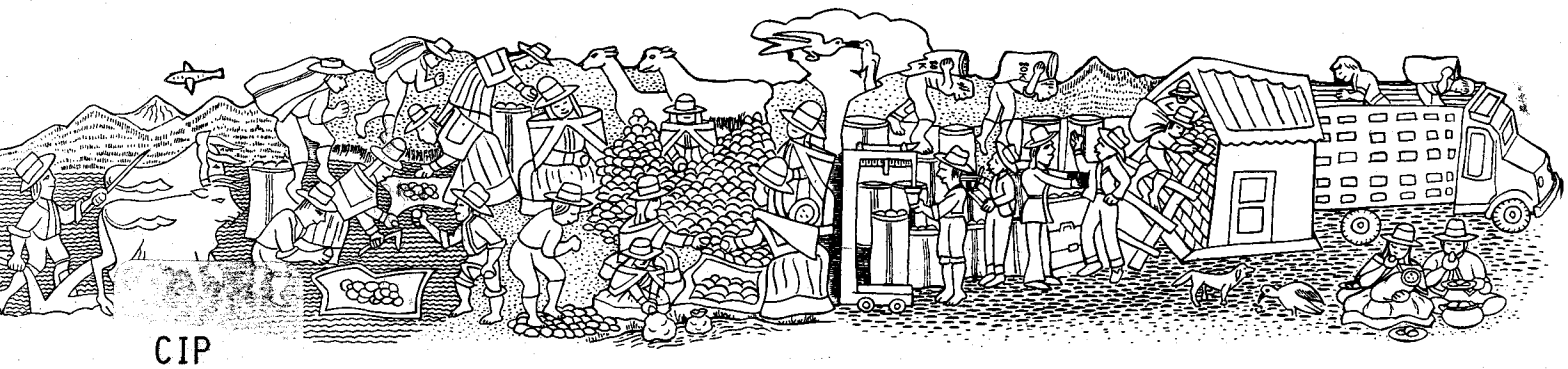
POTATOES IN FOOD SYSTEMS
RESEARCH SERIES
Report No. 2

# Traditional potato production and farmers' selection of varieties in eastern Nepal

Robert E. Rhoades



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**COVER**

The cover is adapted from an intricately carved gourd, or *mate*, obtained in an Andean potato farming community. This work of an anonymous peasant artisan shows Andean people's understanding of the potato's agricultural calendar from the breaking of a field to storage and sale of the harvest.

The purpose of this interdisciplinary research series is to encourage debate and advancement of knowledge about production, distribution, and utilization of potatoes in food systems of developing countries. The views expressed are those of the author(s) and do not necessarily reflect the official position of the International Potato Center.

Comments are invited.

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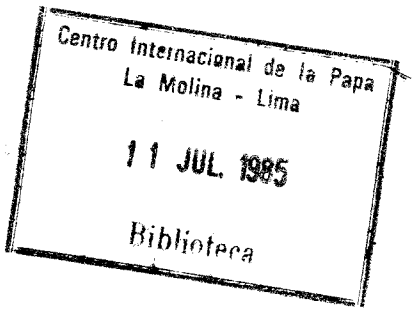


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# TRADITIONAL POTATO PRODUCTION AND FARMERS' SELECTION OF VARIETIES IN EASTERN NEPAL


## Abstract

This document analyzes farmers' traditional potato production and post-harvest strategies in Eastern Nepal. Data were collected in 1982 through ethnographic, open-ended interviews with farmers from both the lowland Nepali Terai on the Gangetic Plains and Mechi hill zone in Ilam District. Himalayan agronomic practices, potato folk taxonomy, and farmer germplasm management bear striking structural similarity to those used by Andean potato farmers. Nepali potato landraces are more varied than previously realized. Thirty-five possibly distinct varieties were identified, over 20 varieties in one hill village alone. Varieties are described and classified according to farmers' opinions about their agronomic, nutritional, and economic qualities. It is recommended that local landraces and traditional practices be studied further and considered in future production improvement efforts.



## Resumen

Este documento analiza las estrategias tradicionales de producción y poscosecha de papa de los agricultores de Nepal oriental. En 1982 se recopilaron datos a través de entrevistas etnográficas a agricultores tanto de las tierras bajas del terai nepalés en las llanuras Gangéticas como de la zona montañosa de Mechi, en el Distrito de Ilam. Las prácticas agronómicas himalayas, la taxonomía popular de la papa y el manejo del germoplasma por parte del agricultor tienen una sorprendente similitud estructural con aquellas de los agricultores paperos de los Andes. Los cultivares nativos de papa nepaleses son mucho más variados de lo que anteriormente se creía. Se identificaron 35 posibles variedades, más de 20 variedades en sólo una de las aldeas de la zona montañosa. Las variedades son descritas y clasificadas de acuerdo a las opiniones de los agricultores en cuanto a sus cualidades agronómicas, nutricionales y económicas. Se recomienda profundizar el estudio de los cultivares nativos y prácticas tradicionales y que ambos sean considerados en los esfuerzos futuros de fomento.

## Acknowledgements

Many individuals have been helpful in the research and publication of this report. Members of the Eastern sector research team were Mr. Nirmal Prasad Gijalung, Mr. R.B. Shresta, and Erwin König. Dr. Hans Peter Maag, P.C.P. Chaurasia, J.S. Gaudin and Erwin König kindly corrected earlier drafts and added new ideas. Finally, a special gratitude goes to Lilia Salinas and Mariella Altet, secretaries of the CIP Social Science Department, who typed and prepared this manuscript for final publication.

Robert E. Rhoades
March 20, 1985
Lima, Peru

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# I. Introduction

After spreading from its Andean homeland in the 16th Century, the potato subsequently had a great impact on three major world zones. The first was the Northern Hemisphere above 40°N latitude, involving the countries of Europe and North America. Today, this cooler climate zone produces 75 percent of the world's potatoes, the fourth most important food crop globally (Horton 1982). Other diffusion zones were subtropical and tropical mountains and subtropical plains with dry winters located in Asia where cool temperatures offered the potato a growing environment roughly similar to its Andean mountain home (Rhoades 1982a).

While much has been studied in all facets about the potato in the Northern Hemisphere and its Andean cradle, little is known about this crop or how it is traditionally produced, stored, and utilized in subtropical and tropical areas outside the Americas. There is, however, a number of sound reasons for overcoming this knowledge gap. Agricultural development projects with a focus on improving or replacing traditional practices and potato varieties in mountainous developing countries have been underway for several years. These projects have operated without the benefit of a socioeconomic understanding of traditional practices or the role of locally grown varieties in existing farming systems. Highland people of East Africa, Himalayas, and the Asian hills and plains subsist in zones labelled by the United Nations Food and Agriculture Organization as "critical zones" where populations exceed the supporting capacity of the land (Jahnke and Kirschke 1984). Many depend upon the potato as a staple food, important vegetable, or for farm income.

This report presents data derived from research conducted in the lowlands and hills of Eastern Nepal as part of a 1982 evaluation of Nepal's National Potato Development Programme (NPDP) at the conclusion of its first five years of existence (SATA and APROSC 1982).[1] A description will be given of farmers' potato production and post-harvest systems in (1) the lowland Terai and (2) Ilam Hill area. Special attention will focus on farmers' strategies in selection and use of varieties. Whenever possible comparisons with other mountainous regions, especially the Andes, will be drawn in an effort to trace common technological responses by mountain potato farmers. No attempt will be made to pass judgement on whether the practices or varieties used by farmers are superior or inferior to those being introduced through national program efforts, but simply to describe what was observed and what farmers gave as reasons for their practices.

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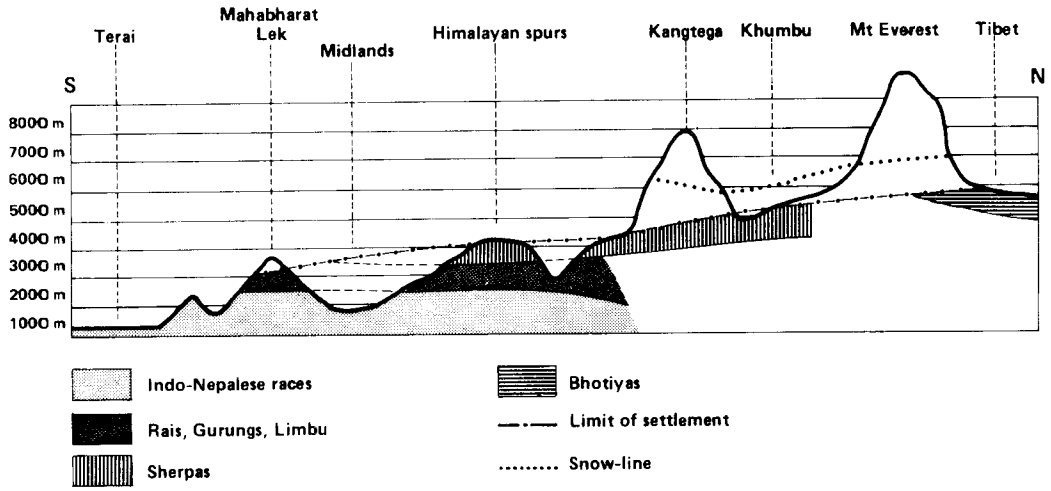
[1] Interview schedules and open-ended ethnographic eliciting techniques were used by the research (see Rhoades 1982b for a description of the methods). The phonetic representation of many Nepali place names and potato varieties may not always be correct.

## II. General Considerations

The potato has been grown as a food crop in Nepal almost as long as in Europe. When Antoine-Auguste Parmentier was still trying to convince the French that potatoes were fit for human consumption, the explorer Kirkpatrick visited Nepal in 1793 and wrote that potato seeds were yearly imported from Patna for use in the Kathmandu Valley (Rhoades 1982c; Kirkpatrick 1811:180). However, the potato probably did not became an important crop until the early 19th Century. Anthropologist Christoph von Fürer-Haimendorf (1964) has argued that the 19th Century introduction of the potato into the Sherpa Khumbu region stimulated population growth and provided the agricultural surplus necessary for the rise of the elaborate Buddhist civilization in Northern Nepal. Today, the potato is produced on over 50,000 hectares and is one of the main food crops in the country (NPDP Evaluation Project 1982:27).

Potatoes are presently grown in Eastern Nepal in all agro-ecological zones stretching from the Terai, a 30 kilometer stip of the Ganges Plains in the south, to the highest valley of the Solu-Khumbu region located at over 3,000 meters on the Chinese border in the north (see Diagram 1). Production systems vary according to altitude. In the lowland Terai, potatoes are typically cropped after upland paddy or jute during the winter. In the mid-hills (800-1,500 m.a.s.l.), potatoes are mainly cropped on irrigated land after paddy. From 1,500 to 1,800 meters, the system gives the way to mixed cropping with maize. By 2,500 and above, however, mixed cropping blends into monocropping of potatoes. In the far North, production is only possible during the 6 months growing season from April to September. The present study concentrates on areas ranging from the Terai in Morang District to around 2,500 meters in the Ilam hill zone (see Map 1).

