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Economic aspects of the improvement and marketing of an orphan crop: Ricebean in India and Nepal

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LIST OF ABBREVIATIONS

APMC	Agricultural Produce Marketing Committee
AOAC	Association of Official Analytical Chemists
BI	Berry-Index
Ca	Calcium
CPI	Consumer Preference Index
EC	European Commission
EI	Entropy-Index
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
Fe	Iron
GDP	Gross Domestic Product
H	Shannon-Index
HI	Herfindahl-Index
INR	Indian Rupees
MSP	Minimum Support Price
NAFED	National Agricultural Cooperative Marketing Federation of India Ltd
NPR	Nepalese Rupees
P	Phosphorus
SCM	Supply Chain Management
VIF	Variance-Inflation-Factor

1 Introduction

1.1 Research problem

Many of the rural poor in developing countries such as India and Nepal rely on a diverse range of little-known crops for food security and nutrition. These are often neglected by scientists and are hence referred to as 'orphan crops'. Commonly described as underutilized or neglected plant species, orphan crops can be identified by the following characteristics:

a) they are locally abundant in developing countries, however they are globally rare;

b) there is scant scientific information and knowledge about them, and

c) their use is limited relative to their economic potential (GRUERE ET AL. 2006).

Although orphan crops are important to rural livelihoods on a local level, particularly in poor areas, they have been largely overlooked by the research community. The majority of orphan crops are locally maintained because they are well adapted to the low-input conditions typical of marginal areas.

1.2 Objectives

The overall purpose of this study is to analyse the potential role of one particular orphan crop in improving food security and livelihoods in India and Nepal. Ricebean (*Vigna umbellata*), in particular was the focus of a EC funded multi-partner research project that aimed to popularise and promote its adoption in order to improve food security in marginal areas and to make it much more widely grown than it is now by providing improved varieties that match farmers' and consumers' needs.

If breeders aspire to develop an improved ricebean variety it should meet farmers’ and consumers’ preferences. Farmers should not only be able to reap the benefits of an improved ricebean variety with higher yields and good pest resistance, but also be able to exploit the yield gain, and improve their financial status above mere subsistence levels by selling the crop to generate income. Ricebean will most probably be accepted by consumers if it meets their requirements, regardless of the farmers' agronomic constraints. Hence, it is essential to identify consumers’ preferences. In the end, there must be a compromise between breeding in order to secure better yields, other agronomic objectives, and the preferences of consumers.

As an improved ricebean variety would not automatically diffuse in Indian and Nepalese markets, a marketing strategy is required for its successful introduction. A precondition to designing a marketing strategy is the analysis of the agricultural marketing systems by which ricebean would be moved from producers to consumers. This implies that agents at each stage, transaction practices, and conditions of the marketing systems have to be identified. The analysis and description of the agricultural marketing systems may reveal where along the chain product value is lost and where savings are possible in transport, storage, handling, and transaction costs.

1.3 Research approaches

Consumer preferences are determined by using hedonic price analysis which explains price variation of products with their characteristics. For this purpose ricebean samples were bought in markets in India and Nepal. These samples were analysed in laboratories to assess characteristics. The hedonic price analysis permits us to put a money value on important traits that reflects consumers' preferences for that trait. The valued traits can be used to develop an index which we call the Consumer Preference Index (CPI). The CPI allows plant breeders to put a monetary value on the traits they incorporate into new varieties. With this index, breeders can assess the expected price of an improved ricebean variety at an early stage in plant breeding since quantities of just 100 to 200 grams of ricebean are sufficient to calculate the CPI.

The introduction of the improved ricebean variety is based on a marketing strategy which requires a detailed analysis of the marketing systems in India and Nepal. The agricultural marketing systems in India and in Nepal are known to be fragmented, complex and even chaotic (WORLD BANK 2008). This complexity cannot be covered adequately by one single theoretical perspective. Therefore, four perspectives were selected to get a more complete picture and to accommodate the complexity of the pulse marketing systems in the two countries. In particular, this study employs the perspectives of:

(i) market places;

(ii) market channels;

(iii) supply chains and networks, and

(iv) generalized markets.

The perspectives are not perfectly separated from each other. Therefore, the key concepts of the different perspectives were consolidated into a 'toolbox', which represents a comprehensive perspective to analyse and describe the marketing systems for pulses in India and Nepal. Data and information about the marketing systems were obtained from literature reviews, data bases, and surveys that were conducted for this study.

1.4 Outline

This study is organized into six sections. Following this introduction, ricebean as an orphan crop is introduced, in terms of its agronomic characteristics and requirements, its origin, its distribution and its diversity. Further, the nutritional importance of pulses in general is highlighted and the composition of ricebean is explained.

In Section Three, the method for estimating values for ricebean traits, hedonic price analysis, is presented. The first sub-section provides a literature review, followed by the presentation of the hedonic model. Details of the model and the variables included in the hedonic equation for ricebean are explained. In this section we also provide details of the data collection. The last sub-section presents the estimated coefficients and evaluates ricebean varieties from India by applying the CPI.

Section Four includes an analysis of markets and marketing options for ricebean. Ricebean is grown in remote areas where semi-subsistence consumption prevails. Therefore, the marketing section starts with a model of subsistence households. Subsequently, the four perspectives used to analyse and describe the marketing system are presented.

In Section Five, the toolbox of perspectives is employed for the description and analysis of the pulse sectors in India and Nepal of which ricebean markets are a small part. Additionally, results of surveys that were carried out in 2008 and 2009 in India and Nepal are reported.

Section Six summarises the results, presents the conclusions of the study and provides suggestions for further research.

2 Ricebean: An orphan pulse crop

Ricebean (*Vigna umbellata*) is an orphan crop and is known by few, and therefore its description warrants some more detail. The *Vigna* species belong to the sub-genus *Ceratropis* that includes seven cultivated species: *V. radiata* (mung bean, green gram), *V. mungo* (black gram, urd bean), *V. angularis* (adzuki bean), *V. umbellata* (ricebean), *V. aconitifolia* (moth bean, mat bean), *V. tribolata* (pillipesara bean, jungle bean) and *V. glabrescens* (GAUTAM 2007).

Ricebean is a fairly short-lived warm-season annual legume. Environments where it grows are humid tropical to sub-tropical and sub-temperate. Ricebean is mainly grown for dried seeds but also used as fodder, green vegetable and green manure. It is cultivated as an intercrop with maize, sorghum and cowpea in Indo-China, Southern China, India, and Bangladesh. As a sole crop, ricebean is commonly grown on uplands. In the past, ricebean was grown as a lowland crop on residual soil water after the harvest of long-season rice which explains its name. However, at present shorter duration rice varieties have displaced it (RAJERISON 2006). Typical for ricebean is the twining habit, photoperiod sensitivity, indeterminate growth, sporadic and asynchronous flowering, strongly dehiscent pods, and small hard seeds. Further, ricebean grows well on many soils types and has an excellent resistance against bruchids an insect that damages pulses in storage. The average yield of ricebean is only 200 to 300 kg/ ha, but experimental works in India have resulted in yields up to 2,500 kg/ ha (GAUTAM 2007).

The centre of domestication is believed to be northern Thailand and Myanmar. Ricebean is grown in South China, North Vietnam, Laos, Thailand, Myanmar, Bangladesh, Nepal, and India. It is also grown outside of Asia, in Egypt, the eastern coast of Africa and the Indian Ocean islands. The quantity of ricebean that is traded internationally is small. Japan is reported to be the main importer with Thailand, Myanmar and China being the major exporters (RAJERISON 2006).

Traits of cultivated forms of *Vigna umbellata* are presented in Table 1. Ricebean plants can reach a height of about 2 meters, using stacks, maize or sorghum plants as support. It takes about 70 days until ricebean flowers and about 100 days or three months until the seeds can be harvested. The mean yield of one ricebean plant that is harvested from about 50 pods is 8 g.

