Promoting integrated disease management (IDM) through farmer field schools in Nepal

Tara Lal Lama[1], Shyam Prasad Dhakal[2], and Dindo M. Campilan[3]

This paper reports on a three-year project experience to develop and pilot-test a farmer field school approach (FFS) to introducing potato integrated disease management (IDM) in Nepal. The project assessed the potentials for using FFS as a vehicle for group learning on IDM together with on-farm production and maintenance of good-quality seed. The FFS-potato IDM approach has been adapted from an earlier model for rice IPM, but fine-tuned to correspond to the particular conditions of potato production and the learning environment of potato farmers. A total of 698 farmers in 10 districts were trained by facilitators from the district-level agricultural development offices (DADOs). Participation in FFS resulted in increased knowledge among farmers irrespective of gender, literacy, and ethnic background. A post-FFS field evaluation likewise showed sustained a level of knowledge and adoption of IDM, improvement in crop performance and farm productivity, enhanced livelihood benefits, and diffusion of innovations. The paper highlights lessons learned and challenges for the future in relation to enhancing farmer capacity for group learning and experimentation.

Potato is the fourth most important food crop in Nepal after rice, maize, and wheat. It is one of the important crops in the food security program in Nepal since it gives the highest dry matter per unit time and area. Potato tubers are available year-round due to three successive cropping seasons in terai, hills, and high hills. Potato is considered as a major food in high hills and a major vegetable in terai and mid-hills with an average per capita consumption of 30 kg/annum (Ojha *et al* 2001), which is the highest in the region. The average productivity of potato is still the lowest at 10.9 t/ha (MoAC 2002). Potato diseases are the most important constraints to better productivity. The major diseases of economic importance are late blight (*Phytophthora infestans*), bacterial wilt (*Ralstonia solanacearum*), wart (*Synchytrium endobioticum),* black scruf (*Rhizoctonia solani*), common scab (*Streptomyces scabies*), and a few viruses. Among them, late blight and bacterial wilt are the major constraints in potato production in Nepal.

To control diseases and pests, farmers indiscrimintaely apply various chemicals, posing threats to the human environment and food safety while adding extra cost to production. Another major problem is the lack of access to quality seed to help ensure the cultivation of a healthy crop.

[1] Department of Agriculture-Potato Development Section, Kathmadnu, Nepal.
[2] Department of Agriculture-Nigaley Seed Farm, Nigaley, Nepal.
[3] CIP-UPWARD, Los Baños, Laguna, Philippines.

FFS on potato IDM

Since 1999, CIP has collaborated with partner institutions in Nepal to address disease and seed constraints in potato production. The overall goal is to enhance farmers' capacity to produce good quality seed and to maintain seed quality on-farm. The project has sought to introduce integrated disease management (IDM) through the development and piloting of a farmer field school (FFS) approach. The project partners include UPWARD, CIP-SDC Potato Project, Department of Agriculture (DoA), Potato Development Section (PDS), Nepal Agricultural Research Council (NARC), and district-level agricultural development offices (DADOs).

In the last three years, the project has conducted 27 FFS in 10 districts, with 698 farmers trained. The FFS were coordinated by the Potato Development Program (PDP) but implemented by technicians from the various District Agricultural Development Offices (DADOs). The project began by using the FFS-rice IPM model, with support from the FAO Community IPM Programme, but this was subsequently adapted for potato IDM.

FFS planning and preparation

Nine districts were initially selected representing different ecological zones (subtropical to temperate) and diseases of economic importance in the specific sites. A series of meetings were organized involving farmers, local leaders, technicians, and I/NGO staff to identify priorities among the major location-specific production constraints. Successive meetings were organized to design the FFS curriculum, identify 20-25 farmer-participants in each site, and to organize farmers into learning groups.

A preparatory meeting was then held to develop the plan of activities indicating schedules, responsibilities sharing, and commitments of the participants. The meeting also decided on sub-group formation to provide a better learning environment in carrying out various activities in the upcoming FFS sessions.

The team of FFS facilitators consisted of a horticulturist, extensionist, and plant protection officer. Junior technicians (J.T./J.T.As) assisted in logistical arrangements and facilitation, while DoA-PDS provided additional technical support.

Group learning process in FFS

In each site, FFS participants were divided into four permanent subgroups, each of which planted and maintained one plot of potato for a full season. Using different approaches to potato growing, the farmers were given the opportunity to investigate and assess IDM along with various farmers' practices.