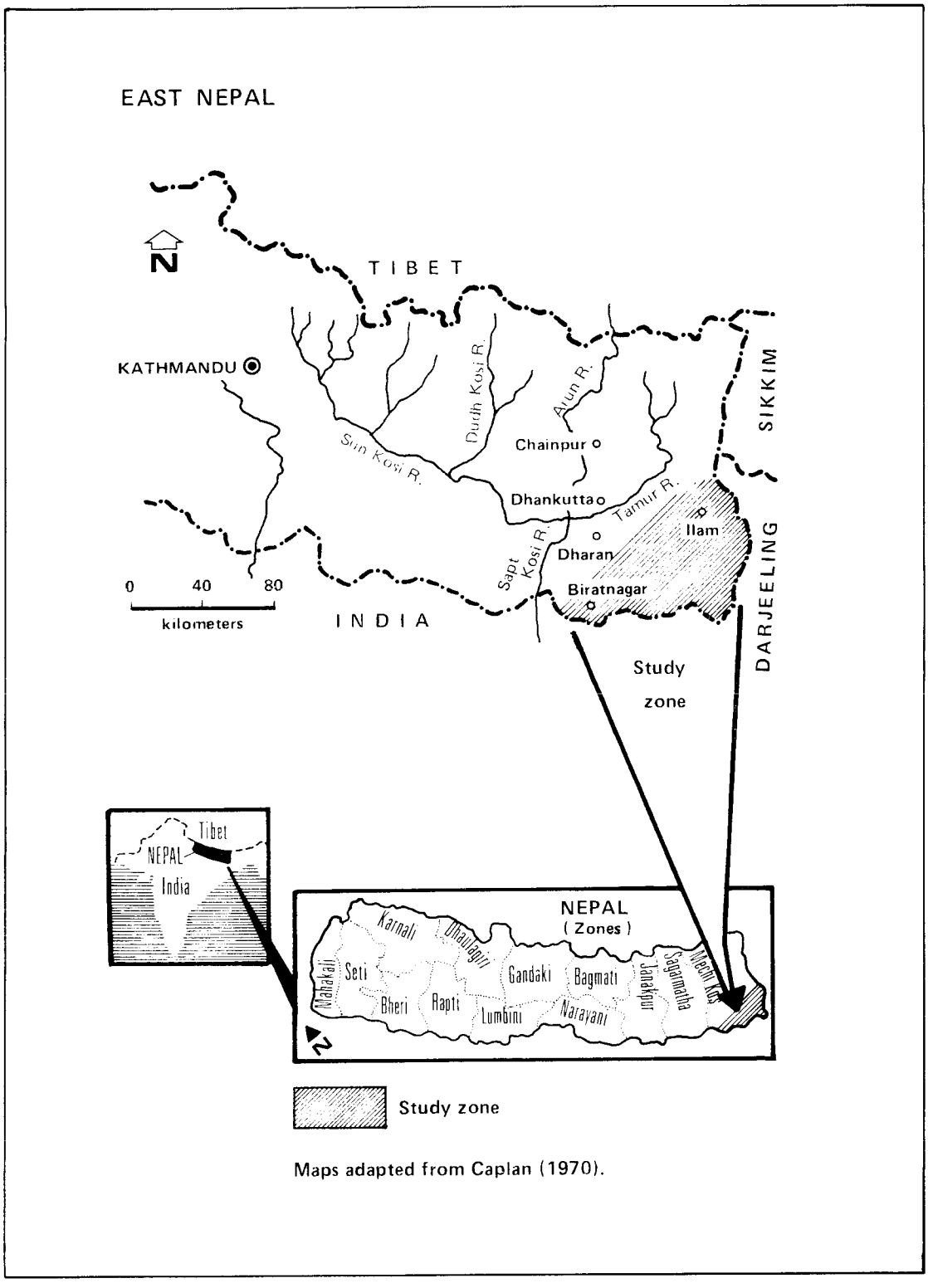
**Diagram 1. Ethnical Cross-Section: Eastern Nepal***




*Although this cross-section was cut further to the west than the study area, the ethnic distributions and altitudinal changes are roughly similar.

Source: Adapted from Hagen (1961 - 1964)

Map 1




Maps adapted from Caplan (1970).

## III. Terai Production Zone: Morang District

### 1. Commercial and Subsistence Production

In the Terai lowlands, the potato is not looked upon by most farmers as an important commercial crop. According to interviewed farmers, incentives to produce for the wider market are strangled by unstable and wildly fluctuating prices brought about by periodic flooding of Indian potatoes into local markets by merchants operating across the open Indian-Nepal border. Additionally, widespread commercial production is constrained by lack of irrigation facilities. In most areas, no water is available in public canals during winter when the potato can be optimally grown. Thus, only vegetable farmers with pumps located near river or those with wells can profitably grow potatoes. Many farmers claim that if more water was available more land would be planted to potatoes.

The Agriculture Development Officer (ADO) of Morang District listed the following 1982 breakdown of important crops:

Table 1. Major crops in Morang District

| Crop | Hectares |
|---|---|
| Paddy | 78,430 |
| Maize | 5,400 |
| Wheat | 12,500 |
| Sugar cane | 1,250 |
| Oil seed | 2,500 |
| Potatoes | 900 |
| Total hectares | 100,980 |

Most of the 900 official potato hectares are farmed by a few large commercial growers, many of whom own tractors and cultivate more than 10 hectares. The best known vegetable growers come from the subcaste Mehata (Koiri) who are located along the river. Some Tharus are also known to be innovative, commercial potato farmers.

Co-existing in Morang District with commercial vegetable production is "kitchen garden" traditional production by small producers for home consumption. Potatoes grown in kitchen gardens, however, are not included in the official figure of 900 hectares since plot size is on the average extremely small. The ADO estimates that the typical farmer may

plant 2 or more kata (kata equals 338.63 $m^2$). According to the ADO, virtually all 70,000 farmers in Morang District have such small winter potato plots. If we assume each farm family only plants one kata, this implies that in Morang District alone over 2,250 hectares of land planted to potatoes may not be included in government statistics. In addition, thousands of village and town dwellers among the 450,000 total population of Morang grow potatoes for home consumption.

How important commercial versus kitchen garden production is throughout the Nepal Terai is unclear but the existence of two systems raises interesting questions and hypothesis as to what should be the nature of potato crop improvement efforts. If lessons from other world areas are valid, subsistence producers have different goals in production and opinions on the quality of potato (texture, taste, cooking quality, and storability) than market-oriented producers (Mayer, 1979). Yield, according to some small farmers, is not crucial as long as it is in an acceptable range. Their strategy is to grow with absolute minimum inputs amounts sufficient for family needs.

In the Terai, the potato is a convenient vegetable to be cropped between main crops. The following cropping patterns were mentioned by farmers: (1) paddy-potato, (2) paddy-potato-maize, (3) paddy-potato-potato, (4) jute-potato-jute, (5) paddy-potato-jute

The most common pattern is paddy-potato, but a few farmers attempt to get 3 crops a year by growing early varieties of paddy and potato followed by maize or jute. Local potatoes are grown generally for only three months in winter. As soon as possible (one week in many cases) after rice is harvested, potatoes are planted. This means that potatoes are traditionally planted after hathiya, a two-week period when the last big rains fall, generally in late September or early October before the onset of the dry season. If rain does not come, farmers still plant.

In many cycles, harvesting of potatoes starts as early as 2 months after planting. Potatoes rarely stay in the ground longer than 3 months in any cropping system. Farmers harvest early not only to free land for the next crop or to fill shortages in the food supply but for other reasons:

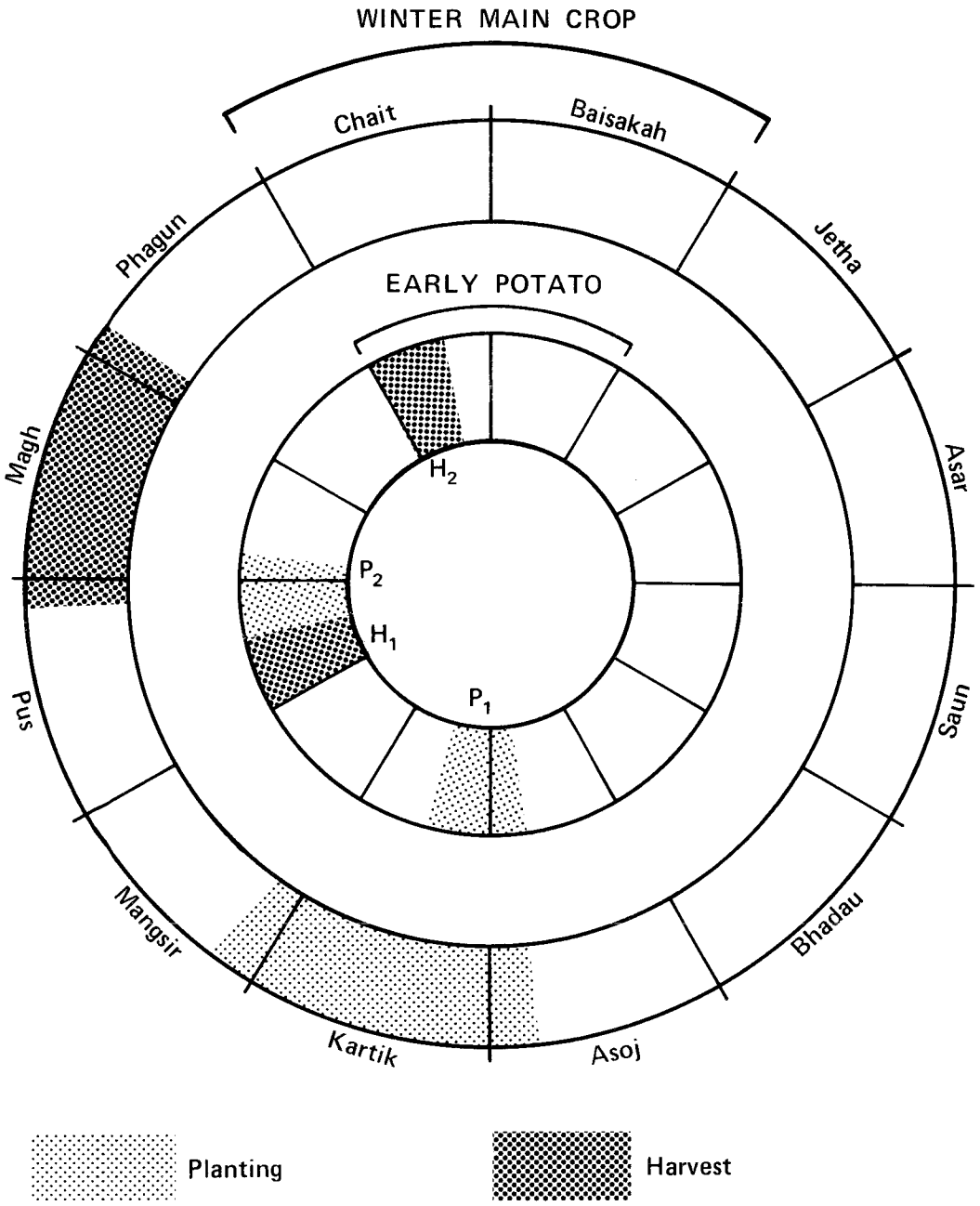
(1) Small potatoes, 15 to 30 grams, are preferred for consumption in tarkari, the typical Nepalese dish.

