Journal of Developments in Sustainable Agriculture 7: 75−88 (2012)

Traditional Rice in Central Cordillera, Philippines: Dynamics of On-Farm Management of Varietal Diversity

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This study was conducted to assess the dynamics of on-farm management of varietal diversity, i.e. continued cultivation of different varieties in their farms, determine socio-economic and cultural variables influencing varietal maintenance and seed sources, and determine the level and potential for on-farm conservation of traditional rice in the central Cordillera, Philippines. Results showed that rice is not only a basic staple but also an economic product for barter and trade; a raw material for traditional foods and beverages; and a commodity for social, cultural, and religious uses. Almost 90% of the 466 recorded varieties were traditional types, with non-glutinous varieties accounting for 77%. Farmers considered adaptation to local agro-ecological conditions, good eating qualities, agriculturally desirable plant characteristics, panicle and grain characteristics, and satisfactory yield performance as desirable traits of local landraces. Negative characteristics were late maturity, slow biomass decomposition, and low yield potential. Seed selection, variety selection, seed exchange and certain gender roles on seed and variety selection can be associated with continued maintenance of traditional varieties on-farm.

The level of on-farm conservation of rice diversity was found to be moderate to slightly high, while the potential for conservation was moderate. Respondents have discarded or lost varieties due to low yield, susceptibility to pests and disease, replacement by a new variety, and loss of seed stocks. The level and potential for on-farm conservation of varieties can be related with cultural and demographic variables, such as number of years in farming, gender, affinity to ethnic customs, and traditions and religious practices. A significant amount of varietal diversity is still maintained through on-farm conservation across the central Cordillera. Agro-ecological, socio-economic, and cultural factors, as well as traditional agricultural practices, influence the continuing conservation and utilization of these diverse varieties. However, modern farming influences and changing preferences threaten the on-farm diversity of landraces. Ways by which this diversity can be maintained and effectively sustain the needs of highland rice farming in the central Cordillera should be explored.

Key words: Cordillera, rice diversity, on-farm conservation, rice seed selection, rice variety selection

Introduction

Rice is consumed by Filipinos at least three times a day, providing more than 40% (Abdullah *et al*. n.d.) of the daily energy requirement of approximately 94 million Filipinos (COP, n.d.). The average per capita consumption in 2009 was officially estimated at 113 kg, equivalent to 308 g/day (BAS, n.d). Total milled rice utilization in 2010 was estimated at 11 million metric tonnes. In 2010, the total volume of domestic rice (palay) production was estimated at 15.8 million metric tonnes, produced from 4.3 million ha of combined rice land, and was valued at PhP 231 million (BAS, n.d.).

The Philippines has long been an importer of its primary staple cereal. In 2010, the Philippines imported at least 2.6 million metric tonnes of milled rice

Received: September 1, 2011, Accepted: December 17, 2011
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(USDA, n.d.). Hence, production and supply glitches in the world market can seriously threaten the domestic supply. The Asian rice crisis in 2008 sent a shockwave through the population, pumping up the retail price of regular milled rice to PhP 34.00 from its 2006 price of PhP 24.00 per kilogram (BAS, n.d.). This economic event was sufficient to raise a political alarm, leading to a renewed drive toward self-sufficiency and security as part of the national agenda. This political program aims to minimize dependence on food imports and places a strong recognition on the value of a broad-based sustainable approach and natural resource management. This is articulated through advocating sustainable crop production practices, such as organic farming, crop and varietal diversification, introduction of underutilized food crops, and reinvigorating subsistence farming systems (DA, n.d.).

The current sustainable approach to food security should also include rice genetic resources as a component. The Philippines is home to a rich reservoir of rice species and varietal diversity. About 20% of the total known wild species in the genus *Oryza* occurs randomly in the country (Borromeo *et al*., 1994). The Philippines also lie along the Southeast Asian dispersal route of domesticated rice. Its archipelagic nature and diverse eco-geography, farming systems, and social cultures have helped shape the wide range of diversity found in cultivated varieties. Historically, it was estimated that more than 3000 landrace varieties of *Oryza sativa* may have existed across the country (Bon and Borromeo, 2001). These rich germplasm resources provide an invaluable source of raw material for food security, and their sustainable use and conservation is essential.

A number of the landraces continue to be cultivated in many remote and subsistence rice farming communities, where they serve the needs and purposes of those growing and maintaining them. This cultivation is essentially a genetically dynamic germplasm conservation practice, formally referred to as on-farm conservation. On-farm conservation leads to evolving genetic traits that are adapted to specific agro-ecological conditions and the individual farmer's needs, requirements, and purpose (Dhillon *et al*., 2004). Given the changing climatic conditions due to global warming and potential effects to on-farm biotic and abiotic elements, which in turn may affect rice productivity, on-farm conservation of landrace genetic resources must be part of any food security program.