Table 1: Traits of ricebean.

Trait	Mean	Range
Height (m)	1.9	1.92 – 1.93
Days to flowering	73.5	52 – 123
Days to maturity	95.0	85 – 150
Pods per plant	51.1	38.2 – 136.0
100-seed weight (g)	5.3	4.89 – 6.68
Seed size (mm)	18.7	10.5 – 32.0
Yield per plant (g)	7.8	6.78 – 9.90

Source: Bisht et al. 2005.

2.1 Pulses in human nutrition

The role of ricebean in human nutrition is represented in the context of pulses in general for two reasons. First, nutrition studies about this crop are scarce and their results differ. The second reason is that the description of the chemical composition of pulses in general can be used to compare ricebean to other pulses.

The edible seeds from leguminous plants are *pulses* from the Latin word *puls*, which means pottage, a thick vegetable soup (AYKROYD AND DOUGHTY 1964). The family of *Leguminosae* consist of about 600 genera and 13,000 species. An important characteristic of legumes is the ability of their roots to fix nitrogen from the atmosphere with nodules where bacteria live. The nitrogen fertilizes the soil when the roots rot. Therefore, legumes fertilise soils if used in crop rotation (AYKROYD AND DOUGHTY 1964).

Pulses are good nutritional sources because they provide protein, complex carbohydrates, unsaturated fatty acids and vitamins. They are traditional foodstuffs in many countries like Nepal and India and offer a relatively inexpensive source of protein and energy. The energy is mainly stored as complex carbohydrates such as starch and non-starch polysaccharides and in the form of fat, but the majority of pulses are low (under 2% of dry weight) in fat, except the soybean and groundnuts (MCINTOSH AND TOPPING 2000). In addition to providing important diet compounds, pulses also have beneficial health aspects, for instance, plasma cholesterol-lowering effects (ANDERSON AND GUSTAFSON 1988).

2.1.1 Composition and nutritive value of pulses

The main components of pulses are: protein, carbohydrates, crude fibre, fat, minerals and vitamins. The bio-availability of these components is affected by anti-nutrients present in pulses. Therefore, mechanisms and possible processing methods that influence the concentration of anti-nutrients are described as well.

Protein

Protein quality and quantity varies greatly in legume species. The quality of proteins differs in terms of the albumin/globulin concentration and amino acid composition. A diet that contains a combination of pulses and cereals is advantageous because pulses provide lysine which is low in cereals, whereas cereals are a good source of essential sulphur amino acids which are low in pulses (McIntosh and Topping 2000). The protein content of pulses ranges between 17 to 25% of dry weight, except for soybean which contain about 42% protein. Hence, pulses covered about 8% of the world's protein demand in 2005 (Food and Agriculture Organization 2008).

Carbohydrates

About 60% of the dry weight of pulses are carbohydrates, mainly starch (Aykroyd and Doughty 1964). Carbohydrates, such as starch, non-starch polysaccharides (NSP), oligosaccharides and simple sugars, are the main sources of energy stored in legumes (McIntosh and Topping 2000). The starch in legumes has a relatively high share of amylose (about 24% of starch content) compared to other foods and therefore a relatively small share of amylopectin (about 76% of starch content). This high amylose starch is more resistant to small intestinal amylolysis and is fermented into short-chain fatty acids. Non-starch polysaccharides are a major part of dietary fibre and legumes contain both soluble as well as insoluble forms. Insoluble forms are mainly found in the hull, which is therefore often removed before consumption. Oligosaccharides such as raffinose, verbascose and stachyose are found in legumes, and due to their resistance to small intestinal digestion they may cause symptoms of discomfort after consumption (flatulence). However, oligosaccharides have a function as prebiotics and stimulate certain bacteria (McIntosh and Topping 2000).

Crude fibre

Crude fibre is the part of carbohydrates that remains undigested after treatment with diluted acids and bases and about 2 to 7% of the dry weight of pulses is crude fibre. The main component is cellulose. Crude fibre is not digested in the small intestine as it is fermented in the large intestine. Crude fibre is different from dietary fibre but dietary fibre is also partly included in crude fibre as both contain cellulose. The fibre structure of cellulose in crude fibre causes that it remains in the stomach over a longer time period which induces a continuing feeling of saturation (ASP 1996).

Fat

The majority of legumes have a fat content of 1 to 2% of the dry weight. Only soybean (19% fat of dry weight) and groundnut (40% fat of dry weight) contain notably more fat. The fat in legumes is generally rich in essential fatty acids which are mainly the unsaturated omega-3 and omega-6 fatty acids (AYKROYD AND DOUGHTY 1964).

Minerals

Pulses are a reasonable source of minerals. The calcium content in legumes is high with values of 100 mg per 100 g. Also iron represents an important part in legumes with 7 mg/100g on average. However, the bioavailability of both calcium and iron is reduced by considerable quantities of phytic acid (phytate) which forms insoluble complexes with calcium and iron (AYKROYD AND DOUGHTY 1964). The phytic acid concentration can be reduced by boiling, soaking and germination which are processing techniques (MCINTOSH AND TOPPING 2000).

Vitamins

Pulses are a good source of vitamins of the B group (e.g. thiamine, riboflavin, niacin, folic acid) (MCINTOSH AND TOPPING 2000). Thiamine is a water soluble coenzyme that is needed for catabolism of carbohydrates. Legumes contain on average 0.45 mg per 100 g thiamine. Legumes are a good source of niacin. On average pulses contain 2.0 mg niacin per 100 g. For riboflavin amounts of 0.1 to 0.4 mg per 100 g were found. Pulses were also found to contain a high level of folic acid (AYKROYD AND DOUGHTY 1964). The content of folic acid in pulses was assessed to be about 107.9 mg/g (BANERJEE ET AL. 1954).

If pulses are not dehulled, then the vitamin E (tocopherol) content is equal to that of cereals. Chattopadhyay (1952) reported mean concentrations of 1.9 mg/100 g in traditional pulses (CHATTOPAHYAY AND BANERJEE 1952).

Anti-nutritional factors

Anti-nutritional factors in pulses include phytate, trypsin inhibitors and tannins. Phytate forms insoluble complexes with iron, calcium or magnesium and reduces the absorption of these minerals. Further, phytate is known to cause the "hard-to-cook-phenomenon" when seeds stay hard while cooking because water uptake is prevented. Trypsin inhibitors reduce the availability of trypsin - an essential enzyme for humans. Trypsin is needed to digest proteins and a trypsin deficit can cause malnutrition. Tannins can also form complexes with proteins, carbohydrates and other polymers in food, as well as with certain metal ions such as iron under suitable conditions and appropriate pH. The tannin content is reflected by the cotyledon colour as darker pulses tend to contain more tannin (KAUR AND KAPOOR 1990a).

2.1.2 Composition and nutritive value of ricebean in comparison with other pulses

The last section presented the composition of pulses in general which is extended in this section by detailed information about the nutritional composition of ricebean in comparison to black gram (*Vigna mungo*). Black gram is a close substitute to ricebean from the *vigna* family and it is available in India and Nepal. Table 2 shows the basic components of ricebean. The moisture content is not considered as it depends on drying after harvest. The calculated protein content varies from 17 to 26% of dry weight; still a mean protein content of 20% of dry weight shows that ricebean is a good source of protein. The protein content of black gram is almost equal. The mean fat content (1.3%) of ricebean is relatively low even for pulses. Carbohydrates form the largest share of all components and provide most of the energy. The content of crude fibre corresponds to the average of pulses that lies between 3 to 8% of dry weight with a mean value of 5.2% of dry weight. The black gram's share of crude fibre (7.2%) is slightly higher. The ash content and calories per 100 g are also close to the average values for all pulses (AYKROYD AND DOUGHTY 1964). When compared to black gram ricebean has a higher mean ash content and provides more calories per 100 g to consumers.

