Market-Based Incentives for Conserving Diversity on Farms: The Case of Rice Landraces in Central Tarai, Nepal

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ABSTRACT

Market-based incentives are one means of encouraging farmers to grow landraces that are also of social value, thereby contributing to the conservation of crop genetic diversity on farms—and in principle, the cheapest. This study uses a participatory, market systems approach supplemented by baseline data from an ongoing project to analyze markets for rice landraces and modern varieties in Nepal. Nepal is located in the area of origin and diversity for Asian rice. With the exception of traditional Basmati rice (which is of high aromatic quality), most rice landraces are traded through small-scale informal channels. Traders earn higher profits handling modern varieties than landraces, with the exception of Basmati, which competes with modern varieties. The superior consumption qualities of Basmati are valued in markets, but conserving these landraces may not have great social value. Furthermore, farmers who grow Basmati are clearly better off than those who do not. Findings raise questions about the role of market-based incentives for conserving landraces on farms, the costs entailed in establishing a structure to generate them, and about efficiency vs. equity considerations in the design of conservation programs.

Key words: landraces, market incentives, on-farm conservation, Nepal, rice diversity
JEL Codes: Q13, O13, D40

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Conserving crop genetic resources on farms

The genetic improvement of crop plants depends on the exploitation of genetic diversity. Today, in the richer and middle-income societies of the world, the genetic improvement that enhances the quality or quantity of food produced is accomplished by professional plant breeders. In the poorer nations of the world, in areas that are environmentally heterogeneous or isolated from market infrastructure, many farmers still rely directly on the harvests of the genetic diversity they sow for food and fodder as well as the next season's seed.

Semidwarf varieties now occupy an estimated three quarters of the area in Asia where *Oryza sativa* is believed to have been domesticated, though ancestral varieties can still be found in upland areas (Jackson and Khush, 2001; Vaughan and Chang. 1992). More heterogeneous than the modern semidwarf varieties that are bred for uniformity in stature and selected on the basis of particular performance criteria, these ancestral varieties or "landraces" are often adapted to specific local human needs and environmental niches (Simmonds, 1979). However, farmers may choose to cease growing either individual landraces or modern varieties if changes in the production or marketing environment cause them to lose their relative advantages.

Since the 1970s, concern for the replacement of landraces by modern varieties and the loss of potentially valuable alleles and genotypes led to the sampling and storage of large numbers of landraces in *ex situ* gene banks (Frankel 1970; Harlan, 1972). More recently, scientific interest in strategies for conservation *in situ* has re-emerged (Brush, 2000; Maxted *et al*., 1997). For cultivated crops, *in situ* conservation of genetic resources refers to the continued cultivation and management

on farms of crop populations where they have evolved under natural and farmer selection pressures (Bellon *et al*., 1997). Plant populations on farms have the capacity to support a greater number of rare alleles and different genotypes than accessions in gene banks (Brown, 2000), but they are vulnerable to human-made and natural disasters, as well as the routine planting decisions of farmers.

The case study reported here was conducted as part of an on farm conservation project in Nepal, where rice landraces still occupy over 30% of total cultivated rice area (ASD, 2000). The purpose of the study was to advance scientific understanding of the incentives farmers have to grow landraces as the market environment changes in the Tarai (Indo-Gangetic plains) region.

Markets can provide strong price signals for farmers to grow one variety rather than another (Unnevehr *et al*. 1992). When consumers are willing to pay a premium for a quality that is associated uniquely with an identifiable landrace or group of landraces grown in a specific geographical area, the price differentials that result can generate an economic incentive for farmers to continue growing them. Most of the relatively few studies on rice marketing (Hayami *et al*, 1999) in Asia have focussed narrowly on modern varieties in commercial production systems. Studying markets for rice landraces requires a different approach (Fleming, 1990) because they are traded outside formal market structures and in small volumes.

The next section summarizes the role of markets as incentives for on-farm conservation of crop genetic resources in developing countries. Research methods are summarized, and findings are then presented. The features of the rice market are described. Policy implications are discussed in the concluding section.