Although on-farm conservation is advantageous for the protection of genetic strains, its practice, as observed in many subsistence yet self-sustaining farming communities in many parts of the world, is complicated. Most communities managing diversity through on-farm conservation are generally indigenous people or isolated farming communities with a long history of cultivation. In addition to being a basic household commodity, crop species and varieties are maintained and managed according to traditions and agro-ecosystem needs (Rana *et al*., 2007); as a consequence, traditions and landrace diversity are co-evolving and shaping each other (Rijal, 2010). The Philippines is similarly home to a significant population of indigenous peoples which managed to keep their customs and traditions (NCIP, n.d.). They were earlier estimated to be 12−15 million, of which about 33% are found in Luzon Island (Anonymous, n.d.) where the Central Cordillera is situated. The Cordillera region in the north-central Philippines is home to a diverse group of people, known as the Cordillerans, composed of different ethno-linguistic subgroups. Six administrative provinces —Apayao, Abra, Kalinga, Benguet, Ifugao, and Mountain—comprise the region, which is situated in the higher altitudes of the Cordillera and Caraballo mountain ranges (Igorot People, n.d). In the province of Ifugao, social status is tightly linked to the amount of rice harvested and terraces built, and upward social movement is founded on ownership and effective management of extensive terraces. Ifugaos are credited for building the 2000-year-old rice terrace complexes found in this region (Banaue Rice Terraces, n.d.) and their rice agricultural practices are assumed to be as old as the rice terraces. Through the centuries Ifugaos have nurtured and sustainably managed rice varieties selected for their adaptation to the cool elevated agro-ecological conditions of the region, and in turn their culture, traditions, and rice varieties have sustained the people of the Cordillera.

While diverse landraces are still cultivated in many parts of the region, modern agricultural practices are threatening the survival of on-farm conservation and varietal diversity. In view of this change, the objective of this study is to understand the dynamics of on-farm management of rice varietal diversity in the central Cordillera provinces of Abra, Ifugao, and Mountain Province. We also identify socio-economic and cultural variables influencing maintenance and management of varietal diversity among rice farmers and as-

sess the current level and potential of on-farm conservation.

Materials and Methods

Identification and selection of study sites

We conducted an initial survey of municipalities and villages in coordination with the respective Provincial Agricultural Offices and Municipal Agricultural Offices within the province to identify potential sites for the study. A stratified multi-stage sampling design was used to select sample sites based on the extent of cultivation of traditional varieties. Four to five villages were included from four municipalities in Abra (Malibcong, Dagiouman, Bucloc, and Baay-Licuan) and Ifugao (Kiangan, Mayoyao, Banaue, and Hungduan) provinces and five municipalities (Sadanga, Bontoc, Barlig, Besao and Sagada) in Mountain Province.

Data Collection and Information Types

From each village, two key informants were interviewed, for a total of 114 respondents. The interviews followed the Rapid Rural Appraisal technique following a pre-defined questionnaire set. Interview process is supplemented by electronic recording of the conversation apart from scribbling responses on individual questionnaires. Data and information were obtained for the following aspects: socio-economic importance of traditional rices, types of varieties being grown; desirable and undesirable characteristics of the local varieties or how respondents described their varieties being grown, number of varieties being maintained and enumeration of varieties discarded. The interview similarly outlines questions on seed sources and acquisitions, socio-cultural aspects in seeds and variety selection, dynamics of adding, discarding and or replacing varieties, reasons for discarding. Likewise respondents demographics were also collected such as gender, age, language, civil status, ethnicity, religion, migration, educational attainment and years of experience in planting rice.

Data preparation and analysis

Responses were categorized based into similarity. Simple frequency distributions of answer categories were then prepared in a Microsoft Excel spreadsheet. We estimated the level of conservation based on the farmers' practices of maintaining, discarding and/or adding rice varieties. Level of conservation was rated as: (1) Low - complete discarding of existing varieties for replacement fewer number of new set of varieties, (3) Moderate — discarding of existing varieties for replacement of same number of new varieties and (5) High — maintaining existing number of varieties and adding other varieties. Respondents were asked to recall by memory varieties they have discarded. Details are shown in Appendix 1. Ratings were then averaged to determine the conservation level index. Conservation level index is an arbitrary measure to express the general condition of the current level of on-farm conservation of the province, in numerical terms. It is based on the rating scale for the individual respondents.

Similarly, the potential for on-farm conservation was evaluated by indicators and rated (1) — maintains 1−2 varieties, (3) maintains 3-5 varieties and (5) maintains 6 or more varieties (Appendix 2). Ratings of all respondents were then averaged to determine the conservation potential index. Conservation potential index is an arbitrary measure to express the general condition of the current potential of on-farm conservation of the province, in numerical terms. It is based on the rating scale for the individual respondents.

Results and Discussion

Cultural and economic importance of traditional rice varieties in the Cordillera

Rice is the staple cereal food and thus a major household item among the people of the Cordillera (Table 1). It is grown and maintained primarily for household food security, but it is also used as the primary raw base material in the preparation of local rice wine and rice-based traditional foods. Growing landrace varieties as household food security has been reported among the subsistence rice growing communities in Nepal (Rana *et al*., 2008). Rice is not, however, a major trading product. Only 31−39% of respondents in Abra use rice to supplement household income whereas less than 16% of respondents in Ifugao and Mountain Provinces trade rice. Extra household income means that only a portion of the total harvest is put on the market for cash when extra production is available. While rice is not primarily grown and intended for market trading, historically rice has been a medium of exchange and a symbol of wealth and power in the Ifugao society (Fowler, n.d.)

