DAP (kg)	MOP (kg)
3	35	38	26
2.5	28	26	21
2	24	23	18
1.5	17	17	13
1	10	10	8
0.5	5	5	4

2018 June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September

Sun	Mon	Tue	Wed	Thu	Fri	Sat
30						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

October

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

November

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Cultivation Rules & Schedule

01 The beginning day of water issue 05-20
02 The final day for cleaning canal bands etc. 04-18
03 The final day for sowing paddy
- for 3 & 3.5 month variety 05-20
04 The final day for transplanting paddy
- for 3.5 month variety
05 The day to remove cattle from paddy 05-25
06 The beginning day of water rotation
07 The final day of water issue 05-25
08 The final day of harvesting

Engtin nge buh seng tur kan tih pun ang?

A chin dan dik tak a chin
- uluk tak a ahmun buatsaih leh tih zawl dap
- Achi tha thei ang ber hman tur
- Hlo thlo hma (Sawt taka thawh)
- Lei tih thatna in tluk tlang taka hman
- Tui tha tak leh sawt taka hmang
- Buh tichhe tu leh natna te lak atanga inven that
- A hun tak a Buh seng

Lei tih thatna hmanga thar chhuah tih tam

Organic manure tam tawk ve tak (compost, straw, husk, green-manure: Sesbania rostrata etc.) inorganic fertilizer hman dawn chuan lei hrisel takin kan chhuah theih mai baka thlai thar tha tak kan nei thei ang.: 5t/ha (70 - 100 sai ip bag/ha) thlai thar tha tur in a tawk viau ang.
Kan thlai leh hnim kuangbang te chu lei kan leh hmasa berin lei nen a tha tak chawhpawlh a tha.
Chemical fertilizers ai chuan Oil cake te, favai te, ar ek te, compost te, Bokashi, Bamboo/ wood ash, hnim hring leh thlai hring atanga lei tha te, etc. chu organic agriculture atan hman tangkai theih vek anni. Amaherawhchu hun a mamawh deuh dawn ani a chhan chu thiamna leh hriatna neih ve a ngaih dawn

Sawttaka Hlo thlo

Uluk tak a ahmun tih zawl a tui dah hian hnim to tur atibuai/veng ani
Buh chi fai tak hnim chi emaw bawlhhlawh dang nen in pawlh te chu hmang loh tur ani. Lei tih thatna kan hman hma in hlo thlo tur ani.
Hlo tur kn hman dawn reng reng in eng hlo nge a nih th kn chian hmasa tur a ni a chuan a hman zat tur dik tak a abur /bawm a a inziah dan a hman tur ani,hnim chu a la tet lai a hlo tur a kah tur ani

Tui pek dan tur

Buh in par a chhuah dawn hunlai hi tui a mamawh hunlai ber ani a, hemi hunlai hian tha taka tui pek tur ani. Tui pek that hunlai hi a kar 12 na thleng vel a awh ani.A lem ah khian entir ani.

[Explanatory note]

Many state government officials simply tell farmers, 'Use this herbicide'. However, it is difficult for farmers to continue using such agrochemicals because dealers are far away from the villages and those are expensive for farmers' tight household budget.

So, we considered if we could make a weeder that would be inexpensive and easy for farmers to make and use. As a result, we devised five (5) weeders that farmers could easily make for between Rs. 50 and Rs. 300.The instructions for making them are summarized below.

HANDMADE MANUAL WEEDERS

1. Development of Handmade Weeders

Many farmers mentioned that the Cono weeders (Figure 1) provided by DOA were heavy and difficult to handle and therefore hard to use for weeding work, especially for women. And few farmers used the Cono weeders during paddy cultivation. However, since weeding is one of the essential tasks in paddy cultivation to increase yields, JPT and BAIDC tried to develop several handmade low-cost manual weeders with resources available to farmers.

	Kono-weeder Provided by DOA Material: Mild Steel Total length: 1550 mm Weight: 5.5 – 6.0 kg Price: Rs. 1,200 – 1,600 as of 2021

Source: JICA Project Team

Figure 1 General Feature of Cono weeder

JPT and BAIDC members developed four (4) types of weeders based on farmers' ideas and suggestions in Mizoram. Then tested them repeatedly at pilot farmers' paddy fields, and four (4) weeders were selected from eight (8) weeders, and those weeders will be introduced to the other farmers through BAIDC activities.

The four (4) weeders are tentatively named: i) Brush type weeder, ii) Saw blade weeder, iii) Mini wooden disc weeder and iv) Wire weeder. In addition, farmers can make all four weeders by themselves or by asking for village carpenters at a low cost.

2. Method of Making and Main Features of Each Weeder

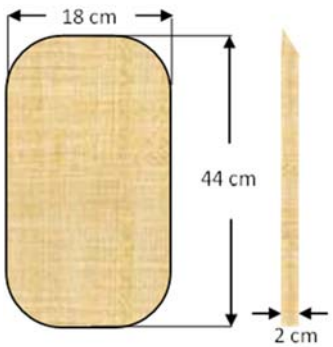
1) Brush Type Weeder

(1) Materials:

- Plank: Thickness around 2 cm x width 18 cm x length 44 cm – 01 nos.
- Handle: dia. 2.5 cm x length around 180 cm – 01 nos.
- Screw & nut: length 6 cm – around 20 nos.
- Iron wire: around 490 cm (total used)

(2) Cost:

Rs. 300 maximum per one set (plank + handle = Rs. 270, Screw & wire = Rs.30)