Table 2: Main components of ricebean in percentages of dry weight.

Source/ article	Moisture	Protein	Fat	Carbo-hydrates	Crude fibre	Ash	Calories /100g
Akroyed, W.R., 1982	11.0	19.3	0.6	65.4	5.8	4.2	338.0
Duke, J.A., 1981	13.3	20.9	0.9	60.7	4.8	4.2	
Dutta, M., 2000		25.0	0.6		4.8	4.3	
Franke, W., 1989	9.6	21.5	0.3	60.9	4.2	3.5	
http://www.genres.de	10.0	20.4	1.2	61.6	4.5	2.3	390.0
Kaur, D., 1990		17.9					
Kaur, D., 1992	10.4	17.9	0.5		7.1	4.4	
Kaur, M., 2002		26.0	1.8		4.7		
Khan, H., 2000		18.2					327.0
Malhotra, S., 1988	7.6	18.6	3.0	62.4	2.9	4.1	
Rodriguez, M.S., 1990	8.9	18.5	3.8	63.2	6.4	4.3	
Saharan, K., 2002		18.2	0.8			5.0	
Saikia, P., 1999	10.5	17.4	0.5		6.9	4.3	
Mean of sources quoted	**10.2**	**20.0**	**1.3**	**62.4**	**5.2**	**4.1**	**351.7**
Black gram (Duke, J.A., 1981)	**11.7**	**20.2**	**1.7**	**59.4**	**7.2**	**3.6**	**334.0**

Table 3 shows the content of minerals, some vitamins and anti-nutrients. The calcium content of ricebean with a mean value of about 300 mg/100g is considerably higher than in black gram. Also the iron content is high compared to other pulses but lower than the one of black gram. The contents of thiamine, riboflavin and niacin do not differ much between ricebean and black gram and are the same as for other pulses. The amount of ascorbic acid and the anti-nutrient phytic acid is higher in ricebean than in and black gram.

Table 3: Minerals, vitamins and anti-nutritional factors of ricebean in mg/100g.

Source/ article	Ca	Fe	P	Thiamine	Ribo-flavin	Niacin	Ascorbic acid	Phytic acid
Akroyed, W.R., 1982	218.0	7.2		0.6	0.1	2.2		
Duke, J.A., 1981	200.0	10.9	390.0	0.5				
Dutta, M., 2000	450.0	6.0	393.0					
Kaur, D., 1992	306.8	6.7	241.8		0.3		1.4	2033.2
Mohan, V.R., 1994	264.0	6.7	124.0					
Saharan, K., 2002	311.0	6.6	257.0					
Saikia, P., 1999	309.0	6.8	241.0					2046.0
Mean of sources quoted	**294.1**	**7.3**	**274.5**	**0.5**	**0.2**	**2.2**	**1.4**	**2039.6**
Black gram (Duke, J.A., 1981)	**167.0**	**9.3**	**295.0**	**0.5**	**0.3**	**2.3**	**0.9**	**1321.0**

The availability of minerals in ricebean is impacted by the method of food preparation (Table 4). Soaking and sprouting tend to reduce anti-nutritional factors such as phytic acid and tannin, because soaking increases the availability of calcium, iron and phosphorus. The availability is increased because the complexes of anti-nutrients and minerals are solubilised by sprouting and soaking (SAHARAN ET AL. 2001).

Table 4: Effect of soaking and sprouting on mineral availability in ricebean.

Mean values	Ca mg/100g		Fe mg/100g		P mg/100g	
	Total	% available	Total	% available	Total	% available
Raw bean	311.7	59.8	6.6	37.9	257.1	33.4
Soaked 12 hours	303	62.1	6.4	39.3	255	37.7
Sprouted 24 hours	299.2	67.5	6.4	41.5	255.8	38.8

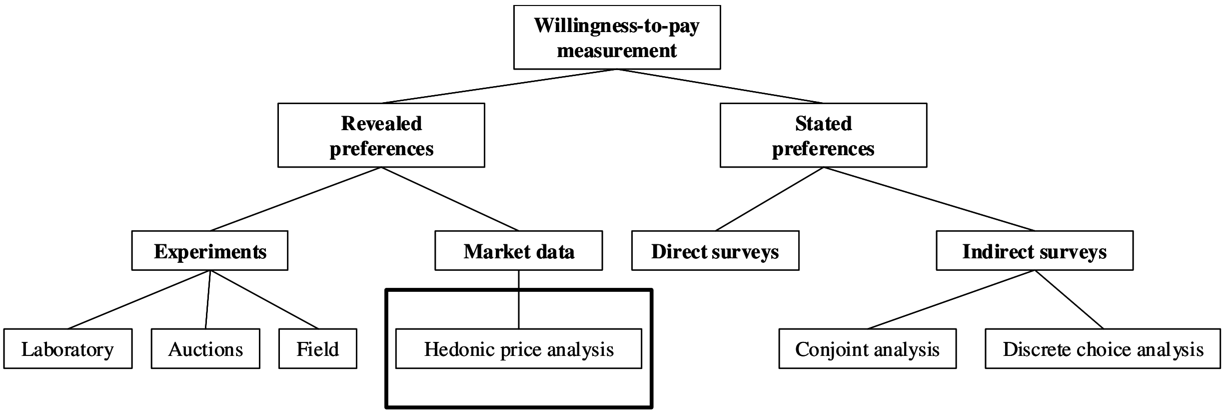
Source: Saharan 2001

To summarize, ricebean has some highly positive nutrition characteristics. It can be a good source of proteins, where proteins from animal sources are scarce or not consumed. Another outstanding characteristic of ricebean is its fat content which is low but has a high proportion of unsaturated fatty acids. Ricebean also contains important minerals in considerable amounts, especially calcium. The concentration of anti-nutritional factors such as phytic acid and tannin can be reduced by common cooking and pre-cooking procedures, such as soaking and sprouting (ANDERSON 2007).

3 Construction and quantification of a Consumer Preference Index (CPI)

There are several approaches that can be used to determine consumer preferences (Figure 1). Consumer preferences are also referred to as 'willingness to pay' and can be quantified either through revealed or through stated preferences. Revealed preferences are obtained from price responses whereas stated preferences are derived from surveys (BREIDERT, 2006).

Figure 1: Classification of approaches to assess the 'willingness-to-pay'.



Source: after Breidert 2006, p. 37

Stated preferences in direct surveys are documented by directly asking consumers about their willingness-to-pay for a certain product, whereas indirect surveys use ranking or sorting of products or product characteristics. Data for conjoint analysis and discrete choice analysis are obtained by indirect surveys, for instance (BREIDERT 2006).

Revealed preferences may be derived from experiments and market data. The hedonic price analysis uses market data. Sources for market data can be panel data from consumer panels or store data from retail outlets. A necessary condition for the usage of market data is that the data contain price variations that cover the range of consumer preferences. An advantage of market data is that these include market prices for which consumers purchase products instead of stated purchase intentions (BREIDERT 2006, WRONKA 2004). Hedonic price analysis determines quality characteristics that are relevant for consumers with indirect cooperation of consumers because the product price that consumers pay under competitive conditions includes all relevant information about consumers' preferences (PECHER 2000).