FFS were conducted, with 15 to 18 weekly sessions depending upon the FFS learning content, agroecological belt, and site. A typical day (Box 1) in the field school was divided into three integral parts and the schedule for each session was developed as follows:

Box 1. Sample schedule of an FFS session	
Day:	Convenient to participants and the facilitator
Time:	9.30 AM to 3.30 PM. (Total time: 6 hours)
Attendance:	5 minutes
Climate setting:	10 minutes
Review of previous activities:	10 minutes
AESA & other observations:	10 minutes
Tea break:	15 minutes
Group dynamics:	As necessary (20-30 minutes)
Presentation:	90 minutes
Special topics:	90 minutes
Summary:	10 minutes
Planning for the next week:	10 minutes

1. Conduct agroecosystem analysis and its relation to the current growth stage of the crop and disease condition.
2. Group discussion in small groups followed by general group and group dynamics activities.
3. Presentation of relevant and timely special topic.

Curricula varied across sites, giving different levels of emphasis to the following learning components: (1) late blight, (2) bacterial wilt, (3) seed quality, and (4) general disease and crop management. Table 1 shows an example of the topical structure and learning activities for the FFS curriculum.

Farmer experimentation and observation

Simple on-farm learning plots, with two treatments (IDM and farmers' practices) and varietal trials, were set up to support the learning process in FFS. The types of experiments were decided jointly by farmer-participants. In the main learning plot (200 m^2), the area was divided between two treatments: recommended IDM practices (i.e., use of quality seed, use of less-susceptible varieties, seed size, spacing, fertilization, judicious use of chemicals) versus farmer's practices. Additional learning plots were established for use during the observation/agroecosystems analysis, and in case farmers wanted to conduct additional experiments (e.g., seedling tuber performance, cut vs. whole seed). Table 2 presents results of the experiments in the learning plots.

In addition, an area of about 15 m^2 was set aside for seed production, such as in using TPS for seedling tuber production. The purpose of this plot was to multiply the clean seed and distribute these to participants at the end of the FFS.

As part of the FFS, each subgroup had its own sample plants (with corresponding tags) in each IDM and farmers' practice (FP) plot. During each FFS session, the sub-group observed tagged plants through agroecosystem analysis (AESA). Plant height, number of main stems, presence of disease symptoms and insect pests, and presence of natural enemies were observed. At the same time, data on climatic conditions, soil conditions, and bacterial wilt and late blight infections were taken. After completing the AESA, each subgroup presented their observations, followed by general discussion.

Table 1. Example of topical structure and learning activities in a IDM FFS curriculum.

Session no.	Subject/Topics
1	• Field preparation, layout of the plots, and planting of the seed potato • Discussion on clean and diseased seed, cut pieces and whole seed, sprouted and nonsprouted seed and the treatment of seeds with fungicide • Pretest
2	• Emergence of different varieties • Layout and different observation study • Group management
3	• 1st agroecosystem analysis started; record observations taken were height of the plant, no. of the main stem, climatic condition of the field, harmful and useful insects, pests and disease etc. • Chemical fertilizer
4	• Observed 10% loss due to hailstone • Earthling-up & top-dressing in seedling tuber plot and IDM plot. • Group unity
5	• Useful insects: ladybird beetle and wasp • Top-dress and earthling up
6	• Bacterial wilt • Harmful insects • Urea sprayed (0.1%) in seedling tuber production plot • Spraying urea and its use by plants
7	• Increment of bacterial wilt in farmer's practice plot • Discussion on the height and main stem of the plants • Few insects were caught and reared in the controlled condition (net house) • Late blight, bacterial wilt
8	• Late blight • True potato seed and its use • Game of handkerchief
9	• Spraying of fungicide; Diathen M-45 • Earthling up in seedling tuber production • Late blight management
10	• Viruses • Spraying of fungicide Diathen M-45 • Quality seed and viruses
11	• Bacterial wilt in both IDM and FP plot • Late blight infection
12	• Bacterial wilt and its management • Bacterial wilt and community approach
13	• Observation of wilted plant • Seed plot technology
14	• Haulm pulling • Major insect pests
15	• Harvesting of the crop • Grading and storage • Posttest

FFS outcomes

In all FFS sites, the average yield in IDM plots was higher than in plots with farmers' seed and practices (Table 2). Meanwhile, the pretest and post test results showed that the participating farmers gained knowledge on varieties, cropping pattern, use of inputs, adoption of appropriate diseases management practices, seed management, and crop management practices. Test scores showed an increase in knowledge ranging from 22 to 57 percent, with an average of 42.2 percent (Table 3).