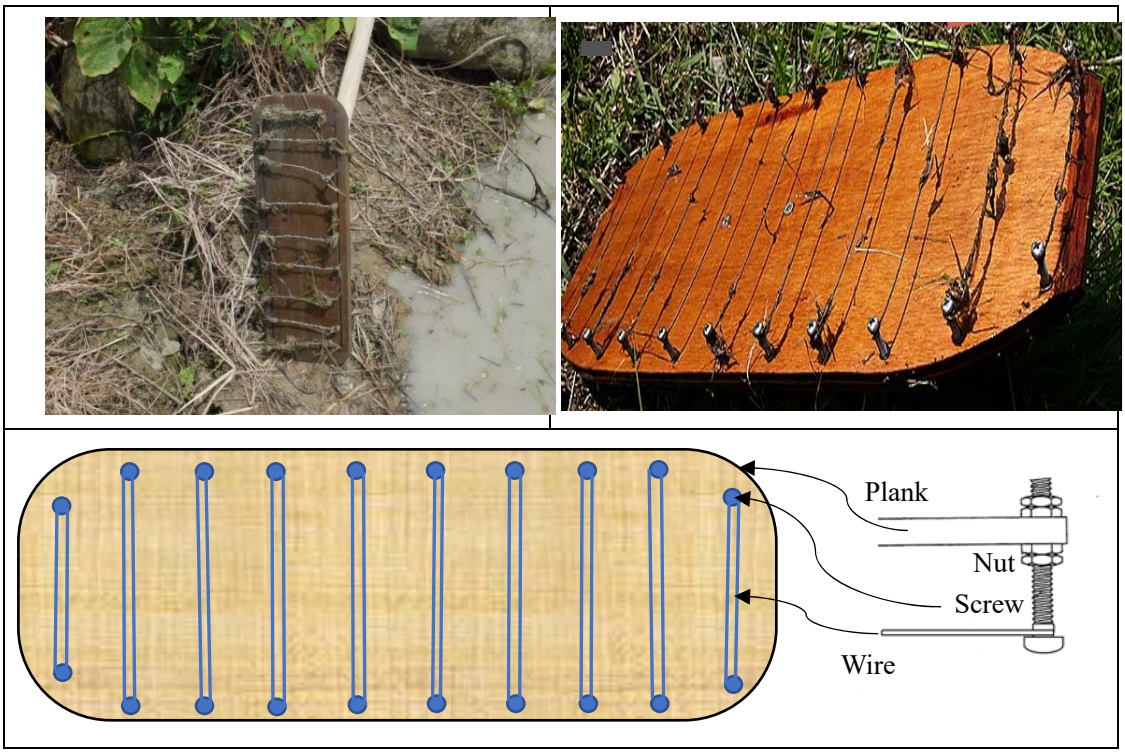


Source: JICA Project Team

Figure 2 Size of Plank

(3) How to make

As shown in the Figure 3 below, first fix the screws and nuts to the board (approx. 10 rows). Then, wrap the wire around the two bolt. Twisting the wire makes it even sturdier.

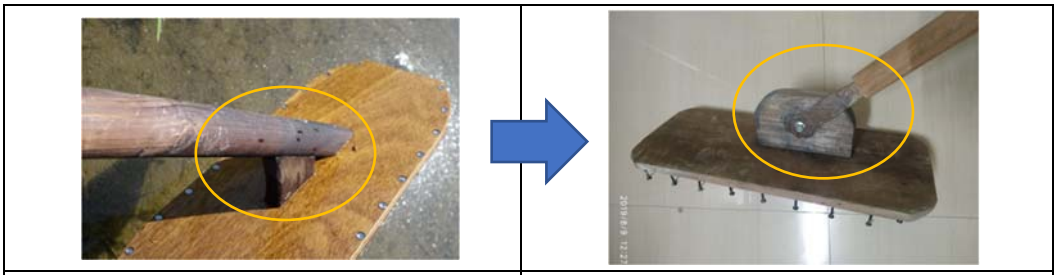


Source: JICA Project Team

Figure 3 How to Fix Screws, Nuts and Wire to the Board

(4) Selection of the handle mounting method

in Different designs of this type of weeder were made and tried. One was designed in such a way that the handle can be locked at two angles, 30° and 40°, using bolts and nuts. Another design was made such that the handle could freely move at different angles depending upon the position of the user. After trial with farmers, it is concluded the brush weeder with freely moving handle was more convenient for the farmer to use comparing to the other brush manual weeder.



Locked Handle	Farmers Recommended Vertically Free-moving Handle

Source: JICA Project Team

Figure 4 Handle Mounting Method

(5) How to Use

- Best time to use this brush weeder is 5 to 10 days after transplanting and 8 weeks after transplanting. If weeding is delayed, weeding activities becomes a very hard work. Therefore, generally, weeding should be done before weeds grow above the water level.
- The weeder has to move back and forth on the ground 3 to 5 times to remove the weeds along with their roots as shown in the photo on the right. The movement of weeder makes the soil loose and improves the growing environment for the paddy.

Source: JICA Project Team

Figure 5 Floated weeds after weeded

- For proper use of these weeders, appropriate spacing of the rice plant is very important. At least line transplanting of paddy should be done for proper utilization of the weeders. Therefore, proper training should be given to the farmers at the time of transplanting.
- Farmers need to improve their paddy field like proper ploughing, maintaining the bunds, etc. for better result of this weeder. If the farmers follow these practices properly, the yield of paddy will (surely) increase.
- For timely implementation of these practices, it is very important that we make use of crop calendars.

Source: JICA Project Team

Figure 6 Weeding scene with Brush weeder in Sailam and Hnahlan Village

2) **Saw Blade Weeder**

Source: JICA Project Team

Figure 7 Saw Blade

Even in the remote villages of Mizoram, used saw blades (wood bandsaw blades) are available in sawmills or carpentry shops. Moreover, it is possible to obtain them free of charge. Two types of weeders (round type & Hoe type) were made by using the used saw blades.

Round Type Saw Blade Weeder

(1) Materials for making a simple structured weeder:

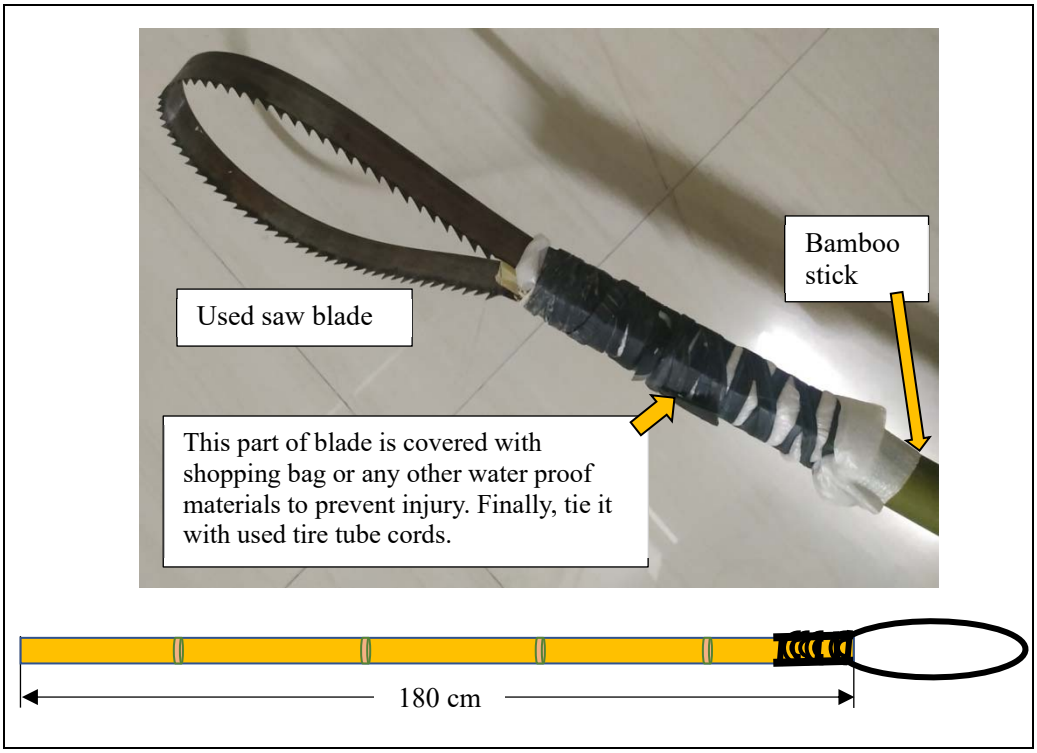
- Used saw blade: about 100 cm
- Bamboo stick: about 180 cm, dia. 2.5 – 3 cm
- Fixing string of wire (used tire tube cords are better)

(2) Cost:

Less than Rs.50. (Used saw blade and bamboo: Free of charge)

(3) How to make:

Simply tying a piece of blade making a round shape at a tip of a bamboo stick as shown in the Figure 8.