Market-based incentives for conservation of crop genetic resources on farms

Incentives are the positive or negative outcomes that people expect from actions they take within the working rules of their physical and social setting. Such rules reflect their individual and cultural values and are embedded in institutions (Ostrom 1997; North 1994). Markets are one type of institution, conveying incentives not only through observable prices, but also through distances from producers to consumers, and as well as working rules that determine how prices are established and the costs of engaging in market transaction.

Market-based incentives are in principle among the least expensive instruments for supporting conservation because there is no need for public interventions when they function well. Incentives might be conveyed successfully through "green" marketing programs, niche markets, and farmer-owned brands (Brush, 2000; Hayes and Lence, 2002). Unnevehr et al. (1992) and Pingali et al. (1997) have reported examples of how price premiums for grain quality that consumers are willing to pay as their income rises have influenced the survival of some rice landraces in Asia. Yet such programs can be costly to mount and implement because they require the creation of new markets or the segregation of markets, supported by the strong revealed preferences of consumers.

Several fundamental questions arise in considering market-based incentives for conservation of crop genetic diversity, for example. First, markets may be "thin" for landraces, which means that the price signals they convey are of limited information. The distinctive attributes of landraces may not be observable in market places where they are sold in bulk or mixed, without labels or other packaging. Second, markets may in general function poorly in the locations where landraces are

still grown. In that case, farmers must rely on their own production for their consumption, and the preferences of farmers as consumers will also affect their choice of seed types and varieties. Furthermore, technological change, along with the development of commercial product markets, tends to provide incentives for specialized production of higher-yielding modern varieties over the cultivation of more diverse combinations of local landraces. Input market development has often been biased toward the introduction and adoption of modern varieties through either direct seed subsidies or hidden subsidies on complementary inputs such as fertilizers. In addition, information problems inherent in new seed technology have often been addressed for modern varieties through publicly funded extension and training programs

The premise of this study was that if the superior traits of rice landraces were easily recognized in markets and valued by those who transact in them, markets could deliver incentives in the form of price premiums for their continued cultivation. In such a context, the cost of on-farm conservation would be both cheap and sustainable—unless farmers' and consumers' preferences shifted away from the unique traits found in the varieties whose conservation is sought.

Research methods

Baseline survey and study site

Three "ecosites" were purposively selected for the project. An ecosite refers to a cluster of communities or villages in a watershed that represents a major

physiographic region in Nepal (mountain, hills, and Indo-Gangetic plain, or Tarai). Ecosite locations are shown in Figure 1.

Figure 1

All households in each ecosite were stratified by wealth criteria in a preliminary ranking exercise conducted with knowledgeable farmers and farmer groups. Criteria included various wealth-related factors, such as the size of the farm (hectares owned), major income sources (business, services, or off-farm employment), capital assets (numbers of animals, mills, carts, tractors), area under cash crops (vegetables etc.), and area in irrigated land. A proportionate random sample was drawn by wealth stratum, with an overall sampling fraction of about 22% for each ecosite.

Data collected in the baseline survey included: household socio-economic characteristics; farm characteristics and production environment; major livelihood systems; cultivar (landraces and modern variety) diversity and use; use of external inputs; farmers' perceptions about variety traits; and farmer access to information and support services. Most data collected was of a qualitative nature, though some quantitative variables were recorded.

Market study

The market study was conducted in the Bara ecosite, which is located in the southern part of Central Tarai, on the Indo-Gangetic plains bordering northern India. The Bara ecosite is close to large market centres on the border between Nepal and India. Rice production systems range from subsistence to semi-commercial. At least some of the

landraces grown in Bara are of particular interest for conservation because of the unique traits they express, and molecular studies are now underway to assist in characterizing their diversity.

Market analysis requires an understanding of: 1) product source(s) and final destination (s), 2) volume and period of purchase and sales, 3) market prices, costs, and margins. Figure 2 depicts the market systems approach used in the study.

