Why farmers practice early transplanting contrary to extension recommendations is an interesting question. Participatory rural appraisals (PRAs) done with farmers reveal some of the reasons farmers transplant late:

- the availability of tube-well irrigation and a cheap, flat rate for electricity
- the continued employment of labor after the wheat harvest
- the limited choice of early-maturing varieties, since high-yielding cultivars tend to have longer maturation periods and need earlier transplanting

Early transplanting of rice has led to multiple problems such as the following:

- a lowering of the water table from greater exploitation of ground-water resources (During May and June, the water requirements for crops are at their peak. The early transplanted crop requires 20% to 30% more water [PAU 1996].)
- the loss of nutrients from evaporation in the extremely hot months, resulting in increased use of chemicals and degradation of the environment
- an increase in diseases and insect pests
- less opportunity for green manuring

Specific varietal adoption patterns

Old varieties are cultivated on a large area. PAU has recommended a number of varieties of rice; however, farmers still prefer to grow old varieties. The varietal surveys conducted by PAU's senior extension specialist (farm management) showed that 36% of the area in the state during 1999 was occupied by varieties released 15 years ago, e.g., PR 106, IR8, Jaya, PR 103, and Govind (Singh 1999).

Weighted average age of varieties is high. The average age of varieties, weighted by the area grown to them in the Punjab, was 12 years in 1996, 11 years in 1997, and 10 years in 1998 and 1999. This average is very close to the 12 years reported by Witcombe et al. (1988) for the whole of India. More recently, farmers have replaced their varieties more rapidly, but the average age remains higher than what could be expected of an agriculturally advanced state. Varieties of wheat and barley grown in the UK in 1999 had an average age of only five years (analysis of data from the National Institute of Agricultural Botany by A.G. Bhasker Raj, *personal communication*).

Nonrecommended varieties occupy large areas. Despite many recommendations by PAU, there is significant adoption of nonrecommended varieties in the state. In fact, the area under non-PAU varieties increased in 1998 and 1999 (table 1).

In Patiala, the adoption of nonrecommended varieties was higher than in the Punjab as a whole (average of 53% over four years). Among nonrecommended varieties, Pusa 44 has the highest adoption. It occupied nearly 50% of the area in the Patiala district in 1996 to 1999. Pusa 44 is highly susceptible to bacterial leaf blight (BLB), and the large-scale cultivation of Pusa 44 has helped to build up the BLB pathogen, which causes losses in other varieties. However, farmers prefer Pusa 44 for its high yield and resistance to lodging.

Table 1. Area of Nonrecommended Varieties in the Punjab and Patiala District from 1996 to 1999

	Area of nonrecommended varieties (% of total rice area)		Area of Pusa 44 (% of total rice area)	
Year	Punjab	Patiala	Punjab	Patiala
1996	31	43	24	43
1997	33	47	28	47
1998	35	60	30	56
1999	38	60	28	54
Mean	34	53	28	50

Note: See figure 1 for information on sample sizes.

Methods and materials

Participatory approaches

Three participatory approaches were used in this study:

1. farmer-managed participatory-research (FAMPAR) varietal trials, in which farmers grow new varieties alongside their local variety under farmer management, with evaluation of many cultivar traits by both scientists and farmers
2. informal research and development (IRD), in which farmers evaluate new varieties with little intervention from scientists; evaluation is mainly from the examination of adoption trends
3. single-replicate design (mother trials), with all varieties grown together as demonstration plots to assess the relative performance of varieties (researcher-designed but farmer-managed trials)

Selection of farmers and villages

Eleven villages (Kalifewala, Chalaila, Kalwa, Barsat, Bhedpura, Gajjumajra, Kaidopur, Dhengera, Partapgarh, Kartarpur, and Jauramajra) were selected to represent agroclimatic situations in the Patiala district. Three villages (Gajjumajra, Bhedpura, and Barsat) represented salt-affected areas with soils having a pH between 9.0 and 9.5. Of these 11 villages, FAMPAR trials were conducted in six and IRD in the rest. All villages have either metaled or good earthen approach roads. All of the agricultural land is irrigated from canals or tube wells.

Farmers were selected to represent small, medium, and large landholdings. Willingness to experiment with new varieties was the key factor in selecting farmers. A total of 497 farmers were involved in participatory research in the *kharif* (monsoon season) of 1999.

