Flood Adaptive Rice Cultivation Practice

Technical Brief

Rice is a major staple food crop of Nepal and south Asia. It contributes more than 50% total edible cereal production and about 20% to Agriculture Domestic Product (AGDP) in the country[i]. During 2015/2016, rice crop covers almost 1.3 million ha with the average productivity of 3.3 t/ha[ii]. Compared to other rice producing countries rice production in Nepal is quiet low as it suffers from different constraints of abiotic and biotic stresses, rice production system like low/poor access to input, poor management practice, poor irrigation and lack of technical knowhow and do how.

Extraordinary geography, poor institutional management capacity and recent trend of climate change have further exacerbated rice production challenges in Nepal. Almost 50% of the area of rice cultivation in Nepal is rain-fed, 30% irrigated and 15% is estimated to be affected by flash flood. The rain-fed lowland that is prone to drought and seasonal flooding has area about 104720 ha[iii]. Most climate projections for the region suggest that rainfall is likely to intensify and that extreme events like flood and drought will become even more frequent[iv].

So, it is necessary to adopt rice production technology adaptive to submergence (flash flood), one of the major rice production constraints, in the coming years.

Rice variety suitable for flood prone area

In general, farmers use different management strategies like adjusting planting time based on flood prediction, double transplanting to cope with flood disaster. However, management strategies alone cannot fully address the adverse effect of flood as rice dies within 7-10 days upon complete submergence[v]. These losses affect rice farmers severely in rain-fed and flood-affected areas where alternative activities for livelihoods are limited.

Figure 1. Swarna Sub-1 after flooding for 15 days
Photo courtesy- RARST, NARC, Tarahara

Nepal Agricultural Research Council (NARC) in collaboration with International Rice Research Institute (IRRI) has developed three flood

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tolerant rice varieties for Nepal that can withstand flash flood up to 15 days (Table 1). These varieties have potential to regenerate even after 10-15 days of complete submergence (Figure 1). Besides tolerant to flood, these varieties are also reported to show some tolerance to different diseases in rice like rice blast, bacterial blight[vi] etc., upon activation of submergence gene.

Table1. Recommended submergence tolerance varieties with their agronomic traits

Varietal Traits				
Variety	**Crop Duration (Days)**	**Plant Height (cm)**	**Delay in Harvesting When Submerged**	**Yield t/ha**
Swarna Sub1	150 - 155	85-95 cm	10 – 15 Days Delay	4.5-5.0
Samba Masuli Sub1	145 - 150	90-100 cm	10 – 15 Days Delay	4.0-4.5
Ciherang Sub1	125	105 cm	10-15 days Delay	4.0-4.5

Cultivation methods and consideration

Though above varieties (Table 1) show maximum tolerance to flash flood and inundation; it is necessary to consider some technical aspects of modern rice cultivation practice, weather forecast and other production related information of the location. This information and consideration will help farmers to develop concrete rice production plan avoiding production constraints and enhance rice yield.

1. Planting Time

These varieties are usually planted as main season crops i.e., June/July. Based on the climate forecast, transplanting time should be adjusted in such a way that seedlings will be at least 15 days old before flood appears. This will provide seedlings enough time to establish and build strength to withstand flood. Normally last week of May to last week of June is considered best time for nursery establishment.

Nursery Establishment and Management

If we use transplanting method rather than direct seeding, it is necessary to prepare nursery bed. Healthy seedling leads to healthy production, so proper care should be taken while raising seedling in nursery bed.

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a. Nursery type and Size

Nursery type and size depends upon the soil type, climatic condition at the time of seeding and total area to be cultivated. Raised and dry bed will be suitable during monsoon or when there is intermittent rainfall (Figure 2). Sunken and wet bed will be more suitable during dry season/prior to monsoon. Similarly, size of nursery bed should be 1 m wide and up to 10 m long.100 m^2 nursery area is required to transplant 1 ha of land. A 50 cm drainage gap should be maintained in between two nursery beds.

Figure 2 Dry bed rice nursery established in Pilot Program for Climate Resilient Agriculture (PPCR) by Practical Action Consulting

b. Land Preparation and Fertilizer Management:

Pebbles and other indecomposable debris should be removed and soil should be finely tilled. Compost manure or well decomposed Farm Yard Manure (FYM) should be added at the rate of 5-10 kg/m^2, depending upon the soil fertility status. Inorganic fertilizer should be avoided if possible as it accelerates seedling growth making it prone to disease/insect infestation.

c. Seed Rate:

30-40 kg quality seed with more than 80% germination percentage is sufficient for cultivating 1 ha of land. Seed should be treated before seeding to avoid seed borne diseases like False smut, Blast etc., with Bavistin, mixed at the rate of 2-3 g/l water.

d. Weed/Insect/Disease Management:

Nursery bed should be maintained free from weed/insect/diseases by adopting clean cultivation practices. If possible, use of chemical weedicides or pesticides should be avoided. Manual weeding can be done to control weeding and organic pesticides like neem extract or other home-made organic pesticides can be used if necessary.

2. Transplanting and Post Transplanting Crop Management

Usually 25-30 days after seeding, seedling becomes ready for transplanting. Delay in transplanting affects tillering potential of the variety. Care should be taken during uprooting of seedling from nursery bed to avoid root damage. Seedling should be transplanted as soon as possible after uprooting.

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a. Land Preparation

These varieties require plenty of irrigation water, so they should be planted in low land with assured irrigation facility. Depending upon the nature/type of soil one deep ploughing and 2 cross harrowing with disc harrow are enough. Land should be puddled and levelled before transplanting.

b. Fertilizer Management

Integration of environmental, agronomic and economic aspect of fertilizer management is one of the most important strategies of economic fertilizer management. Recommended dose of fertilizer as a whole is not always right for particular crops in particular context and knowing how much fertilizer to apply can be a difficult task.

