**Table 1. Rice Varieties Included in the Participatory Varietal Selection Program, 1997–1998 (The first 12 varieties were first offered in 1997, the last 4 in 1998.)**

| | | | Country and year of release | |
|---|---|---|---|---|
| **Name of variety** | **Entry name** | **Parentage** | **India** | **Nepal** |
| IR51672 | IR51672 | — | — | PR |
| Narendra 80 | NDR 80 | N22/IR36 | 1986 | NR |
| Radha 11 (India:Rajshree) | TCA 80-4 | Local selection in India | 1989 | 1995 |
| Rampur Masuli | AS781-1 | Lalnakanda/IR30 | — | 1997 |
| Pant Dhan 4 | BG 90-2 | IR262/Ramadja | 1984 | NR |
| Pant Dhan 10 | IR9763 | IR32/Mahshuri/IR28 | 1993 | NR |
| PNR 381 | — | Tainan 3 mutant/Basmati 370 | 1992 | NR |
| PR 103 | IR661 | IR8/IR127-2-2 | 1976 | NR |
| PR 106 | IR665-79 | IR8/Peta/Bella Patna | 1978 | NR |
| PR 111 | — | IR54/PR106 | 1993 | NR |
| Pusa basmati-1 | Pusa 615 | Pusa 150/Karnal local | 1989 | NR |
| Swarna | MTU7029 | Vasista/Mahshuri | 1982 | NR |
| Pusa 33 | — | Improved Sabarmati/Ratna | 1983 | NR |
| Pusa 44 | Pusa 44-33 | IARI 5901-2/IR 8 | 1993 | NR |
| Pusa 834 | — | IR 50/Pusa 33//IR 50/Pusa 33 | 1995 | NR |
| Sarwati | — | — | — | NR |

*Note:* NR = not released; PR = pre-release; (–) information not available.

chance of mixing the new variety with the existing farmer's variety from seed sowing through to post-harvest assessment. The area of the trial plots was measured by researchers, while farmers measured yield in local volumetric units, which were later converted to metric units. A paired *t*-test was used to test the significance of the difference for yield between the test entry and the existing rice variety.

To conduct the trials, each trial site was jointly identified and demarcated by the participating farmers and researchers. There were regular visits by researchers to the trial plots with the participating farmers to see the performance of the variety at different growth stages. A farm walk was organized in which researchers, participating farmers, and other interested farmers saw the standing crop in all or most of the plots when the crop was near to maturity. Immediately after each farm walk, a focus-group discussion was held, which included preparing a narrative summary of each rice variety, describing all its positive and negative traits, and preparing an overall preference ranking of all the varieties. A post-harvest evaluation of the rice varieties was done on the basis of farmers' perceptions two to three months after the harvest of the crop. This gave the farmers enough time to assess post-harvest traits. A structured questionnaire was used, which included questions on grain quality, market preference, and the farmers' intentions on whether to adopt or reject the variety. Questions were also asked on the distribution of the seed of the variety by farmers to monitor the adoption and spread of the new rice varieties through 1997 to 1999. In 1999, households that received seeds in 1997 and 1998 were visited first (purposive sampling) and then new adopters were interviewed based on the distribution list provided by each farmer.

The project mobilized existing farmers' groups in the project villages. These groups had been formed for different purposes, including agriculture, livestock/dairy, and water use. Distribution of the seed of the new varieties was done following discussions with the groups. Participatory well-being ranking was done to identify farmers from different resource categories. Through group consensus, an equal number of farmers from all three well-being categories were selected to participate in the trials. A brief overview of all the varieties included in the trials was given to farmers.

## Varietal diversity in the project area before PCI

The baseline study showed that varietal diversity was low in *chaite* rice, wheat, and maize (Rana et al. 2000). In *chaite* rice, CH 45 covered over 97% of the *chaite* rice area in the project villages. In maize, varieties Arun 2 and Arun 4 occupied about 70% of the area, and Rampur Composite about 30%. In wheat, two varieties, UP 262 (50%) and RR 21 (20%), occupied most of the area.

For main-season rice, the greatest varietal diversity was in the East Chitwan cluster (ECC) of villages where 11 different rice varieties were grown by the farmers, of which Masuli and Ekhattar (a sister line of Sabitri) together occupied two-thirds of the rice area (figure 1).