In this study, consumer preferences were captured by estimating a hedonic price function for ricebean. There were several reasons why the hedonic analysis was chosen to estimate consumer preferences. Firstly, the hedonic analysis is based on preferences revealed in real purchase data instead of using stated preferences. Secondly, the determination of relevant quality characteristics using surveys and observations is very time- and cost consuming because information about quality perception, preferences and behavioural pattern are often missing, especially in marginal areas. Therefore preliminary analyses are required. Information about ricebean and its characteristics is scarce since ricebean is an orphan crop that has been neglected by scientists. Finally, the greatest advantage of hedonic analysis is the assessment of characteristics' implicit prices. The implicit prices of ricebean characteristics should be used to guide breeding for an improved ricebean variety.

3.1 The hedonic equation

The central idea of hedonic price analysis is that goods are valued by consumers for their utility generating characteristics (LANCASTER 1966). Further it is assumed that consumers are not evaluating the good itself but its characteristics and demand is a function of product characteristics, not of the product. The demand for a special characteristic is than revealed through the demand for a product that contains this characteristic. Therefore, it is assumed that if the amount of the characteristic demanded changes, the product prices will change also (BROCKMEIER 1993).

Rosen's theoretical analysis (1974) uses a plane of several dimensions to represent product characteristics. Locations in the plane are identified by vectors of coordinates $z = (z_1, z_2, z_3, z_n)$ where z_i measures the amount of the *ith* characteristic in the product. Products are described by n objectively measured characteristics and are completely described by numerical values of z that represent different amounts of characteristics.

A typical hedonic price function ((1) assumes that the product price is determined by its product characteristics and may be specified as follows:

(1): $p_i = p_i(z_{i1}, z_{i2}, z_{i3}, ..., z_{im})$

where p_i is the product price, z_{ij} is the quantity of characteristic j (j = 1,2,..m) contained in one unit of sample i. The equation can be estimated with empirically determined price data and data on product characteristics.

Griliches (1971) analysed the impact that changes of characteristics of automobiles have on price indices. He found that at one point in time, products are sold at different prices because of different characteristics, and showed that it is possible to derive implicit prices per unit of a chosen characteristic of a good.

The implicit price or shadow price of a characteristic can be derived from the estimated hedonic function. The implicit price of a characteristic, such as protein, is the partial derivative of the hedonic function with respect to the particular characteristic:

(2): $$\frac{\partial p_i}{\partial z_{ij}} = p_j\left(z_{i1}, z_{i2},..., z_{im}\right)$$

Rosen (1974) defined hedonic prices as implicit prices of product characteristics that are revealed to consumers from observed prices of products and their associated specific amounts of characteristics. Further, in competitive markets consumers evaluate characteristics by purchasing products with the desired characteristic (ROSEN 1974).

The implicit price p_j of a characteristic allows a statement about the change of the product price if the amount of characteristic j changes under *ceteris paribus* conditions. The absolute price change could be calculated by multiplying the absolute change in the characteristic's level with the implicit price (BROCKMEIER 1993).

A generally superior form of the hedonic price function cannot be derived from the economic theory. Most of the empirical applications of hedonic price analysis use simple functional forms such as linear, semi-log, double-log or linear Box-Cox-forms (WRONKA 2004). The advantage of these simple function forms is that they are less sensitive to missing variables and to the usage of proxy variables (CROPPER ET AL. 1988).

To summarize, an econometric estimation of a hedonic price function provides the following possibilities:

i) to get an impression about the magnitude of implicit prices of studied characteristics;

ii) to calculate the price variation caused by marginal and absolute variation in the amount of characteristics, and

iii) to estimate the price of new products that are product variations of already existing products by assessing the implicit prices of characteristics and multiplying these prices with the amount of the considered characteristics (BROCKMEIER 1993).

3.2 Literature review

The hedonic price analysis has been applied many times to identify food characteristics which significantly influence the price. These studies confirmed the relationship between food quality and price. This was first done by Waugh (1928) who investigated the relationship between asparagus, tomato and cucumber quality and its price. Ladd and Suvannunt (1976) aimed to develop a consumer goods characteristics model with retail prices per pound of 31 different meat, dairy and poultry items. They found a willingness to pay for energy and protein and a willingness to avoid phosphorus, iron and Vitamin C within this large variety of different products.

Altemeier (1989) analysed the relationship of quality characteristics and price of maize, soybean, and groundnut by estimating a hedonic price equation for different market levels in Indonesia. He observed a preference for well-dried (low moisture content) and cleaned maize. Soybeans were also more preferred when they are well-dried, but there seemed to be no preference for cleaned soybeans. Groundnuts should be large, well-dried and cleaned to meet the preferences. Altemeier (1989) aimed to identify the economically important quality characteristics for farmers, wholesalers and consumers and he only included evident characteristics that are visible for the for the respective level of the market chain.

Brockmeier (1993) analysed consumer preferences for German fruit juice quality characteristics. The following characteristics were used: calories, minerals and vitamins. In addition variables for flavours and returnable or non-returnable packaging were included. The prices of 131 fruit juices were documented. Brockmeier's (1993) study revealed that consumers prefer fruit juice with a low content of minerals, they prefer energy in the form of calories and vitamins and they like non-returnable packages more than returnable ones. In her analysis, Brockmeier (1993) also included cryptic characteristics that are not visible for consumers such as calories and vitamins.

Several studies went a step further and used the results of the hedonic price analysis in form of implicit prices of characteristics to improve varieties through breeding. In the field of plant breeding, von Oppen (1976) was the first to define breeding goals by applying hedonic estimation. He developed a preference index to evaluate the acceptance of new food grains.

Unnevehr (1986) used implicit prices of grain characteristics to evaluate rice-breeding goals in Thailand, Indonesia and the Philippines. Rice samples of each rice grade sold by a retailer were collected along with information about name and price. The samples were analysed in a laboratory for physical characteristics such as whiteness, shape or chalkiness and for chemical characteristics such as amylose content, gel consistency or gelatinization temperature. The implicit prices of the grain quality characteristics represent the change in rice price associated with a change in a characteristic. Results showed that the demand for milling quality is similar in Thailand, Philippines and Indonesia, whereas the demand for grain shape and some chemical characteristics, such as per cent share of amylose, varies. The study of Unnevehr also included cryptic product characteristics that are not visible for consumers and showed that there is a relationship between product prices and cryptic characteristics (UNNEVEHR 1986).

Pecher (2000) studied consumer preferences for barley to guide breeding. In her study, 121 barley samples were collected in Syrian wholesale markets together with their respective prices. In Syria, barley is used as seed and fodder for sheep. Therefore the utility depends on forage quality, seed quality, local adaptation and key characteristics like colour. The hedonic price function proved that characteristics which influence the quality positively are also preferred by consumers. These evident and cryptic characteristics were: crude protein, 1000 seed weight and loose awn. Broken or empty grains were found to affect price negatively. Furthermore, preferences for barley varieties differed between peasants from West and East Syria.

Jiménez-Portugal (2004) investigated beans in Mexico and the relationships between price and quality characteristics. The quality characteristics that were determined to influence the price significantly were moisture content, cooked protein, carbohydrates digestibility, hectolitre, dry weight and non-shrunken beans. As this study also investigated pulses it provided detailed information about the selection of evident and cryptic characteristics that may be relevant for consumers.

The literature review about hedonic price analysis shows that it has been applied successfully to

i) determine quality characteristics that significantly influence the product price,

ii) estimate implicit prices of evident and cryptic characteristics, and

iii) improve plant varieties through breeding.

3.3 Determinants of ricebean quality

As indicated at the beginning of this section, we assume that goods are valued by consumers because of their utility-generating characteristics. The value of a specific good as evidenced through consumer acceptance and purchase is not determined by a few visible characteristics (evident). It is more a complex composition of several characteristics where many of them are cryptic and cannot be perceived by buyers at the time of purchase (VON OPPEN 1978). Evident characteristics like colour or shape in contrast, are visible to consumers whereas cryptic traits are not visible and can only be judged after consumption. Examples of cryptic traits are composite ingredients such as fat or protein and culinary qualities like swelling capacity. Both types of characteristics, evident and cryptic, are related to each other. In consequence, consumers evaluate cryptic characteristics, by evaluating one or several evident characteristics. For instance, it is widely known that a really green apple will taste sour whereas red or yellow apples tend to be sweet (JIMÉNEZ PORTUGAL 2004).

