Chapter Six
Agro-Enterprise Oriented Technologies

Introduction

Mountain farming has been stagnant for a long time, with the economy of farming societies revolving around grain and livestock production for subsistence level domestic needs. Any surplus is exchanged for other living necessities. Fewer choices for income generation and inaccessibility to markets have further hindered poverty alleviation in the mountain ecosystem. Various sociocultural restrictions also discourage the development of agro-based cottage industries.Consequently, an effective and viable integration of various farm operations having a commercial perspective could not occur.

Advances in communication, transport, and technology in the modern era enable mountain farmers to exploit the situation in their favour while using native farm resources. Shifts in traditional farming systems are in progress, however, this change is only visible in urbanised niches. Changes in remote areas are taking place more gradually and are less discernible. Successful models of agricultural transportation in the mountains, and the subsequently improved economy and quality of life of traditional farming communities (such as the fruit and vegetable growers in HP, India), are now being acknowledged by others. There are other similarly successful models of cash crop transformation within a very short period of time in the HKH regions of China and Pakistan.

Mountain communities are now very close to accepting the verdict that cultivating cereals for subsistence farming is no longer economically feasible on small and marginal land holdings (Partap 1996). However, it would be rather difficult for them to give up the traditional approach altogether. It will remain a significant part of the transformed system for some time. Because of many socioeconomic reasons, there will be a compromise between the two approaches. Taking all their needs into account, farmers are inclined to opt for technologies that are agroenterprise-oriented. The technologies that would become popular most quickly are those which incorporate the traditional regenerative and resource recycling agricultural practices of mountain farmers (Partap 1996). This chapter describes some successful agro-enterprise oriented technologies which have the potential for significant income generation, simply through by intelligent processing and marketing.

Dry Fruit Processing

Significance

Fruit production continues to be a principal farm activity in the HKH region. Historically, the area lacked good marketing

Plate 42: **Common Dry Fruits of Dry, Cold Mountains**

Dry fruit processing lacks quality control and good standards of hygiene. Market presentation is poor. If farmers are trained in these aspects, they can significantly improve the product's market value and acceptance.

channels as well as modern cold storage facilities. Human population densities used to be very low and consequently, local consumption was also low. All these factors caused wastage of surplus orchard produce. The wastage of fruit crops possessing a shorter shelf life was significantly higher. Local farmers initially preserved the surplus by drying rapidly perishable fruits in order to store them for longer periods, mainly for domestic consumption. It was this practice that eventually turned into a potential source of farm income. Nowadays, dry fruit processing is becoming a popular activity for the mountain farmer. In most of the large towns and cities, there are special dry fruit markets that attract tourists. With improvements in transportation, communication, and road infrastructure, dry fruits are now transported to other regions where they fetch a good price.

Components

Grapes, apricots, figs, pomegranates, and dates are common sun-dried fruits. To begin with, the local farmer estimates his surplus harvest. He selects a dry, clean, and open site exposed to maximum sunlight during the day. The roof of the house is a favourite place. Apricot and pomegranate seeds are layered on the ground and left there until completely dry. Generally, this takes 40 to 60 days, depending upon weather conditions and the number of sunny days. Finally, the dried fruit is collected and packed for marketing and domestic consumption.

Technology is allowing apricots to be produced commercially in the Ladakh area. A subsidy package that contains superior planting stock of promising varieties and other inputs, such as drying trays, a poly solar drier, ultraviolet film, and a waterproof nylon sheet, are being offered to farmers by the government to help improve quality and gain a better market price.

Grapes are dried in two ways to make raisins.

- Bunches on the vines are tightly covered with cloths to protect them from air and sun. They are harvested after they become dry. The quality of this type of raisins is believed to be good and farmers generally produce these raisins for home consumption.

- For commercial raisin production, bunches of grapes are dipped once into boiling hot water and are later dried in the sun, similar to the way apricots are dried.