JICA Project Team

Fig 8 A piece of Used Saw Blade and Bamboo Stick Weeder.

Hoe Type Saw Blade Weeder

(1) Materials for Hoe type weeder

This weeder is designed in such a way that a piece of blade is welded with iron and attached to a wooden stick as shown in the Figure 9. Therefore, it takes a little more

time and costs to make this type of weeder.

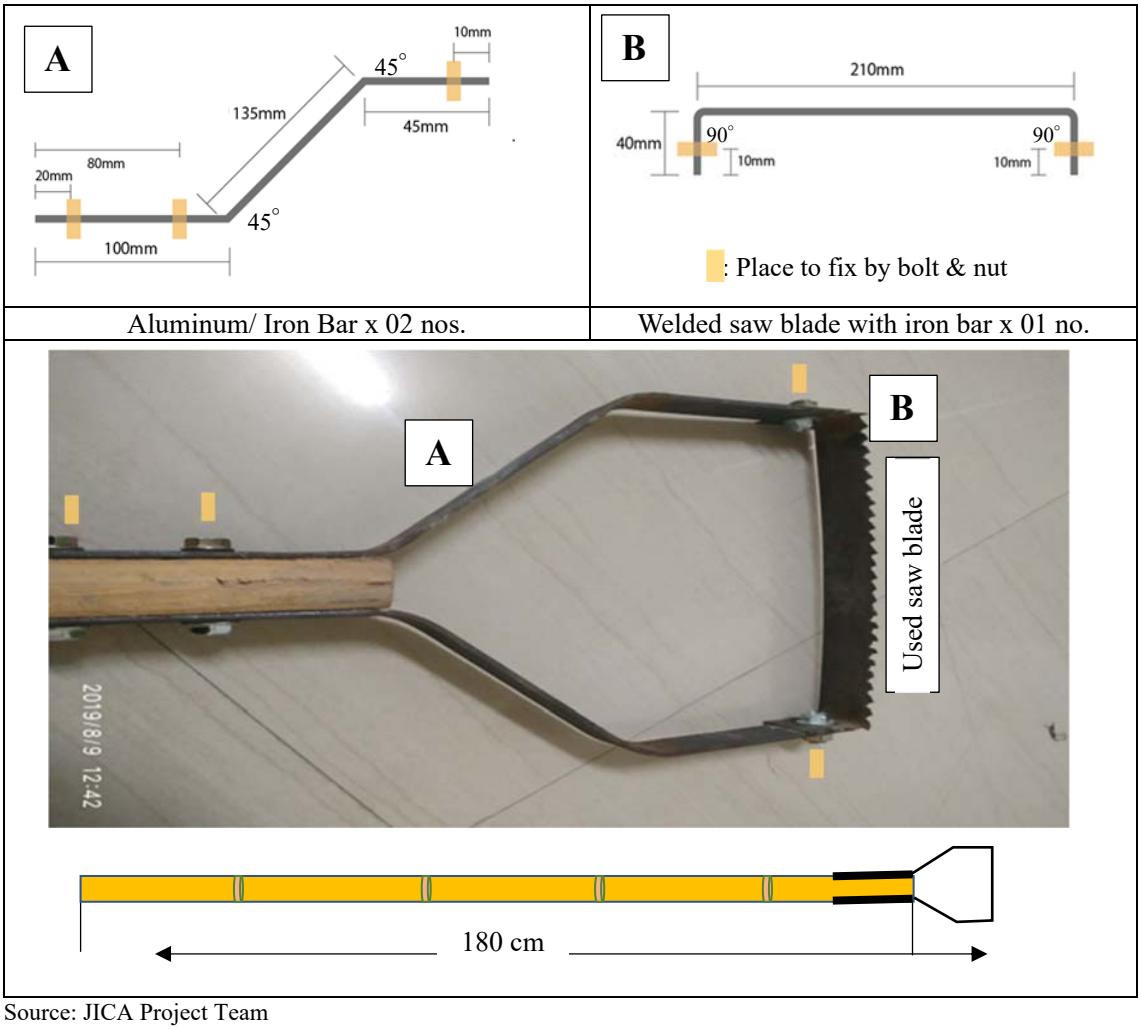
- Aluminum or Iron bar: Thickness 3mm x Width 15mm x Length 280mm – 02 nos.
- Welded Saw blade with iron bar: Width 15mm x Length 290mm – 01 nos.
- Bolt & nut: Diameter 5 – 6 mm, length 20 mm x 02 nos., Diameter 5 – 6 mm, length 40 mm x 02 nos.
- Wooden or Bamboo stick: dia. 25 – 30 mm, length 1.8m

(2) Cost

Welding fees + Aluminum or Iron bar + Bolt & nut: More than Rs. 250

(3) How to make:

Prepare two parts A (2 sets) and B (1 set) shown in the Figure XX below, and fix them with bolts and nuts as shown in the picture below.



Source: JICA Project Team

Figure 9 Structure of Hoe Type Saw Blade Weeder

Since this weeder is fixing saw blade horizontally, it is more suitable for weeding in dry-field. It seems that used saw blades can be used to make a variety of low-cost weeding tools.

3) **Mini Wooden Disk Weeder:**

In this type of weeder, spikes are attached to circular plank along with handles. There are two types of handles i.e., long one (100 cm) and short one (12 cm). Both types of weeders can be easily handled and used. It was commented by farmers that both type of weeders is good but it is preferred to use the long handle weeder because it can be used while standing.

(1) Materials:

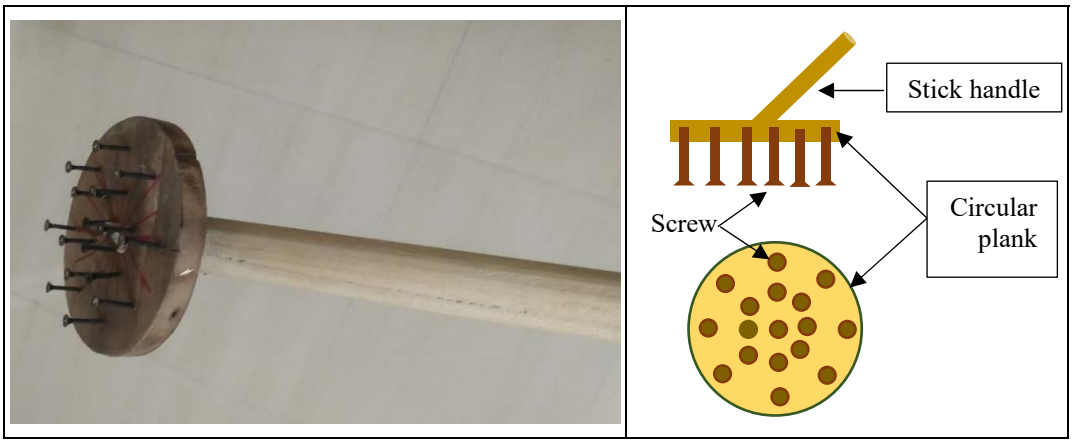
- Circular plank with 15 cm diameter
- Wooden stick handle about 100 cm and 10 cm
- Screw 5cm length 16 – 20 nos.