(2) Farmers wish to avoid minor theft by harvesting early. They even use field guards as they near harvest. One problem with introducing haulm pulling is that once a field appears harvested (as is the case after haulm pulling) villagers by local custom may enter a field and glean what is left.

(3) Early harvest is said to prevent loss caused by rodents, mainly field rats and mice.

Larger commercial growers and subsistence-kitchen gardeners differ in planting pratices. Larger farmers plant Indian "improved" varieties,

Diagram 2. Potato Cropping Calendar: Terai




NEPALI MONTHS

| | | | | | |
|---|---|---|---|---|---|
| Baisakh | .. | .. | mid - Apr. | to | mid - May |
| Jetha | .. | .. | mid - May | to | mid - June |
| Asar | .. | .. | mid - June | to | mid - July |
| Saun | .. | .. | mid - July | to | mid - Aug. |
| Bhadau | .. | .. | mid - Aug. | to | mid - Sept. |
| Asoj | .. | .. | mid - Sep. | to | mid - Oct. |
| Kartik | .. | .. | mid - Oct. | to | mid - Nov. |
| Mangsir | .. | .. | mid - Nov. | to | mid - Dec. |
| Pus | .. | .. | mid - Dec. | to | mid - Jan. |
| Magh | .. | .. | mid - Jan. | to | mid - Feb. |
| Phagun | .. | .. | mid - Feb. | to | mid - Mar. |
| Chait | .. | .. | mid - Mar. | to | mid - Apr. |

These months are only approximate as they follow the lunar calendar.

follow line planting and hilling up while small producers plant flat and scattered, i.e., not in lines, to save on labor costs. The "local potato" (local alu), a term which will be discussed later, is the predominant type grown in kitchen gardens. A few Terai farmers interviewed mentioned that if improved varieties and local varieties are both affected with late blight and no sprays available, local potatoes will yield more. Also, if no irrigation is available some farmers claim that local practices and varieties are better adapted to stress conditions than those being introduced through the potato program. Estimates by farmers on yield range from 6 to 24 tons per hectare.

Presprouting of seed potatoes is important to farmers since moist soil conditions do not permit leaving potato seed dormant in the ground for very long. Merchants will presprout or purchase presprouted material from farmers for resale. Subsistence farmers buy the cheapest possible potatoes with preference for small size. Terai farmers prefer a marble to medium size potato for seed (10-30 grams). They cut larger ones into seed pieces. Local seed rate is 15 maunds per bhiga while agronomists recommend 22 maunds per bhiga.[2] Traditional spacing is much closer than western agronomy normally recommends, about 50 cm. between line planting and about 15 cm. between plants. Farmers cling tenaciously to the idea of using small seed arguing this practice allows them denser emergence on more land. The small seed strategy is one of minimum input - minimum risk and is a widespread practice in the Andes (Werge, 1980).

According to Mr. Erwin König, SATA agronomist, some farmers in the Terai bend potato plants and then cover most of the above ground stem to increase production. This works with "local varieties" but not with those being introduced through program efforts, such as the variety Kufri Sindhuri.

In the Terai, ploughing is done by men while women plant and weed. Women are cheaper to hire as laborers. At harvest time, men unearth the potatoes, women place in baskets, and both grade.

## 2. Marketing: Terai

Kitchen garden potato producers in the Terai are rarely market-oriented. Commercial farmers, however, tend to sell most of their harvest to get cash for the upcoming paddy planting. Some commercial farmers use cash from potato sales to loan to small, poorer farmers. Some estimate they get 100 per cent interest on this money. This strategy is more profitable than putting potatoes in cold store and waiting for higher potato prices.

Prices are highest in September, October, and November (Nepali months: Kartik and Mangsir) due to high demand and scarcity of seed potatoes in the market. The consumer potato market also supplies seed

[2] A bhiga is equal to 6,772.66 m2. A maund is equal to 37 kg 324 grs.

potatoes to small-scale producers. Nepali farmers complain of poor market access for potatoes and would like to see the Indian border closed to potato imports. Some Terai farmers receive "free" seed from Indian traders, but have to sell their crop to these same traders at pre-fixed prices.

Indian merchants are a key element in the marketing industry. They move Indian potatoes, including seed, across the Nepalese border. The power of middlemen and merchants lie with their extensive knowledge of prices, varieties, markets, and marketing channels. Using a far-flung merchant-kin communications network, Indian merchants know almost immediately when prices are favorable in the Nepali Terai and can quickly supply the market with potatoes from Indian cold stores. Table potatoes are brought by Indian merchants from as far away as Bhutan via India during the 3-month monsoon period from June to September. Non-hill potatoes in the Dharan market (Sunsari district) are almost totally supplied by one Indian merchant, Mr. Ramji Bania. He has connections reaching to Bhutan in the East and the Punjab in the west. Some merchants selling highland potatoes in the Terai often falsely claim their seed comes from Jaubari farm in Ilam District. Seed formerly produced by this now abandoned Indian Government funded research station carried prestige some years ago.[3]

## 3. Terai Storage

Storage is that part of the crop production cycle aimed at preserving or holding food energy until it is ready to be utilized or released onto the market or moved toward utilization/consumption. In short, storage can range from preserving energy in the form of domesticated animals to preservation of vegetable matter in fresh or processed form.

In Nepal, six main types of potato storage can be identified of which only the first three are found in the study area of Eastern Nepal:

- Cold stores (exclusively in Terai)
- In-house store (all ecological zones)
- Separate storage building (kholma: general barn or store house)
- Hanging baskets (Kathmandu Valley)
- In-ground (delayed harvest)
- Pit storage (only in far north)

Although climatic conditions are unusually hot and humid in the Eastern Terai, many small producers store potatoes for home consumption. Given the difficult climate, farmers stress the importance of natural

[3] A similar strategy has been reported among rice seed merchants in the Philippines. They simple place a number like IR-36 on a bag of rice seed misleading the purchaser to believe it is produced by or originates from International Rice Research Institute stock.

Marketing potatoes in the Nepal Terai. The tubers represent several local varieties from the mid-hills. They are highly valued for their culinary and storage quality.

"keeping quality" of varieties. Most commercial Terai farmers immediately sell their crop, although like kitchen gardeners they store from 4 to 7 months amounts sufficient for family consumption. Storage for later speculation is still an uneconomical alternative given available post-harvest technology and uncertainty about effects on price from Indian imports.

a. On-farm ware potato storage. Typically, ware potatoes are spread out to dry for 7-10 days after harvesting and then piled in a corner, under a bed or stored in closed bamboo silos or straw baskets of various kinds (dehri, dhoko or netu). Sometimes layers of moist sand are alternated with potatoes to prevent further drying. Farmers recognize storage quality of highland potatoes, and many criticize improved varieties for poor keeping quality. Some highland migrants to the Terai have transferred hill storage practices to the lowlands. They do not store in containers but pile or spread both seed and ware potatoes in a corner of an upstairs room or veranda. Women select out a few tubers for preparation in tarkari at each meal. These stored potatoes can last up to 4 or 5 months.

Tharus, the native people of the Eastern Terai, store potatoes for 6 months on the second floor of their houses. This practices causes greening of potatoes which farmers claim is not harmful for consumption.[4] This, in part, may be due to the low level of daily consumption of potatoes (in tarkari) where any disagreeable taste is overcome by curry and spices.

b. On-farm seed storage. Seed potatoes are rarely stored in the Terai except in small amounts. At harvest, small tubers are selected, spread out for approximately one month and then piled in a corner or placed in a bamboo basket in layers alternating with layers of sand. The basket called netu is mudlined inside, wrapped in straw on the outside, and serves to keep the potatoes in darkness and protected from rotting and rats. The seed storage period is usually 6 to 7 months. Seed stored in netu is for kitchen garden potatoes only.

c. Cold storage. The only cold store in Biratnagar was purchased in 1981 by SATA (Swiss Association for Technical Assistance) for use in storing the potato development program seed. Farmers lost confidence in the store under previous management due to electricity shortages, nonfunctioning standby generator, and spoilage of produce.

[4] We were unable to interview Tharu women on this point. They undoubtedly know more about this aspect than the men.

## 4. Varieties Utilized in the Terai

Farmers interviewed in the Terai, like their hill counterparts, exhibited an intense interest in varieties. They constantly seek new genetic material and have definite opinions on kinds of varieties appropriate for their agroecological and consumption needs. Before discussing functions of different varieties in the traditional system, however, a brief word on some Nepali beliefs about kinds of potatoes and nomenclature is in order.

a. Beliefs about types of potatoes. Many Nepali males believe that white-skinned potatoes contain more water than red-skinned potatoes and that white "development" potatoes (seto bikashkoalu) in particular cause a disease known as hydrocele. Dr. Spock (1976:572) describes hydrocele as it affects infants.

> Hydrocele is often confused with hernia or rupture because it also causes a swelling in the scrotum. Each testicle in the scrotum is surrounded by a delicate sac that contains a few drops of fluid. This helps protect the testicle.

A swelling caused by hydrocele can make the sac appear several times the normal size. Nepali men fear this will happen to them if they eat white, improved potatoes. Stories are told of one Brahmin whose testicles swelled to such a size they burst and he died. The "disease" is said to be cured by injection and recommendation that one stops eating white potatoes. In Nepal (especially in the Terai) there are paramedical specialists in hydrocele. They frequently recommend a drug called Venicedefort administered in tablet form.

Preference for white skinned potatoes is found in some villages such as Bhaktaphur, a Newar community in the Kathmandu valley. In this town, villagers prefer white potatoes (seto alu) but only "local" white potatoes. They still shun white "development" potatoes (seto bikashkoalu).

Alu, or potato, in Hindu culture also refers to a person who is stupid.[5] If you get a zero on an exam, you are an alu. Among educated, urban Nepalis the potato is considered symbolically "very funny." Also some Nepalis believe potatoes cause diarrhea. As in the Andes, potato is a less prestigious food while the staple grains such as rice (maize in the Andes) are higher status, ritualistic foods (see Murra 1960) on the Andes.

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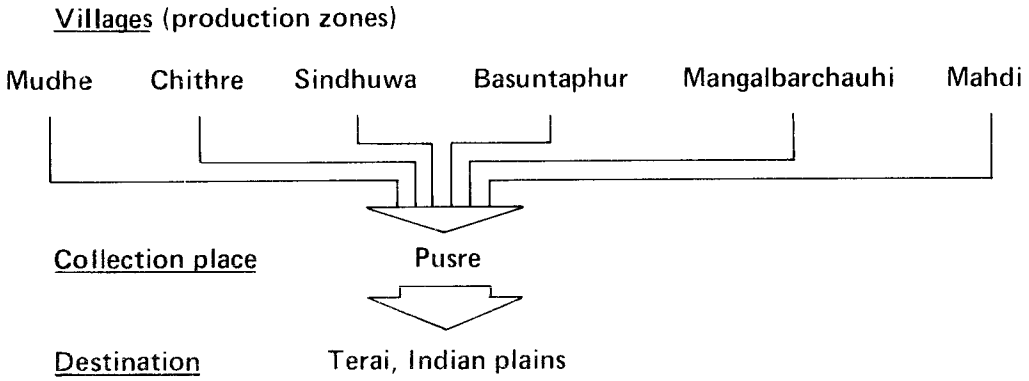
[5] Erwin König reports that locally Nepalis say the word alu comes from A lé (A, lé, lé) which is what a farmer tells his wife when he wants her to bring food.

b. Lexicography. At the most general folk taxonomy level, potatoes are divided into two major types: local alu (local potatoes) and bikashkoalu (development or "improved" potatoes). Lexicography then becomes more refined depending on location. This follows a pattern strikingly similar to that found in the Andes where potatoes are generally divided also into two major types: papa nativa (native potatoes) and papa mejorada (improved potatoes).