Harvested green walnuts are sun dried for a couple of days to start the green shells' peeling process. The walnuts are later stored in wooden boxes with a bedding of wheat or barley straw for 10 to 15 days. Afterwards, the green shell peels off easily and the walnuts are ready for marketing.

Figs are dried in a different way. A fresh fig is pressed flat using an indigenous instrument. It is important to select fruit at a specific stage of maturity to prevent its rupturing while pressing. The individually pressed figs are threaded on to a palm leaf string. The fig 'necklace' is usually half a metre to one metre long and may weigh approximately two kilogrammes. The necklaces are hung in an open yard for drying and are stored or marketed in this shape.

Chilghoza

Significance

Chilghoza is an edible nut collected annually from the Nut Pine (*P. Gerardiana*) which grows at high altitudes (2,500m above sea level) in Afghanistan, Zhob (Pakistan), and Kinnaur, India. These nuts are used as dry fruit, particularly during the winter. *Chilghoza* nuts are sold widely in the dry fruit markets in both the mountains and the plains. It is the most expensive among all dry fruits. Local farmers make a considerable profit from selling *chilghoza* nuts.

Chilghoza production is restricted to very high altitudes where the Nut Pine grows

Plate 43: ***Chilghoza Cones Being Sun Dried at High Altitudes in Zhob, Pakistan***

naturally. Its demand in neighbouring regions has encouraged local dwellers to sell the nuts to supplement their income.

Components

Chilghoza nuts are obtained from the naturally growing Nut Pine. Small, oval cones are harvested from the trees. These cones are spread on the ground to dry in the sunshine for a few days. The cones crack naturally during drying, or are cut into four pieces with an axe. Sticks are used to separate *chilghoza* nuts from the dried up fruit cones. On average, 25 to 30 cones yield one kg of *chilghoza* nuts. The *chilghoza* are packed in gunny bags and are marketed roasted or unroasted.

In Ladakh, the community manages the cone harvest. Harvesting dates are fixed, with each family sending two of its members to do the work. One person harvests the cones by lopping branches, while the other collects the cones that fall to the ground. The day's total harvest is divided equally amongst all the farm families.

Domestic Wine

Significance

Domestic wine production is a general feature of each household in Kinnaur, India. During the extremely cold winter, consumption of domestic wine is extensive over the entire expanse of this cold desert region. The quality of domestic wine extracted from grapes is comparable with any imported liquor. The government discourages its large-scale production by issuing special permits to each family for keeping a maximum of 24 bottles in their possession at any one time. There is great scope for developing a cottage industry to produce wine on a commercial scale, taking into account the regulations of the region. The government may encourage domestic wine production by involving any licensed liquor company to purchase any surplus product.

Components

Domestic wine is prepared mainly from grapes; however, wild apricots, pears, apples, wild almonds, etc are also used. Millet serves as the main source of alcohol. Fruits such as apples and pears are cut into pieces before fermenting. Apricots are sun dried on the roof after removing the kernel. The fruit is then put into wooden drums for fermentation. Molasses or *gour* (a brown sweetener derived from sugarcane) are added to the fruit. The drums are tightly covered with a wooden or stone lid until the fermentation process is over. Indigenous wisdom is used for assessing a good ferment. The judgement for determining a complete fermentation is made after removing the lid and is usually based on the following guidelines:

- when larva in the pulp are not alive,
- by the quantity of vapour on the inner side of the lid, and
- when a flame quickly extinguishes above the pulp while inside the drum.

Farmers have standardised the local distillation process. The pulp is put in a metallic pitcher, which is covered with a stone slate with a hole in the centre. This slate is used to avoid any overflow of material during boiling. A metallic pan is kept on the slate, which has also a hole of the same size. The pan has a side pipe through which the condensed alcohol comes out.