The higher amount of trade in rice found in Abra may be associated with a number of socioeconomic

Table 1. Cultural and Economic Importance of Traditional Varieties in Abra, Ifugao and Mountain Province.

USE	ABRA	IFUGAO	MOUNTAIN PROVINCE
Staple household food	100	100	100
Extra household income (NG)	39	11	16
Extra household income (G)	31	14	15
Barter / trading good	64	33	20
Gift or church offering	53	91	42
Rice-based food preparations (NG)	33	34	0
Rice-based food preparations (G)	100	100	100
Rice wine ingredient	100	100	100

NG (non-glutinous types), G (glutinous types)
Values represent proportion of respondents giving the respective response
Data summarized from KI interviews

and technological factors. Abra is relatively accessible to lowland market goods, including subsidized commercial rice types, and rice traders are putting premiums on the preferred qualities of traditional varieties. Also, modern varieties are better adapted to the lower elevations of Abra compared to the higher elevations of the two other provinces. In some cases respondents indeed mentioned that they may sell larger proportion of the harvest to supplement household income and in turn buy cheaper-priced subsidized commercial rice. Relative to area planted, Rana et al (2007) noted that Nepalese subsistence farmers planted varieties that command premium market prices in larger proportion.

Interestingly, 64% of respondents in Abra Province, 33% in Ifugao Province, and 20% in Mountain Province use a portion of their production for bartering; these are higher percentages than the percentages of farmers who trade rice for cash. Barter trading for most respondents is prompted by a stronger need for another product than for cash. Goods traded for rice include sugar, canned products, fruits, seeds, meat, beans, and other household commodities. The amount of rice traded depends on the product; for example, two to three bags of rice may be traded for one bag of fertilizer. In Ifugao, barter trading has historically been a form of exchange and asset manipulation (Fowler, n.d.).

Rice is also important in sociocultural practices. A high proportion of respondents (91% in Ifugao) indicated that rice is often given as a gift or offering in church or other religious practices. Rice with favored eating characteristics (e.g., good eating qualities, aromatic rices, or glutinous types) is commonly offered to the church or used at family or community events and festivities. In Ifugao, for instance, rice heads (panicle) are used to wrap a pig's carcass in the ceremony ending the harvest festival (Barton, 1922). Rice has a symbolic importance in religious offerings to deities and is presented as different rice dishes prepared from specific landrace varieties (Rana *et al*., 2007; Rijal, 2010). Although present-day Cordillerans are Christian converts, in certain indigenous cultures, rice landraces have become entwined with pre-Christian cultures and traditions.

For the Cordillerans, rice is therefore primarily a food security item for individual households rather than a market-oriented product. There is no apparent effort to direct production to the market in exchange for cash, except for the occasional enterprising farmers. This emphasis on rice for household needs may ensure survival of local rice diversity and cultivation, at least in the near future.

Survey of rice varieties maintained through on-farm management

Table 2 summarizes the variety names count by province. Mountain Province has the highest number and proportion of traditional varieties with 95.4%, followed by Abra and Ifugao with 87.6% and 83.5%, respectively. Of the traditional varieties 23.0% were glutinous types while 77.0% were ordinary non-glu-

Table 2. Number of Distinctly Named Traditional Varieties of Rice, by Endosperm Type

PROVINCE	NON-GLUTINOUS	GLUTINOUS	TOTAL
Abra	127	25	152
Ifugao	107	42	149
Mountain	125	40	165
TOTAL	359	107	466

tinous rice (data not shown). By proportion, 88.8% of varieties can be classified as traditional, with the remaining classified as modern. A similar proportion of landraces to modern varieties was reported by Rana *et al*. (2007). Although the variety names do not necessarily accurately reflect the level of genetic diversity (Rana *et al*., 2007), the high number of varieties and differences in the visual appearance of panicles and seed samples suggest substantial potential genetic diversity of the Cordillera landraces.

There are several possible explanations for the high percentage of traditional varieties in the study area. The central Cordillera provinces are located at medium to high altitudes, and the eco-geographic characteristics of the region, such as colder temperatures than at lower altitudes, may have contributed to the continued cultivation of these varieties. Cordillera rices are classified as Javanica types, which are generally adapted to the cool elevated conditions of the Cordillera region. A second explanation for the number of varieties in cultivation is that some farmers prefer the long culms of traditional varieties due to the deep soil layer of the terraces.

Cold-tolerant modern varieties are found in the low to medium elevations of the region. Even within the study area, more than 10% of varieties are classified as modern varieties indicating potential adaptability of modern varieties in the study area. In Abra, for instance, a total of 30 modern variety names were listed as being in cultivation. This is approximately 54% of the total rice area harvested or 60% of the total rice production volume of the province Abra is classified as low to medium elevation; hence modern varieties (rice varieties developed for commercial production using modern technical knowledge and methods in variety breeding and selection) may be better adapted to conditions in Abra since the temperature regime is less stressful. In Abra, several respondents noted that modern varieties have higher yields than traditional types. Rana *et al*. (2007) noted that under favorable environmental conditions, such as good irrigation and below 800 m above sea level (asl), modern varieties outperform landraces. This is one of the main reasons for wider adoption of modern varieties in these low-altitude environments.