Local alu is a generic term which encompasses all potatoes grown for several years in Nepal or India and is distinguished from bikashkoalu which specifically designates those being introduced through development efforts. However, bikashkoalu can pass to the status of local alu if it proves to be useful and is adopted. Further distinction among local alu is drawn between pahari (hill) potatoes and madesi (Indian) potatoes, the latter literally means plains dweller but in fact designates India. Naming features also include skin color (e.g., rato alu (red), seto alu (white), nilo alu (blue)), place of presumed origin (Chisapani) or a combination of several naming traits (e.g., seto pahari alu or white hill potato). Also, names of varieties are often changed locally. For example, the Indian variety 3696 (probably an experiment station release number) is now called "military" in Biratnagar because of its round, robust appearance.

While variety naming is more generalized in the Terai than the hills, Terai people still further distinguish pahari potato by the market collection place in the foothills or midhills. Pusre alu, for example, refers to a market called Pusre located north of Dharan where hill potatoes are brought to be marketed (see Map 1, Diagram 3). Foothill communities such as Pusre are "hinge communities" between the highlands and lowlands.

Diagram 3.- Flow of seed toward lowlands



In Eastern Nepal the best-known "local" potatoes are designated by their mid-hill collection place: e.g., Ilam, Suthani, Letang, Katari and Mahdi. However, the Terai name for local white pahari alu (hill potato) can be sherpa alu, designating an ethnic origin. The Sherpa are a high mountain group from the best seed producing zones. These general lowland names are rarely used in the highlands above 2,000 meters where potato lexicography is more detailed.

c. Seed sources and varieties: Terai. Eastern Terai seed potatoes are derived from three sources: Nepalese hills, Indian plains via cold stores, and a minor flow from Bhutan via India (see also Scott 1983). Whether a greater seed volume for the Nepal Terai planting comes from India or the Nepali hills is not known although given more small-scale producers than commercial growers more seed probably comes directly from the hills. Some seed entering Nepal from Indian cold stores actually originated from the Nepal hills.

Table 2. Varieties according to Terai production system

| Commercially Grown Varieties (Indian origin) | Kitchen Garden Varieties (Nepali Hill origin) |
|---|---|
| Lalgulab | Chisapani |
| Kufri Sinduri (C140 or C40) | Ilam blue |
| Phulwa | Ilam red |
| 3696 (Military) | Letang white |

Due to taste preferences, cooking quality, drought resistance, and keeping quality, kitchen gardeners prefer pahari alu (highland potatoes) such as Ilam red, Ilam blue, and the famous Chisapani (a central eastern hill collection place).[6] Terai rice is often bartered for potatoes thus facilitating the flow of seed from the hills. Indian varieties are used for commercial production (see Table 2).

Chisapani is a hill variety renown throughout Nepal and Northern India. Along with a variety called mathi, it is in high demand in India's Uttar Pradesh and Bihar. Potatoes come to the Chisapani market from Nepal's Okaldhunga District, and are picked up by Indian merchants

[6] Letang in Morang District of eastern Nepal is a similar although less renown collection place in Eastern Nepal. Potatoes arriving here for collection are called Letang alu by lower elevation Terai farmers.

for distribution in India. Collection takes place during months of Asoj, Kartik, Mangsir, and Pus (e.g., from mid-September to mid-December). Weekly, 1200-1500 maunds are collected in Chisapani.

Chisapani potatoes sell for 7-8 rupees/kg at seed time while other varieties sell for 2.75-3 rupees/kg. Normally chisapani is double the price of other varieties. According to farmers, advantages of pahari varieties like chisapani are:

(1) simplier to cultivate and require few inputs for cultivation;

(2) no irrigation needed due to drought tolerance;

(3) stores well at home;

(4) high taste and cooking quality. Needs less oil to cook.

Farmers identify hill potato varieties in the market by cutting and examining color and design of cortex. Chisapani, for example, when cut has a blue ring inside. Farmers also cut seed to examine for disease such as brown rot and hollow heart.

## IV. Hill Production Zone

### 1. Introduction

Mechi hill zone in Ilam district above 1,700 meters elevation is primarily a potato production belt. An estimated 2,500 hectares of potatoes yielding 16,500 tons are cultivated in Ilam District, more than any other single district in Nepal (NPDP 1983). Potato is the main subsistence and exchange crop and along with maize forms the backbone of the local subsistence economy. Paddy is cultivated in the lowlands (besi) near the river bottoms. Cardamon is an important cash crop throughout much of the region.

In Ilam district, intensification in land-use due to population pressure has reached what may be ecologically dangerous levels. Food supplies are already scarce for the hill population.[7] Former pasture land has been brought into cultivation and extensive forest tracks have been cleared. The land is intensely cropped and with less pasture available, farmers tend to have fewer animals and thus less manure and compost. Chemical fertilizers are not available. Hill families still maintain economically viable farm sizes through inheritance patterns which allow one offspring, either the oldest or youngest son, to become primary operator if not outright owner at the parent's death. Other siblings, even if they maintain partial ownership, are forced to migrate to the Terai. This shaky equilibrium, however, may not be maintained once the Terai becomes fully colonized.

### 2. Cultivation Practices

Farmer cropping strategies at four village locations (Map 2) were studied: Jasbire (1785 m.a.s.l.), Maipokhari (2000 m.a.s.l.), Rakse (2000 m.a.s.l.) and Sukhepokhari (2510 m.a.s.l.). Practices are roughly similar in each place with a tendency for more intercropping of potatoes and maize at lower zones blending into monocropping at higher elevations. Most agriculturists in the area are ethnically Rai, Limbu, Mukhiya, Gurung, and Sherpa (Diagram 1.)

Cultivation practices vary depending on a combination of ecological zones within communities, potato variety and function of potatoes in the diet or exchange system.[8] Farmers in many Ilam communities divide their ecology into three micro-zones: lek (highlands), katchar (mid-zone) and besi (river valley). Each zone has its own cropping system, soil type, and climatic condition. In the mid zone and

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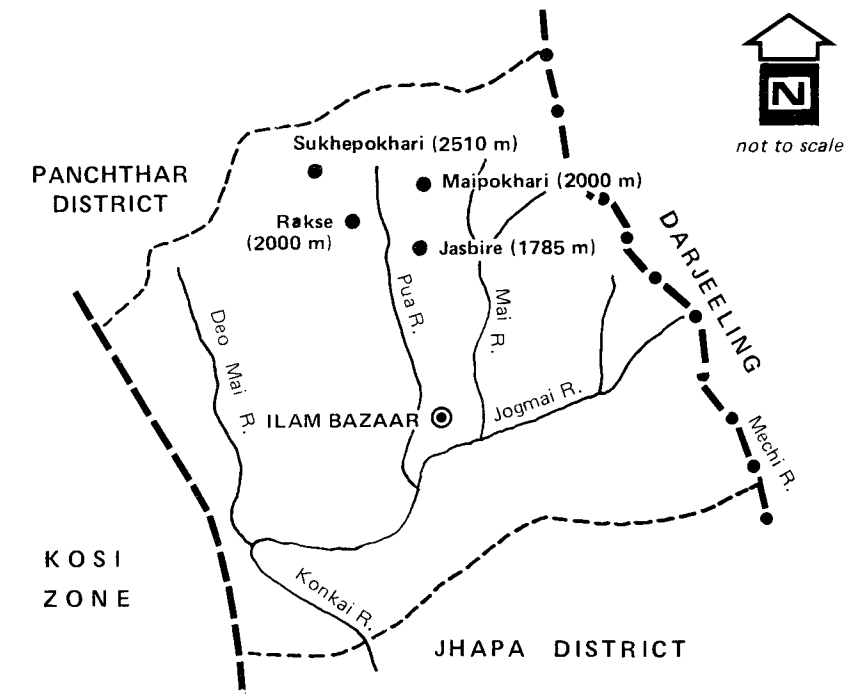
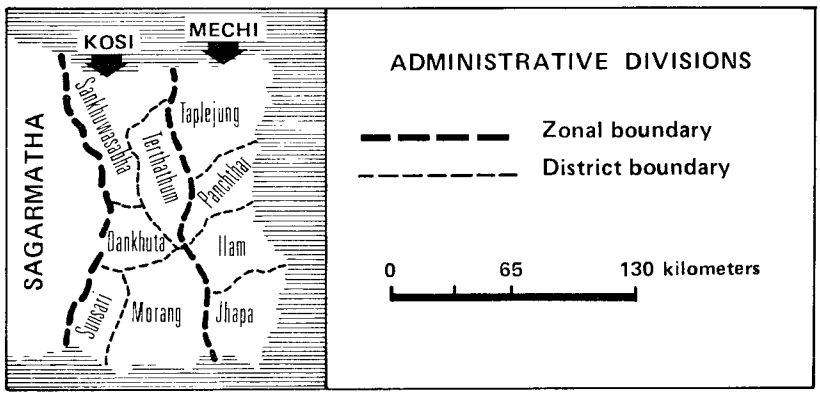
[7] Caplan (1970:76-77) who conducted fieldwork in 1964-65 in Limbu villages north of Ilam already spoke of the food gap. Sixty-four percent of his sample of families produced less than they required.

[8] For another account of potato cultivation practices in Eastern Nepal's Ilam District see Shrestha (n.d.).

Map 2




Village locations estimated.

Maps adapted from Caplan (1970)

highlands potatoes are mixed cropped with maize while in the lowlands rotation is with rice. Farmers have land in each zone or access to the products of other zones through kin ties or exchange networks.

Around Jasbire, for example, potatoes in the lek zone are typically rotated or intercropped with maize. Wheat, however, is rotated with beans in the mid-zone but never potatoes since the wheat season conflicts with potato growing season. When potatoes are monocropped the rotation cycle in both the lek and katchar is potato-fallow-maize. If a field is affected with brown rot, however, the field could be fallowed for several seasons. Animals are always rotated over fallow fields.

In Jasbire, winter potatoes are generally planted in Pus/Magh (mid-December to mid-February) when the workload is not great and labor is available. Harvest begins in Jetha/Asar (mid-May to mid-June) and is spread over 2 to 3 months due to ecological zonation and to better schedule labor. Seed potatoes are normally harvested two weeks before table potatoes.