Farmer-managed trials

Twelve varieties were tested in participatory trials: IR36, IR64, HKR 120, HKR 126, Pant Dhan 4, Pant Dhan 10, Gurjari, Kalinga III, Govind, Pusa 834, PR 111, and PR 114. Of these, varieties, PR 111 and PR 114 are recommended for the Punjab. All other varieties are out-of-state released varieties. Small bags (2–5 kg) of seed (varying according to the demand of farmers) were given to farmers with the understanding that they would grow the new variety alongside their local variety under the same management and that they would participate in the evaluation.

The plot area for FAMPAR trials varied from 40–5000 m^2. Most trials had an area of more than 1000 m^2 under any variety. Some farmers, particularly in IRD villages, pooled the seed to grow a larger area.

Researchers and farmers jointly evaluated the trials. Frequent farm walks, focus-group discussions, and household-level questionnaires were used for recording farmers' perceptions. Grain yield data were recorded jointly; researchers measured the plot size and farmers weighed the plot yield.

Demonstration plots of all varieties grown in the same field in a single-replicate trial were grown in all villages as mother trials.

Results and discussion

Of the 12 varieties tested with farmers, three (IR64, IR36, and PR 114) were preferred but IR64 was the most preferred. We shall restrict the description of trials to IR64 only. Variety IR64 was tested with 43 farmers (26 in FAMPAR villages and 17 in IRD villages) and compared to Pusa 44.

Farmer trials over several dates of sowing

The greatest power of participatory trials was experienced in this study when IR64 was tested over a span of time representing the whole of the transplanting period in the Punjab. This was not deliberately designed but was a result of the reasonably large sample size that represented the normal practices of farmers. This was not possible in earlier on-station trials that were invariably sown over a restricted, usually late, period. These on-station trials, done in 1985, 1986, and 1987, did not identify IR64 because it yielded less than the check varieties in trials that were transplanted in July.

Performance of IR64

IR64 had a significant yield superiority of 5% over Pusa 44 in 43 trials, giving an extra 300 kg of grain ha^{-1} over a base of 6550 kg (figure 2). IR64 showed the best performance (a 12% yield increase over Pusa 44) when transplanted from 21–24 June. The yield advantage decreased when IR64 was transplanted earlier or later in June, which fits very well with the extension recommendation to spread transplanting equally around 20 June.

An important feature of IR64 is that it matures 26 days earlier than Pusa 44. This trait, along with high yield, favors its adoption in various situations (figure 3).

Farmers' perceptions for traits other than grain yield (figure 4) identified IR64 to be superior to Pusa 44 for number of tillers per plant and resistance to BLB, stem borer, and leaf folder. IR64 is shorter so it is resistant to lodging, which allows it to be responsive to inputs.

Advantages of IR64 over Pusa 44

IR64 had the following advantages over Pusa 44:

- superior grain quality and higher yields
- earlier maturity, leading to a saving of irrigation water
- resistance to BLB and tolerance to white-backed plant hoppers
- resistance to lodging