A total of 21 modern varieties were reported as being used in Ifugao, and approximately 70% of the total rice area of Ifugao is planted to modern varieties. The Ifugao region is located at medium to high elevations, and modern varieties may have acceptable performance in the low elevation municipalities where cold stress is less. Ifugao is a common research site for cool elevated highland rice cultivation by a number of rice research groups, including the International Rice Research Institute and the National Cooperative Testing for Cool Elevated Rice of the Rice Varietal Improvement Program. Hence, Ifugao may have significantly benefited from the resulting infusion of technology, which has included improved varieties suited to the region. Ifugao also has the most extensive network of rice terraces in the region. Modern varieties are usually developed for irrigated lowland rice ecosystem. In addition Ifugao, as well as Abra, have a good road network and are easily accessible from the lowlands.

Respondents from Mountain Province, on the other hand, listed only a total of eight modern varieties, and modern varieties in this region make up approximately 1.5% of the total rice area. Mountain Province is landlocked in the heart of the Cordilleras and so has accessibility limitations. Rana *et al*. (2007) noted that access to extension services is negatively correlated with maintenance of on-farm varietal diversity. For example, farmers in Nepal with less contact from formal research, development and extension services maintain high levels of landrace diversity. However,

the adoption of modern varieties in Mountain Province may have also been limited by lower temperatures, since this province is located at higher elevations (from about 800 to 1600 m asl), where average temperatures may drop to 18 to 15C compared to the 32C average summer temperature in its neighboring low-elevation province, Nueva Ecija (Data and Surveys, n.d.). The number of modern varieties suited to these colder conditions is still limited, and farmers, therefore, may stick to their landrace varieties by default in the absence of suitable alternatives (Rana *et al*., 2007)

A significant proportion of glutinous varieties of rice are maintained through on-farm conservation, with respondents listing a total of 107 named glutinous varieties, accounting for about 23% of the total traditional varieties (Table 2). Indeed, respondents across the study sites commonly maintained one or two glutinous types of rice alongside non-glutinous varieties. The people of the Cordillera make up a major indigeneous ethnic group, and rice is at the core of their culture and traditions. Glutinous rice is the raw material for rice wine, and the Cordillera region, especially Ifugao, is known for its local rice wine (*tappuy*). During the rice harvest season, rice wine (Barton, 1922), rice beer (*bayah*) (Anonymous, 2008), and rice cakes are served in abundance (Barton, 1922). Apart from *tappuy*, glutinous rice is also the main ingredient for various foods prepared for traditional household and community occasions and practices. Hence, inclusion and maintenance of glutinous endosperm types in the livelihood of the Cordillera provinces is anchored in sociocultural practices as well as in meeting projected household needs.

The results of the questionnaire revealed that the central Cordillera region still maintains substantial varietal diversity through on-farm conservation for both the glutinous and non-glutinous types, and that these are dominated by traditional varieties. Agro-ecogeography, cultural traditions, and household needs and purposes may have contributed to the maintenance of on-farm conservation of varietal diversity of the traditional rice. Rijal (2010) noted that food tradition is indirectly linked to the continued cultivation of crop landraces. It should be noted, however, that newer modern varieties can now adapt in the less favorable growing environment of the highland Cordilleras giving farmers an option against their traditional varieties. In general, on-farm varietal diversity addresses different needs; the farmer's choice of a variety is primarily influenced by intended use and food security for the household (Rana *et al*., 2007).

Characteristics of the Cordillera traditional rices from farmers' perspectives

Our questionnaire was also designed to provide insights into farmers' preferences for rice varieties, as these preferences are key factors in maintaining on-farm diversity. Respondents characterized both positive and negative plant and population characteristics of their varieties (Table 3). A major characteristic of local varieties in all three provinces is adaptability to soil and climatic regime in the region. Most of the varieties, therefore, are generally cold-tolerant, particularly those in the higher elevation areas. Adaptability to their local soil and climatic is also identified as important positive characteristic. Most respondents were subsistence farmers with very limited inputs particularly fertilizers and other agro-chemicals. Some farmers cultivate rice in the uplands and rely on rainfall for rice growth. Under this type of agro-ecosystem, traditional varieties are considered by farmers to perform far better than the modern varieties. Modern varieties, although selected for cold tolerance, are also designed for a high-input irrigated lowland production environment. In some instances, farmers may associate a local variety with a particular soil type or depth. Rana *et al*. (2007) suggested that landraces may persist because of their good agronomic performance under specific field conditions. This preferential characteristic for agro-ecological adaptability is common across study sites in the region.