(2) Cost:

less than Rs.100

(3) How to make:

Attach screws to the circular plank as shown below and fix the wooden handles on the circular plank.



Source: JICA Project Team

Figure 10 Mini Wooden Disk Weeder

(4) How to use:

- It is light and can be easily used in the field even if no proper line is maintained.
- With its spikes it can easily hook and remove weeds from the field.
- It can easily move around and accurately remove weeds near the paddy without damaging the paddy.
- It is made using a circle plank with spike attached and a stick (1m) attached to the plank at 40° angle.

4) **Wire Weeder**

Structure of this weeder is very simple and easy to make. It is used to remove debris of the weeds that are still lingering in the field after using the brush weeder.

(1) Materials:

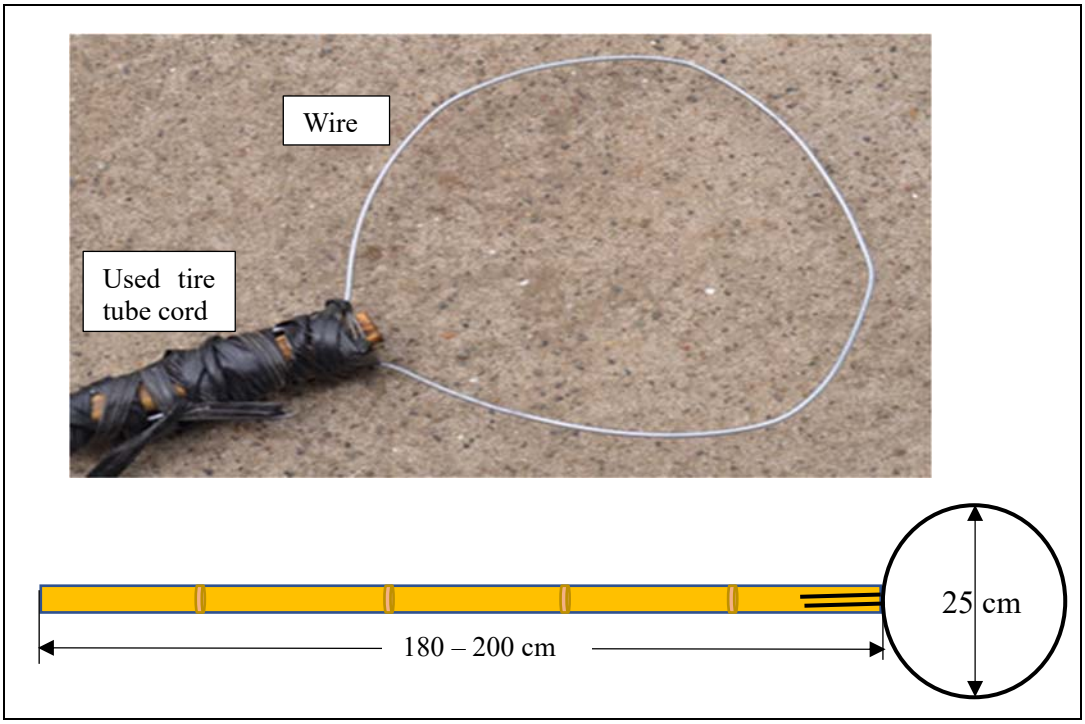
- Large bore wire: about 100 cm
- Bamboo stick: about 180 – 200 cm
- Fixing string of wire (used tire tube cord may be good)

(2) Cost:

Less than Rs. 50-

(3) How to make

Simply tying wire making a round shape at a tip of a bamboo stick as shown in the Figure 10.



Source: JICA Project Team

Figure 11 Wire Weeder

(4) How to Use:

- This weeder is very light and easy to handle. Therefore, farmers are taking this weeder whenever they go to the paddy field, and farmers can eradicate weeds.
- With wire ring, the weeds that have been rooted up by the weeder can be easily pick up with this tool.

Source: JICA Project Team

Figure 12 Removed weeds were coiled around the weeder's wire

3. Opportunity to Improve Rice Cultivation by Using Manual Weeder

1) Weeding is one of the most important practices in Rice cultivation. Using these manual weeders, farmers can weed their fields more conveniently comparing to other weeding practices. So, by introducing such techniques, we can motivate farmers to improve and give importance to other basic practices in rice cultivation such as land levelling, maintaining field bunds, etc.

2) By using these weeders, practical farmers will come to know the importance of other practices such as ploughing the field properly and maintaining proper lines and space during transplanting. Farmers will come to know that maintaining line and space will make other activities easier, and thereby it is possible to convince them to implement such practices.

3) Preparation and maintaining cultivation calendars will also be an important aspect. Using such a cultivation calendar, farmers can plan and determine the timing for weeding and essential field management practices, including water management. It is also very important that the state extension officers make use of appropriate techniques and relay them that are easily implemented by the farmers.

4) So, by slow and steadily integrating such practices, we can improve the yield and condition of our farmers.

[Explanatory Note]
When JPT started 1st pilot activities in the Buchangphai village, it was required to have sufficient knowledge and skills in cultivating and marketing Broom grass. Therefore, a model village for Broom grass cultivation was sought in consultation with Dr James of Mizoram University, who conducted a village survey in relevant RD Blocks of the 1st pilot activities. As a result, Saipum village was selected to obtain the useful infomation. In addition, various information on the market was obtained by interviewing Traders in Bagha Bazar in Assam. In the case of Mizoram, it is very important to check and consolidate all the reliable information and technologies one by one for farmers.

Agricultural Technical Note Based on Experiences in Mizoram – JICA TCP

Technical Guidance:	Basic information on Broom cultivation in Mizoram
ID. No.:	BRM-1
Date Created:	2020/02/03
Reference Materials:	MANJARI, Tripura: http://nce.gov.in/publication/ManjariOctober2014.pdf Economic Return from Broom Grass Cultivation, Nagaland
Purpose/ Background:	Many small-scale farmers do not have essential information and therefore do not know the optimum harvesting time or post-harvest handling methods. It leads them to be bought product cheaper by traders, small-scale farmers face many problems, which could be solved by organising farmer organizations.
Expected Outcome:	1) Farmers will obtain basic information on growing Broom grass and selling the product. 2) Know how to share information with traders and sell Broom at the highest possible price. 3) Understand that there are issues that can be solved by farmers by organising themselves, such as loans to pay labour costs.

