A Field Guide to Participatory Methods for Sourcing New Crop Diversity[1]

Farmers observing a plot of naked barley in Jugu. Photo: LI-BIRD Photo Bank

Crop genetic diversity can make farming systems more resilient, but many farmers still lack access to crop genetic resources (Tripp, 1997). For a long time, formal institutions would introduce new varieties to farmers in two ways. In the research phase, breeding programmes set up farmer field trials (FFT) to evaluate performance and measure farmer's acceptance of the varieties being developed. In the extension phase, extension agents include new varieties in the package of seeds and inputs called mini-kit to promote new varieties. These approaches incorporated farmers' views late in the stage of variety development and dissemination and hence specifically struggled in providing varieties that met the needs of a large number of smallholder farmers in marginal lands (Witcombe et al., 1998).

To overcome this, breeding and variety development strategies have become more participatory, and the number of methods to deploy diversity has increased (Witcombe et al., 1996; Eyzaguirre and Iwanaga, 1996; Sperling, and Scheidegger, 1996; van Etten, et al., 2016). However, confusion and many interpretations of the methods have made it difficult to choose the appropriate method and to communicate results consistently.

This guide provides details on the history, use, and pros and cons of four participatory diversity deployment methods (IRD, Diversity Kits, PVS, TRICOT) to help practitioners distinguish between the methods and choose ones that fit their needs.

1. Informal Research and Development (IRD) – informal method for testing and popularizing seed of choice based on individual farmer knowledge and expertise (Joshi and Sthapit, 1990). In this method;

- Each household is given a seed packet (100g to 1 kg as per seed size) for a single variety as a gift
- Packets are given out in clusters of villages to analyse performance in different conditions
- No external inputs are included
- An informational leaflet with varietal characteristics is often included
- Name and address including geo-reference of seed recipient are recorded
- Farmers are free to select where to grow the variety and how much input to provide
- Feedback is collected informally through anecdotes, and in some cases via sample HH surveys

IRD was developed out of necessity at the Lumle Agriculture Research Centre in Nepal over three decades ago. At the time, researchers had to hike for days to get to remote villages and frequent visits to any particular site was not practical. Hence, they carried seeds of new and pipeline varieties to distribute whenever they visited. Feedback was collected during the next visit, a year or two later. The feedback was anecdotal, informal and utilized observation of how far the variety had spread, giving the name 'informal research and development.'

2. Diversity Kits – distribution of seed packets with seeds of promising local and improved varieties to each household so that farmers can test them informally under their own conditions (Sthapit et al., 2006). In this method;

- Seed packets (10 g to 1 kg as per seed size) are distributed, with 3 varieties per household for cereals and pseudo-cereals, and many varieties or multiple species per household for vegetables;
- Farmers informally test the varieties compared to their local check and safe-guard seed;
- Feedback about acceptance or rejection and the reason are collected via sample survey;
- In total, 50-500 sets of kits are distributed randomly in a village.

By providing wider access to farmer varieties – identified through diversity fairs and blocks – diversity kits promote use and conservation of

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Farmers picking up their IRD kit for bean seed in Hanku. Photo: Lalita Ale Magar

agricultural biodiversity. Diversity kits deploy a portfolio of farmer varieties, from within and outside the village, and encourage farmers to select, exchange, and disseminate best varieties for a certain location based on local environment and cultural preferences.

3. Participatory Varietal Selection (PVS) – selection of fixed genotypes by farmers in their target environments using their own selection criteria (Joshi and Witcombe, 1996). In this method;

- Farmers' requirements in a variety are identified using PRA
- Researcher searches and identifies candidate varieties (best landrace, escaped variety, released, and pre-released varieties) that could meet the farmers' requirements
- Candidate varieties are tested in farmers' fields using mother and baby trials
- Farmer-preferred varieties are scaled up, often deployed as IRD kits.

Testing of candidate varieties to identify the ones preferred by farmers is done using designed field experiments. There are 2-3 mother trials in a village and 25-50 baby trials for each variety. Mother trials compare all varieties in an RCBD with 2-3 replications, and analysis of variance is computed to compare means. Baby trials allow each household to compare one or two varieties with their best local as the check. Researchers organize a farm walk at harvest to compare improved and existing varieties by participatory preference ranking, often conducted separately with male and female farmers. Farmers exchange knowledge about the traits of tested varieties in a focus group discussion (FGD). From the baby trials, individual household's perception (in terms of better, same, or worse) on yield and important traits of the candidate variety versus the local check are compared.

4. Triadic Comparison of Technologies (TRICOT) Method – involves distributing a pool of pipeline varieties in combination of three to individual farmers who test them under farm conditions and compare their overall performances (van Etten et al., 2016; Steinke et al., 2017). The process includes;

- Seed assembly and distribution is similar to IRD and Diversity Kits
- Blind trial of 3 varieties per household (farmers are not given variety names until they send feedback)
- Farmers rank performance of the 3 varieties; check variety is included but not known to farmers
- Farmers self-report feedback using mobile phones
- In total, large number of kits (1500 -2000) are distributed randomly in a village
- iButton data loggers are used to record environmental data in the test environment
- ClimMob software is used for data analysis using the Bradley-Terry model for ranking 3 varieties.