Respondents across the study sites gave a positive response to the morphoagronomic characteristics of good grain and panicle size. Favored varieties were characterized as having long panicles, well-filled bold grains, and a high percentage of filled grain relative to unfilled grain which in general are opposite to the grain and panicle characteristics of modern varieties. Other important positive characteristics were resistance to pests and diseases, eating quality, yield performance, and maturity. In Abra, all respondents considered their local varieties to be tolerant or resistant to pests and diseases and having good consumption characteristics, while these were not traits noted by all respondents in Ifugao and Mountain Province. Consumption characteristics are related to the softness of cooked rice, aroma, and texture. In some instances, respondents maintain a variety that has poorer eating characteristics but

Table 3. Preferences for Local Traditional Varieties by Proportion of Respondents Responses

CHARACTERISTICS	ABRA	IFUGAO	MOUNTAIN PROVINCE
Desirable Characteristics			
Cold-tolerant	100	100	100
Adapted to soil and farming practices	100	100	100
Satisfactory yield levels	48	56	66
Good eating qualities	100	66	85
Good grain/panicle characteristics	100	100	100
Tolerant to pests and diseases	100	64	71
High market value	67	0	0
Early maturing	43	50	90
Undesirable Characteristics			
Low yield	87	64	88
Late maturity	80	67	50
Poor eating quality	57	55	80
Too long to decompose	0	100	40
Susceptible to pest and diseases	0	76	79
Difficult to thresh	0	0	100
No undersirable characteristic mentioned	68	52	55

0 value means that none of the KIs mentioned the particular response in that provicne.

better cooking characteristics and provides a longer period of satiety. Such grain types are normally high in amylose and are therefore have harder texture when cooked compared to low-amylose types. These types of rice are normally set aside during the lean months with the purpose of tiding the family over until the next harvest.

Endosperm type plays an important varietal selection option in relation to cultural and family traditions and practices, and it is a common practice to maintain two endosperm types. It is customary for farmers to plant one or two glutinous types along with several other non-glutinous types. As noted previously, the glutinous type of rice is an essential variety in the Cordillera, and hence we do not consider endosperm type to be a plant characteristic preference. Rana *et al*. (2007) noted that varietal diversity of glutinous rice in the Philippines is due to its usage in the preparation of various local rice-based sweet delicacies.

Essentially, respondents described their current production levels from traditional varieties to be just or barely sufficient to meet the food requirements of the household. In all three study areas, respondents expressed dissatisfaction with the yield performance of their varieties. Only 66% of respondents in Mountain Province considered their local varieties to have satisfactory yield levels, and the percentages of respondents in Ifugao and Abra were less (Table 3). However, most of the respondents in Mountain Province were satisfied with the maturity period of their local varieties, while only about half of the respondents in Abra and Ifugao considered their varieties to be early-maturing. Some traditional varieties in Abra were also characterized as having a high market value. Due to Abra's location and accessibility, rice farming in Abra may be influenced by local market forces, hence the preference for traditional varieties which are fetching better price in the market.

Respondents were familiar with the negative characteristics of their varieties. Foremost to all provinces were characteristics of low yield and late maturity (Table 3). Biomass decomposition and susceptibility to pests were also noted as negative traits in Ifugao and Mountain Province. Due to the high biomass of long-culmed traditional varieties, total decomposition of stubbles takes time, consequently affecting land prepa-

ration, planting activities and effective planting area. This may be the reason why some farmers opt to burn straw after the harvest. Threshability was a universal concern in Mountain Province. In general, Cordillera rices are non-shattering types. These rices are normally harvested by panicle, bound, and stored in bundles, with threshing being done by heavy pounding. For a significant proportion of respondents, no negative trait overrode the positive characteristics of the varieties. This reflects a general satisfaction with the performance of their varieties. Virk and Whitcombe (2007) argued that in the absence of alternative varieties, farmers are satisfied with their current varieties.

In summary, Cordillera rices are characteristically maintained and selected to suit the needs and situation of their agro-ecosystem. Characteristics are therefore a trade-off between desirable and undesirable plant and population features. It currently appears that the varieties maintained through on-farm conservation serve the needs and requirements of the communities.

Seed sources and gender roles in seed and variety selection

The seed sources in the region may have similarly influenced the dynamics of diversity and on-farm conservation. The mode of acquisition reflects a fluid movement of varieties among farmers and within the community (Table 4). The free flow of seed exchange is evident. About half of the respondents acquired their varieties by passing on to them varieties of their immediate relatives and/or family. On the other, data also indicate that about half of the respondents obtained their varieties elsewhere. It could thus indicate that about half of them may replace varieties planted from time to time depending what varieties are available from their sources. Barter and direct requests from fellow farmers also form a significant mode for seed and variety exchange. Bartering occasionally occurs when a farmer decides to change the variety that he or she uses. Formal institutions such as the local agriculturist office are also a recognized source of seeds for planting. Abra has the highest proportion of respondents to obtain seeds from such sources. Across study provinces respondents produce enough seeds to

Table 4. Seed Sourcing and Gender Roles in Seed and Variety Selection in Abra, Ifugao and Mountain Province