At Kakse, higher in elevation than Jasbire, farmers' perceived problems in potato production are:

- lack of land and increasing shortage of compost due to fewer grazing animals;
- due to food shortages all stored potatoes may be consumed before planting, leaving a shortage of seed;
- hail;
- plant disease (mainly late blight, Phytophthora infestans).

Hill farmers plant very small (10-15 grams size) seed potatoes, sometimes planting 2 or 3 small tubers together. With small or cut seed farmers claim their seed rate is less than in the recommended NPDP practice of planting whole, larger seed pieces. Cutting was explained in the following manner:

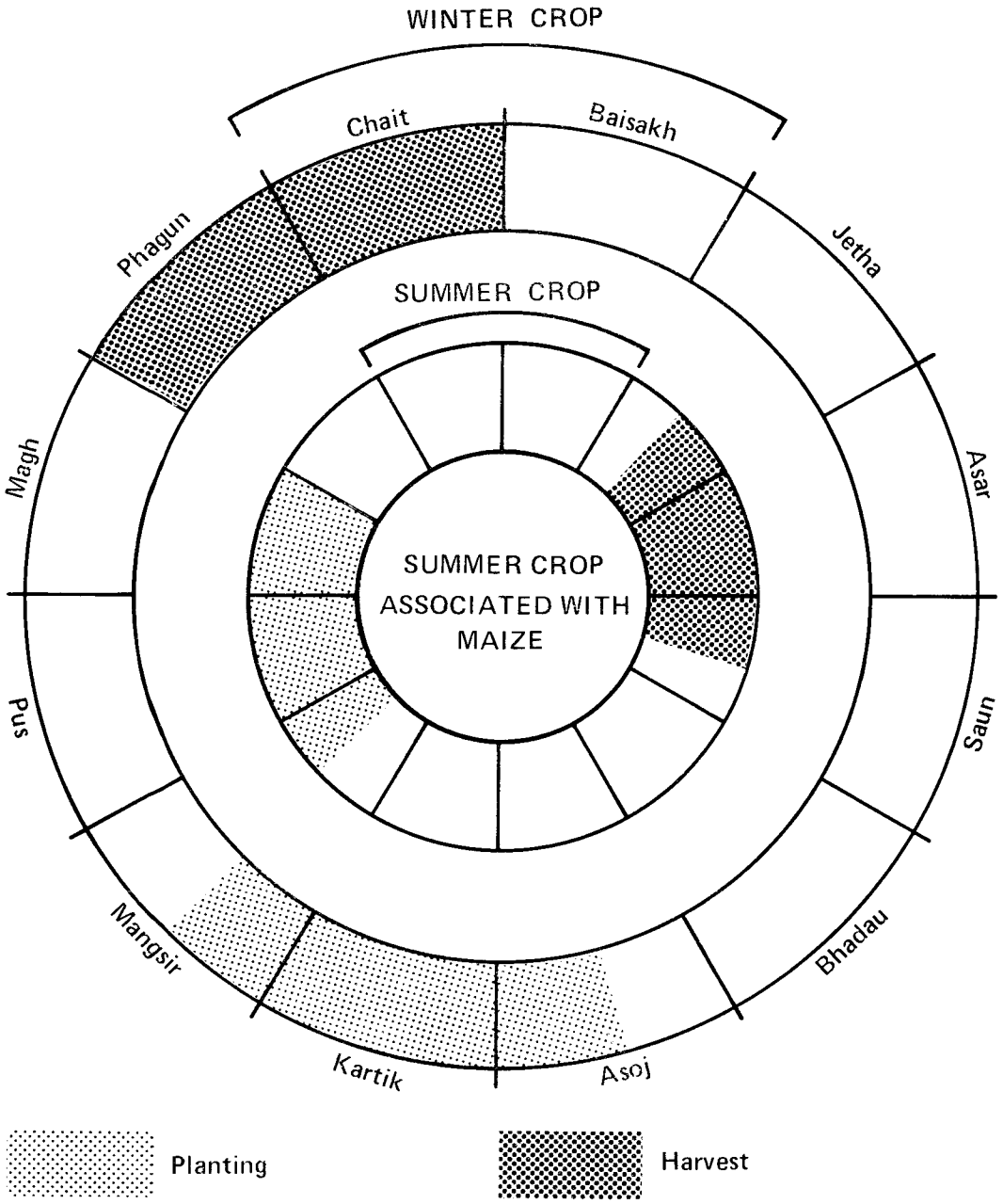
(1) Cut out largest eye first (farmers are aware of physiological aging; the main sprout is called King "Raja" of sprouts).

(2) Then cut top half in two pieces.

(3) Bottom part is used for eating: if any eyes this piece may also be used for seed.

Reasons from farmers' point of view for using small or cut seed are: (1) greater density of plant emergence and higher survival rate; (2) lower seed rate; (3) diminishes risk due to lower input costs; (4) traditional agronomic practice requires less work at planting since hilling up not always executed.

Diagram 4. Potato Cropping Calendar: Ilam Hill Zone




NEPALI MONTHS

| | | | | | |
|---|---|---|---|---|---|
| Baisakh | .. | .. | mid - Apr. | to | mid - May |
| Jetha | .. | .. | mid - May | to | mid - June |
| Asar | .. | .. | mid - June | to | mid - July |
| Saun | .. | .. | mid - July | to | mid - Aug. |
| Bhadau | .. | .. | mid - Aug. | to | mid - Sept. |
| Asoj | .. | .. | mid - Sep. | to | mid - Oct. |
| Kartik | .. | .. | mid - Oct. | to | mid - Nov. |
| Mangsir | .. | .. | mid - Nov. | to | mid - Dec. |
| Pus | .. | .. | mid - Dec. | to | mid - Jan. |
| Magh | .. | .. | mid - Jan. | to | mid - Feb. |
| Phagun | .. | .. | mid - Feb. | to | mid - Mar. |
| Chait | .. | .. | mid - Mar. | to | mid - Apr. |

These months are only approximate as they follow the lunar calendar.

One reason for dense planting is to take advantage of premature tubers, basically to obtain a guaranteed harvest of small tubers before late blight (Phytophthora infestans) hits. This strategy is related to marginal survival and insecure food supplies. If farmers plant far apart with large tubers and blight or hail hits, then available food supplies may be reduced to nothing. Furthermore, if a new system is introduced where tubers are grown to maturity, then a marketing and storage infrastructure compatible with this system is necessary. These do not exist in Nepal. Finally, farmers claim a plant producing many small potatoes yields more utilizable food than a plant with only a few large tubers. Although agronomically not necessarily correct, it may be correct in the existing consumption and marketing system.

While farmers know how to care for stolons in cultivation frequently hired laborers often break stolons since they do not take care in weeding or hilling up. Some farmers criticize the improved agronomic recommendation of hilling up since rains may wash away the soil leaving the tuber seed exposed. With irrigation and machinery, row ridge planting would be advantageous but in the eastern hill section, few potatoes are irrigated and all labor is by hand.

### 3. Exchange and Marketing Systems

Although Ilam District is commercially linked to Darjeeling, India, the marketing system is still in large part based on non-monetarized, altitudinal exchange and barter (cf. Humphrey 1985). If farmers in Jasbire run short of consumption potatoes for home use, they can promise exchange of 15 kg of seed to be delivered at seeding time for an advance of 20 kg of consumer potatoes from Barbote (lower, hill elevation village located above and near Ilam). In the exchange system, people generally come up to lek or katchar from the besi, (lower altitude zone) with their barter produce.

Potato seed and maize are generally exchanged for rice. Four kg of potato seed can be exchanged for 4 kg of unhusked rice (dhan), millet (kodo), or maize (makai). At harvest time, however, 4 kg of ware potatoes is exchanged for 4 kg of dhan. Farmers from the lowlands looking for potato seed bring dhan uphill.

Exchange volumes are often measured in tin or metal containers called pathi or dharni. If potatoes low in price, they practice chuli-chuli, heaping up top in exchange for a levelled basket of rice. If potatoes high in price, they level across top of basket. This is especially the case with seed potato-unhusked rice exchange which involves primarily rato alu (red potatoes). The exchange occurs between 3 panchayats (political unit) probably traditional trading zones (Jasbire, Barbote, and Maipokhari). Jasbire exchanges maize and potatoes, Barbote (1,500 m.a.s.l.) exchanges paddy and millet, and Maipokhari (2,000 m.a.s.l.) exchanges only potato. Maipokhari farmers, however, often pay

cash for seed they obtain from higher zones.[9] Traders come up to potato zone to buy seed to market later in India.

Potatoes are a means to obtain cash or other foods. If hill farmers have no cash, they try to sell potatoes to buy cereals, especially rice, maize, and millet. This probably represents a more favorable energy exchange system for farm families with potatoes to barter. Farmers claim not to like pure potato meals, preferring at least 50-50 cereal-potato staple diets. Farmers with expendible capital will first try to buy rice, those families with little money will buy wheat.

Grading of potatoes is practiced in Ilam District. Large potatoes (plum size: 80-100 grams) are for eating, middle-size (large marble: 20-30 grams) for seed in local area or farmers own use, and small (pea size: 10 grams) are for exchange with lower zones. The small size is considered necessary in the exchange system, not only because of consumption desires and seed requirements, but also due to packing density in the trading containers.

Farmers also have precise rules on handling potatoes. They say if you handle tubers too much it causes a "black spot" (bruising) that ruins tubers.

## 4. Hill Storage and Processing

Potatoes are stored in the hills in three locations: houses, separate multipurpose storage buildings, and in-ground.

a. House storage. Consumption and seed potatoes are stored in the dark, either under beds or in baskets. Some farmers separate table potatoes from seed potatoes while others make no initial distinction. Seed potatoes in the latter case may be extremely small tubers still left over at planting time from ware potato stock.

Storage is approximately from Asoj (mid-September to mid-October) to Pus (mid-December to mid-February). Farmers say they heap potatoes on the ground story of houses to keep from going dry and shrinking. Seed should be free of soil before storing for the next planting season. According to farmers, heaping reduces damage by rats or mice. Some put in dhoko (basket), other put in a rounded mat silo made from bamboo. Farmers complain that lack of storage space is a problem. Limited space in farm dwellings for presprouting sometimes causes farmers to plant 1 or 2 months earlier than recommended to allow seed to sprout.

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9 Shrestha (n.d.) reports that in Ilam District seed potatoes are brought from Panchthar at a cost of Rs. 20 I.C. per maund or a maund of seed is obtained and paid back later with two maunds of potatoes.

b. Separate storage building. Farmers do not store potatoes in special potato stores, but rather spread or store in baskets in a separate multipurpose building called kholma. The use of kholma is more common in the hills than Terai. The kholma is considered cooler and better ventilated than the warm, smoke-filled upstairs typical of Nepalese farm houses.

c. In-ground storage. Hill farmers harvest small amounts at regular intervals from many fields, including where the crop has matured but left purposely in-ground. Lack of space and a need to schedule scarce family labor are motivations for in-ground storage.

d. Processed potatoes. A dehydrated potato product called masheura has been made by Rai and Chhetri households in the Rakse area for as long as older people remember.[10] Farmers use any quality potato, not only discards. Annually, about 15 kg per family are processed into dehydrated form. Similar processing by Newars has been reported at Nigale near Kathmandu.