Results also showed that one did not have to be a male, literate farmer from a dominant ethnic group in order to participate meaningfully in the FFS. Of those who successfully completed the FFS during the 1999-2000 season, one out of four (26 percent)

Table 2. Potato IDM FFS learning plots and trials with corresponding yields.

Districts	Plot sizes & Area (m^2)	Treatments (N Replicated)	Trials Conducted	Yield (mt/ha)	Yield increment (%)
1. Sarlahi	300	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST	4	FP =15.0 IDM =24.0	60.0
2. Rupandehi	Total = 446 7.14 X 25 = 178.5 10.7 X 25 = 267.5	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST	4	FP = 18.0 IDM = 38.0 ST (F1C2) = 30.0	111.2
3. Kapilbastu	300	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST	4	FP = 19.1 IDM = 28.0	46.6
4 Dhanusha	500	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST	3	FP = 18.0 IDM = 35.0	94.4
5. Shurkhet	Total = 300 10 X 20 = 200 10 X 10 = 100	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST	5	FP = 18.5 IDM = 29.5 TPS = 42.8	59.4
6. Kavrepalanchok	FP: 201 IDM: 201 Fertilizer & variety: 201	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST 4. Fertilizers	4	FP = 22.0 IDM = 28.0	27.2
7. Kathmandu	141	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. Fungicides	4	Higher yield in IDM by 44% compared to FP	44.0
8. Shindhupalchok	550	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST	4	FP = 27.0 IDM = 28.0 ST F1C2 = 35.0 ST F1C1 = 50.0	3.7
9. Sunsari	706	1. LP = A. IP + BS, B. FP+ LS 2. Varieties 3. TPS & ST.	4	FP = 8.0 IDM = 15.0 ST (F1C2) = 24.0	87.5

Note: LP = learning plots. IP = improved practices, FP = farmers' practice, CS = clean seed, LS = local seed, BS = basic seed, ST = seedling tuber from TPS, F1C1 = first generation tubers from TPS, F1C2 = crop raised from F1C2 TPS seedling tubers, IDM = integrated disease management

Table 3. Pretest and post test results of FFS participants (2000-2001 season).

Districts	Test method	Result (%)	
		Pretest	Posttest
1. Sarlahi	Questionnaire & spotting	45	77
2. Rupandehi	Ballot-box & spotting	25	80
3. Kapilbastu	Questionnaire	27	81
4. Dhanusha	Questionnaire, interview & PRA	41	89
5. Shurkhet	Interview & spot test	32	89
6. Kavre	Questionnaire	55	83
7. Kathmandu	Questionnaire	54	76
8. Shindhupal	Spot test percent questionnaire	38	82
9. Sunsari	Questionnaire & ballot-box	35	75

was illiterate, and one out of three (36 percent) was female. Moreover, in seven of the nine FFS, there were participants coming from ethnic groups.

Over the last three years, a total of 698 farmers have been trained through the FFS approach. Nearly half of them (333 participants) were women. In fact, in three sites during the 2001-2002 season, 85 to 100 percent of the participants were women (Table 4).

Of the 32 facilitators involved in the FFS for potato IDM, one-third had previously implemented FFS activities for rice IPM. Assuming that they have adequate skills in FFS implementation, the project focused more on strengthening their technical capacity on potato IDM. However, during a project workshop at the end of the first year, FFS facilitators reported that major adaptations of the FFS approach were needed since the nature of potato disease problems was markedly different from those of rice insect pests (Table 5).

It was suggested that agroecosystems analyses (AESA) - the centerpiece of FFS on rice IPM - be used more selectively in potato IDM. Unlike in rice FFS: (a) weekly AESAs early in the season often do not yield significantly different or new observations about the potato crop, (b) the detailed data (e.g., number of leaves) gathered in rice AESAs are not directly relevant to the learning content in potato AESAs, and (c) AESAs need to be combined with other observation methods and exercises to facilitate farmers' discovery/learning about potato diseases (e.g., field trials).