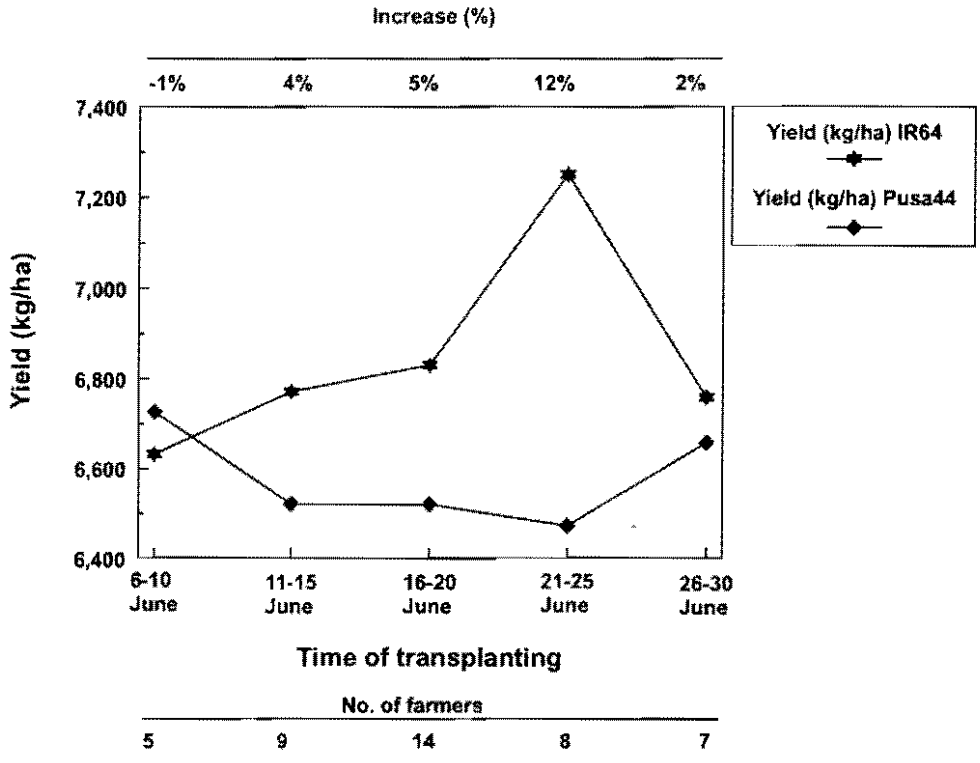

Figure 2. Yield (kg ha^{-1}) of IR64 and Pusa 44 in 43 farmers' field trials (26 FAMPAR and 17 IRD) in the Patiala district during the monsoon season of 1999
(The overall mean yield of 6860 kg ha^{-1} of IR64 was significantly higher [at the 1% level] than the 6550 kg ha^{-1} yield of Pusa 44 with a *t*-value of 4.1 over 43 sites.)

- allowing a green-manure crop or summer mung (*Vigna radiata* [L.] Wilczek) to be grown between the wheat harvest and rice transplanting

Adoption and further testing of IR64

All participating farmers saved IR64 seed in 1999 for growing in *kharif* 2000. There was considerable seed exchange from farmer-to-farmer. Seed demand in *kharif* 2000, from farmers who had seen the trials was considerable, but only five tones of seed could be procured and supplied to farmers. Some entrepreneurial farmers and farmers' groups in the state have already become active in producing and procuring IR64 seed.

As a consequence of the participatory trials in Patiala, PAU is retesting IR64 at a number of research stations under appropriate management. The Krishi Vigyan Kendra (KVK), Patiala, has undertaken large-scale testing on farmers' fields in Patiala and other districts of the Punjab in *kharif* 2000.

To exploit the advantage of IR64's early maturity, new agronomic practices and cropping patterns are being tested by the KVK Patiala in more than 40 trials with farmers. These are on growing summer mung and green manuring with sesbania in *kharif* 2000.