We focus on the most important characteristics that were identified by reviewing literature to reveal characteristics that are relevant for consumers when they purchase and consume pulses. The characteristics in Table 5 were chosen after reviewing articles concerning the nutritional composition of ricebean as well as about domestic processing and cooking (AYKROYD AND DOUGHTY 1964, KAUR AND KAPOOR 1992, KAUR AND KAPOOR 1990b, JIMÉNEZ PORTUGAL 2004, MALHORTA ET AL. 1988, THARANATHAN AND MAHADEVAMMA 2003, PATWARDHAN 1962, REYES-MORENO ET AL. 2000).

After choosing the characteristics that should be assessed, proper chemical analyses were determined. A catalogue provided by the AOAC (Association of Official Analytical Chemists) was used (CUNNIFF 1995). It was important to choose one standard method for each characteristic since it was not clear at the outset of this study whether all samples could be analysed in the same laboratory. Further, the methods had to be appropriate for laboratories in India and Nepal.

It is illegally to import ricebean seed from Nepal into India, and vice versa. Therefore one laboratory in each country was used. The analysis in Nepal was conducted by the lab of a project partner, Li-Bird in Pokhara. In India, the samples were analysed at the Agricultural University in Anand, Gujarat.

Table 5: Selected characteristics for the hedonic price analysis.

Characteristic	Units	Classification
Moisture	%	Cryptic
Protein	%	Cryptic
Fat	%	Cryptic
Crude fibre	%	Cryptic
Carbohydrate	%	Cryptic
Ash	%	Cryptic
Seed weight	g	Evident
Foreign matter	%	Evident
Length/Breadth ratio	Index	Evident
Water up-take capacity	%	Cryptic
Swelling capacity	%	Cryptic
Colour diversity	%	Evident

The impact that the chosen characteristics in Table 5 have on the quality of ricebean is explained in the following section. The moisture content depicts the remaining water in the seeds. It is determined by drying a grounded sample at 100°C in the oven until the weight is constant. The weight loss is the measure of moisture content. Moisture content is often disliked by consumers because good quality ricebean is carefully dried in the sun, while freshly harvested seeds have considerably higher water content (ALTEMEIER ET AL. 1989).

An important component for the inhabitants of India and Nepal is protein because many South Asians are vegetarians and protein from animal products is more expensive than those from plant products. Protein content was measured as crude protein with the Kjeldahl analysis, wherein the nitrogen content is determined. The measured value is than multiplied by 6.25 to calculate the per cent share of crude protein in a sample (AOAC 1998).

The fat content of the majority of pulses is between 1 to 2% of dry weight (AYKROYD AND DOUGHTY 1964). Despite its minor role it was also determined in order to be able to calculate the content of carbohydrates of ricebean. Fat content is usually quantified by extraction using solvents like petroleum ether (AOAC 1998).

Carbohydrates form the largest part of all components of pulses and provide most of the calories. The digestible carbohydrates were calculated based on the Weender analysis. Carbohydrates are determined as residual from the total dry weight. Due to the fact that moisture, fat, protein, ash and crude fibre are determined in per cent of dry weight they can be subtracted from the total dry weight. The remaining part then contains digestible carbohydrates (ASP 1994).

Crude fibres are part of carbohydrates but they cannot be fully digested by humans. Crude fibre is the residue left after digestion of a sample with sulfuric acid and sodium hydroxide. The residue left after digestion is specified in per cent of total dry weight (AOAC 1998).

The characteristic ash is the mass remaining after the ricebean sample was burned in a funnel. Therefore, ash does not contain any organic material and consist only of minerals such as iron, zinc or copper (SAHARAN 2001).

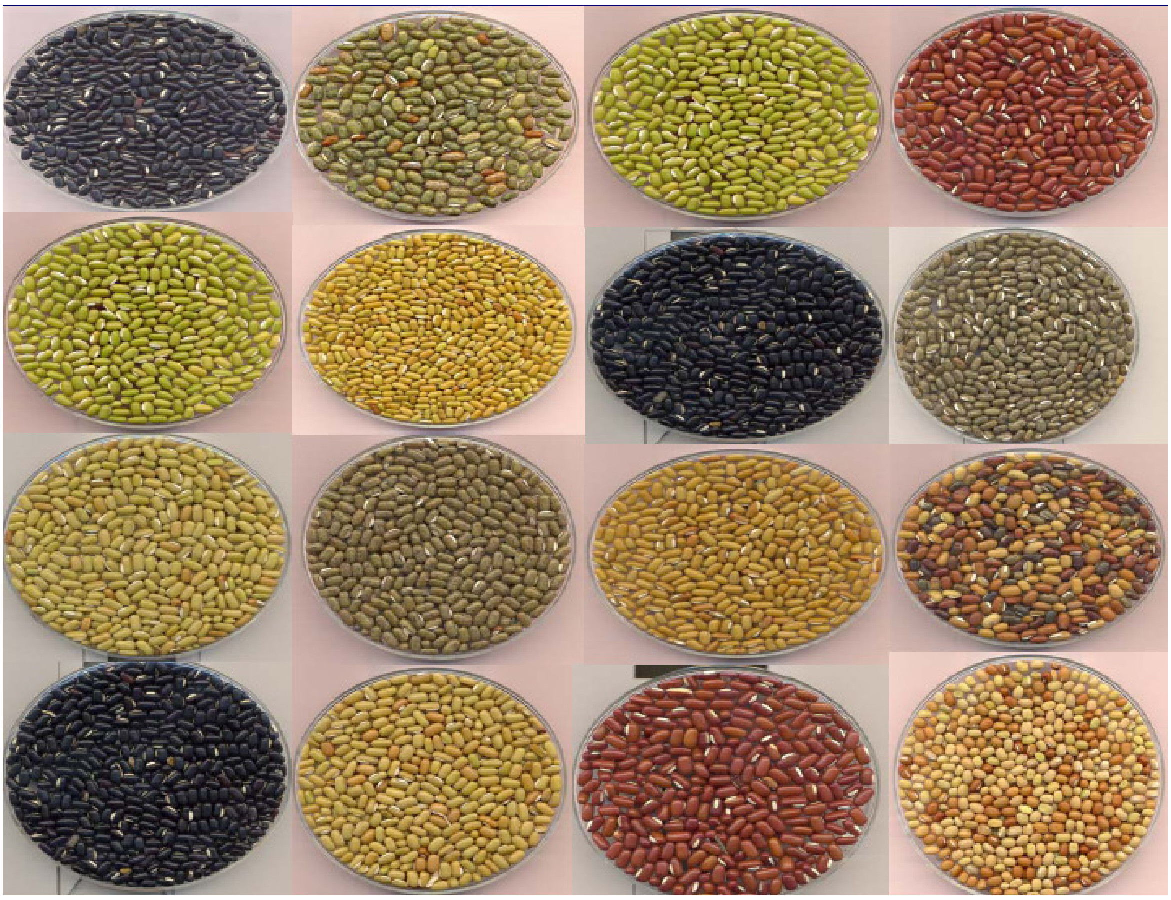
The hundred-seed weight is used as an indicator for seed size. The higher the weight of a sample of 100 seeds, the bigger the seeds (VON OPPEN 1978).

The foreign material corresponds to the share of a sample which would be removed before soaking or cooking ricebean. The foreign material was determined by weighing the sample with and without dirt (referred to as foreign matter). Dirt and foreign materials may include small stones, other pulses and broken/destroyed beans (JIMÉNEZ PORTUGAL 2004).