Contents	Technical Guide
Introduction	Broom is an important semi-domesticated non-timber forest produce (NTFP) in Mizoram that has good potential for generating local employment and providing cash income in the area. The Broom grass has an advantage to cope soil erosion and to promote the sustainable use of fragile and degraded lands, because fibrous roots system binds the soil and helps to reduce soil erosion in hilly slope. Broom grass grows as a natural vegetation throughout Mizoram. The following three varieties are cultivated in Mizoram, of which the Phiahthir variety has the highest market value. 1) Phiahpui (The one which has big leaves). 2) Phiahfang (Little bit smaller than phiahpui). 3) Phiahthir (Colour is like an iron rush).
Harvest before blooming stage for Grade-1	In the broom market, grasses are divided in the 3 grades. Grade-1(most highly priced) is harvested in December, January or February before blooming stage and dried properly. Grade-1 broom grass could be sold in big markets in India and internationally. Grade-2 and 3 broom grasses are harvested in late February and March after blooming stage, and they are handled in local markets and used by local broom producers.
Cost of Broom grass cultivation and Income for 4 years	Cultivation of broom grass can be a profitable enterprise. Estimates of cultivation costs, yield and economic returns per ha have been calculated based on data from other states. However, labour costs are used in Kolasib 2022.

Cost of Broom Grass Cultivation

ITEMS (per hectare basis)	Q'ty	Unit	Unit Cost (Rs.)	Total (Rs.)
Jungle cutting, debris removal, ranging, clearing, stacking labour cost	50	MD	450	22,500
Digging of 3000 pits (30 cmx30cmx30cm), transportation and planting	180	MD	450	81,000
Farm Yard Manure, BHC or Gamexine @ 10g/Pit (LS)		LS		15,000
Weeding and soil working (3 times): Labour cost	15	MD	450	6,750
Harvesting and drying of brooms: Labour cost	30	MD	450	13,500
Bundling, transportation and other expenses: Labour cost	20	MD	450	9,000
Cost of seedlings/propagules 3000 nos.	3,000	nos.	20	60,000
Totalcost of cultivation for the first year				207,750
Maintenance cost in 2nd and subsequent years				29,250

Expected Yield and Income from the Cultivation of Broom-grass/ha

Yield	1st year	2nd year	3rd year	4th year
Average yield of culms/tussock	18	60	225	180
Total yield of culms (from 3000 tussock)	54,000	180,000	675,000	540,000
Total No. of brooms or Jhadu (Av. 25 sticks/jhadu)	2,160	7,200	27,000	21,600
Total income (@ Rs80 per jhadu (Av.)	172,800	576,000	2,160,000	1,728,000
Net Profit (Rs.)	- 34,950	511,800	2,130,750	1,698,750

Calculations show that planting 3000 Broom grass plants per hectare (at 2m x 2m spacing) will give the maximum profit. Growing broom grass requires a high initial investment, but is a profitable form of agriculture if properly harvested and marketed. For small-scale farmers based on subsistence farming, Broom grass is a convenient source of cash income. However, starting Broom grass cultivation would require initial investment as shown in the table above.

Good relationship with traders

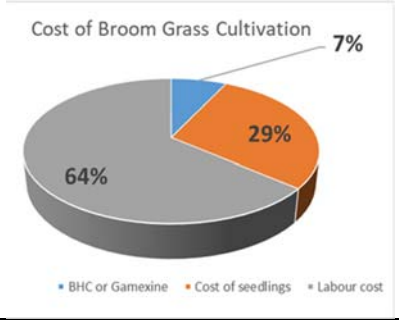
Large traders who have been buying Broom for more than 20 years in Mizoram speak Mizo and have a wide range of information including technical know-how. Therefore, utilizing their specific information is another essential resource for improving Broom grass cultivation. It is also necessary to know which varieties traders buy at a higher price and the price difference between the buyers. This information should be used to determine a suitable variety to be grown. However, cultivation with other varieties had better incorporated to avoid unpredictable diseases and other unavoidable risks.

Shipping can also be done in a collaborative way where truckloads of blooms are collected and sold to traders at a higher price, rather than shipped individually. In addition, in the case of communal shipping, it is even easier to negotiate selling prices with traders if all farmers try to maintain the same quality.

How you can bring down initial costs

As shown in the diagram on the right, 64% of the initial costs of growing broom grass are labor costs, since labor costs in Mizoram being two to three times higher than in other states.

There are many challenges, such as how to reduce these labor costs, and to find financing schemes to pay for labor costs.



Quality and Packing method

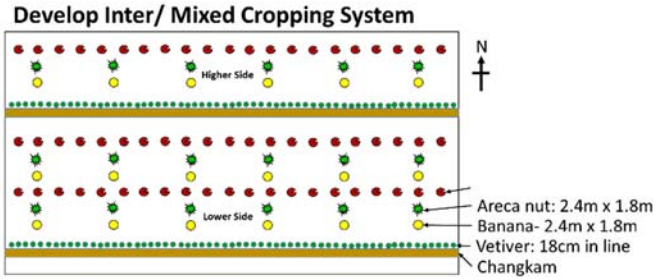
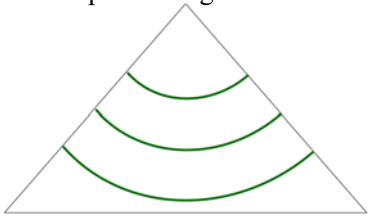
In order to sell at a higher price to traders, it is also necessary to produce quality products and improve packaging methods to avoid transport losses. At Shillong, the following packaging method is used. In other states, drying method is also used as shown in the picture on the right.

Shillong Broom Grass Packing Size: 50 kg, 3.5 to 5 feet

[Explanatory Note]
In the case of Areca nut cultivation, farmers can only earn income 5 to 7 years after planting the seedlings. Therefore, to secure income until harvesting begins, the Areca nut guide recommends mixed crop cultivation and appropriate soil conservation practices. Based on this type of technical guide, agriculture extension workers and farmers can develop appropriate technologies step by step in Mizoram. Sharing such technologies with government officials and farmers is very much important for agricultural development in Mizoram.