CATEGORY	ABRA	IFUGAO	MOUNTAIN PROVINCE
MODE OF SEED ACQUISITION			
Passed on/inherited	44	49	40
Exchanged/barter with seeds	22	18	15
Request from fellow farmer	23	31	42
Provided by formal organization/institutions	11	0	0
Directly purchased	0	2	3
SEED SOURCES			
Immediate family/relatives	48	48	57
Fellow farmers/neighbors	30	44	41
Formal organizations/institutions	22	8	2
GENDER ROLES IN SEED SELECTION			
Head female	70	78	55
Head male	6	12	11
Both	24	10	34
GENDER ROLES IN VARIETY SELECTION			
Head female	50	58	58
Head male	2	18	8
Both	48	24	34

meet their seed requirements since most of the rice land holdings are small. These different modes of seed sourcing (i.e., saving seeds from previous crops, exchange between farmers, direct purchases) have also been reported among the Nepalese subsistence rice farmers (Rana *et al*., 2008).

Excess planting materials i.e. seedlings and/or seeds may also be offered to neighboring farmers. Such practices could help maintain on-farm varietal diversity. Sharing of seedlings with those in need has been a traditional custom for the people of Mountain Province (Corpuz, n.d.). In Abra, however, formal institutions, such as the government agricultural office, have become a recognized source of modern varieties for planting, and this has led to the highest number of modern varieties (30 variety names enumerated, data not shown) being found in Abra compared to the other provinces.

Gender roles in variety and seed selection indicate a varied decision-making process, which may affect on-farm rice diversity. However, much of the decision-making and actual on-farm activity of variety and seed selection is carried out by head women. As much as 78% of respondents in Ifugao, 70% in Abra, and 55% in Mountain Province reported that women alone determine and carry out seed selection. In Mountain Province, seed selection is performed by the most experienced women segregating the best panicles during harvest (Corpuz, n.d). In some cases, head women may be aided by elders considered to be expert seed selectors.

In general, however, rice farming in the Cordillera region has been the domain of women (Corpuz, n.d.). Daily routine tending of the farm is delegated to women at most of the study sites, particularly Ifugao, since men seek additional temporary off-farm employment. Seed selection is one activity considered to be light farm work and so is designated to women. There have been similar reports from Nepalese subsistence rice farmers where the traditional division of work is based on the physical strength required to accomplish the task (Rana *et al*., 2008). This may also explain why a small proportion of men perform the activities alone (Table 4). Our study highlighted the role of women in rice agriculture in general and in the management of varietal diversity in the central Cordillera, in particular. However, there were more respondents who conduct the activities jointly by head male and head female than head males alone. In all three provinces, seed selection criteria include a uniform and good crop; a high number of productive tillers; long panicles; healthy, clean, and well-filled grains; high spikelet fertility; and properly matured grains. Seed selection may be done before or after harvest, but majority of respondents particularly in Abra and Ifugao select panicles for seeds in the field after harvest but prior to bundling. When selecting after harvest, the weight of the panicle bundle and the length and weight of the panicles are also considered.

Level and potential of on-farm conservation of diversity and varieties discarded

Table 5 summarizes the estimated level of on-farm conservation of diversity. All three provinces were found to have High to Moderate levels. Level of conservation refers to the dynamics of adding new variety and discarding existing ones by the individual farmer. Proportions of ratings for Moderate and High categories were similar for the three study provinces. However, proportions of ratings for Low category were different between provinces. Abra had the largest proportion of Low rating, indicating a greater prevalence for replacing traditional varieties with modern varieties. Indeed, Abra has a greater number

Table 5. Proportion of Ratings for the Level of On-farm Conservation of Diversity in Abra, Ifugao and Mountain Province

CATEGORY	ABRA	IFUGAO	MOUNTAIN PROVINCE
Low (%)	19	12	3
Moderate (%)	50	62	63
High (%)	31	26	34
Conservation Level Index*	3.3	3.3	3.6

**average of all respondents ratings for the province*

of modern varieties compared to the two other provinces. Mountain Province on the other hand, had the highest conservation index having the highest frequency for Moderate and High ratings. This means that respondents in Mountain Province can still maintain the number of varieties they are keeping or even add more varieties.

In general, at the time of this survey on-farm varietal diversity was still sufficiently maintained (i.e., the present number of varieties in cultivation, although not necessarily the same varieties, was being maintained at the farmer level). Further, to some extent, a few farmers may even add new varieties without discarding any existing variety, thus increasing diversity relative to variety count. On-farm diversity is noted as being highest in subsistence farming environments with zero to minimal applications of external farm resources such as fertilizers and the likes, primarily due to the absence of attractive options to replace landraces (Virk and Witcombe, 2007). This may hold true for those respondents being rated High to Moderate, while respondents rated Low response indicate adoption of modern varieties. This is evident in Abra, the province with the highest proportion of Low rating, as the lower elevations in Abra allow for the better adaptability of modern varieties.

Few demographic and economic variables were connected with the level of for conservation. In Abra, the number of years in farming, gender, and language spoken seemed to relate with level of conservation at the farmer level. Results of the questionnaire indicated respondents with Moderate to High ratings for potential for conservation also have many years in farming. It therefore suggests that farmers with more farming experience tend to conserve diversity. Rana *et al*. (2007) reported that the relative age of a farmer increased varietal diversity.