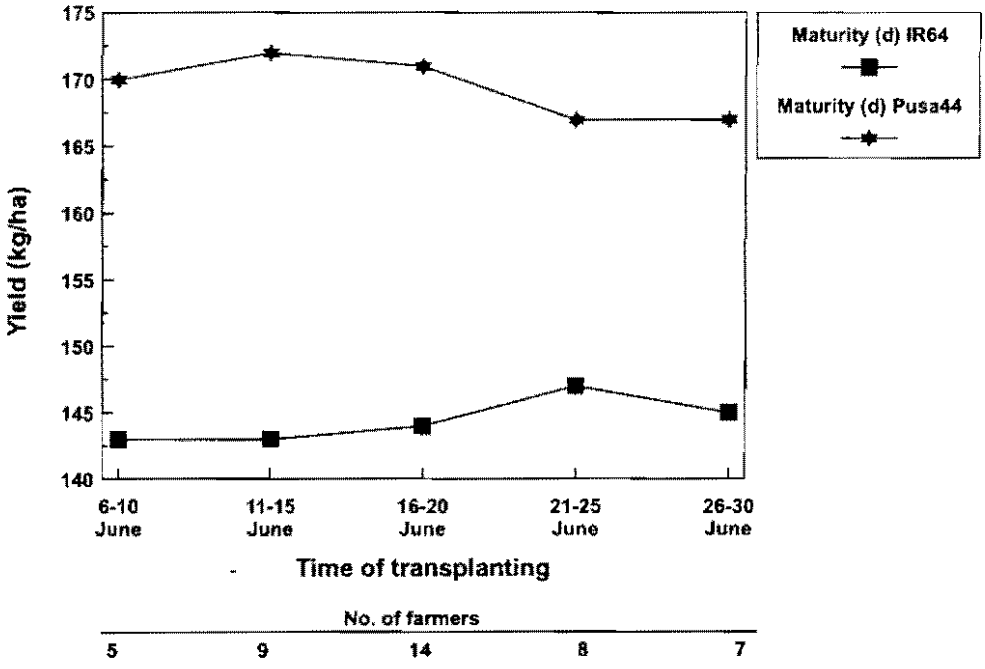

Figure 3. Days to maturity of IR64 and Pusa 44 in 43 farmers' field trials (26 FAMPAR and 17 IRD) in the Patiala district during the monsoon season of 1999
(Over 43 trials, IR64 matured significantly earlier [144 days] compared to Pusa 44 [170 days].)

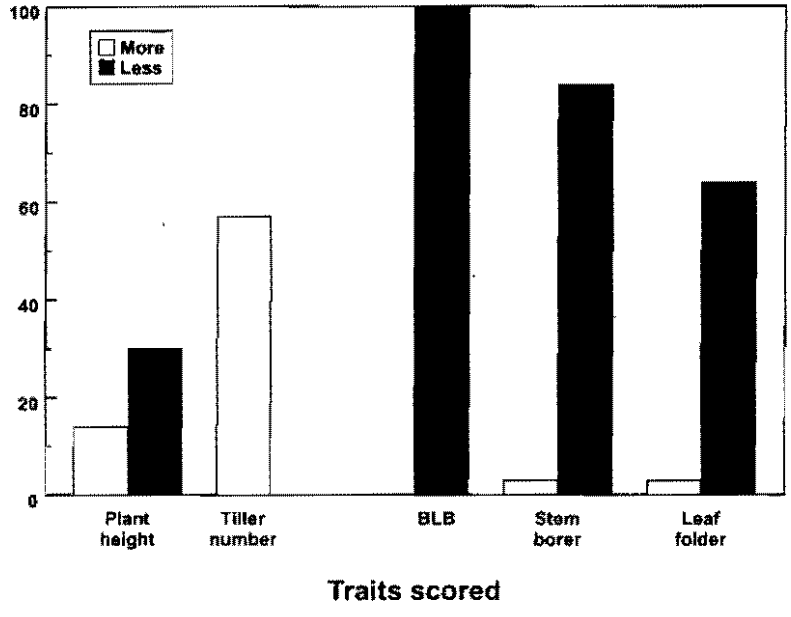

Figure 4. Farmers' perceptions (%) for IR64 in comparison to Pusa 44 for plant height, tiller number per plant, and resistance to bacterial leaf blight (BLB), stem borer, and leaf folder over 48 farmers
(Like Pusa 44, IR64 was found to be 100% lodging resistant.)

Conclusions

The PVS approach has been shown to be a potent tool:

- to identify farmer-preferred varieties
- to identify the correct recommendation domain of a variety (IR64 was previously tested in formal trials but was rejected for the Punjab because formal testing did not represent the temporal variability that exists in high-potential production systems)
- to correctly determine the best time of transplanting of a variety
- to identify varieties that give farmers new agronomic options
- to promote the rapid adoption and dissemination of a variety

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Equity Issues in Varietal Dissemination through Farmers' Fairs (*Kisan Melas*) in Punjab, India

J. Singh, S.S. Malhi, J.R. Witcombe, and D.S. Virk

Abstract

In the Punjab state of India, grain production has rapidly increased. One factor in this increase has been the fast adoption of new varieties. Punjab Agricultural University (PAU) has played a major role in distributing certified seed of new varieties to the farmers of the state. Most of the seed is distributed by sales at farmers' fairs (*kisan melas*) held at PAU and its regional research stations. In this study, equity issues in the sale of wheat seed were examined in farmers' fairs held in September 1999.

In the PAU *kisan mela*, smallholder farmers were found to be considerably underrepresented and large farmers considerably overrepresented. The geographical distribution of the farmers who purchased seed was also studied. As might be expected, farmers tended to come to where the *kisan mela* was held from nearby administrative areas (termed *blocks*). This resulted in certain blocks being poorly represented.

PAU needs to address equity issues, both socioeconomically and geographically, by increasing the outlets for seed sales in remote districts and areas of the state, and by encouraging small farmers to attend the *kisan melas* and purchase seed.