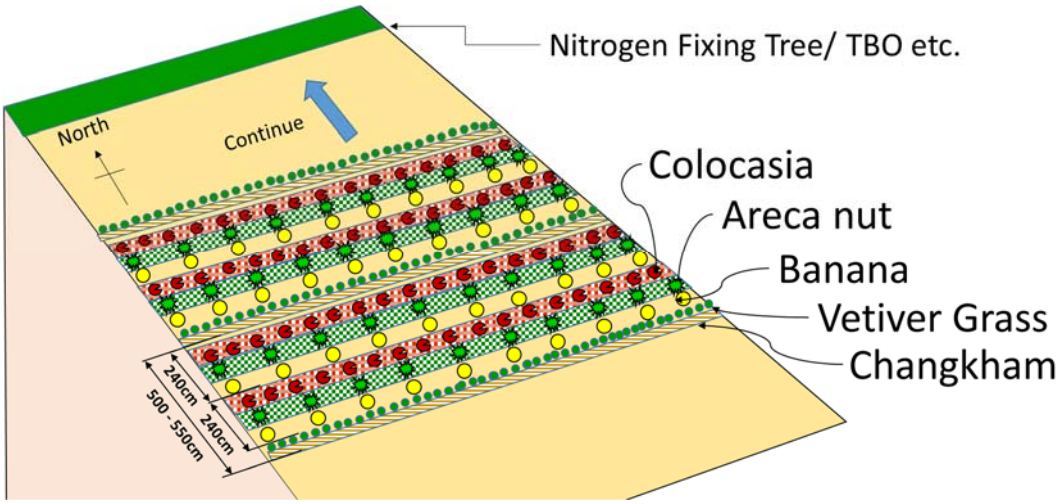
Agricultural Technical Note Based on Experiences in Mizoram – JICA TCP

Technical Guidance:	Areca nut/ Betel nut based inter/ mixed cropping System
Target Area:	Kolasib and Marmit areas
ID. No.:	AN-1
Date Created:	2018/06/03. Revised 2020/05/12
Reference Materials:	Calendar for Areca nut: https://www.dasd.gov.in/adminimage/Arecanut_calendar.pdf
Purpose/ Background:	The main challenges of areca nut cultivation are high investment costs with low returns in the initial (7-10 years) years due to the long pre-bearing period. Furthermore, soil conservation measures are also essential, as areca nut is mainly grown on slope areas. Bananas, pineapples, peppers, etc., can be grown inter-spaces of areca nut as a mixed crop.
Expected Outcome:	Areca nut can be harvested for long periods and sometime over the next generation. However, it also takes several years to reach full harvesting. Therefore, it is expected that areca nut cultivation could be carried out only after careful planning in consultation with family members and experts. Areca nut cultivation is expected to take full account of land productivity with inter/ mixed cropping and soil run-off control.

Contents	Technical Guide
Introduction	India leads the world in production of areca nut followed by China and Bangladesh. Areca nut is a profitable commercial plantation crop. **Climate and soil requirement** Areca nut requires abundant and well-distributed rainfall. It grows well within the temperature range of 14-36°C. It can be cultivated up to an altitude of 1000 m in deep and well-drained soils with low water table. Laterite, red loam and alluvial soils are most suited. **Drainage and Soil Erosion** In case of slope areas, soil conservation system is the most important practice depend on the growing stage of Areca nut plants. Before planting, it is better to establish changkham system with Vetiver grass for soil conservation measure for 3 to 5 years. After growing the Areca nut thickly, the vetiver grass will not be grown because it is not tolerant of shade. Therefore, Banana plant after harvesting and other plant residues should be put along with changkham or contour line for soil conservation purpose. **Shading** The Areca nut palms are highly susceptible for sun scorching. The seedlings should be given protection against the direct exposure to sun. This may be done either covering the plants with areca or other leaves or by raising crops like banana in between two rows of Areca nut. Sun scorching is mostly seen during October – February. For this a quick growing shade plant can be planted on Southern and Western sides of the palm garden. Planting of banana along with Areca nut is a very good practice where banana provides shade to young Areca nut plants at the same time giving additional income to the farmer.
Inter/ Mixed cropping	The long pre-bearing period and high investment and low returns in the initial years (7-10 years) are the main reasons which make it essential to take up inter/ mixed cropping in Areca nut plantations.
In case of slope area	1) Variety of Areca nut: local variety is better 2) Spacing: 1.8 m x 1.8 m or 1.8 x 2.4 m (narrow spaced planting space is adopted in case of **low yielding variety** to increase total amount of yield in unit area: Keeping yield records is important for identifying good local varieties) 3) Number of plants for 1 Bigha: about 330 (1.8 x 2.4 m) to 430 (1.8 x 1.8m) plants 4) Recommending crops with areca nut: Banana (shading plants for areca nut seedlings), Colocasia, Ginger, Turmeric, Black pepper, Coffee, Cardamom, citrus, etc. 5) Before starting cultivation, first and foremost, it is better to take soil conservation measures properly. Soil conservation measures and cultivation procedures are shown below:
Develop Inter/ Mixed cropping system 1) Changkham & Vetiver grass for soil conservation	**Develop Inter/ Mixed Cropping System**  Need to plant along contour lines  Farming on slopes requires, first and foremost, soil conservation. For this, it is advisable to consider

methods that do not require much funds.

1) Install Changkham and plant Vetiver grass along contour line for soil conservation.
2) Then, plant Banana and Colocasia (Taro), a year before planting areca nut seedlings
3) Bananas provide shade for areca nut seedlings. Taro and bananas are harvested the following year to obtain cash income.



4) Ginger and turmeric can be planted other than taro, but farmers should research and decide in advance which crops are easier to sell (ask some traders to obtain specific information).
5) In the next year, plant Areca nut seedlings (see Fig. B). The bananas grown at this time are used as shading plants for Areca nut seedlings. Vetiver is to be used as mulch for Areca nut.

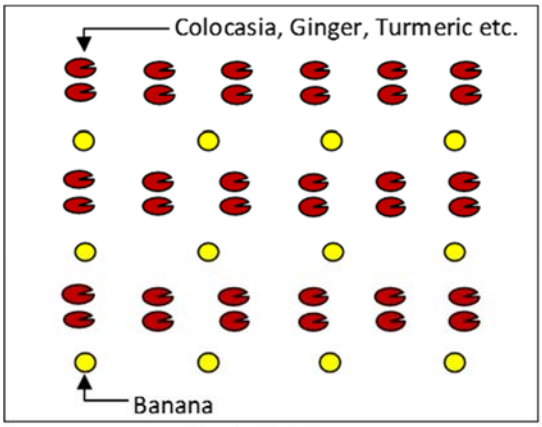


Fig. A: 1st Year
Harvesting Colocasia/ Ginger/ Turmelic

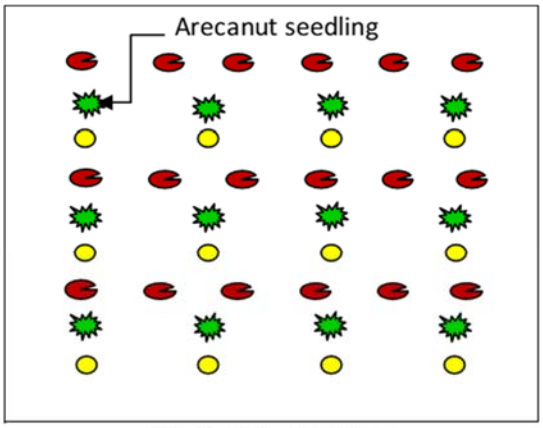


Fig. B: 2nd - 3 rd Year
Harvesting Banana & other

6) Replant bananas (Fig. C) and plant pepper seedlings near Areca nut trees. The Areca nut trees will support pepper (Fig D).