Figure 2

Field research was conducted from December 1999 to August 2000 during the marketing season. Because local traders are generally hesitant to disclose information, social science methods such as direct observation, key informant and focus group interviews are generally more effective than sample survey approaches. Participatory methods were employed to understand marketing systems, marketing practices, and the flow of rice products through different marketing agents, channels and centres (Mendoza, 1995). Focus group discussions and key informant interviews were implemented with (1) less visible, small-scale vendors in villages, and (2) large-scale market intermediaries and (3) large vendors in nearby towns and market centers. Interviews with selected market participants of different types (18 individuals) were undertaken using semi-structured questionnaires. Interviews were conducted sequentially based on information obtained from the previous respondents in the marketing chain, similar to the "pedestrian approach" described by Hayami and Kawagoe (1993).

Findings

Market shares and channels

The most commonly traded landraces were *Basmati, Mutmur, Sotwa, Nakhisaro, and Sathi.* The major marketed modern rice varieties are *China-4, Sabitri, Masula, and Masuli*. Landraces represented only about 25% of the total marketed volume of rice. Market channels and the flow of rice products in Bara ecosite are summarized in Table 1.

Table 1

The largest volume of landrace grain marketed was sold informally. *Basmati*, an aromatic landrace of high consumption quality, was marketed in limited volume through formal market channels such as *Golas* or local rice mills. *Golas* are market intermediaries who purchase grain from local farmers and store, transport and sell to distant market agents such as processors (rice mills/shellers) and wholesalers. They operate on a large scale and have a significant influence on the marketing and pricing of local products.

Basmati is in greater demand on these formal markets compared to coarse-grained landraces (such as *Mutmur*) and has a price premium. Since landraces with coarse grain are available irregularly in limited amounts and are of heterogeneous grain types, market agents such as *Golas* do not get involved in their transaction. Small amounts of grain from these landraces are either sold in cash or exchanged with other commodities by informal market agents such as *Bania*, *Kutuwa*¸ *Paldar*, *Kawarni* and local roadside vendors.

Bania and *Kutuwa* are normally landless, tenants or marginal farmers involved in trading of rice grain. *Bania* are small market intermediaries that collect rice produce from farmers and trade to *Golas (*large traders/collector*),* rice mills, or retailers. *Kutuwa* are small-scale traders of milled rice who visit farmers door to door to collect rough rice (paddy) and market the produce after shelling the grain in local mills.

Paldar, Kawarni and roadside vendors are very small-scale informal traders of local rice. Using a scale, *Paldar* purchase small volumes of grain from producers and sell in the roadside intersections and weekly village markets (*haat*). *Kawarni* are local women traders who exchange vegetables with rice grain in small amounts for their livelihood. Roadside vendors (e.g. confectionary, jewellery, toys etc.) are of different kinds and are involved in trade or exchange of their commodities with local rice and other agricultural products. They handle small volumes of 10-100kg and do not specialize in any particular landrace or products. These informal market agents also trade landraces by mixing them with commonly traded modern varieties that are similar in appearance but genetically distinct, thereby providing an outlet for farmer produce. When the grain of landrace and the grain of modern varieties are mixed, purchasers often cannot differentiate between the two, and there is an asymmetry of information between sellers and purchasers.

Marketing margins and prices

In conventional market analyses, the magnitude of the marketing margins indicates the competitiveness and efficiency of production marketing. The market margin reflects the differences in product prices and transactions at different levels or in

different types of marketing chains. The margin is a signal to traders of the profits they may be able to realize from marketing an agricultural product.

The marketing margin depends on marketing costs as well as selling (farm gate) and buying (consumer or final market) price. The final market or consumer price is the base or common denominator for all marketing margins. The gross margin is the difference between the final market price and farm gate price. The gross marketing margin is the gross margin expressed as a percentage of the final market price. The net marketing margin is the gross margin less marketing costs, as a percentage of the final market price (Mendoza, 1995: 267-268).

Comparative marketing costs and margins were calculated for the coarse grain landrace *Mutmur*, the aromatic quality landrace *Basmati*, and modern varieties that occupy similar production niches and compete in local markets (*Mutmur* vs. *China-4* and *Basmati* vs. *Sabitri*). The highest gross and net margins are revealed for *Basmati* landraces, followed by the modern varieties (*China-4* and *Sabitri*). *Basmati* landraces received higher farm gate and market prices, and traders who sell them also earned higher profits. The coarse-grained landrace *Mutmur* had both the lowest farmgate price and the lowest market price (Table 2).