One farmer described the procedures as follows:

(1) Potatoes are prepared into a paste through first cooking and then smashing.

(2) After smashing, they are mixed with a pulse powder and made into a small ball.

(3) Leave in sun 2-3 days to dry.

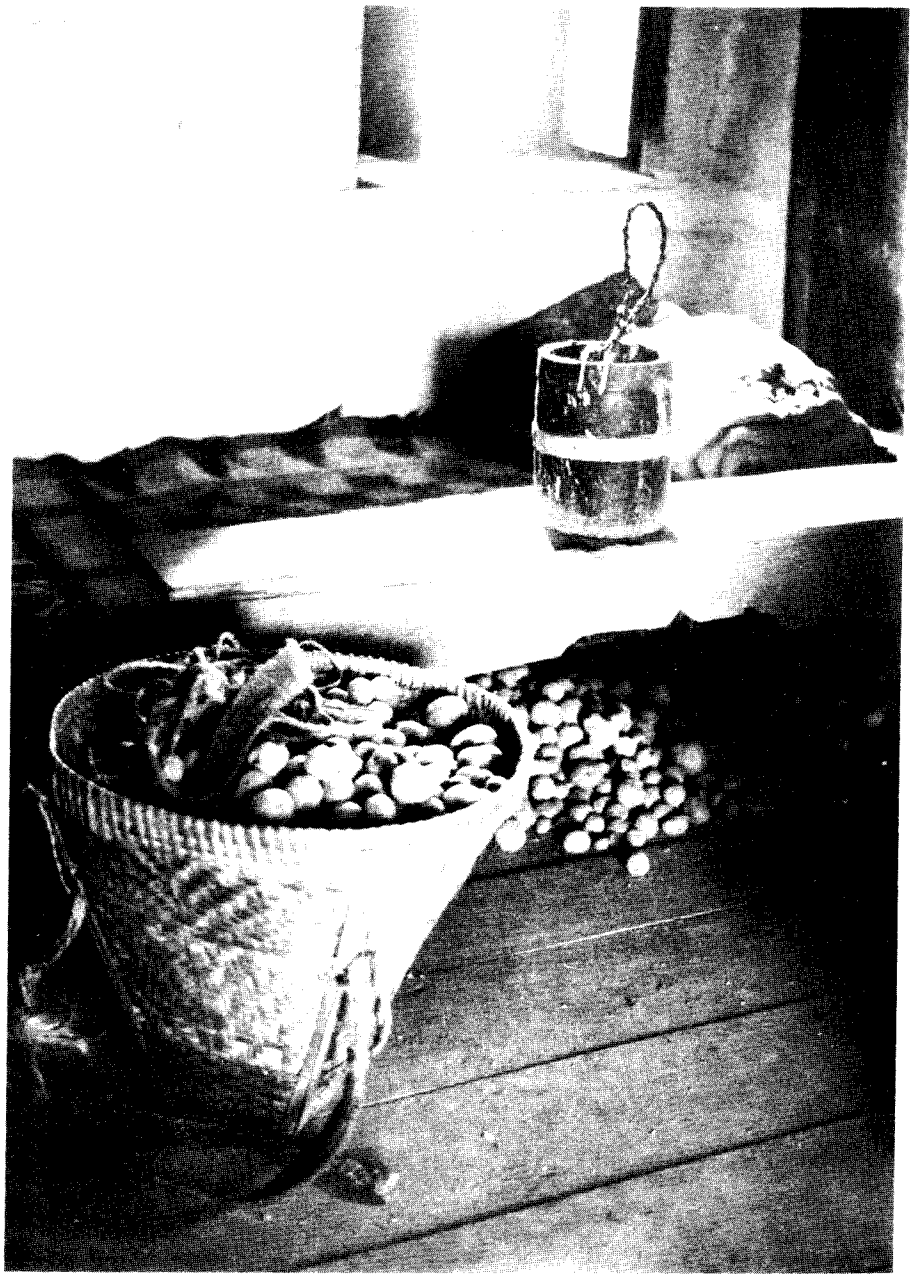
(4) Store for 4-5 months in tin or plastic containers (earlier in cloth).

(5) The product is fried, although some report boiling in soups.

## 5. Seed Sources and Flows: Hill Zone

Potato seed flow is stepwise: higher communities produce for lower elevation communities which in turn produce for still lower communities. These flows reflect complex trading vertical exchange networks which have historically tied diverse ecological zones into a singular economic unit. Even new germplasm brought in from India is soon integrated into the traditional vertical flow system. Once varieties enter the Nepal hills from India they are reproduced locally. Through time more favorable seed producing zones become seed suppliers of this germplasm to growers. One example is kufri jyoti, originally introduced into Nepal by the Indian government through their support of the Jaubari seed farm in Ilam. Districts higher in elevation (e.g. Panchthar) now produce kufri jyoti as seed for lower elevation communities such as Jasbire in Ilam.

[10] This same name designates a different product in other Nepali regions.



In-house potato storage in Ilam District. The basket, called dhali, is used to measure and transport potatoes for sale or barter for rice.

Potatoes are often stored in separate storage buildings which are better ventilated than upstairs rooms of farm houses.

A local custom is that seed must never move uphill, always downhill. When using their own seed farmers should not even bring seed from a lower terrace, even one only 10 meters below. They never replant seed in the same plot where it was produced. Within communities farmers exchange seed among themselves. If good local seed is scarce, farmers seek quality seed at higher elevations. At Jasbire seed is renewed approximately every three years depending on degree of soil and airborne pathogen build-up.

Table 3. Marketing linkages and seed flows in Eastern Nepal

| Links[11] | Example Communities |
|---|---|
| Grower | Northern (Sherpa) |
| ↓ | ↓ |
| Trader who visits different villages and carries on his trade on horseback | Panchthar |
| ↓ | ↓ |
| Local trader | Sokrepokhari |
| ↓ | ↓ |
| Trader on border | Rokse |
| ↓ | ↓ |
| Trader who exports commodities | Jasberi |
| | ↓ |
| | Ilam |
| | ↓ |
| | Terai |

[11] This linkage chart is adopted directly from Shrestha (n.d.). Unfortunately, no date is given on his report. Perhaps road building activities have altered this pattern.

## 6. Farmer Selection and Utilization of Germplasm

The study of farmer decision making in selection and use of varieties gives insights as to what germplasm qualities farmers seek and why. In European potato systems yield is of predominant importance. Potatoes are monocropped, cultivated hilled-up in rows by mechanization, and disease or pest control is largely through chemical cultural practices. In Nepal's mountainous environment, strategies and problems related to production are quite different than in highly commercialized growing regions such as Europe or North America.[12] Some characteristics of the Nepal situation are:

(1) difficult transport conditions and complex mountain ecology;

(2) absence of fungicides or pesticides to control disease and pests;

(3) absence of chemical fertilizers;

(4) subsistence base wherein food supplies are periodically scarce;

(5) need to multicrop (e.g., potatoes with maize) to better utilize land and reduce risk;

(6) exchange system based as much on barter as cash. Potatoes function to acquire rice and thus the variety grown must fit the demands of lowland rice growers for their own potato production or consumption desires.

In most western commercial production systems, desired functions of varieties are by definition tied closely to yield, tuber uniformity, and market demand. Since prices are paid on a gross weight basis, efforts are made to grow potatoes to an ultimate acceptable weight, all other aspects held constant. Control of pests and diseases through chemicals and cultural practices is thus highly important. Most modern breeding program logically address themselves to production-centered aspects such as yield, resistance, and earliness of maturation.

Varieties in Eastern Nepal hill zone are distinguished by a number of dimensions which are important to farm households in a subsistence/barter-exchange system:

(1) Consumer preferences (culinary and size): taste is of predominant importance and smaller sized potatoes preferred.

(2) Cultivation qualities (yield and disease tolerance): amendability to mixed cropping and multiple harvesting.

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12 See Calkins (1982) for a general discussion of constraints affecting development of vegetable programs in the Nepal's hill zone.

(3) Storability ("Keeping quality"): "development potatoes" are said to have more storage problems

(4) Barter qualities: packing density, seed requirements of lowland rice growers.

In Eastern Nepal, farmer sensitivity to variety differences increases with altitude. By 1785 m.a.s.l. at Jasbire, potatoes are classified according to home consumption and nutritional qualities versus market or barter qualities. Nepali hill people are extremely sensitive to culinary quality. For instance, local red and white varieties rate extremely high in "taste" while local Ilam blue and Hollange (Olongue) are considered best for the market. Besi and Terai farmers prefer Ilam red which is better adapted to wet, warm conditions. Local red, the favorite barter variety, is especially esteemed for feeding sick people.

a. Hill lexicography. Local lexicography of the potato becomes richer with increase in altitude. For example, while potatoes in Ilam Bazaar are simply designated in Nepali as "local white," "local red" or "Ilam blue" Maipokhari (2,000 m.a.s.l.) farmers separate whites into 3 varieties, blues into two, and reds into two.[13]

(1) White varieties:

- Tare (short stolon).
- Jhyalle or Jyale (long stolon). Good yielding variety tolerant to drought.
- Farse. Maipokhari's main white variety. It originally came from Sikkim according to local farmers.

(2) Blue varieties:

- Chakyre (Deep blue color). Chakyre exhibits a deep violet purple ring inside when cut. Considered to be most tolerant variety to diseases and hail.
- Kaleje (Light bluish). Kaleje is the highest yielding variety.

(3) Red varieties:

Light red is called lal (a variety susceptible to brown rot). Hollange, another red, is considered most resistant to late blight and is probably of Dutch (Holland) origin.

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13 However, if Ilam blue is mixed in a basket with other reds, the mix is called rato alu. The author is not yet convinced that Ilam red and blue are different varieties but rather reflective of the natural skin color variation within one variety (Darjeeling round red). They may represent intraclonal variation of the same variety.

b. Oral history. Farmers' oral history about each variety is rich. They claim, for example, that jhyalle seto changed its physical characteristics, mainly in the stolon, in the 50 or 60 years it has been grown in the area. Originally a short stolon variety, jhyalle through time developed long stolons. They pinpoint the appearance of chakyre, a dark blue variety, at about 50 years ago.

Farmers remember clearly the local fate of kufri jyoti. Seven years ago this "improved" variety was introduced by Indians at the Jaubari farm (now non-operational). After 5 years yield declined and its initial 2 week tolerance advantage to late blight over local varieties broke down. Kufri jyoti, while still grown, is not one of the more popular varieties.

c. Varieties and poduction. Farmers are keenly aware of varietal differences related to agronomic practices. What farmers call "red," "white," and "blue" varieties are planted in separate fields often in different zones. Around Jasbire, farmers plant proportionally more land in the following order: (1) red, (2) white and (3) blue. Generally, fields are not rotated with different varieties. For example, if red is planted where white was, farmers claim that volunteer white will also emerge and render overall production low. This probably represents an ideal as we observed several times mixed colors of potatoes being harvested in a single parcel. With the red variety,[14] however, farmers claim to change fields every year. If red is planted constantly in the same field, production is lowered and disease increases. A field goes fallow after being planted in red.