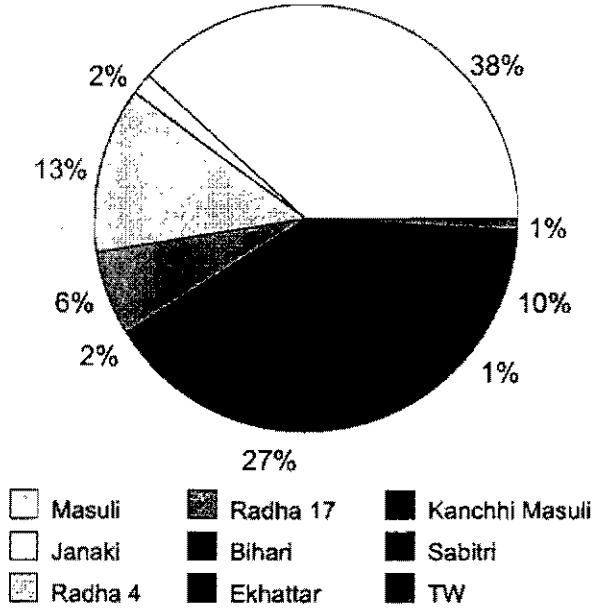


**Figure 1. Area under main-season rice varieties in three study villages of East Chitwan cluster, 1997 (Himali and Chaite 6 occupied an insignificant area and are not shown.)**

Six different rice varieties were grown by the farmers in the West Chitwan cluster (WCC) but Masuli alone covered 98% of the total rice area (figure 2). The narrow varietal diversity in this cluster could be attributed to a more uniform physical environment as the majority of the area is low lying and retains standing water during most of the rice-growing season. Another reason is that in WCC, in contrast to ECC, few vegetables are grown. Vegetable growing promotes diversity because farmers grow rice varieties of shorter duration than Masuli to allow timely sowing of the vegetable crops.

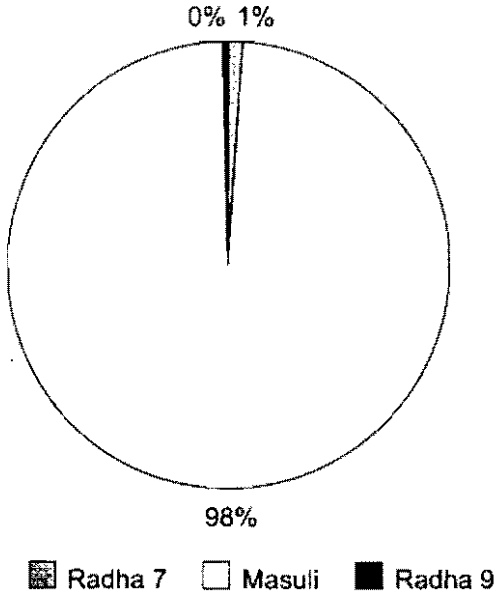


**Figure 2. Area under main-season rice varieties in three villages of West Chitwan Cluster, 1997 (Sabitri, Kanchhi Masuli, and Radha 4 occupied an insignificant area and are not shown.)**

The varietal diversity at the Nawalparasi cluster (NPC) is closer to WCC than to ECC. The main differences are that in Nawalparasi there is more Masuli and Sabitri and no Ekhattar at all (figure 3).

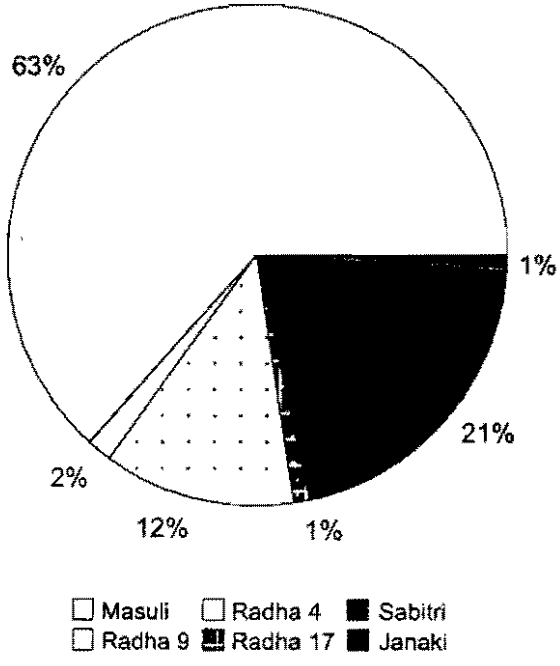


**Figure 3. Area under main-season rice varieties in three villages of Nawalparasi cluster, 1997 (Kanchhi Masuli and Radha 7 occupied an insignificant area and are not shown.)**

## Varietal dynamics

The distribution of varieties over time is dynamic, as new varieties are adopted and old and obsolete varieties are dropped. How dynamic the system is can be quantified by measuring temporal diversity. A dynamic situation is found not only in high-potential systems with modern varieties, it also occurs in marginal areas and even for landraces (Joshi and Witcombe, this volume). As a result of the introduction of new varieties by PVS, most farmers indicated that the new varieties they were adopting would replace Masuli. Other varieties also likely to be replaced were Kanchhi Masuli, Radha 4 (also known as Chaurasi or Bammorcha) and Sabitri. Twenty varieties were listed as likely to be replaced, but 16 of them accounted for only 18% of the total varietal replacement indicated by farmers.

## On-farm varietal diversity

The introduction of new modern varieties contributed to an increase in on-farm varietal diversity when diversity is measured simply as the number of varieties grown in each village (figure 4).