This utensil is covered with a larger metallic pan which is cooled during extraction. Two pipes, one inlet and one outlet, open into this pan through which cold water falls on the pan and warm water goes out. This topmost pan is kept on a slight slant. The inlet of water is on the upper side and the outlet is on the lower side. This cools the bottom of the utensil and condenses the alcohol vapours touching its lower surface. The condensed material runs out through the side pipe of the lower utensil from where it is collected in a pot. A rubber pipe is also attached to the metallic side pipe to keep some distance between the collection pot and the distillation plant. Approximately 12 to 13 bottles of alcohol are collected from 40kg of fruit. However, when it is mixed with *gour* (molasses, 5 to 6kg) the yield is 18 to 19 bottles. Fuelwood is used for heating. All joints are made using barley, *faphra*, or wheat paste.

Chewing Tobacco

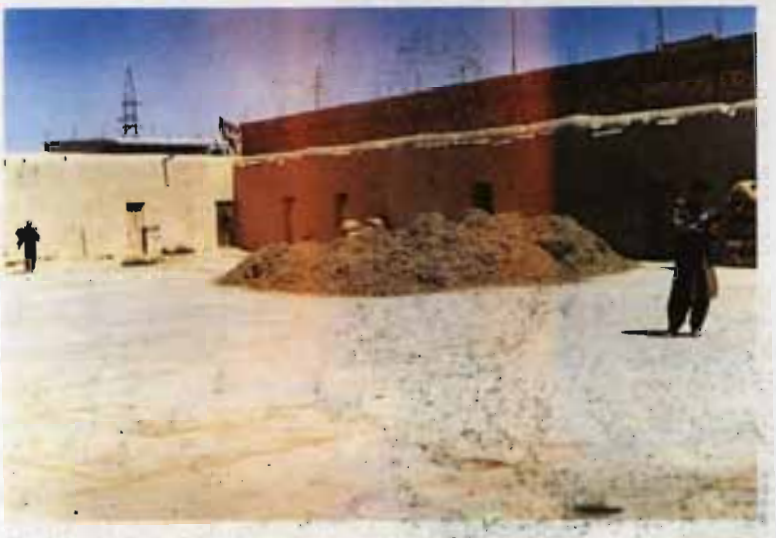
Significance

Chewing tobacco, called *naswar*, is used extensively throughout both Afghanistan and Pakistan. Historically, mankind used tobacco as a drug and it is being raised in fields as a special crop. A large number of small *naswar* producing units are operating locally in both countries, these units purchase raw tobacco from local farmers. Tobacco has emerged as a high-value crop for these farmers.

Components

Naswar is manufactured after tobacco passes through a series of processes. Cut tobacco leaves are sun dried in the field, and are sold to a local manufacturer. Before any processing, the leaves are cleaned and again dried within the factory. The dry

Plate 44: ***A Local Naswar Producing Unit in Balochistan, Pakistan***



The introduction of small, modern, cooperative based tobacco processing units will improve the quality of the tobacco and will reduce processing losses. It will create better marketing opportunities and a healthy competition amongst producers. Multinational cigarette companies may be attracted to the area in order to grow high-yield, high-value tobacco varieties as they are doing in the North West Frontier Province (NWFP) of Pakistan.

leaves are converted into powder by grinding machines. This powder is supplemented by some other premixes of different ingredients. The premixes differ according to the nature of the demand in the various regions of a country. Dry supplemented powder, *naswar*, is marketed in packets of varying sizes.

Gour

Significance

Gour is the traditional brown sweetener found throughout rural areas. During the past couple of decades, the sugar mill industry has been expanding tremendously, and *gour* is gradually being replaced by sugar. However, *gour* will remain the favourite sweetener of rural communities, particularly in the mountains. Its production will continue to be a vigorous activity at the farm level wherever sugarcane grows. Farmers prepare *gour* for domestic use and they earn cash by selling the surplus. Compared to sugar, *gour* is relatively crude in form: however, its handling losses during transportation, marketing, domestic use, etc are very low. Influenced by the irrigated plains, farmers in mountainous Balochistan and Rod Kohi, Pakistan, grow sugarcane, and *gour* is produced at the farm level in the absence of any sugar mill. Nowadays it fetches a better price than sugar in the market. A special kind of *gour*, in which different kinds of nuts are added for winter use, is sold at relatively higher prices as a speciality of the mountains.