Ricebean form was measured by the length to breadth ratio. A value of 1 would reveal a round form because length and breath are equal and values above 1 indicate a longish form. Ricebean, like other pulses kept in water overnight before cooking to soak water which decreases to cooking time. The water uptake measures the weight increase after soaking. Apart from weight increase, the swelling capacity also documents the effect of soaking on volume increase (SAHARAN 2001).

Colours were considered as percent share of the sample weight and the colour diversity of a sample as index. Figure 2 gives an impression of the possible colours of ricebean. The laboratory in Nepal used a colour scale that is usually used to determine soil colour. The colours of the samples from India were determined subjectively without using a standard colour scale. The different colours prevalent in each sample were measured to identify preferred colours and the colour diversity index was included into the hedonic analysis to determines whether consumers prefer mixed coloured or single-coloured lots of ricebean. Usually ricebean is offered in bags at the markets and consumers will find e.g. pure black, yellow and gray ricebean or they find all or some of these colours mixed together in one bag.

Figure 2: Colour diversity of ricebean.



Source: Dua 2010

Several diversity indices that are used in scientific fields such as ecology are available. The simplest way to measure diversity would be to count the different colours, but that does not consider the frequency i.e. the per cent share of each colour (DRESCHER 2007). The Herfindahl-Index (*HI*) shown in equation (3) is often used to determine the concentration of industries by firm size (PATIL AND TAILLIE 1982). It is calculated as the sum of the squares of colour shares of each sample (DRESCHER 2007). The Herfindahl-Index (*HI*) is defined as follows:

(3): $HI = \sum_{i=1}^{n} s_i^2$

where, s_i is the relative abundance of the *i*th colour (e.g. black) in the sample (MOUILLOT AND LEPRÊTRE 1999). It ranges from 1/n to 1, whereas n represents the number of present colours. The maximum value of 1 indicates total concentration i.e. the sample consists only of one single colour. (DRESCHER 2007).

The Simpson or Berry-Index (*BI*) presented in (4) is closely related to the Herfindahl-Index as their indices are reversions of each other. The Berry-Index ranges from 0 to 1-1/n, where 0 indicates no diversity in colour and 1-1/n means equal distributed colours.

(4): $BI = 1 - \sum_{i=1}^{n} s_i^2$

Economists take advantage of the Berry-Index to determine industrial concentrations and ecologists apply it as the Simpson-Index to estimate diversities of species (PATIL AND TAILLIE 1982).

The third diversity index presented in (5) is the Entropy-Index (*EI*), which is defined as follows:

(5): $EI = \sum_{i=1}^{n} s_i \ln\left(\frac{1}{s_i}\right)$

Values of *EI* range between zero and ln(*n*), where the value of zero reveals unequal distribution. Thus, the maximum value of ln of *n* presents a perfectly equal distribution (LEE AND BROWN 1989).

Another similar diversity index presented (6) is the Shannon-Index (*H*) (MOUILLOT AND LEPRÊTRE 1999):

(6): $H = -\sum_{i=1}^{n} s_i \log(s_i)$

where, each share *(s_i)*is weighted with its logarithm. In the end the negative value of the added up shares form the Shannon-Index.

This review of diversity indices does not claim to be complete. Several indices like Gatlin's-Redundancy-Index, Camargo-Evenness-Index, Pielou-Regularity-Index or the Gini-Coefficient have also been used to determine diversity but it is not necessary for our purpose to enter into a detailed explanation of all of these methods (PATIL AND TAILLIE 1982).

For this study the Herfindahl-Index was chosen because it cannot take the value zero. This is important because of the metric variables entering the regression in log form and the logarithm of zero is not defined.

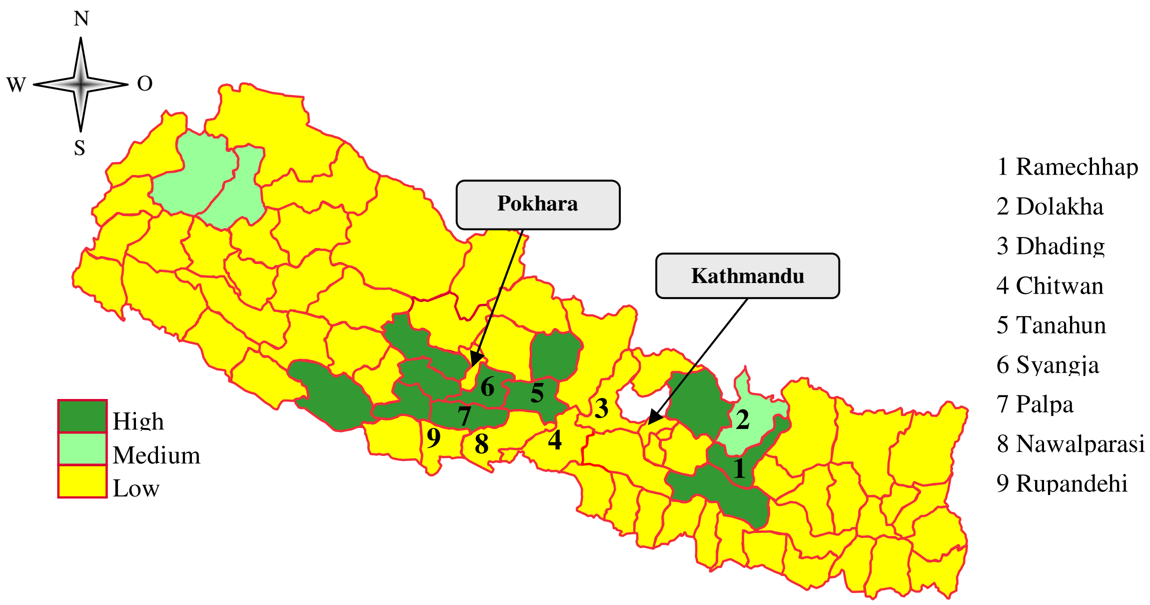
3.4 Pre-test

In March 2007 we conducted a pre-test. This was necessary to test the chemical analyses and to verify the relationship between characteristics of pulses and price. Therefore, 73 samples of different pulses such as ricebean, chickpea, peas, kidney bean and mung bean were collected in Nepal. Half of them were analysed in the laboratories of the University at Kiel and half in the laboratories of NARC in Kathmandu, Nepal. From the total of 73 samples six were analysed in Germany and Nepal to determine differences of the laboratories. The results confirmed the assumption that quality characteristics of pulses significantly influence their prices.

3.5 Data collection: ricebean samples

This section describes the procedure of collecting ricebean samples collection, including the selection of areas from where the samples were collected in India and Nepal. All samples were collected between January 10th and March 9th in 2008 because ricebean is planted in June-July and the harvest season is from October to November. We assumed that the probability to find ricebean in markets will be high in January after harvest in November and some time for drying in December. Further, the sample collection in India and Nepal had to be organised within a restricted time period to ensure comparable qualities.

Figure 3: Ricebean distribution in Nepal and visited districts.



Source: Gautam 2007

Each sample contained at least 250 grams of ricebean which was enough to conduct all the chosen laboratory analyses. The locations investigated were selected using a report provided by the Nepalese and Indian project partners (GAUTAM 2007). This report classifies districts in India and Nepal into districts with high, medium or low prevalence of ricebean.

In Nepal the sample collection began in Ramechhap, which is located in the East (see Figure 3). The complete route is shown by the dotted black line in Figure 3 from East to South-West. In total, 14 market places were visited in 9 districts (Table 6) to collect a total of 114 ricebean samples in Nepal.