In Mountain Province and Ifugao it was noted that female respondents tended to have Moderate to High ratings for the level of on-farm conservation, and those with more years in farming were likely to practice on-farm conservation and maintain varietal diversity. We also noted that older respondents in Ifugao who have maintained their culture and traditions had higher conservation level scores and maintained more varieties for household and traditional purposes. This was also reported by CECAP and PhilRice (2000) in Ifugao. In addition, respondents who are regular churchgoers and active in religious events had higher ratings for conservation. Rice, particularly traditional varieties with good eating qualities or glutinous types, are commonly used as church offerings by many Christianized Cordillerans. The practice of barter trading also seemed to increase scores, possibly due to the premium given to traditional varieties. In contrast, respondents who intentionally sell portions of their production had lower scores since they tended to maintain fewer varieties and prefer new high-yielding varieties.

The assessment for the potential of on-farm conservation of rice diversity is presented in Table 6. The potential for conservation is related to the number of varieties maintained on an individual farmer basis. The majority of respondents fell into the Moderate category, indicating that they maintain three to five varieties. Rana *et al*. (2007) reported that Nepalese farmers maintain three to four varieties. The number of varieties maintained could be a function of land area, as rice cultivation is limited by topographic constraints, especially in Ifugao and Mountain Province. Abra, in contrast, being at lower elevations, has rolling areas suited for upland expansion of cultivated areas. Abra has the largest rice-growing area, with 16 478 ha, whereas Mountain Province has the smallest, with 8807 ha. This is possibly why 20% of respondents in

Table 6. Proportion of Ratings for the Potential for On-farm Conservation of Diversity in Abra, Ifugao and Mountain Province

CATEGORY	ABRA	IFUGAO	MOUNTAIN PROVINCE
Low (%)	12	14	20
Moderate (%)	50	74	58
High (%)	38	12	22
Conservation Potential Index*	3.5	3.0	3.0

**average of all respondents ratings for the province*

Mountain Province opt to maintain only one to two varieties, whereas 38% of respondents in Abra have the ability to maintain six or more varieties, with the majority maintaining three to five. Moreover, a significant proportion of respondents may add new varieties without replacing existing varieties, thereby effectively improving farm-level diversity of varieties regardless of whether these are modern or traditional varieties.

The present level of on-farm varietal diversity and the potential for conservation is substantial among the study sites. However, socioeconomic variables could influence the maintenance of on-farm varietal diversity in the near to distant future. For instance, technological advancements in modern rice farming, such as the use of modern varieties, is already evident in the three provinces.

The number of varieties enumerated by memory recollection is also reflected in the levels of conservation (Table 7). In Ifugao, 71% discarded one to five varieties. In Abra, 69% of respondents discarded from one to seven varieties, and in Mountain Province, 66% discarded from one to five varieties. Abra respondents indicated a higher number of variety names, which could indicate that there is higher on-farm varietal diversity. The proportion of discards thus is an indicator of the changes to on-farm varietal diversity within the study area.

Table 8 lists some of the main reasons for discarding a variety. Perceived low yield was the most frequent reason in Ifugao and Mountain Province. Among Nepalese traditional rice farmers, Rana *et al*. (2008) also concluded that low productivity was the main reason for discarding a variety. On the other hand, loss of planting or seed stock such as when seed materials are consumed to sustain a household until the next harvest or seed is traded for some immediate household need and testing of new varieties, were the most common reasons provided by respondents in Abra. Testing of new varieties means a new variety is available but there is not sufficient planting area to adopt it. Poor resistance to pests and diseases, late maturity, and poor threshability were common reasons for discarding a variety. Most of the reasons cited for discarding varieties were associated with the characteristics of their landraces and traditional farmers' varieties. In some cases, adoption of modern varieties has been discontinued due to the poor eating qualities of these newer varieties. This is not surprising given that many respondents noted that the primary reason for selecting a particular variety was the eating quality (Table 3). In general, Rana *et al*. (2008) mentioned that socioeconomic and policy factors, among others influence a

Table 7. Proportion of Respondents and Number of Discarded Varieties

CATEGORY	ABRA	IFUGAO	MOUNTAIN PROVINCE
Proportion of repondents who discarded (%)	69	71	66
Minimum number of discards	1	1	1
Average number of discards	3	2	2
Maximum number of discards	7	5	5
Total number of discards	61	54	57

Table 8. Proportion of Repondents Citing the Particular Reason for Discarding a Variety

REASON	ABRA	IFUGAO	MOUNTAIN PROVINCE
Low yield	12	31	33
Susceptible to pests and diseases	8	23	11
Late maturing	12	9	4
Hard to thresh	8	13	7
To try a new variety	16	6	0
Loss of planting/seed stocks	20	0	0

farmer's decision to maintain or replace a variety. In the present study, it was shown that discarding or maintaining a variety used in on-farm conservation is a deliberate decision by the farmer in relation to the needs and evaluation of the merits of a variety.