Components

An animal operated machine crushes the sugarcane. The juice of the crushed sugarcane is collected from the crushing unit and is transferred to a huge boiling pan. It continues to boil until it reaches a specific point of condensation. The highly concentrated juice is then transferred to

Plate 45: ***Gour Production at the Farm Level***

Gour, being a product free of chemicals, remains a favourite natural sweetener. The process for making gour is labourious, unhygienic and consumes considerable fuel for boiling the raw juice. Modified modern boiler units such as those used in candy factories may be introduced to save wood. The training of farmers in hygienic processing and market presentation is required.

a tray where it is allowed to cool and crystallise. Later, it is converted into small, irregular, oval-shaped pieces of varying size (100 to 200g). After sun drying, it is stored under normal conditions. *Gour* has a long shelf life. It is used for making all kinds of sweets and dishes. It is also used raw.

High-Value Cash Crops

Significance

Unconventional high-value cash crops are now playing an essential role in improving the economy of localised niches. The Lahaul Valley, India, has earned special distinction in this regard. Parallel to modern cash crops, such as seed potatoes and peas, the Government of India has successfully exploited the commercial potential of indigenously growing plant species by introducing their cultivation through R & D packages.

Components

These high-value cash crops include *kuth*, hop, *saffron*, *kalazeera*, etc. *Kuth* has been growing in the Lahaul Valley for the last four to five decades. It is a two-year crop: its roots are exported and fetch a good price. The process of transforming Lahaul's poor economy into a market economy was in fact initiated by *kuth*. *Kuth* farming is regarded as a modern day example of how farmers can take the initiative to domesticate and cultivate the wild gene pool. The farmers' work led to the formation of a cooperative for marketing *kuth* and has earned large dividends besides export-based production.

Hop cultivation is another successful model. It has been introduced all over H.P., India. It has already been introduced for cultivation in the Ladakh area, since the climatic conditions of cold mountainous deserts are very suitable for the cultivation of hops. However, the Lahaul Valley has adopted it as a new agro-enterprise in a spectacular way. As a crop, hops has shown great promise and farmers are reaping large dividends. Two hops processing units have been established for a guaranteed remuneration to the hops' producers. Government patronage has helped in making it a highly profitable agro-enterprise. Four processing units have been installed for drying green matter prior to its marketing. Now, different varieties of hops have been released to promote its cultivation.

Saffron cultivation is currently being tested as a commercial crop in Kinnaur. Saffron flowers produced in the cold, dry mountain climate are considered superior in quality to those produced in humid and sub-humid areas.

Technology for the domestication and commercial production of *kalazeera* has been developed in Kinnaur and Ladakh.

Non-fat Dry Cheese

Significance

Non-fat dry cheese is produced all over the HKH region. The product is fat free and is a highly nutritious, daily food supplement. It can be stored under ordinary conditions for long periods and nowadays is being commercially marketed. In Afghanistan and Pakistan, it is called *khurad*. A pastoral family in mountainous tracts with large flocks of sheep and goats or large herds of cattle cannot consume all the milk produced by lactating females every day, and there is no opportunity for marketing it. The surplus milk is eventually fermented and churned for making butter. The non-

Plate 46: **Dry Cheese, a Popular Product of Livestock Households**

Dry cheese, with its distinctive taste, is a primitive technology used by almost all types of livestock households. Although dry cheese is a highly nutritious food supplement, the cheese-making process lacks hygiene. Its commercial marketing through the introduction of new food technology techniques (including different flavours, colours, quality packing, etc) and by modern advertising campaigns could generate substantial income for livestock producers.

fat solids of residual milk, called *lassi*, are separated from the water and are dried as small balls for domestic use. The dried milk balls are used for making *curry* and are diluted to make *lassi* a pure, natural drink.