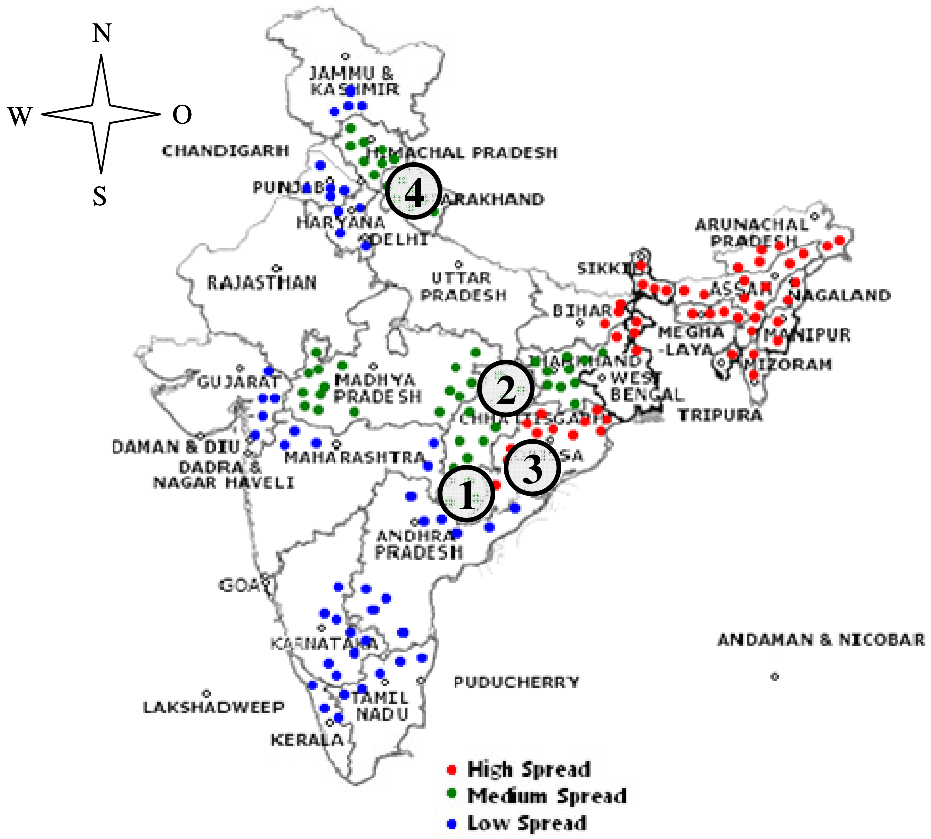
Table 6: Ricebean samples collected per district in Nepal.

District	No. of samples	% of total
Ramechhap	22	19
Dolakha	3	3
Dhading	10	9
Chitwan	15	13
Tanahun	15	13
Syangja	5	4
Palpa	3	3
Nawalparasi	4	4
Rupandehi	37	32
Total	114	100

In India, 53 ricebean samples were collected in three states: Chhattisgarh, Orissa and Uttarakhand. In Chhattisgarh samples were collected in two districts Dhamtari and Bastar. Khandhamal and Koraput were the two districts in Orissa and in Uttarakhand samples from the districts Dheradun and Theri Garhwal were collected. The prevalence of ricebean in India is lower than in Nepal and we found fewer samples. The sample collection in the east of Madhya Pradesh was unsuccessful because ricebean was not available in the markets - only ricebean-growing farmers were found. The samples came from 16 markets in six districts of India. The first samples were collected in Chhattisgarh. The two districts in Chhattisgarh are marked in Figure 4 with black circles with the numbers ‘1’ and ‘2’ within the circles. The neighbouring districts in Orissa, on the East coast of India, are marked with number ‘3’. The last station ‘4’ denotes the districts in Uttarakhand in the north. Although, the North East of India shows a high spread of ricebean, it was not possible to collect ricebean there due to security reasons. Even in

Chhattisgarh, our collection was constrained for that reason. Due to political problems, we were denied access to remote areas and markets.

Figure 4: Ricebean distribution in India and selected locations.



Source: Gautam 2007

Table 7 shows the number of samples from India that were used in our research from each district. We found more market places and stores where ricebean was available in the states of Orissa and Uttarakhand.

Table 7: Ricebean samples collected per district in India.

District	No. of samples	% of total	State
Dhamtari	1	2	Chattisgarh
Bastar	5	9	Chattisgarh
Dehradun	9	17	Uttarakhand
Theri Garhwal	10	19	Uttarakhand
Khandhamal	8	15	Orissa
Koraput	20	38	Orissa
Total	53	100	

3.6 Ricebean prices and characteristics

The price of ricebean samples is the most important market information. The price is assumed to reflect the preferences of consumers for cryptic and evident ricebean characteristics. The price range of ricebean samples can be explained as a function of qualities of ricebean. There are also other variables that influence the price which are unrelated to ricebean quality. In the hedonic analysis we must control for the influence of factors that are unrelated to quality. Controlling for all non-quality determinants of price is impossible and control must, for practical reasons, be limited to the most important ones.

As agricultural production is located in rural and remote areas, and not in the proximity of cities, the price is also influenced by market location. It can be assumed that ricebean found in urban markets is cultivated in rural areas and then traded via wholesalers or commission agents to retailers in cities. To characterize market locations, all markets included in the study were labelled either rural, semi-urban or urban. This classification of markets is a way to avoid confounding price differences based on trading costs with price differences due to quality differences (BUERGELT ET AL. 2009).

The population density in persons/km² was used to classify the districts in which markets are located in the three classes. A subjective classification was used if the correlation between district and market was not given. This was possible because we have been to all markets. A market in a district with a population density under 150 persons/ km² was defined as rural, semi-urban markets had a population density of 150 to 250 persons/km² and urban markets over 250 persons/km².

3.6.1 Nepal

The population density of each district in Nepal that is integrated in this study is shown in Table 8. In Nepal ricebean were available in all three kinds of markets. The majority of the markets are semi-urban, only two markets are rural and four are urban. But this distribution does not reflect the number of samples from each market type.

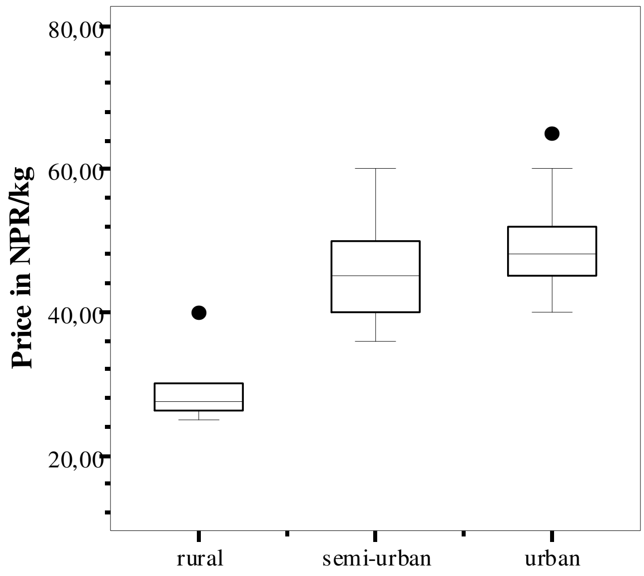
Table 8: Population density of districts in Nepal.