Summary and Conclusions

Our results show that the diversity of traditional rice varieties in the central Cordillera region has been maintained in remote and subsistence farming communities despite the influences of social, economic, and technological changes. Our study revealed that rice production in Abra, Ifugao, and Mountain Provinces is primarily intended to sustain household needs until the next harvesting season and is tied to cultural traditions and practices and to the need to provide various rice-based traditional foods, such as raw material for *tappuy* that will be consumed during household and community occasions. Rice may also be used as offerings in religious activities. In times of good harvests or during emergencies, portions of the produce may be traded directly for cash or bartered for other desired goods. Our results did not vary much among provinces, but Abra showed a higher proportion of respondents practicing rice trading and bartering as a source of additional household income.

All three provinces had a similar number of variety types in cultivation, with both glutinous and non-glutinous types maintained, although the latter were maintained in greater numbers. Given the number of variety and landrace names recorded during the survey, it is evident that the central Cordillera still maintains high on-farm varietal diversity. However, the presence and adoption of modern varieties as a result of technological advancement, increasing accessibility of information, and increasing market integration may indicate a changing Cordilleran rice landscape.

The perpetuation of traditional varieties in the region can be attributed to a number of preferential factors desired by the Cordilleran farmers. Local varieties are primarily maintained for their adaptability to both restrictive cool climates at higher elevations and to sustain subsistence farming. Being a staple cereal used for subsistence farming, rice with good eating qualities is strongly desired. Phenotypically, local varieties are commonly preferred for their long panicles, high spikelet fertility ratio, bold and well-filled grains, acceptable yield performance, and maturity and tolerance to pests and diseases. Though many respondents considered that local varieties have no negative traits, others found local varieties to have low yield, to mature late, to have a long decomposition period, and to be hard to thresh.

Analysis of the seed sources and gender roles in seeds and variety selection showed a free exchange of varieties among farmers and within the community, with passing on or handing down varieties from parents and relatives being the most common method for seed acquisition. Bartering or exchanging varieties, loaning seeds, or giving away excess seeds and seedlings to fellow farmers also contributed to seed exchange and acquisition. Women had the bigger role in seed and variety selection, both in decision-making and actual field work, although to some extent men may also participate in the process.

We found, in general, moderate levels of and potential for on-farm conservation of varietal diversity in the three provinces, indicating that varietal diversity through on-farm conservation is being maintained across the central Cordillera despite decisions to discard a variety in favor of another. Abra scored higher in potential for on-farm conservation compared to the other two provinces because of its elevation and topography and the greater availability of land for planting. Hence, some farmers in Abra can add new varieties without discarding an old variety. Abra had the most respondents who maintained more than five varieties. Variety replacement or addition can pertain to both traditional and modern varieties, and are common variables in the dynamics of on-farm varietal diversity. Low yield was a common reason for discarding a variety, but notable reasons in Abra for discarding a variety were the physical loss of planting stock and testing of new varieties. The testing of a new variety can have an important effect on traditional diversity if the test results favor adoption of a modern variety. Other factors affecting the level and potential for on-farm conservation included the amount of experience in rice farming, being female, being old, going to church regularly, being active in religious-related activities, practicing ethnic traditions and culture, and barter trading. In contrast, those practicing direct rice trading for cash scored low in the level of and potential for on-farm conservation of diversity.

Given the agro-ecological conditions of the region and local preferences, the present varieties planted essentially satisfy the needs and preferences of the local farmers. Although agro-ecological limitations and sub-

sistence farming practices favor traditional varieties, technological interventions and other socioeconomic influences may alter the level of varietal diversity in the near future. Direct trading of modern varieties for cash and the introduction of modern varieties more adaptable to the local climatic and soils condition are becoming obvious options for many, as exemplified by the number of modern varieties now in use. Moreover, certain demographic and socio-cultural variables are some factors shaping the varietal diversity of on-farm conservation. Gradual successes in modern varietal development and improved modern farming practices are likely to be unavoidable pressures affecting varietal diversity in the communities of the central Cordillera and may negatively affect the sustainable use and maintenance of varietal diversity through on-farm conservation.

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Appendix 1. Indicators and corresponding rating for level of on-farm conservation of rice diversity

INDICATOR	RATING	LEVEL OF CONSERVATION
Complete discarding of existing varieties for replacement by new set of varieties • Same area maintained but all existing varieties replaced with only one or two modern varieties • Same area maintained but all existing varieties replaced with only one or two traditional varieties	1	Low
Discarding existing varieties for replacement by new set of varieties • Same number of varieties maintained but all existing varieties discarded for replacement by new varieties • Partial discarding of existing varieties for replacement by new varieties	3	Moderate
Maintaining existing number of varieties Adding other varieties (modern or traditional) from time to time without replacing or discarding existing varieties	5	High

Appendix 2. Indicators and corresponding rating and farmer' potential for on-farm conservation of rice diversity

INDICATOR	RATING	POTENTIAL FOR CONSERVATION
Maintains one to two rice varieties	1	Low
Maintains three to five rice varieties	3	Moderate
Maintains six or more rice varieties	5	High