Table 2

The baseline survey provides supporting evidence. In 1999, 36 farmers (18%) in the Bara ecosite grew *Basmati*, and 28 (14%) grew *Mutmur*. The ratios of the average farmgate and market prices reported for *Basmati* to those of the nearest competing modern variety were both greater than one, while those for *Mutmur* were less than one (Table 3).

Table 3

Prices of many of the rice varieties vary over seasons and places as a result of supply and demand factors as well as hoarding. Farm gate prices are in general lowest during the harvest period (December-January) and highest during pre-harvest period (August-September). Most of the marketing of landrace grain occurs at rice harvest time when the market price is extremely low. Some marketing of rice continues through May. During and following the rainy season from June to November, rice grain is largely absent from markets, principally because rice that has not been sold is being consumed on-farms and farmers are either less willing or less able to sell it due to poor road and weather conditions.

Except for high quality rice (*Basmati*), market prices for many of the coarse-grained landraces like *Mutmur* were lower than those of modern varieties over the entire season. Among landraces, *Basmati* is valued in the marketplace for its known cooking quality and for cultural reasons, and this quality is signalled at least in part by its visual appearance and name; coarse-grained landraces are often adapted to marginal conditions and specific agroecological niches such as poor soils and uplands (Gauchan, 2000). In 2002, 13 farmers were asked to rate *Basmati* and *Mutmur* according to agronomic and consumption attributes. All rated *Basmati* lower than *Mutmur* for agronomic attributes (drought, disease, and pest tolerance) and most rated it higher for consumption attributes (eating, cooking and fodder yield) other than home processing quality (Gauchan, unpublished data). The inferior physical appearance of coarse-grained landraces is visible in the marketplace, though their superior agronomic traits are not. Direct observation during the survey suggests that

these landraces are primarily used for subsistence and payment to farm laborers for rice cultivation and harvesting, though data on the extent to which food-deficit households depend on them was not collected systematically.

Market participation and rice varieties grown on farms

Farmers in the Bara ecosite choose to grow various combinations of landraces and modern varieties simultaneously. In the baseline survey, 197 of the 202 sample households in the Bara ecosite grew rice. About half grew only modern varieties during the survey season, though nearly the same proportion grew both landraces and modern rice varieties at the same time. Only a minority of 14 farmers in the sample grew landraces alone.

Less than half (46%) of the households sold part of their rice harvest (defined here as "market participation") in Bara ecosite. These include both households that produce less than they need for their consumption needs (deficit producers) and those who produce a surplus.

Farmers who sold rice produce in the market were more likely to be growing both landraces and modern varieties than to be growing modern varieties or landraces alone. They also grew a larger number of either landraces, or modern varieties, or both than those who did not. However, they seemed to specialize more in modern varieties than in landraces, as evidenced by the larger proportion of rice area they planted to them (Table 4).

Table 4

Some explanation for these results is provided by the fact that farm households growing combinations of landraces and modern varieties had much larger farm sizes and a greater percentage of them were classified in the group ranked highest in overall wealth. Though on average they possessed the same total stock of adult labor, they allocated a larger share of it to farm production. Those growing only modern varieties or only landraces had larger stocks of adult labor employed off-farm, and fewer months of rice self-sufficiency. In some respects, those growing only modern varieties or only landraces were more similar to each other than either was to those who grew more complex combinations of rice types and varieties (Table 5).

Table 5

Consistent with this pattern, human capital and wealth status of farmers differed significantly between those who participate and those who do not participate in markets, though the size of the stock of family labor did not. Farmers who sold rice had a greater cultivated area and were more likely to be literate. They were more likely to be classified among the wealthy, while a higher percentage of those who do not sell rice are classified among the poorest (Table 6).

Table 6

Though detailed data were not collected about the relative profitability of growing *Basmati*, it is clear that the farmers who grew this highly marketable landrace were among the better off in the Bara ecosite. Those who grew *Basmati* had nearly 11 months of self-sufficiency in rice on average, while those who did not reported only 6-7 months. A third of *Basmati* growers were classified among the wealthiest, as compared to a mere 7% for those who did not grow this landrace. Their average farm

size was over twice as great. They focused much more heavily on farm rather than off-farm work. (Table 7).