Table 4. Total number of participants in potato IDM/FFS from 1999-2001.

District	1999/2000			2000/2001			2001/00			Total		Grand Total (M+F)
	M	F	Total	M	F	Total	M	F	Total	M	F	
1. Sarlahi	19	12	31	20	13	33	14	5	19	53	30	83
2. Rupendehi	14	4	18	16	5	21	16	5	21	46	14	60
3. Kapilvastu	14	3	17	0	25	25	31	0	31	45	28	73
4. Dhanusa	22	8	30	30	0	30	10	22	32	62	30	92
5. Surkhet	3	36	39	3	18	21	3	16	19	9	70	79
6. Kavre	21	4	25	24	7	31	10	16	26	55	27	82
7. Kathmandu	15	6	21	16	5	21	9	14	23	40	25	65
8. Sindhupa	8	16	24	1	25	26	1	26	27	10	67	77
9. Sunsari	21	13	34	21	4	25	3	25	28	45	42	87
Total	137	102	239	131	102	233	97	129	226	365	333	698
%Male/Female	57.3	42.6		56.2	43.7		42.9	57.0		52.2	47.7	

Table 5. Comparison of rice IPM FFS approach and potato IDM FFS approach.

Aspect	Rice FFS	Potato IDM	Remarks
Time frame	Season-long	Multi-season	IDM requires longer time frame since its success is determined by doing a follow-up by replanting produced seeds in next seasons.
Learning plots	Experimen-tation	Experimentation, seed multiplication/ maintenance	Seed is an important component of IDM. Learning plot is also used to multiply/maintain good-quality seed.
Frequency of sessions	Weekly	Weekly, but with more frequent inspection for late blight detection.	Depends on appearance of disease symptoms, especially for late blight. Sessions need not be weekly early in the season. However, they need to be more frequent (2-3 per week) when late blight/bacterial wilt symptoms begin to appear.
AESA	Basic method for learning by “discovery” by farmers	AESA needs to be complemented by other “discovery” methods	To be used more selectively since weekly AESA produces data which may not be directly useful/relevant for potato IDM.
Making things visible	Directly through AESA	Directly and indirectly	Unlike insects, pathogens are often not visible. Experiments to show the “effects” need to be done.
Evaluation	Impact after FFS season	Impact after several seasons	Disease management takes several seasons to complete. Impact assessment needs to be done only after several seasons.
Scope	Single constraint – crop	Multiple constraints – cropping system	Disease and seed management are closely interrelated. FFS needs to deal with the interaction among disease and seed factors, as well as dynamics between potato and other crops.

The FFS learning plots were also intended to serve as vehicles for multiplying healthy potato seed tubers that could be distributed to local farmers at the end of the FFS. In many of the FFS sites, however, this goal was not achieved because the farmers did not discuss in advance how the tubers harvested from the learning plots would be divided among them. The informal agreement was for the harvested tubers to be given as an incentive to landowners whose fields were used as learning plots. As it turned out, these landowners wanted immediate cash, so they either sold the tubers in the market as ware potatoes, or to other farmers as seed for the next season.

A major lesson derived from this experience is that learning, such as through the FFS, is possible and the technology available can meet farmers’ needs for healthy seeds, and for IDM in general. However, it was not successful in promoting the multiplication and maintenance of healthy seeds among farmers. Equally important in potato IDM is the setting up of social and institutional arrangements for ensuring a more equitable access and sharing of good quality seed produced through the FFS. Both FFS facilitators and farmers recognized this to be a key negotiation point that has to be made during the preparatory meeting in the subsequent FFS.

Post-FFS field evaluation

An impact evaluation of the project was carried out in December 2001-May 2002 to determine field-level impact after the FFS. As a pilot evaluation, it sought to gather preliminary information and field-test the evaluation methods, in preparation for a larger-scale evaluation.

The evaluation involved a sample of 120 farmer-respondents plus key informants. Its main goal was to compare three groups of farmers: (1) FFS participants, (2) other farmers who had contact with FFS participants (G1), and (3) other farmers who had no contact with FFS participants (G2). The highlights of the evaluation findings were as follows:

1. *Knowledge level.* A knowledge test was administered to assess recall (after 1-2 years) of IDM knowledge by FFS participants and to compare this with knowledge level of non-FFS participants. Judicious use of chemicals was the knowledge item correctly answered by 82 percent of FFS participants, and by about half of non-FFS participants. However, the latter had zero score for other IDM knowledge items, e.g., rouging, use of healthy seed, crop rotation, and improved varieties.