TRICOT is a modification of PVS in terms of i) collecting comparison data on 3 varieties instead of 2, ii) getting blind feedback by giving number rather than names to varieties being tested, and iii) using mobile technology and apps to automate the process of data collection and analysis. Crowdsourcing (citizen science) engages a large number of volunteers (unpaid citizen scientists) to collect, enter or analyze a large set of data. Farmers provide feedback by mobile phone, which is integrated to provide variety recommendations for dissemination through community seed banks and farmer-to-farmer exchanges.

The blind testing helps reduce farmer bias in evaluating varieties. However,

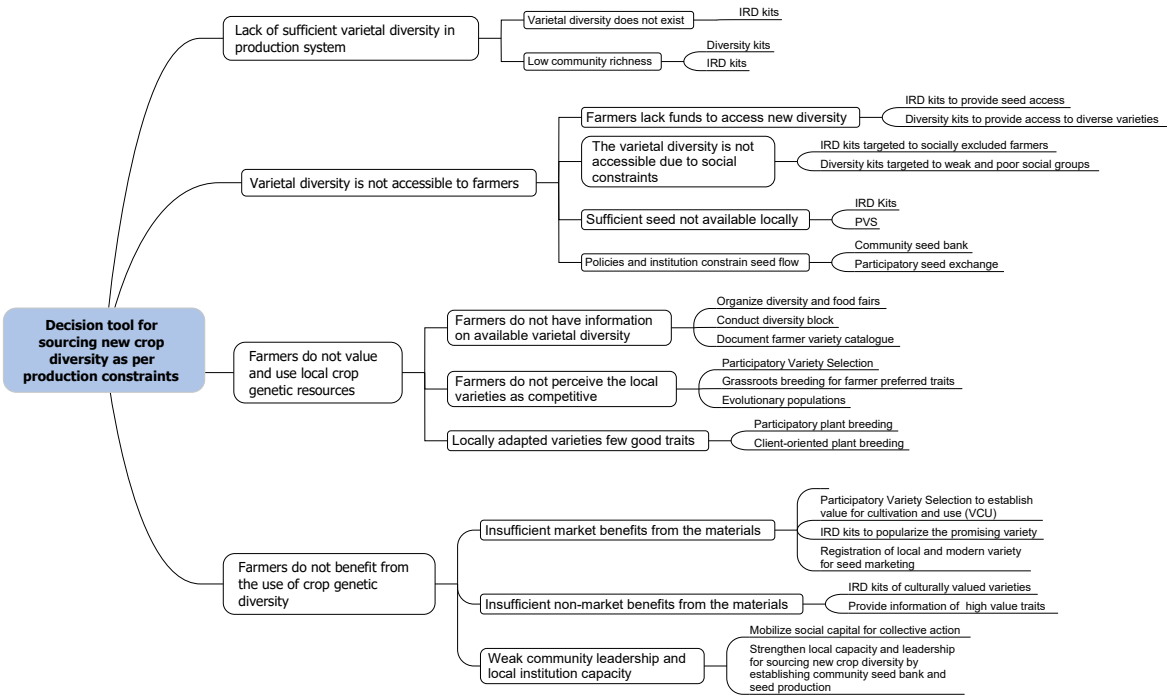

Figure 1. Decision tool for choosing interventions and methods for sourcing new crop diversity as per production constraints.
Figure adapted and modified from Jarvis et a. 2011. Published with licence by Taylor and Francis. Permission to modify provided by the lead author.

practitioners in Nepal have reported a trade-off between reducing bias and the lack of name recognition of the preferred variety when it comes to dissemination.

Decision Tool for Method Selection

A summary of methodological differences of participatory and conventional methods is given in Table 1. Figure 1 summarizes possible interventions that can be taken based on production constraints including selection of appropriate variety sourcing methods discussed in this guide. IRD, Diversity Kits and TRICOT methods are preferred when sufficient varietal diversity does not exist or diversity is not easily accessible to farmers. The choice of variety sourcing methods also depends on pros and cons of the method (Table 2) and institutional capacity and constraints.

PVS, diversity kits, IRD, and TRICOT accelerate the adoption of new varieties, increase crop genetic diversity, and provide information on acceptability in different locations.