Table 7

Conclusions

Genotypes or genetic variants of probable social value on both local and global scales continue to be found among the landraces grown in the Central Tarai (Indo-Gangetic plains) of Nepal. Nepal is ranked among one of the poorest countries of the world (World Bank, 2000), but it is the well-endowed among the households in Bara ecosite that maintain the more complex combinations of landraces and modern varieties, as well as the *Basmati* landraces that provide stiff competition for modern varieties in terms of marketability.

Rice production in Bara ecosite of the Central Tarai is gradually commercialising, though only about half of farmers sell rice. They continue to grow both modern varieties and landrace types simultaneously, and their demand for these types is clearly shaped in part as a derived demand from markets and in part by the consumption preferences of their families.

Other than for this landrace of widely-recognized consumption quality, markets for coarse landraces are thin. In well-developed markets, signals are conveyed to farmers and traders through: (1) prices and transactions costs that define net margins or trader profits; (2) product volume; and (3) other indicators of quality such as physical appearance or brand (variety) names. Formal market channels in the study site recognize fine- versus coarse-grained rice. Many of the coarse-grained

landraces like *Mutmur* have superior agronomic attributes that are valued by the farmers (who are also consumers) but are not valued in market prices because they are not observable. These landraces are also marketed in less attractive form and in very small, irregular volumes, and are sometimes mixed with modern varieties. There is limited quantity and quality of seed of the more desirable of coarse-grained types, as well as limited means of storing the grain in order to sell it during periods when rice prices are more favorable.

In contrast, more developed market and information systems clearly exist for modern varieties. Extension systems that deliver information regarding these varieties, as well as complementary inputs (e.g. fertilizer and pesticides, etc.), are directly or indirectly subsidized. Bulk markets also exist for modern varieties of rice and are promoted.

Implications

When markets fail, government intervention may be justified if there is social priority placed on rice landraces for biodiversity conservation and/or on the welfare of the people who grow them. One public intervention might be the development of market niches for those landraces of probable socially desirable (more genetically diverse)—though the feasibility and nature of the support still requires evaluation because the strength of consumer preferences for their distinctive attributes is unclear. Trademarks or labels of origin have been proposed in some instances to handle situations in which product quality is not transparent to consumers, though these also entail costs that must be supported by dedicated consumers.

Some coarse-grained landraces like *Mutmur* grow in poor, rainfed soils where modern varieties do not, or have other desirable agronomic traits that are important to farmers with few resources who produce for subsistence. They may also provide an important source of cheaper rice for food-deficit producers, though the data collected in this study are not sufficient to test this hypothesis. Ways of organizing farmers or traders to improve the profitability of marketing landraces in order to increase the range of products available to food-deficit producers might be investigated. Informal market intermediaries might be linked more effectively with growers of valued landraces.

In any case, further analyses of relevant costs and benefits would be necessary before any specific strategy, or mix of interventions, can be recommended. Marketing options must be compared to others that emphasize the production performance of landraces, such as participatory crop improvement. Changing extension messages and radio programs in order to provide information to producers and consumers about selected landraces is comparatively low-cost.

In contrast to the situation for coarse-grained rice landraces, market incentives appear relatively strong for the high quality, aromatic *Basmati* landraces in Bara ecosite—though cheaper Indian *Basmati* also flows across the open border with India (Gauchan, 2000). Furthermore, since Basmati is so grown so widely in Pakistan and India, it is not clear what contribution it makes to diversity on a regional or global scale, even if it does contribute high value to the basket of landraces grown in Bara ecosite. Continuing to grow Basmati may provide private value without generating any social value associated with conservation.

The findings of this case study underscore two important considerations in designing policies to promote conservation through market-based incentives. First,

not all landraces are equal. Even if markets develop for landraces, comparative advantage and the preferences of urban consumers will likely induce some specialization of production among landraces with valued traits. Such market-based incentives by no means imply the maintenance of a dynamic system that enables the continued evolution of genetically diverse varieties. Nor would they imply that diversity of value to society in general is maintained.