Components

The daily surplus milk is usually fermented into curd overnight. The next day, the curd is shaken vigorously in a soft leather pouch made of goat skin until the butter is separated from the *lassi*. The pouch can accommodate 15 to 20 litres of curd. In some areas, a ceramic pitcher is used and curd is manually churned in a wooden structure on the ground called a *madhani*.

The *lassi* is sieved through a clean muslin cloth by hanging it up for two to five days. The non-fat milk solids are collected from the muslin cloth after the water is completely drained through. These solids are finally converted into small balls of cheese (each ball weighs roughly 50g), which are sun dried. The dry cheese is ready for domestic consumption as well as for the outside market.

Winter Lamb Mutton

Significance

Winter is severe in the highlands. The temperature is below freezing and is coupled with chilling winds. Local inhabitants in remote communities are confined within their homes for about two to four months. Climatic restrictions rarely allow any food supplies from outside. Farmers prepare themselves for this imposed hibernation well ahead of time by storing sufficient quanti-

Plate 47: ***Landhai is Traditionally Prepared from Lamb Mutton***

Landhai mutton is traditionally preserved for domestic needs. It has considerable potential to emerge as high income-generating technology for sheep producers. It is simply a matter of motivating them to produce and market landhai mutton as a speciality winter lamb mutton along commercial lines. They may be trained to shift from the selling of live animals for cash to producing landhai from the surplus flock. By marketing landhai mutton, they will fetch higher returns compared to the prevailing practice. The markets of the plains may also be explored through proper advertisement and presentation.

ties of grain and preserving mutton for their daily consumption while their flocks migrate down to the warmer plains. Winter lamb mutton, called *landhai*, is locally preserved sheep meat which, under normal conditions, can be stored safely during the long winter.

Components

Landhai is made only from sheep meat. Fat and healthy animals are chosen for slaughtering. Wool is plucked from the carcass manually by the frequent application of boiling hot water and the skin remains a part of the carcass. The abdominal cavity is opened with an incision. After removing the stomach and other visceral organs, it is re-stitched. A long, sharp iron rod is passed through the abdominal cavity parallel to the vertebral column. The carcass is rolled on a hot fire for a few minutes to burn away the remaining wool fibres, if any. This is followed by cleaning the carcass with a dilute solution of caustic soda. All the bones are separated from flesh in a skilled manner. The flesh is treated with the desired quantities of salt and the meat is hung in an open and well-ventilated room for 40 to 50 days. Once it is air dried, it is cut into small pieces and stored for use during the winter for making many routine food dishes.

Post-harvest Apple Storage

Significance

This technology originates in mountainous Balochistan, Pakistan, where about 81 per cent of the total apple crop is produced. Cold storage facilities exist in the big cities of other parts of the country, so

Plate 48: **Post-harvest Apples Stored in a Farmer's Field**

Post-harvest apple storage at field level helps farmers to market their produce with a good margin of profit by using better market intelligence. Additionally, it allows them to harvest the apple crop earlier and to cultivate orchards for other crops

in the absence of any proper storage facility, local farmers invented a conventional apple storage method to check post-harvest losses. It enables them to store the apple produce for 30-60 days. Meanwhile, a farmer observes market fluctuations and he is not compelled to sell his farm produce readily to middle-men. When apples are destined for domestic consumption, this technology also improves the apples' shelf life. It is believed that this storage improves the ripening of the apples during the post-harvest period and gives a good colour to the fruit.

Components

The technology is very simple and cheap. Rice straw and used newspapers are key components. Rice straw is transported from the irrigated plains at very cheap rates.

A safe and levelled corner of the field or house is selected for this storage. The ground is covered with a thick layer of rice straw, which is covered by newspapers. Apples are heaped on it. The total covered ground area and the height of the heap will vary according to the quantity of apples to be stored. Apples are covered with newspapers and, finally, a thick layer of rice straw is applied on top. These will stay there until the apples are packed in crates for the final marketing process.