2. *Adoption of IDM practices.* Use of healthy seed was the most commonly adopted IDM practice (88 percent of FFS participants, 80 percent of G1 farmers, and 52 percent of G2 farmers). Reduced use of chemicals was reported by FFS participants. Only 13 percent sprayed more than six times in the previous season. In comparison, nearly half of non-FFS participants said that they had sprayed more than six times.

   On the whole, only 10 percent of FFS participants said they did not adopt any of the IDM practices learned from FFS. In contrast, 70 percent of non-FFS participants did not adopt any of the IDM practices or did not know what these IDM practices are.

3. *Farm-level changes.* FFS participants observed an increase in crop yield - averaging 11 t/ha before FFS and 18 t/ha after the FFS. Meanwhile, late blight incidence was noted as moderate to very high by 48 percent of FFS participants; G2 and G1 farmers noted 97 percent and 60 percent incidence, respectively.

   Among FFS participants, crop loss due to diseases decreased from 86 percent (pre-FFS) to 20 percent (post-FFS). During the same post-FFS cropping season, crop loss for G2 and G3 farmers were 85 percent and 36 percent, respectively.

4. *Livelihood benefits.* An analysis of net profit indicated that FFS participants earned NRp 74,200 (approximately US$950) per hectare. This was 17 percent and 7 percent higher than the net profits obtained by G2 and G1 farmers, respectively. About three out of five respondents across the three farmers' groups reported that potato contributed over 20 percent to total household income.

   Reduced input cost was cited as the main benefit by 60 percent of farmers adopting IDM practices. Twenty four (24) percent of the farmers reported savings in the cost for fungicide and chemical fertilizer, whereas 21 percent and 15 percent reported savings in labor and seed costs, respectively.

5. *Diffusion of IDM innovation.* A multiplier effect was noted from FFS participants to other farmers in the community. The former reported that after participating in the FFS, they shared potato IDM knowledge with an average of 18 other farmers. Eighty (80) percent of these farmers were from their own village, 48 percent from other villages, and 8 percent from other parts of the country.

   Among G1 farmers, one out of five claimed that they learned about potato IDM from FFS farmer-participants. Meanwhile, one out of three G2 farmers claimed that they learned about potato IDM from G1 farmers.

6. *Overall benefits from FFS-potato IDM*. FFS participants rated the overall benefits of FFS-potato IDM on a scale of 1-3. As expected, the three main benefits (average score of 2.9) cited by FFS participants were: improved knowledge, increased income, and enhanced potato productivity. Two additional benefits were cited: improved quality of extension service by government technicians (average rating of 2.3) and strengthened team effort and group formation among local farmers (average rating of 2.5).

7. *Farmers' suggestions to improve FFS-potato IDM.* The main criticisms and suggestions made by respondents were: (1) facilitators need to be more flexible in adjusting the FFS curriculum since disease problems vary across seasons or villages, (2) promote interagency coordination and explore a possible "integrated approach" for parallel FFS on various crops in the same locality, (3) increase the number of FFS facilitators to cover other villages by training other technicians or tapping graduates of previous FFS, and (4) systematize project efforts to support post-FFS activities among farmer-graduates.

References

Hidalgo, O., Campilan D. and T. Lama. 2001. Strengthening farmer capacity to grow a healthy potato crop in Nepal. *In*: Farmer and scientist partnership. CIP Program Report 1999-2000. Lima, Peru: CIP. pp. 336-342.

MoAC, 2002. Statistical information in Nepalese agriculture 2001/2002. Kathmandu, Nepal: HMG-Nepal, Ministry of Agriculture and Cooperatives, Agri-business Promotion and Statistical Division.

Ojha, D. 2002. Impact evaluation of the farmer field schools for potato integrated disease management in Nepal. Project Report. Los Baños, Laguna, Philippines: CIP-UPWARD.

Ojha, D.N., O.A. Hidalgo and T.L. Lama. 2001. A report on informal high quality seed-potato production and marketing in Nepal. *In*: Farmer and scientist partnership. CIP Program Report 1999-2000. Lima, Peru: CIP. pp. 245-250.