Second, the tacit assumption that it is the poor who maintain diversity clearly needs empirical qualification. In Bara ecosite, those who grow both landraces and modern varieties, and those who grow the highly marketable *Basmati*, are clearly better off. Selling rice in markets is associated with farmers who have more of both modern varieties and landraces, though they specialize in modern varieties. Future work related to this project will shed more light on where the pockets of the most unique landraces are still found within these communities. Genetics studies, combined with the survey data, may reveal that some poor households harbor specific types with rare alleles. If so, there may be trade-offs between efficiency and equity in designing community conservation programs.

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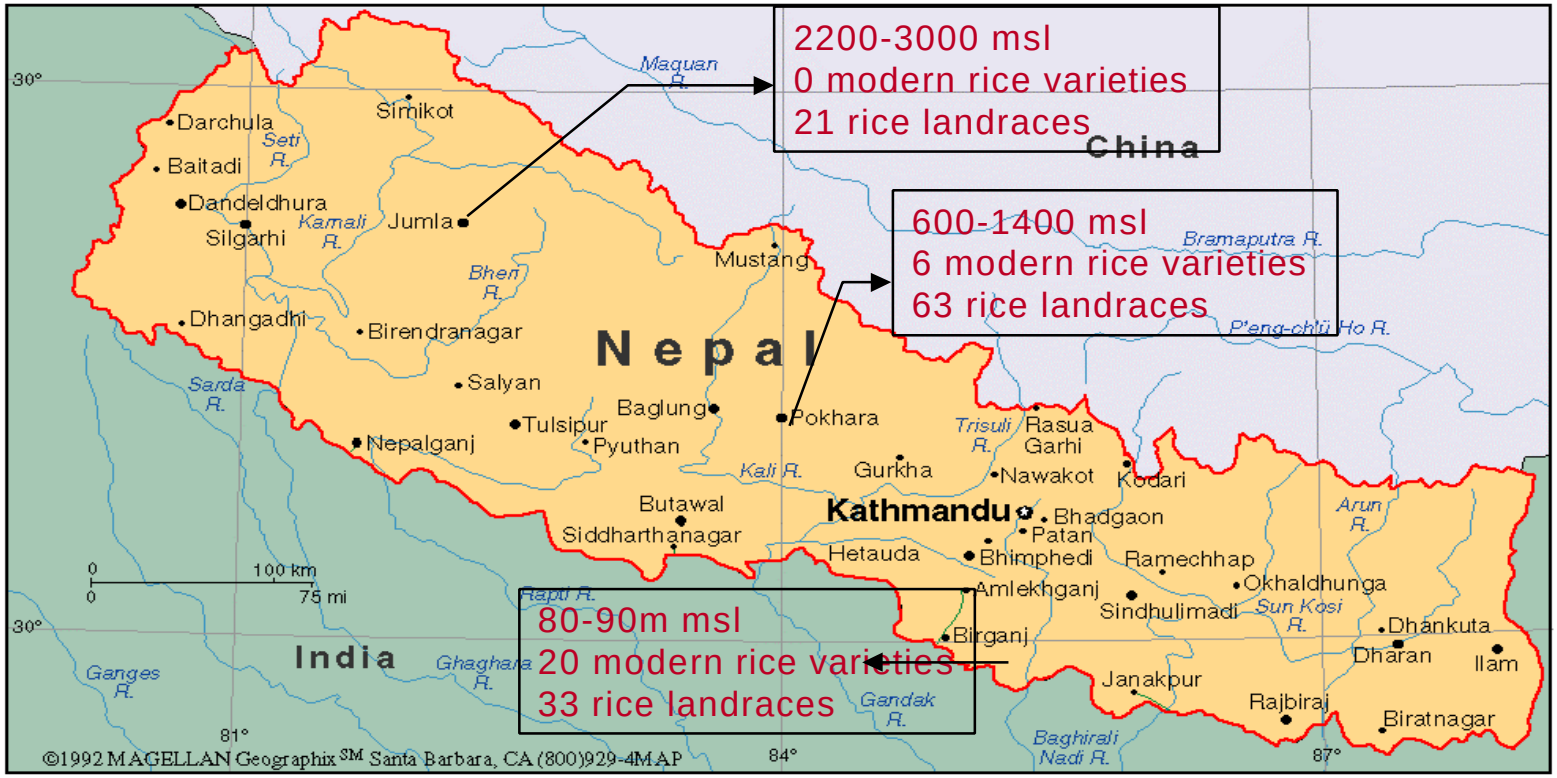