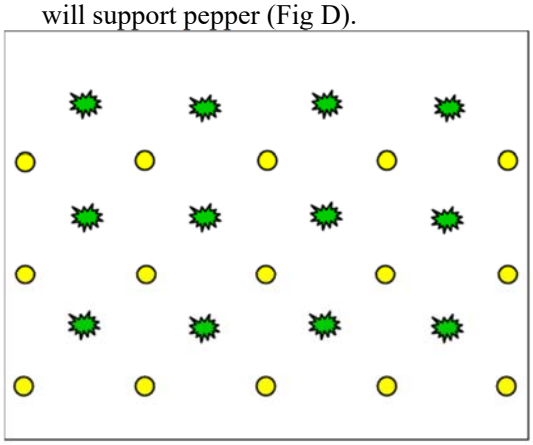


Fig C: 4 - 5th Year
Replant Banana

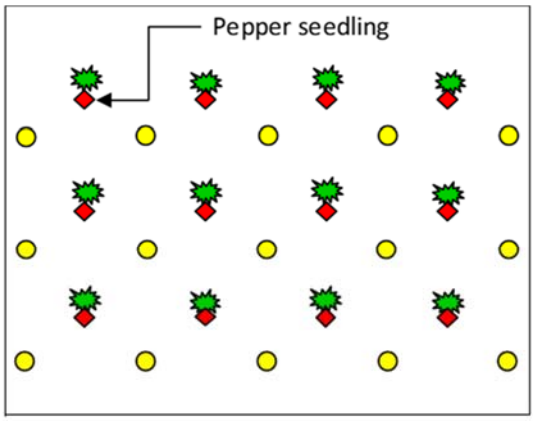


Fig D: 7 - 10th Year
Start full harvesting of Arecanut

7) After 10 years, pepper can be harvested.

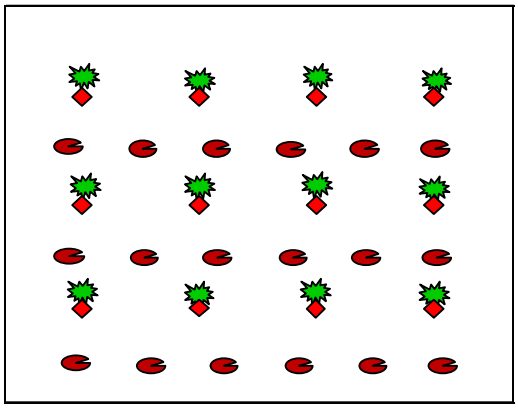


Fig. E: 11 - 13th Year
Start harvesting Pepper
& Possible to plant other crops.

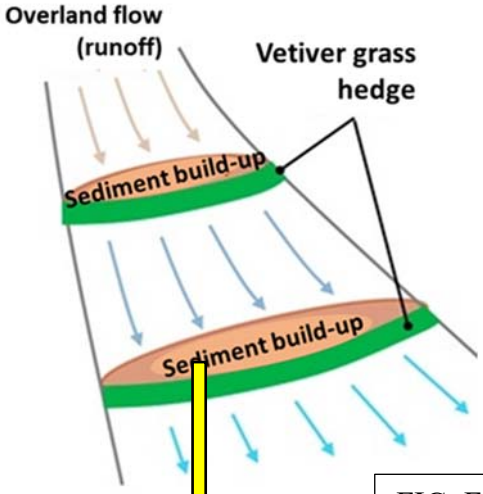


FIG. F

8) Vetiver grass Heage and Terracing

Vetiver grass in southern India has deep subterranean roots and is a valuable soil conservation measure. Over the years, soil accumulates in the Vetiver grass hedge (Fig F &G). After sediment has been deposited, terraces can be created by manually cutting away a small section of the slope (see Fig. H).

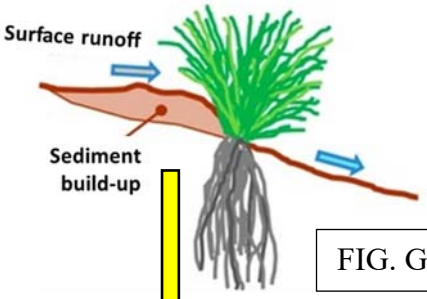


FIG. G

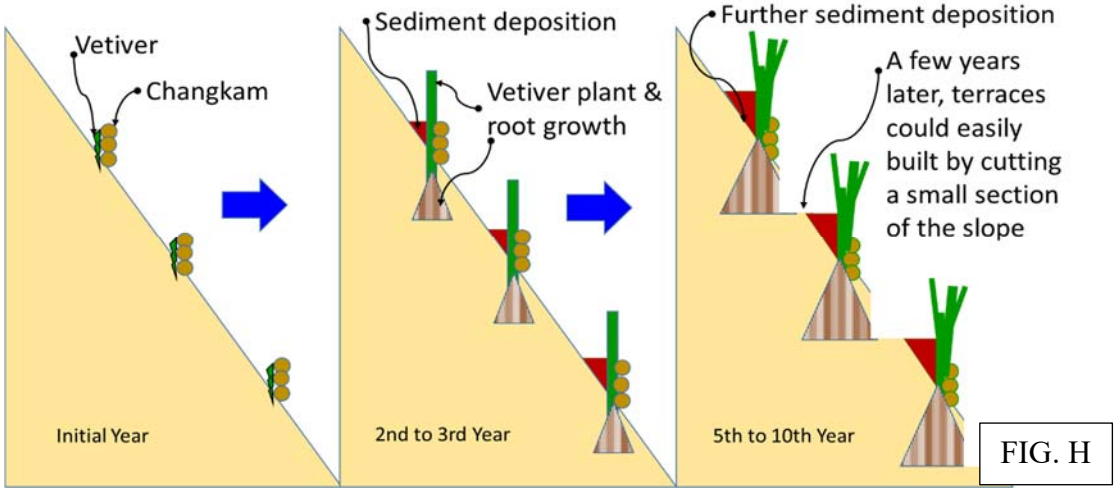


FIG. H

[**Explanatory Note**] Vetiver grass was purchased from Tamil Nadu during the JICA TCP project implementation. Because soil erosion control is one of the priority issues in the agricultural development in Mizoram. Soil run-off control measured through civil works is very costly. However, if farmers and villagers learn how to utilize vetiver grass, soil erosion control can be carried out by the farmers/ villagers across Mizoram at very low costs. All information on vetiver grass is available from 'The Vetiver Network' (https://www.vetiver.org/). First, agriculture extension workers/ officers need to understand how to utilize vetiver grass for the farm community.