Undoubtedly to spread risks and labor inputs planting dates for different varieties are staggered[15] as illustrated by the Maipokhari case.

Table 4. Planting dates by varieties: Maipokhari

| Variety | Planting month |
|---|---|
| Chakyre | Pus (mid-December to mid-January) |
| Lal | Pus |
| Kaleje | Pus |
| Hollange | Phalgun (mid-Feb to mid-March) |
| Seto (2 varieties) | Magh (mid-Jan to mid-Feb) |
| Farse | Phalgun |

[14] The term red variety (rato alu) refers to Ilam red which is the same as Darjeeling red round.

[15] Similar cultivation strategies were found at Rakse (2,000 m.a.s.l.) about 6 hours treck from Jasbire. Predominantly a Rai and Sherpa community, Rakse shares many characteristics in potato production with Jasbire.

Weeding potatoes in Ilam District. Note the intercropping with maize and the scattered as opposed to line method of planting.

A Swiss agronomist and technician of the National Potato Program discuss with a farmer cooperator new methods of potato production.

Farmers are especially sensitive toward stolon type. If a variety has long stolons, earthing up is practiced early in the growing season with great care. Farmers claim if they do not earth-up, yield will be low. A shallow stolon variety, for example, is difficult to cultivate if potatoes are mixed cropped with maize. Farmers thus purposely select deep stolon varieties to mix crop with maize. White varieties are said to require a hilling up around roots one week after weeding. Hilling up of red potatoes is done early or not at all since long stolons may suffer damage. Farmers consider red potatoes (rato alu) labor demanding since weeding must be done carefully by hand.

Varieties also require different treatment in cutting of seed: (1) white variety seed is cut and cured up to one week before planting; (2) red must be planted within 2 days after cutting; (3) if rains come during the curing period, then the red variety is placed in a covered hole until conditions become favorable.

d. Multiple potato harvests. Most Ilam peasant households are faced with a shortage of land and uncertain food supplies (Caplan 1970). The potato growing season corresponds annually to one of the greatest food shortages periods. Thus, potato production is geared not only to outside markets but perhaps more importantly for feeding the family under food deficient conditions. The potato, unlike the grains, can be harvested early as food as soon as 60 gram size tubers or even smaller appear. The potato can thus be a constant source of food during the growing season. This makes the indigenous model of potato production in Ilam different than in most western countries where potatoes are generally not harvested early unless farmers are trying to catch special price conditions.

Farm households in the Rakse area rely on a minimum of 4 varieties. These varieties are valued for many reasons, one of the most important is the number of times they can be successfully harvested during a given growing season. One woman gave the following breakdown on the six varieties she grows:

Table 5. Multiple harvesting of potatoes in Ilam District

| Varieties | Harvesting frequency |
|---|---|
| Hollange | 2 |
| Farse | 2 |
| Jhyalle | 3 (60 gr. size) |
| Kaleje | 1 |
| Lal (local red) | 1 |
| Sindurje | 2 |

The red varieties kaleje and lal are harvested only once because their stolons break easily. In this multiple harvesting system, the tuber at the end of the stolon is first removed, the others later. Although stolon characteristic is important no difference in spacing between red and white varieties was observed.

Multiple harvest and mixed cropping of potatoes and maize should be considered in determining per hectare yields. If, national or regional statistics are based only on samples taken at the third harvest that which has already been harvested will not be counted. Potatoes mixed cropped with maize will obviously yield lower per unit of land than monocropped potatoes which is normally the case in agronomic experiments.

## 7. Description of Varieties by One Farmer: An illustration of Diversity

The large number of different varieties utilized in Nepal has not been catalogued or extensively researched (see Appendix 1).[16] The use of different varieties in different zones for different production goals parallels potato farmer strategies in the Andes (Brush et al. 1980; Mayer, 1979; Franco, et al., 1979). We also discovered an amazing parallel with the typology developed by Centro de Desarrollo Agropecuario (1983) from a study of farmer adoption of cassava. The typology involves "newcomers," "drop outs," "classics," and "historicals" as terms to describe varieties of cassava.

To illustrate complexity in the Nepali system, the following information was provided by one Rai potato farmer who lives near Rakse. He was interviewed on basic information about varieties: culinary, storage, production, flowering and true seed producing characteristics. Also, to gain a time dimension, he was asked about the history of varieties. He structured his information first around white varieties and then red varieties.

### a. White varieties

Seto Dalle or Bombai: A round, white potato grown for many decades but disappeared 10 years ago because of a disease called ainjeru, probably wart. The farmer claimed seto dalle also required too much compost. Now peasant households have less land, less pasture, and fewer animals for compost. They cannot let land lie fallow long enough for this variety. However, it is a famous "historical variety" still reminisced about by peasants.

Jhyalle: A "classic local variety" that replaced seto dalle. This is an oval shaped, medium-sized white variety with multiplication rate of 4 to 1. The reasons given by farmers as to why they plant more land

16 Following this study, Mr. P.C.P. Chaurasia of NPDP began collecting tubers through the program's regional agronomists.

in jhyalle are: (1) tastier and more nutritious , (2) more tolerant to disease compared to other varieties, (3) can be used before maturity when food is scarce. Less rice is needed if sufficient quantities of jhyalle are consumed.[17] Carries a white flower but berries are rare. Flowers last of all varieties.

Pharse: A round, large variety like kufri jyoti, not so tasty. Although few farmers grow pharse (farse), when they do it is planted in Besi. Primarily a home consumption potato, it can be harvested early for tarkari. Problems: sensitive to frost, red ants, cut worms (katne kira). Pharse has a white flower with yellow color inside. Berries are rare.

Syandorje: A rough skin, round, medium size, potato that is not so tasty. It has become a "dropout" because of sensitivity to disease and insect pests and needed "new" land every year. The eyes easily rot. Syandorje is name of a Sherpa from Kalpokhari who brought this variety to Rakse.

Dhwashe: A browish, white round variety that has now disappeared. It is not so tasty and its said to "smell bad when eaten before maturity." The farmer claims it needs "new" fallow or new potato land every year.

b. Red varieties

Rato Nile: This high yielding variety still grown by this farmer exhibits a round, yellow ring inside when cut. Produces more flowers than any variety. After excessive rain rato nile is often attacked by a disease called kalo chhirke.

Chakyre: A round, bluish red variety with blue ring when cut. Although susceptible to late blight, chakyre is still under cultivation because:

- adapted to Terai conditions and is thus seed highly sought after by Terai farmers;
- best variety to exchange for cereals: rice, millet, and maize from lowlands;
- good storability;

Exhibits a white flower with red color inside. Produces abundance of berries and is first variety to flower in a season.

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[17] Another farmer in praise of jhyalle gave the following qualities: (1) best for sick people, (2) tastiest, (3) thin skin for tarkari preparation, (4) highest yielder, (5) disease resistant, (6) best tolerance to hail, (7) rainfall/hot season does not disturb, (8) yields well in infertile soil and is thus good variety for poor families, (9) gives good volunteer stand in next year and yields some tubers after main harvest, (10) earlier variety than others.

Kanchhi: A variety which disappeared 8 years ago. It was very sensitive to rainfall and was affected strongly by late blight and had poor storability. This variety is same as the one called rato puwale. This variety's legend is that a young girl (kanchhi in Nepali means youngest sister) brought the variety to Rakse. Other farmers say the name comes from the belief that the variety produces well only in virgin soil.

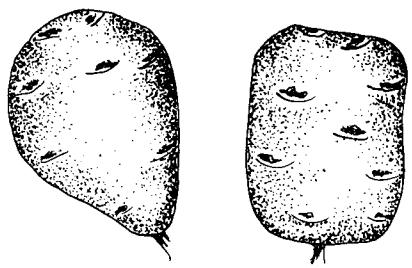
Rato Pharse: This was an early maturing, tasty variety that disappeared 8 or 9 years ago. He no longer plants because he "ran out of new land" where this variety does well. Yields declined rapidly when planted sequentially in the same field. Seed is no longer available.

## 8. Variety Use in Sukhepokhari: Further Illustration of Complexity

Sukhepokhari (2,510 meters), a Sherpa community, produces seed potatoes for lower zones, especially Jhapa District. In this village, we collected a list of 23 varieties which have been or are still grown in the community (see Appendix 1 for a list of 36 varieties encountered during the study).

Seto jhyalle is Sukhepokhari's favorite variety. According to older farmers, it was originally brought to Sukhepokhari in 2 bags assumed to contain one variety but, in fact, turned out to have contained 2 varieties or clones. As sketched by farmers in the dust both had andigena characteristics. The clone on the left survived and is today called seto jhyalle. Some farmers do not like jhyalle since its stem end is of poor taste and has to be cut away.

Shapes



Ilam blue (Ilam Nilo) is the second most important variety -due to its exchange value, good yields, and preferred taste. At planting time, however, rato nile gets best price, e.g., 5-10 rupees more per maund than other varieties, depending on quality.

Sukhepokhari farmers accept or reject varieties depending on how they fit mixed cropping cultivation practices. For example, kufri naveen (Naveen) was a high yielding variety rejected by farmers because of its tall, thick foliage that supressed growth of young maize. If grown at all, it is rarely mix cropped. The local variety chokane was rejected by farmers because of its long stolon which disturbed intra-cultural operations (i.e., earthing up) when mixed planted with maize. Long, shallow stolon varieties do not permit farmers to hoe maize.

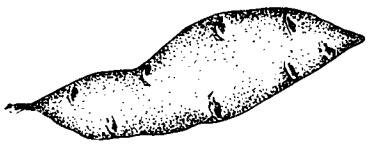
Interviewing a farmer about varieties grown in the Sherpa village of Sukhepokhari (2,500 meters). A list of 23 historic or contemporary varieties was completed.

Table 6. Farmer classification of varieties by stolon type

| Long stolon varieties | Short stolon varieties |
|---|---|
| Kamare jhyalle | Lamche jhyalle |
| Chokane | Barha seasone |
| Rato nile | Syangdorje |
| Hollange | Seto pharse |
| Kanchi | Dwase |
| Kufri naveen | |

Sukhepokhari farmers readily recall how varieties came to their village. Pharse, it is said, was brought from Tibet by a Sherpa guide working for the British. His name was Sundurje and the variety is also known by this name (see earlier discussion of syandorje on page 38). This was in the Nepali year 2001 (Gregorian calendar year 1945). Pharse seto was introduced in 1899 brought in by a military man from Darjeeling on three loaded horses. Dhwase seto was brought in by the same military man one year later.

According to farmers, the most famous potato ever in the area was Bombai. After this came belayti seto. Bombai was a round variety; belayti was oblong. Belayti, like Bombai, disappeared because of wart after introduction of jhyalle. Another variety chuche seto was described in very andigena-like terms and was drawn to us as:



Most varieties produce true seed. The variety kaleje produces best: 10-15 berries per plant under favorable climatic conditions. True seed is not seen as a way of production but farmers believe if you plant true seed you will get some production. Farmers say that in years of heavy rain and no sun, few seed balls are produced. If the plant gets late blight, then seed ball rots. A farmer from Sukhepokhari (2,500 meters) tried to plant true seed of Bombai and jhyalle, and neither produced. This was in a crisis period when farmers were having difficulty obtaining good seed of these varieties and they hoped to obtain material through true seed.