Introduction

The Punjab State of India has witnessed a rapid increase in the production of food grains, particularly wheat. Wheat production was only 1.74 million tonnes in 1960–61, but it rapidly increased to 14.46 million tonnes in 1998–99 as a result of increases in both yield and the area under the crop. Wheat yields averaged only 1.2 t ha^{-1} in 1960–61, but this increased to reach 4.3 t ha^{-1} in 1998–99. This very large increase in productivity was due to several factors, including the breeding and popularization of high-yielding varieties (HYVs), increased irrigation and fertilizer use, and the mechanization of farm operations. The fast adoption of quality seed was a major—perhaps the most important—factor.

A survey of the wheat crop in the Indian Punjab (Singh 2000) showed that 79% of farmers kept seed from the previous crop, 12% purchased from private seed dealers, and 6% kept part of the seed and purchased part from seed traders. Only 3% of farmers practiced farmer-to-farmer seed purchase. About 4% of the purchased seed was bought from institutional sources such as the Punjab Agricultural University (PAU), the Punjab State Seeds Corporation, or the National Seeds Corporation. However, for new varieties, farmers tended, in the beginning at least, to purchase seed from PAU.

PAU produces and disseminates seed. Its primary responsibility for production is breeder and foundation seed. However, it also produces certified seed of recommended varieties and, for wider dissemination, recently released varieties. Most of this certified seed is distributed during farmers' fairs (*kisan melas*) that are held at the main campus at Ludhiana (PAU *mela*) and at four regional research stations (RRSs) situated at Rauni, Bathinda, Ballowal Saunkhari, and Gurdaspur. In this

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study, we examine the equity issues in PAU's wheat-seed distribution system at the time of the farmers' fairs.

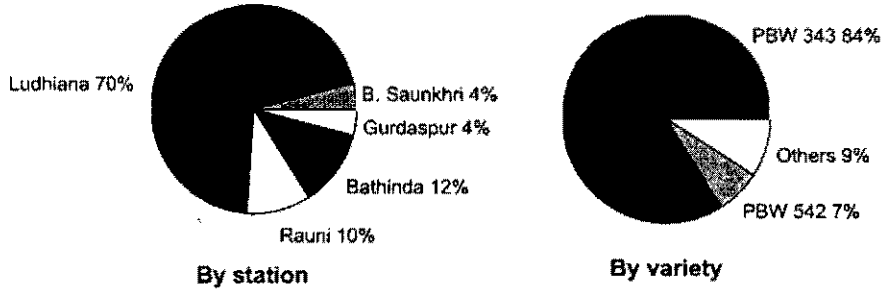
Methods

PAU holds farmers' fairs twice a year at the main campus and at four RRSs. At the fairs, certified or truthfully labeled seed is sold for the *kharif* (monsoon season) and *rabi* (winter season) crops. The seed is sold on a "first-come-first-served" basis—farmers queue for their turn to buy seed for cash. In September 1999, wheat seed sales at the five *kisan melas* were surveyed by distributing a simple questionnaire to the farmers in the queues. There was a random sample of 359 farmers who purchased wheat seed at the PAU campus *mela* and a random sample of 285 farmers at the RRS *melas*. Farmers were asked about their farm size, the location of their farm and the amount of seed they had purchased.

Results and discussion

Station-wise and variety-wise seed sales

Nearly 28 t of wheat seed was sold in all *kisan melas*. A major share of the seed was sold at Ludhiana (70%) because it is centrally placed and is the main campus of the university (figure 1). When farmers visit Ludhiana for seed purchases, they also have the opportunity to learn about other technologies. Also, this *mela* is widely advertised and is a more significant event than the regional *melas*. After the PAU campus, Rauni (10%) and Bathinda (12%) accounted for most of the remaining seed sales (figure 1).



Source: Director of Seeds, PAU and Ludhiana, personal communication.
Note: "Others" include varieties PDW 233 (1.8%), PBW 138 (2.1%), PBW 175 (0.3%), PBW 299 (0.4%), PBW 373 (2.5%), and PBW 396 (1.7%), all of which individually account for less than 5% of seed sales.