Figure 1. Map of Nepal showing the location of three eco-sites and their main features

Figure 2. Market systems approach to identifying incentives for cultivating rice landraces in Bara ecosite, Nepal

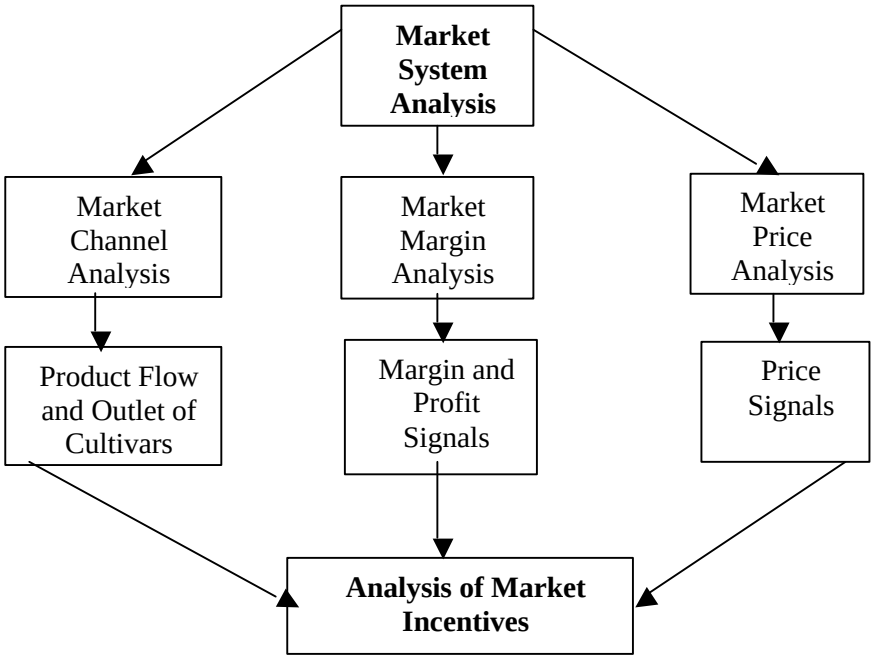

Table 1. Rice market channels and product flow

Channel	Producer	Market intermediaries					End user
I	Farmer	*Bania, Gola*	Gola	Rice mills, shellers wholesalers	Retailer	---	Consumer
II	Farmer	*Bania, Kutuwa, Paldar*	-----	----	Retailer	----	Consumer
III	Farmer	*Kawarni*, Local vendors	----	----	----	Local weekly market (*Haat*)	Consumer

Table 2. Comparison of marketing margins among rice varieties during the harvesting season (December-January) 1999-2000

Rice Cultivars	Price in Rs/Qtl		Marketing costs Rs/Qtl	Gross Marketing margins (%)	Net Market Margin (%)
	Farm gate	Market			
Mutmur	700	800	60.0	12.50	5.0
China-4	725	850	60.0	14.70	7.65
Sabitri	750	900	60.0	16.66	10.0
Basmati	850	1100	60.0	22.72	17.27

Note: *Mutmur* is an early season, coarse-grained landrace that competes most closely with *China-4*, an early season, coarse-grained modern variety. *Basmati* is a normal season, high grain quality landrace that competes most closely with *Sabitri*, a normal season modern variety. Calculation of margins defined in text.
Source: Computed from market survey data (1999-2000)

Table 3. Rice grain price of *Basmati* and *Mutmur* landraces relative to that of competing modern variety, as reported by farmers in Bara ecosite, 1999