Table 1. Differences between Conventional (FFT, Minikit) and Participatory Methods (PVS, Diversity Kit, IRD, and TRICOT)

Method	FFT	Minikit	PVS	Diversity kits	IRD	TRICOT
Purpose	Testing on-farm for overall performance and farmers' acceptance	Popularize improved variety with improved technology	Obtain varietal preference and performance perception data from farmers	Provide access to diverse portfolio of varieties (often farmer varieties) to farmers	Provide access to new seed; test and popularize promising variety	Test and determine variety suitability by voluntary participation of citizens
Tool	Research verification	Extension	Research and Extension	Research and Extension	Extension	Research and Extension
Type of variety	Pipeline varieties	Registered or release varieties	Pipeline varieties	farmer varieties, landraces	Pipeline, registered or released varieties	Pipeline varieties
Size of trial per village (N)	3-6	<25	25-50	>50-500	>500-1000	>1500-2000
Experimental design	Replicated trials	No design; performance assessed by feedback	RCBD in mother trials to compare with farmers' local check; Chi-square test for qualitative and Paired t-test for quantitative data	No design; include diverse set of varieties (n=3)	Paired plot comparison; new versus old. 't'- test on biological data and Chi square test on the perception data	Blind test of 3 entries per HH with random check; frequency of preferences at each location used to determine best adapted cultivars
No. of entry	About 4 entries with one farmer check (can vary)	Variable (1-3 entries per HH)	5-6 entries per village, 1-2 entries per HH, simple design large plots	A portfolio of 3 varieties per HH; 6-12 varieties per village; small plots	1 entry per HH (avoid confusion in recall); 1-3 varieties per village	3 varieties per HH; 12-24 varieties per agro-ecosystem; small plots
Trial management	Researcher-designed with improved management	Farmer-managed but sometimes influenced by extension staff	Researcher-designed and farmer-managed	Farmer-designed and farmer-managed	Farmer- designed and farmer- managed	Researcher-designed and farmer-managed
Yield data Measurement	Yield measured with agronomic traits	Yield is measured by farmer	Yield is measured in mother trial but not in baby trial. Instead perception data is collected.	Yield is not measured but perception data collected	Yield is not measured but farmer perception collected against local check	Yield is not measured but assessed by crowd wisdom
Feedback information collected	Farmers' feedback using preference ranking	Farmers' feedback by post	Overall crop performance from farm walk and preference ranking; Farmers' perception from Household Level Questionnaires 2-3 months after harvest	Farmers' perception from mobile or a sample feedback survey (staff); feedback for best and worst variety asked in case of 3 varieties compared to local check	Farmers' perceptions from informal anecdote; In some cases, sample HH surveys 2 years after kits distributed	Farmers' perception provided by volunteers via mobile
Use of feedback information	Variety registration/ release proposal	Monitor and evaluate technology adoption	Variety registration/ release proposal	Monitor and evaluate adoption of varieties	Monitor and evaluate adoption of registered/ released varieties, or use in registration/ release proposal for pipeline varieties	Fast tracking variety registration/ release proposal
Benefits to farmers	Farmer has free seed and benefits	Farmer has free seed and benefits	Farmer has free seed and bears the risk	Farmer has free seed of varietal choice	Farmer has free seed for one time	Farmer has free seed and random choice of variety
Contribution to increase diversity	+/-	+/-	Varietal richness and evenness (++)	Community evenness (+++)	Varietal evenness (++)	Community evenness +++
Cost	High	High	High	Low	Low	Low

(Source: Sthapit et al., 2017 in press)

Table 2. Comparison of Pros and Cons of Participatory Methods (PVS, IRD, and Diversity Kits)

	PVS	IRD	Diversity Kits
Pros	• Testing available materials based upon need assessment. Helps to set new breeding goals & identifies suitable parents • Variety spread is rapid as need assessment is taken into account and farmers get the seeds during the testing phase rather than only after release • Early feedback from end-users • Social scientists can identify preferred varieties, reasons for preference, and constraints to adoption • Allows evaluation of multiple traits and trade-off between traits; identifies new farmer-important traits • Widely accepted & used by CGIAR and NARS institutions globally	• Provides access to new varieties • Simple, informal R & D approach; flexible data collection requirement. Farmers' feedback collected informally by anecdote; hence even crowdsourcing approach of data collection through mobile phone can be used • Appropriate and cost-effective in geographically challenging areas • Covers many farmers across large and diverse geographical area • Low cost and rapid varietal uptake, if variety is found to be suitable can be managed by local organizations	• Provide fast access to diverse portfolio of farmer varieties and landraces • Practical where seed must be carried by porters & seed availability is limited • Promotes local-level seed selection and exchange, evolutionary breeding on-farm • Ensures resilient seed system • Can be managed by local institutions • Identifies markets for new varieties • Can serve as crowdsourcing data if farmers self-report by mobile
Cons	• Relatively high cost and involvement of researchers and farmers • High level of advanced planning and coordination • Mother trials require tightly timed visits during cropping cycle	• Challenging to obtain sufficient quantity of truthfully labelled or certified seed • Requires high labour cost of packaging • Requires timely distribution of IRD kits and follow-up sample survey	• Differing methods used in practice due to simple terminology • Used as cheap way to win farmer support for short term projects with inclusion of hybrid seeds • No published evidence of rapid uptake • Knowledge-intensive to select varieties for kits and monitor village-level use trends

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