The Vetiver Grass

Vetiver grass commonly known as khus grass is a perennial grass of Indian origin

Scientific name; Vetiver zizanioides

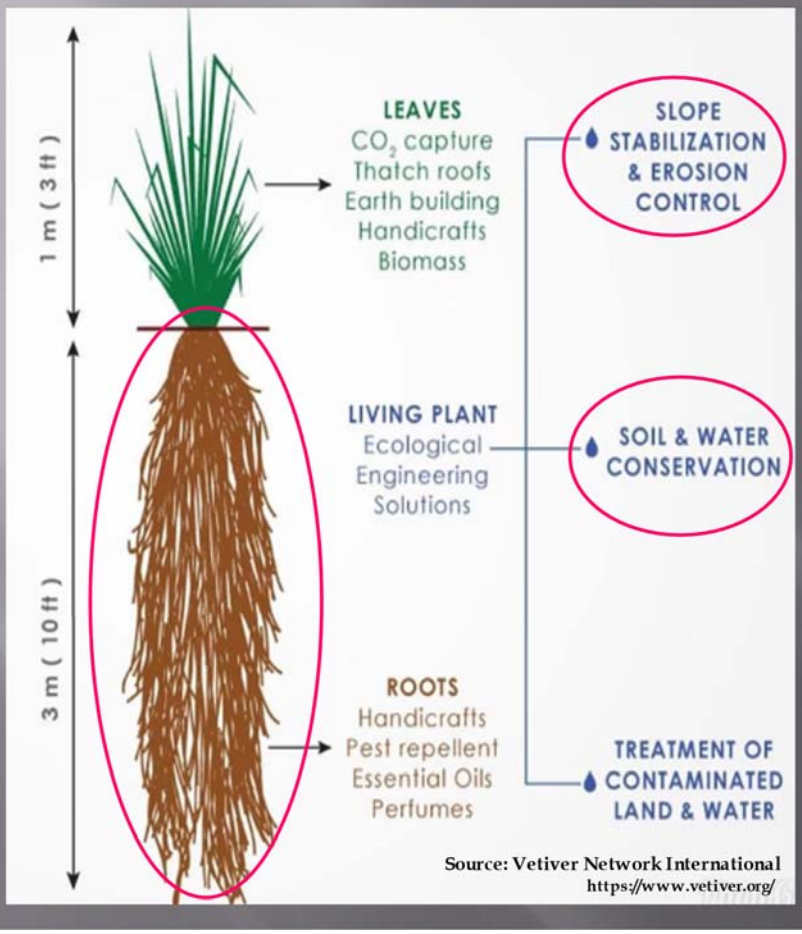
Family; Poaceae

Distribution pattern, growth behavior and type of Vetiver grass

- In India there are two type namely 'South Indian' and 'North Indian' under cultivation
- In this project we will used only 'south Indian' variety because 'North Indian' variety is flowering type and spreading seed it might become weed and hard to control
- 'South Indian' vetiver can be propagated by only slips, and the root is deep and there is no flower and seeds, so it can be utilized for agricultural purpose and easy to maintained
- It is a perennial grass which can grown 1-2 m height
- It can be grown almost every kind of soil
- Plant population varies from 27,800-1,10,000 plants/ha
- Vetiver is a hardy crop and infestation by pest is not a serious concern

Cultivation of Vetiver grass. The Hedge against Erosion

Cross section of a vetiver hedge showing build up of eroded soil after two years. Dark brown layer original top soil. The plant grows up its own created terrace riser. P.K. Yoon Source: Vetiver Network International https://www.vetiver.org/



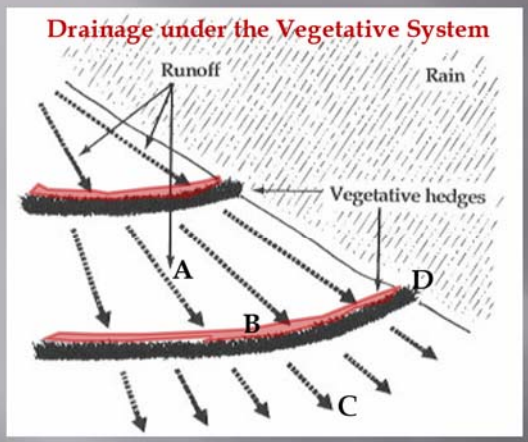
Two year old vetiver - the leaves and stems (Colombia)

Linear section through one year old vetiver hedgerow (P.K. Yoon, Malaysia)

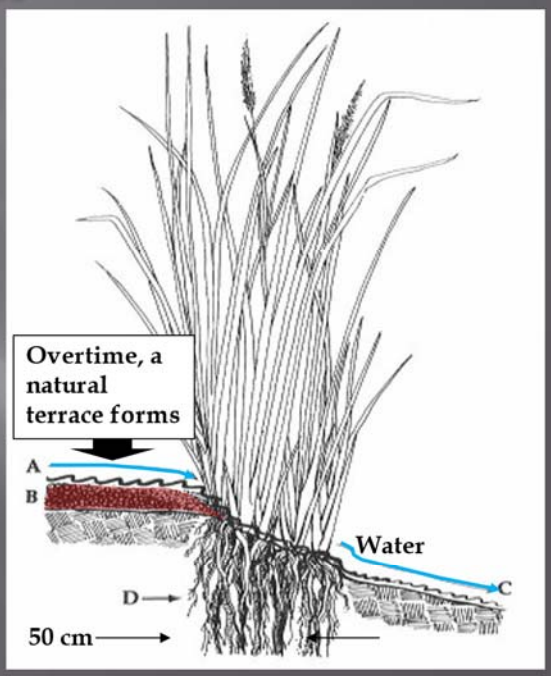
•The root of vetiver is deep so it can be very helpful for erosion control, and also it can useful for termite control

Vetiver Grass Left: 1 -year-old root (Malaysia). Above right: linear section through vetiver hedge showing dense root pattern (Malaysia). Bottom right: 30-year-old dense vetiver hedge showing 2m self-developed (Fiji).
Source: Vetiver Network International https://www.vetiver.org/

Important and Uses of Vetiver grass



To be effective as a method of soil conservation, the vegetative system must form a continuous hedge with no gaps. It generally rakes 2 to 3 growing seasons to establish a hedge dense enough to withstand torrential rains and protect the soil .



Source: Vetiver Network International https://www.vetiver.org/

•Vetiver mulch improve soil moisture and farm ecological environment

Mulching by vetiver for dragon fruit cultivation

Vetiver mulch lasts longer.

Vetiver hedge on the contour supporting an excellent adjacent maize crop

Source: Vetiver Network International https://www.vetiver.org/

Conservation

Stabilizing a cliff, Oaxaca, Mexico

Extreme slope stabilization Ho Chi Minh Highway, Vietnam

Soil nail with vetiver, Vietnam

Canal bank stabilization, Central Vietnam

Source: Vetiver Network International https://www.vetiver.org/