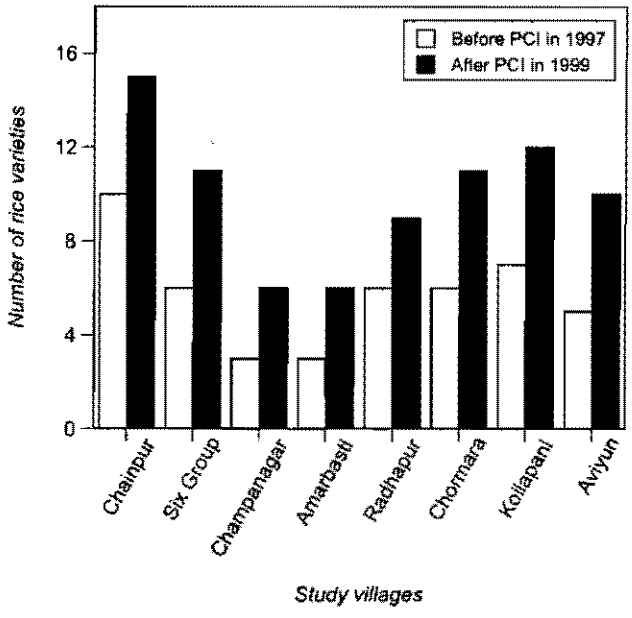


**Figure 4. Varietal diversity in rice before and after a participatory crop improvement program across all nine FAMPAR villages, 1997 to 1999**

## Grain yield

Four varieties (Swarna, PNR 381, Pant 10, and PR103) had a statistically significant yield advantage over the farmers' existing varieties (table 2). From a few kilograms of seeds in 1997, these four varieties covered 22 ha by 1999 in the FAMPAR villages, which contributed 65 t of additional yield. A further 25 ha were occupied by four other new varieties: Rampur Masuli, Sarwati, IR51672, and Pusa 44. On average, these yielded 7% more than existing varieties ($p < .05$ in a pooled analysis). The added yield from these varieties was about 9 t. A similar or higher amount can

**Table 2. Yields of New Main-Season Rice Varieties Compared to Existing Varieties in Participatory Varietal Trials in Eight FAMPAR Villages, Main Season, 1999**

| | Grain yield of rice varieties (t ha-1) | | Difference relative to Masuli | | |
|---|---|---|---|---|---|
| Variety name | New | Existing | Yield (%) | Maturity (days) | Area covered (%) by 1999 |
| Swarna | 4.40 | 3.35 | 31.0*** | +5 | 5.2 |
| PNR 381 | 4.04 | 3.45 | 17.0* | -30 | 2.1 |
| Pant 10 | 4.37 | 3.95 | 13.5* | -25 | 0.7 |
| PR 103 | 4.45 | 3.86 | 15.3** | -18 | 0.8 |
| Other new varieties ‡ | 4.17 | 3.80 | 7.0* | — | 3.0 |

* $p<.05$.
** $p<.01$.
*** $p<.001$.
‡ Mean of Rampur Masuli, IR51672, Sarwati and Pusa 44.

be expected for the IRD villages that were found to have higher farmer-to-farmer spread of new varieties than the FAMPAR ones. The monitoring of varietal adoption and spread done in 1999 confirmed that Swarna, Rampur Masuli, PNR 381, Pant 10, PR 103, and Sarwati covered significant areas, although other varieties, such as IR 51672, Radha 11, PR 106, and NDR 80, were also adopted to some extent.

## Discussion

The existing varietal diversity in main-season rice was low in general and very low in the West Chitwan cluster. The differences between clusters reflected their physical and agronomic diversity. Because the dominant crop varieties grown by the farmers in the villages of the study area were 30 to 35 years old, farmers were not benefitting from several decades of progress in plant breeding, and because of narrow varietal diversity, these systems may be more vulnerable to pests and disease attacks, which contribute to instability in food production.

The participatory varietal selection program was successful in this high-potential production system. Farmers identified and adopted seven new rice varieties from the 16 given in PVS. Some of these, such as Swarna, PNR 381, PR103, and Pant 10, had a distinct yield advantage over the varieties farmers were currently growing. Others were preferred for their early maturity, lower water and nutrient requirements, or better grain quality. New varieties were adapted to specific niches. For example Swarna is suitable for fields where the water stands for nearly all of the growing season; Pant 10, PNR 381, and Sarwati are suited to conditions of partial irrigation and medium fertility; and PR 103 and PR 106 were adopted for more fertile, higher yielding environments. Radha 11 was found to be suitable for late planting conditions and for transplanting when the seedlings are more than one and one-half months old. This is an important trait for areas where rice transplanting is dependent on unpredictable monsoon rains.

Varietal diversity can be quantified but such quantification is scale sensitive. Diversity estimated over all the FAMPAR villages as one unit gives different results than if it's estimated on the basis of clusters. The varietal diversity in the WCC increased far more than in the other two clusters, which