	Basmati	*Mutmur*
Number of households growing	36	28
Percent of households growing	18	14
Price relative to competing modern variety (farmgate)	1.13	0.96
Price relative to competing modern variety (market)	1.22	0.94

Note: *Mutmur* is an early season, coarse-grained landrace that competes most closely with *China-4*, an early season, coarse-grained modern variety. *Basmati* is a normal season, high grain quality landrace that competes most closely with *Sabitri*, a normal season modern variety.
Source: Computed from Baseline Survey (1999), *In Situ* conservation project, Nepal

Table 4. Rice types grown by farmers, by their market participation, Bara ecosite, Nepal

	Sells in rice market (n=90)	Does not sell in rice market (n=107)	All Households (n=197)
Percent of farmers (+)			
Growing landraces only	4	9	7
Growing modern varieties only	38	62	51
Grow both landraces and modern varieties	58	29	42
	100	100	100
Mean among farmers			
No of landraces grown	1.14*	0.476	0.78
No of modern varieties	2.33*	1.58	1.92
Number of total varieties grown	3.48*	2.065	2.71
Percentage rice area in landraces	20. 2	19.2	19.7
Percentage rice area in modern varieties	92.0*	42.0	80.3

Note: (*) Pairwise t-tests show statistically significant difference of means between households participating and not participating in market ($P < 5\%$ with two-tailed test); (+) χ^2 tests show statistically significant difference in percentage distributions of rice types grown by market sales ($P < 5\ \%$).
Source: Computed from Baseline Survey (1999), *In Situ* conservation project, Nepal

Table 5. Household labor stocks, food self-sufficiency and wealth status by type of rice varieties grown, Bara ecosite, Nepal

Rice cultivation pattern	No. of adults working on-farm	No. of adults working off-farm	Share of total labor working on-farm	Farm size (ha)	Food sufficiency (mos.)	Highest wealth rank
	Mean					**Percent**
Growing only modern varieties	2.58	0.78*	0.77	0.598	6.26	7
Growing only landraces	2.79	1.21**	0. 71**	0.459**	5.11**	14
Grow both landraces and modern varieties	2.78	0.3976***	0.88***	1.325***	9.05***	17

Note: Pairwise t-tests show significant difference of means between groups at the 0.05 level with two-tailed test: (*)grow modern variety only; (**) grow landrace only (***); grow both landraces and modern varieties. χ^2 tests show statistically significant difference in percentage distributions by wealth rank between groups ($P < 5$ %).

Source: Computed from Baseline Survey (1999), *In Situ* conservation project, Nepal

Table 6. Wealth status and literacy, by market participation, Bara ecosite, Nepal

Household characteristics	Sells in rice market (n=90)	Does not sell in rice market (n=107)	All Households (n=197)
Mean among farmers			
Farm size (hectare)	1.30*	0.76	0.89
Percent among farmers			
Literate (+)	52	33	42
Highest wealth rank (+)	18	7	13
Lowest wealth rank (+)	30	71	56

Note: (*) Pairwise t-tests show statistically significant difference of means between households participating and not participating in market ($P < 5\%$); (+)χ^2 tests show significant difference in percentages by market participation ($P < 5\%$).
Source: Computed from Baseline Survey (1999), *In Situ* conservation project, Nepal

Table 7. Household labor stocks, food self-sufficiency and wealth status for growers of *Basmati* rice landraces and modern rice varieties, Bara ecosite, Nepal

	No. of adults working on-farm	No. of adults working off-farm	Share of total labor working on-farm	Farm size (ha)	Food sufficiency (mos.)	Highest wealth rank
	Mean					**Percent**
Grow *Basmati*	2.75	0.39*	0.89*	1.74*	10.56*	33
Do not grow *Basmati*	2.67	0.70	0.79	0.71	6.63	7
Grow modern varieties	2.67	0.60**	0.82	0.93**	7.52**	11
Do not grow modern varieties	2.78	1.21	0.71	0.46	5.11	14

Note: Pairwise t-tests show significant difference of means (*,**) between those who grow Basmati or those who grow modern varieties and those who do not (0.05 level with two-tailed test.): χ^2 tests show statistically significant difference in percentage distributions in wealth rank by group($P < 5$ %).