Figure 1. Wheat-seed sales of PAU at the main campus and regional research stations

Melas at Gurdaspur (4%) and Ballowal Saunkhari (4%) do not account for major sales of wheat seed. Gurdaspur is located on the northern corner of the state and is not well connected. Ballowal Saunkhari represents the mainly rainfed *kandi* belt of the state—a 10 km tract adjoining the hilly state of Himachal Pradesh, where irrigation facilities are very poor. Farmers in this area largely belong to the low-resource category.

Variety PBW 343 was in the greatest demand and accounted for 84% of the total seed sales (figure 1). The only other variety to account for an appreciable proportion of seed sales was WH 542 at 7%. The remaining five varieties accounted, in total, for only 9% of the sales.

Patterns of seed distribution in addressing equity issues

Overall seed distribution in the state in all *kisan melas*. A large proportion (45%) of the farmers in the Punjab have small landholdings of fewer than 5 acres. These farmers own only 12% of the cultivable land (table 1). In contrast, 29% of farmers who have more than 10 acres own 67% of the cultivable land (table 1).

Table 1. Patterns of Wheat-Seed Sales at Farmers' Fair at PAU, Ludhiana, September 1999

Farm size	Farmers attending the *mela*		Quantity of seed sold		Proportion of farmers in the state by	
(acres)	Number	%	Tonnes	%	Number (%)	Area (%)
< 5	20	6	0.9	5	45	12
5 to 10	49	14	2.0	11	26	21
10 to 20	125	35	6.1	35	23	40
> 20	165	46	8.7	50	6	27

When farmers attending all the *melas* were categorized by the size of landholding, it was found that smallholder farmers with fewer than five acres were extremely underrepresented (7% of purchasers versus 45% of the farmers as a whole). The 7% of the farmers from this category purchased 6% of the seed sold (figure 2). In contrast, farmers with large landholdings were hugely over-represented (46% of purchasers but only 6% of the farmers in the state). Less marked, but nonetheless quite large, underrepresentation occurred for farmers in the five- to 10-acre landholding category, and there was overrepresentation for farmers in the 10- to 20-acre category (figure 2). A similar, but less marked, bias was found for seed quantities purchased relative to the area of land held by each category of farmer (figure 2).

Seed sales as a percentage of total sales varied little from the data for farmers purchasing seed, i.e., once farmers decided to purchase seed, there was little difference in the quantity purchased, whatever the category of farmer.

The same analysis was done, disaggregated into the PAU *mela* (table 1) and the regional *melas* (table 2). Although, in both cases, there was underrepresentation of smallholder farmers and over-representation of larger landholding farmers, the situation was better in the regional *melas*. The biggest difference between the regional *melas* and the Ludhiana *mela* that there were fewer large landholding farmers purchasing seed (46% in the Ludhiana *mela* compared to 28% in the regional *melas*).

Spatial coverage

The geographical distribution of the farmers who purchased seed was also studied. The Punjab state is divided into 136 administrative units, called development blocks, that represent clusters of contiguous villages. As expected, farmers tended to come from nearby administrative areas or blocks