In this context, it is better to analyse soil tests report and recommend dose of fertilizer required by crop to calculate exact application dose of fertilizer. This not only lowers environmental and health risk but also lowers production cost.

In general Nitrogen (N) is applied in split dose, as it doesn't last for long in soil. It might be lost due to leaching. Also excess amount of nitrogen can accelerate seedling growth making it prone to insect and diseases. Therefore, depending upon the crop duration of the variety it should be applied in 2 – 3 split doses (Table 2). Half of the required dose of Nitrogen and full doses of Phosphorus (P) and Potassium (K) should be applied at the time of final land preparation before puddling. In case of Zinc (Zn), it should not be mixed with NPK during application but should be applied before or after NPK application.

Table 2. Recommended dose of fertilizers and application time

Fertilizer	Rate Per Kattha*	Application Time
Farm Yard Manure(FYM) 	400-450 kg	During final land preparation
Green Manure/Compost 	200-250 kg	During final land preparation
Urea 	1-1.3 kg	During final land preparation
	0.6 kg	20-25 Days after transplanting
	1 kg	40-45 Days after transplanting

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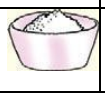
	0.6 kg	60-65 Days after transplanting
Diammonium phosphate (DAP) 	2-2.1 kg	During final land preparation
Muriate of Potash (MOP 	1.5 kg	During final land preparation
Zinc Sulfate 	0.5 to 1 kg	During final land preparation

*30 Kattha equals to 1 Hectare

** In case of flooding, 1.5 KG Urea and 1 KG DAP should be applied 7days after flood water recedes.

c. Transplanting

Generally, 25 to 35 days old seedlings are suitable for transplanting. Planting of 1-2 seedlings in line spaced at 25 cm plant to plant and 25 cm row to row gives good results (Figure 3). Planting too many seedlings with closer spacing leads to reduced tillering and ultimately lowered production. For line transplanting, a baseline should be made with the help of rope or string (marked 25 cm apart) and planting should be done following the baseline mark. Line transplanting allows easier intercultural operation like machine weeding and fertilizer/ pesticide application.

Figure 3.Line transplanting of Swarna Sub-1 in PPCR Project by Practical Action Consulting.

d. Weed Management

It is important to control weeds from initial stage of rice cultivation i.e., land preparation. Land preparation should be started 3-4 weeks before planting and weed should be well incorporated into the soil. Different stages for weed control.

During transplanting: Pre-emergence herbicide Pretilachlor 50% EC (Emulsifiable Concentrate) should be applied either mixing with sand or water (at the rate of 1000 ml 30 kg/ha sand or 1000 ml/500 l/ha water) within 48 hours after transplanting.

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- **25-30 days after transplanting or active tillering phase:** Depending upon the presence of weed, mechanical weeding by cono weeder/manual hand weeding can be done. If labor is scarce or wage rate is high post emergence herbicide can be used alone or in combination with manual/mechanical weeding. Post emergence herbicides like Bispyribac (Nomineegold) @ 30 ml/15 l water/Kattha observed to be effective) 2-4 D amino salt or ethyl ester (include dose) can be used to control weeds at 3-4 leaf stage depending upon the weed type. Flat fan nozzle should be used to spray herbicide. Use of multi nozzle boom sprayer is also good for efficient herbicide spray within a limited time. Herbicide should always be sprayed before top dressing with urea. Herbicides should be carefully sprayed as per the instruction with proper dose for better weed control.

- **Booting stage:** same as above

e. Irrigation

As these varieties are flood tolerant, they require more moisture compared to other varieties for better production. So, rice field should be continuously flooded/ponded up to 10-15 days before harvesting. Continuous flooding helps ensure sufficient water and control weeds.

In case of water scarcity, water-saving technologies such as Alternate Wetting and Drying (AWD) should be applied and critical growth stage should be considered for irrigation. Critical growth stages for irrigation are:

i. Active tillering
ii. Booting
iii. Heading
iv. Milking

f. Insect-pest and Disease Management

Farmers lose an estimated average of 37% of their rice crop to pests and diseases every year. In addition to good crop management, timely and accurate diagnosis insect pest and diseases can significantly reduce losses. The best control for pests and disease problems is prevention.

To limit pest and disease damage one should follow following practice:

- Clean cultivation practice
- Use of healthy and treated seeds and resistant variety
- Planting at the same time as neighbor
- Adequate application of fertilizer
- Encouraging natural enemies

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In case of pest/disease infestation, Integrated Pest Management (IPM) approach can be used to maintain pest damage below the economic injury level.

g. Harvesting

It is important to apply good harvesting methods to be able to maximize grain yield, and minimize grain damage and quality deterioration. Harvesting rice consists of the basic operations which can be done in individual steps or in combination using a combine harvester. These include:

- Reaping - cutting the mature panicles and straw above ground
- Threshing - separating the paddy grain from the rest of cut crop
- Cleaning - removing immature, unfilled, non-grain inert materials
- Hauling - moving the cut crop to the threshing location
- Field drying - leaving the cut crop in the field and exposing it to the sun for drying *(optional)*
- Stacking/piling - temporarily storing the harvested crop in stacks or piles *(optional)*
- Bagging - putting the threshed grain in bags for transport and storage

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Further Information

1. http://answers.practicalaction.org/our-resources/item/rice-cultivation-using-alternate-wet-and-dry-irrigation-awdi
2. http://answers.practicalaction.org/our-resources/item/intensive-rice-cultivation
3. http://www.knowledgebank.irri.org/step-by-step-production

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