## V. Conclusions

The purpose of this paper has been to describe farmer practices related to the potato in Eastern Nepal. Although more detailed research is called for, the following general conclusions of interest to students of agriculture can be drawn.

1. Despite reported low yields (in a western agronomic sense) and the virus degenerated status of local potato landraces of Nepal, this germplasm material is complex, respected by farmers, and has experienced long duration in specific locations. The potato has been grown as a food crop in South Asia almost as long as in Europe and many early introductions were made from European materials. The local varieties are, in a sense, time-tested and fit in the present food systems. If disease free seed stock were made available, yields of these landraces might be improved. Their potential as germplasm for breeding purpose might be considered (see Brücher 1975 for a discussion on the germplasm value of non-American local varieties in Africa and Asia).

2. Himalayan potato agriculture resembles in many respects the complexity found in the Andes. This is reflected not only in traditional agronomy and the wide range of varieties grown but a rich folk taxonomy (see Brush, et al 1980). Maintenance of diversity of traditional germplasm is a central feature of the Himalayan system, as it is in the Andes. The Himalayan system is a matured potato culture and must be understood as such if it is to be improved.

3. Agronomic practices encountered are based on long-term adaptations and parallel practices found in other mountainous areas, especially the Andes. Use of small seed, planting in different zones, staggering planting dates to spread risks, seed exchange through barter systems, and manipulation of many varieties for different purposes are but a few examples. Each practice may be considered "poor technology" if understood outside the context in which they function. The fact that these practices occur independently in widespread world areas in response to similar conditions suggests that they are rational. To understand them as adaptive, however, does not mean they cannot be improved upon. Introduced varieties or practices must at least be equally adaptive.

4. The potato technology which historically changes and spreads most rapidly among farmers are varieties. Interest in and knowledge of varieties shown by farmers were among the most striking findings of the study. We view this as a positive fact and probably the area where the greatest improvement in the system can be made. New germplasm can complement existing, proven local varieties while the latter might profitably be upgraded through cleaning or breeding.

APPENDIX 1

## Description of Some Varieties in Eastern Nepal

The following names of varieties were collected in Morang and Ilam Districts during the 1982 fieldwork. It is uncertain how many are duplicates or the correct phonetic representation. No doubt, many of these varieties are the same as those discussed in great deal by Pushkarnath (1964) in his Potato in India. Pushkarnath gathered 40 synonyms of the variety Phulwa and 49 names of Darjeeling red round. The list presented here is intended as a first approximation until more detailed and systematic information can be collected.

1. Lalgulab. Terai grown variety from India. Round red, highly valued for consumption and bring 5 rupees more for 40 kg. than other varieties. It has uniform size and good "keeping quality." Merchants say it does not deteriorate as rapidly as others. Skin is thick and scaly. Pinker in color than kufri sinduri. Good for curry dishes.

2. C140. Probably same variety as kufri sinduri and C40. Grown in Terai.

3. 3697. Also called Military because of its robust appearance. Terai potato. Big, white tuber similar to kufri jyoti.

4. Chisapani. Perhaps same as Katari and Mahdi. These potatoes come to Chisapani market from Okladhunga. It is best known in the Janakphur area, but its fame reaches to Morang District. Famous because does not need irrigation, has best taste, and storage. At seeding time, chisapani seed fetches double price of other varieties.

5. Letang White. Letang is a foothill market community in Morang District where seed for Terai planting is obtained. We were unable to determine hill name for this variety, but it may be seto jhyalle. Also, referred to as "rainy season potato." Brownish color.

6. Fuluwa. Maybe 1645 or Darjeeling White. It is not known if this is the famous Indian variety known as Phulwa.

7. Ilam Blue. This could be a color variant of Ilam Red. A hill variety also grown in the Terai. In Terai, it is sometimes called Nilo alu (blue potato) because of blue color.

8. Jalandhari. Shape and color is similar to letang white. In month of Baisakh (mid-April to mid-May), this variety comes to Nepal from Uttar Pradesh and Punjab.

9. Mahdi. A red variety used for seed in the Nepal Terai and India. It has a distinct red cortex ring when cut. Mahdi may be name of a low hills collection place.

10. Kufri Jyoti. Sometimes called Bikashko seto alu (improved white development potato). Farmers complain of taste and that it requires too much cooking time. Kufri jyoti was also introduced into the hills by Indian assistance program seven years ago. Its late blight tolerance rapidly broke down but is still grown in isolated pockets.

11. Holland. (Helen, Helenge). Rumor is that Bhutan gets seed from Japan which buys from Holland and is ultimately sold through Biratnagar by Indians. Local red is not same as Helenge. Arrives in Terai market in month of Bhadau. Appeared in hills 9 years ago after introduced from Jaubari farm Indian project. Stolon spreads. Oily variety. Produces a white flower.

12. Ilam Red. (Same as Darjeeling Round Red). This variety is grown extensively in the hills as seed for the lowlands. It is an excellent yielder in the Terai also called rato alu and rato kaleje Ilam Red is exchanged for cereals. Produces a blue flower.

13. K22. (Kufri Dewa). No information.

14. Suthini (Nanital). A local red that comes from Dhankuta area to Dharan market during Pus, Magh, Phagun (mid-December to mid-March).

15. Kufri Chandramukhi. "Improved" potato from India.

16. Pusre. Variety known for hill collection center 2 km from Dharan.

17. Sarkhari (white). No information. Maybe same as pharsi seto.

18. Nilo Kaleje. Same or similar to Ilam blue, kaleje, chakyre, maybe other names.

19. Dalle. Hill variety. Also known as Bombay, Bombai, and seto ambunge alu. Appeared 60-80 years ago. Round, white, big. Replaced by jhyalle. Rai in Rakse says disappeared 10 years ago. Given up earlier in other areas. Multiplication rate was 1-5. Had white blossom. Attack by red ant and worms. If rainfall heavy had poor yield due to sangle (late blight), but finally disappeared because of ainjeru (wart). Farmers tried to rotate to save from wart, but failed.

20. Jhyalle (probably Magnum Bonum). One of the most popular varieties still grown in the hill area. There are two types: Kamare (stolon spreads) and lamche (stolon does not spread). They were brought from Taplejung District in Nepali year 2007 (1951). Jhyalle is considered to have the best taste of all varieties and is said to be highly nutritious. Yields well in heavy rainfall and poor soil.

21. Chakyre or Chhakre. Possibly the same as Ilam blue or Kaleje. Color ranges from blue to black. Tubers are medium size and round.

22. Pharse or Farse. (Hill varieties). Two kinds, red and white. (a) Red: a hill grown variety. We encountered name first in Jasberi. Red pharse came from India (Phara in Nepali means where a new settlement

was established). Seto pharse also came from there. Rato pharse may be same as Holange. Taste is poor. Not resistant to most diseases. Storage latter than Jhyalle and Kaleje. Round. Price was average. Around Rakse disappeared 8-9 years ago. Big; lengthy size. Needs new land, farmer in Rakse gave up because says "it needs new land." Only one year and yield drops. (b) White: appeared 35 years ago. Big, round (2 tubers = 1 kg). It needs virgin land to produce well. White flowers and yield berries. Quick maturing. Grown in lower valley area. Brought from Darjeeling to Gorka (Ilam) by military man in the Nepali year 1199; 3 horses loaded. Stolon does not spread; shallow eyes. Average taste, good storage, good yield on new land (possibly brown rot, soft rot, or wart). Appeared before Holland. One to 10 multiplication rate. One plant = 5/6 potatoes = 1 kg Sarkari is perhaps another name for pharsgei seto. Says white Pharse came from Skikkum, 30 years ago. 1952. In Nepali Pharas means a place just cleaned in jungle and planted first time in a crop. Possibly pharse potatoes were first imported from Darjeeling hills to Ilam and planted in new land (Pharas) after burning the jungle.

23. Kofri Nabin (Kufri Naveen). Difficult to separate K. nabin from K. jyoti, only by looking at plant. Nabin is taller than jyoti. Multiplication rate is higher than jyoti but K. nabin cannot be planted with maize since foliage over shadows maize plant. Has to be planted deeper than other varieties. It does not yield well in besi. Considered to have a better taste than jyoti.

24. Syandorje (Sundurje). Potato was carried from Tibet to Pharas by guide of a British trekker in Nepali year 2007 (1951). Characterized by deep eyes and yellowish color.

25. Dhwashe (seto). One plant generally yields 10 tubers. Brought in by military men.

26. Puwale. (lal; local red); perhaps also called kanchi.

27. Belayti (seto). After Bombay variety came belayti seto. It disappeared due to wart. Oblong variety.

28. Chuche seto. Maybe same as Bombay. Disappeared after Nepali years 1984-85. Stolon spreads and did not yield well.

29. Bara seasone (seto). Appeared 6 years ago. White. Large stolon does not spread. Yellow fleshed. Still tolerant to local diseases.

30. Chokane (seto alu). Long stolon variety. Farmers claim one plant can yield 40 potatoes. Round shape, deep eyes. No flowering. Appeared 6 years ago. Came from Jamuna. Rejected 2 years ago because stolons disturbed with maize weeding. Had poor yield and could not be mixed cropped.

31. Kusume seto. Destroyed by wart after 2,000 (1944 A.D). A large plant whose stolons spread. Did not yield well except in Katchad zone.

32. Pothre seto. Destroyed by wart after 2,000 (1944 A.D.).

33. Chille seto. Destroyed by wart after 2,000 (1944 A.D.).

34. Kalankhe. Round potato with black eyes. Medium size with red flower. It was replaced by Nile rato about 50 years ago due to attack of Sangle (late blight). Not so tasty. Large plant, small tubers. Now rarely planted.

35. Kanchi alu. Maybe same as Puwale. Deep red color. Stolon spreads. Medium size. See text of this paper for theories on name kanchi for this variety.

36. Boksi. Now it is called Kalo. Still widely planted in higher zones (Dhopper). In Mechi area it is planted in katchar and does well in sandy soil. Wart susceptible. Small size, round, and blue color.

APPENDIX 2

List of Eastern Hill Region Varieties by
Erwin Konig, SATA Agronomist

Location: Jasbire, Rakse, Sukhepokhari, i.e. Ilam District

Altitude: 1'500 m. to 2'500 m.

Name of the old local varieties (*) or of the improved localized varieties (**)

| | | Color | Tubers | |
|---|---|---|---|---|
| 1. | Kufri Naveen** | white | B, R - O, | similar to Kufri Jyoti |
| 2. | Syandorje** | white | B, R - O | |
| 3. | Farse red** | red | M, R - O, | hardly available |
| 4. | Farse** | white | M, R - O | |
| 5. | Jhyalle* | white | S, L - O | |
| 6. | Bara sesone** | white | B, L - O | |
| 7. | Local red* | red | S, R | |
| 8. | Ilam Blue or Chhakre, kaleje | blue to black | M, R | |
| 9. | Olongue** | red | B, R - O | |
| 10. | Olongue blue** | blue | B, R - O | |
| 11. | Olongue white** | white | B, R - O | |

B = big M = medium S = small
R = round O = oval L = long

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