Post-harvest Grain Storage

Significance

The resource-poor farmer cannot construct proper storage facilities for farm produce, particularly for grains. The farmer needs to store his grains somewhere for long periods to find better market prices as well as during domestic use. This storage technology is used successfully for storing grains under the open sky for long periods and with negligible storage losses. The materials used in storage are called

Plate 49: ***Wheat Grain Stored in Chitai Sacks under the Open Sky***

Palm chitai(s) are multipurpose and are also being used for packing various farm produce for marketing, for example, dates are also marketed in chitai sacks. Chitai packing can successfully replace wooden crates for apples and marketing of other fruit. It could save thousands of trees from being cut down for this purpose.

chitai and are cheap and easily available in the region. Sometimes, the farmer's family will make *chitai* on its own by using palm leaves naturally growing in the area. *Chitai* grain storage is very popular in certain areas of Pakistan, mainly due to its low cost and very low storage losses.

Components

An elevated platform two feet above the ground is constructed under the open sky. It is usually close to residential areas. The platform is erected by placing long, flat pieces of wood on mud pillars that are set at desired distances. The length of this platform may vary according to the number of *chitai* storage sacks to be placed on it. Its width is roughly two metres, however, this may vary with the size of the *chitai* sacks.

Grains are stored in *chitai* sacks. A sack is made by a *chitai* measuring 4 x 1.25m, although its dimensions may vary. The required number of empty sacks is placed on a platform in a row, and they are filled with grains. The opening of each filled sack is closed with another piece of *chitai* and finally the top of the sack is plastered with mud.

Corrugated Fibreboard Cartons

Significance

As farm productivity grows, marketing becomes a very important aspect in order to take farm produce to the non-agricultural sector. Most of the fruits are traditionally marketed in wooden boxes. These boxes are not properly standardised for one or different commodities. With the current timber crisis, high costs, and ecological as well as environmental concerns, a corrugated fibreboard (CFB) carton has been developed to replace wooden cartons. The CFB cartons consume less wood and are comparable in performance. These cartons with paper pulp trays have long

been used for packing and transport of fruits and vegetables in many developed countries (Anand and Grover 1993).

Components

A CFB carton consumes only 30 to 40 per cent of wood used for a wooden box of the same capacity. These cartons can also be made from other agro-wastes such as biomass, bamboo, bagasse, wheat, and rice straw. The corrugated texture helps to minimise the bruising of fruit. The weight of such a carton is only one-fifth of a similar wooden box. The cartons are also punched and ventilated. They can be fabricated and turned out quickly in highly precise and accurate sizes and are recyclable into pulp, unlike wooden boxes which are invariably used as fuel. The CFB cartons used in apple packaging have an inner dimension of 50.8 x 30.8 x 28cm. They are assembled by fitting two standard telescopic pieces of five-ply into each other, thus giving a 10-ply thickness on the sides and a five-ply thickness on the top and bottom of the carton. The fruit is packed in paper pulp-moulded trays with the appropriate sized cavities and the trays are stacked one above the other, carrying 120 pieces of fruit altogether. Each tray is arranged in the opposite direction to the one beneath in order to distribute the weight evenly on the projections of the tray cavities. Details of CFB cartons used for apples, plums, apricots, and almond packaging are given in Table 23. (Anand and Grover 1993).

Table 23: Details of the CFB Carton Used for Apple, Plum, Apricot, and Almond Packaging

Type	Size (cm)	Approx. capacity (kg)
Telescopic CFB carton with 6 trays for apples	50.8 x 30.8 x 28.0	20
Universal CFB carton	45.0 x 30.0 x 27.5	18
Universal *Kullu Dabba*	48.7 x 20.5 x 22.5	10
Universal CFB carton for plums, apricots, and almonds	37.0 x 18.0 x 15.0	5-6