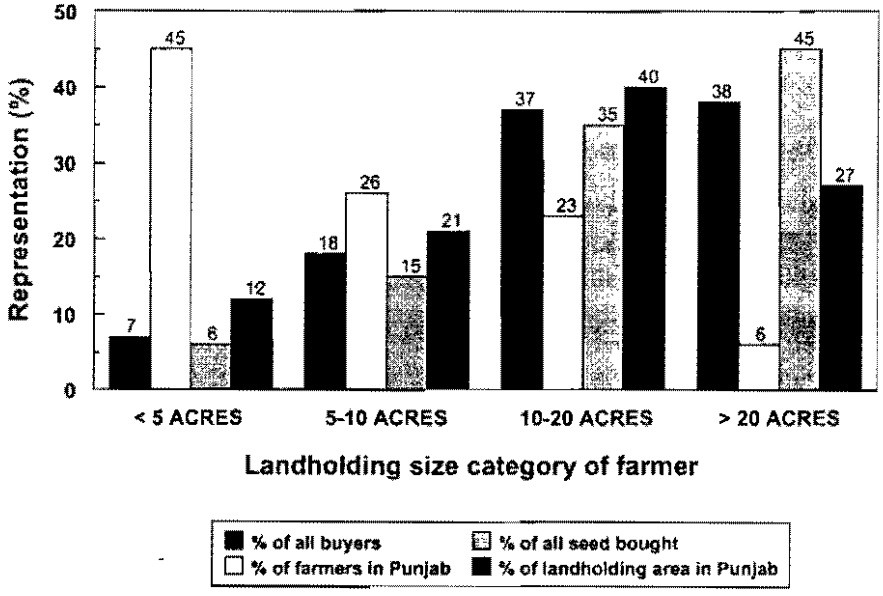


Figure 2. Wheat-seed sales by PAU at its main campus and four regional research stations, categorized by landholding size
(Sales by number of purchases and quantity of seed purchased are compared to the number of farmers and the area of land in the state by the landholding categories. The data presented are from a random sample of 644 farmers: 359 at the main campus and 285 at regional research stations.)

Table 2. Patterns of Wheat-Seed Sales at Farmers' Fair at Four PAU Regional Research Stations, September 1999

Farm size	Farmers attending the mela		Quantity of seed sold	
(acres)	Number	%	Tonnes	%
< 5	25	9	0.9	7
5 to 10	65	23	2.4	19
10 to 20	114	40	4.5	36
> 20	81	28	4.7	37

to where the *kisan mela* was held. Farmers who visited *kisan melas* at the main campus and RRSs belonged to 95 blocks out of 136 blocks in the Punjab.

In the PAU campus fair, the farmers sampled came from 65 development blocks of the Punjab state. Farmers also came from nine development blocks of the surrounding states of Haryana and Rajasthan. In the regional fairs, farmers came from 59 development blocks to buy seed. The geographical distribution at block level shows the following:

- Seed is only disseminated to 70% of the blocks in the Punjab despite the five kisan melas in the state. Forty-one blocks showed no representation among the farmers who were sampled.

- The majority of underrepresented blocks were in the Amritsar and Ferozepur districts where no fairs are presently held.

PAU developed its seed-dissemination system in the post-Green-Revolution period to improve the equity of seed distribution in the state. In this system, small kits of seed are sold to many farmers rather than larger quantities being sold to a few better-off farmers. When it was felt that farmers from remote areas were unable to travel to the main campus in Ludhiana, regional kisan melas were started in order to make seed available in the regions. However, the seed-dissemination system of PAU at present does not address these issues satisfactorily. It is not known if these equity issues have always been present or if they have worsened over time. It is possible that over years, small farmers and those in remote geographical areas have become less enthusiastic about traveling to kisan melas, and small farmers have become dependent on larger farmers for their seed supply. Another factor may be that farmers with smaller landholdings are less prepared to take the risk of trying new varieties immediately after their release and wait until they can judge their performance on the fields of better-off farmers in their village. Why small farmers have lower representation in melas and why they buy less seed are important issues that need to be addressed.

Large farmers, who generally employ labor for farm operations, can afford to be away from their farms. They have the means and the time to travel long distances to purchase seed to increase farm revenues. On the other hand, small farmers

- lack the resources to travel long distances
- lack time because of their involvement in farm and off-farm activities, particularly in September when they are busy attending to the maturing rice crop
- lack sufficient funds to purchase seed at the time when they have incurred heavy expenditures on the standing rice crop, and have yet to gain a return from it
- perhaps lack enthusiasm to try new varieties because their possible failure represents for them a greater risk to their livelihoods than it does for larger farmers

Although not ideal, the representation of small farmers is slightly better at the regional fairs because, on average, seed purchasers have traveled less far. Even there, they buy seed in smaller quantities than their representation. Small farmers require smaller quantities of seed because of their small landholdings, but this may also indicate that they lack money to buy more and that they have greater aversion to risk than large landholders.

Despite the sale of seed at regional stations, there are 41 blocks that were not served by the system in the sample. Most of these are in the border districts of Amritsar and Ferozepur where there are no RRSs. Ferozepur borders on Haryana and Rajasthan. Lack of availability of seed from sources in the Punjab probably leads to a higher adoption of varieties from adjoining states.

Conclusions

The PAU system needs to open more outlets for seed sales to address both equity issues. If new regional stations cannot be opened in the Amritsar and Ferozepur districts, *kisan melas* can be held in these districts in collaboration with the Department of Agriculture. More *kisan melas,* especially in poorly served blocks, may also help address the needs of small farmers in the state. Policies at the state level, involving Punjab State Seeds Corporation and the Department of Agriculture, that are