Market	District	Population density (persons/km²)	Classification
Adamgath	Chitwan	213	Semi-urban
Mugling	Chitwan	213	Semi-urban
Malekhu	Dhading	176	Semi-urban
Charaundi	Dhading	176	Semi-urban
Charikot	Dolakha	93	Rural
Pragatinagar	Nawalparasi	260	Urban
Aryabhenjyng	Palpa	196	Semi-urban
Randi	Palpa	196	Semi-urban
Ramechhap	Ramechhap	137	Rural
Butwal	Rupandehi	521	Urban
Syangja Bazaar	Syangja	273	Urban
Badhkhola	Syangja	273	Urban
Abukhaireni	Tanahun	204	Semi-urban
Damauli	Tanahun	204	Semi-urban

Source: Government of Nepal 2003

In Figure 5 the price distribution of ricebean samples from in rural, semi-urban and urban markets in Nepal are compared. The bottom and top of the box represent the 25% and 75% percentile of the prices. The line in the box is the median and the ends of the whiskers show the smallest and the largest values that are not extreme values. The black dots are outliers. The median of each market type in Figure 5 indicates that prices in rural areas are on average lower than in semi-urban and urban areas. The highest median prices are found in urban areas, which are cities like Butwal or Syangia Bazaar.

Figure 5: Price levels in rural, semi-rural and urban areas in Nepal, January to March 2008.



The prices and the descriptive statistic of the analysed characteristics of the ricebean samples from Nepal are shown in Table 9. The prices of the 108 ricebean samples vary over a range of 40.00 Nepalese Rupees (NPR)/kg, from a minimum of 25.00 NPR/kg to a maximum of 65.00 NPR/kg. The mean moisture content is similar to values from reviewed studies (see Table 2). The maximum moisture content of 15.5% is probably from a sample that was not well-dried. The protein content varies to a great extent, the mean value, however, of 24.7% is comparable to values in the reviewed literature (DUTTA ET AL. 2000). The fat content of ricebean is very low, with a mean of 0.3% in all samples. The values of crude fibre, carbohydrates and ash are similar to the ones reported in the literature (MALHORTA ET AL. 1988). The 100-seed weight that represents the seed size ranges from 5.8 – 19.4 g/100 seeds. The content of foreign matter is not a characteristic of ricebean itself, but as the values show the dirtiest samples had almost one fifth foreign material, which affects consumer willingness to pay for ricebean. The range of the content of foreign matter may also indicate that some ricebean samples were cleaned before they were sold. The Length/Breadth (L/B) ratio of Nepalese samples shows that the beans have an elongated form with a mean value of 1.6 because a value of one would correspond to a round form. The mean water uptake ratio of 2.0 indicates that the samples double their weight when they are soaked over night. The mean value of swelling capacity of 1.1 shows that the volumes increase by soaking is 10% of the initial volume. The colour diversity measured as Herfindahl-

Index ranges from 0.3 to 1.0, where 1.0 indicates that the sample only contains one colour. Thus, the lower the Herfindahl-Index, the more colours are present in a sample.

Table 9: Descriptive statistics of ricebean samples from Nepal.

Characteristic	Unit	Minimum	Maximum	Mean	Standard deviation
Price	Nepalese Rupees (NPR)/kg	25.00	65.00	43.52	10.03
Moisture content	%	8.2	15.5	10.5	1.1
Protein content	%	18.8	32.2	24.7	3.1
Fat content	%	0.1	0.5	0.3	0.1
CrudeFibre	%	3.6	5.5	4.4	0.4
Carbohydrates	%	58.1	72.0	66.4	3.1
Ash	%	3.5	4.9	4.2	0.3
Seedweight	g/100 seeds	5.8	19.4	10.3	3.1
Foreign matter	%	2.3	19.3	8.1	3.5
L/BRatio	Ratio length to breadth	1.4	2.1	1.6	0.2
Water uptake	Ratio of weight increase	1.7	2.2	2.0	0.1
Swelling capacity	Ratio of volume increase	1.0	1.2	1.1	0.0
Colour diversity	%	0.3	1.0	0.6	0.2
N=108					

Table 10 gives an overview of the colours of individual ricebean seeds contained in the samples. The minimum of 0 means that a given colour was missing in at least one sample. Pure samples of uniform colour were only found for brown and yellow varieties, which is indicated by the maximum value of 100. The mean values show that yellow is the most frequent colour found across all samples and black is the least frequent one.

Table 10: Colour variation of ricebean samples from Nepal in percentages of the total sample.

Colour	Minimum	Maximum	Mean
Black	0	49	2
Brown	0	100	14
Gray	0	83	10
Olive	0	93	10
Red	0	94	6
Yellow	0	100	57
N: 108			

3.6.2 India

The categorization of Indian ricebean markets as rural, semi-urban and urban required more subjective classification. For example, there are four markets in the district Koraput. The population density of the district would classify all four as rural, but a town like Koraput with nearly 40,000 inhabitants was rather perceived as urban than as rural. The numbers of inhabitants of towns or villages (in Table 11) were taken from the Census of India 2001.

Table 11: Population density of districts in India.

Market	State	District	Population density (persons/km²)	Classification	Population of town/village
Dhamtari	Chattisgarh	Dhamtari	209	Urban	82.111
Lohandiguda	Chattisgarh	Bastar	87	Rural	0
Kunduli	Orissa	Koraput	134	Rural	1.675
Sunabeda	Orissa	Koraput	134	Urban	58.884
Koraput	Orissa	Koraput	134	Urban	39.548
Pukali	Orissa	Koraput	134	Rural	2.491
Semiliguda	Orissa	Koraput	134	Rural	91
Phulabani	Orissa	Kandhamal	81	Urban	33.890
Tikabali	Orissa	Kandhamal	81	Semi-urban	3.313
Bhanya Nagara	Orissa	Kandhamal	81	Rural	n.a.
Dehradun	Uttatakhand	Dehradun	415	Urban	530.263
Doiwalla	Uttatakhand	Dehradun	415	Semi-urban	8.043
Chamba	Uttatakhand	Tehri Garhwal	148	Semi-urban	6.580
Ranichhauri	Uttatakhand	Tehri Garhwal	148	Rural	n.a.
Baurari Chak	Uttatakhand	Tehri Garhwal	148	Rural	4
New Tehri	Uttatakhand	Tehri Garhwal	148	Semi-urban	25.423
Diwara	Uttatakhand	Tehri Garhwal	148	rural	173
Nail	Uttatakhand	Tehri Garhwal	148	rural	131
Agrakhal	Uttatakhand	Tehri Garhwal	148	rural	n.a.

Source: Census of India 2001

The box plot Figure 6 depicts the median prices of the 45 samples from rural, semi-urban and urban markets in India. Similar to Nepal, the median prices in Indian rural areas are lower than in semi-urban areas and urban areas have the highest prices.

Figure 6: Price levels in rural, semi-rural and urban areas in India, January to March 2008.

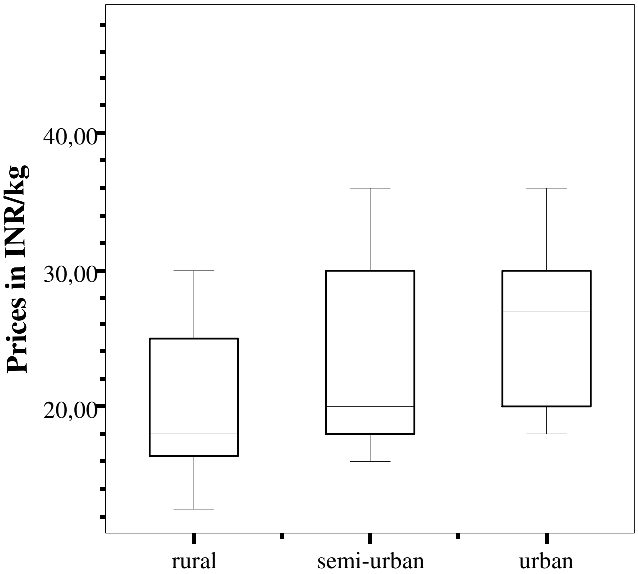


Table 12 summarizes the data on the characteristics of the ricebean samples from India. The price range of ricebean samples in India is 23.50 Indian Rupees (INR)/kg. The maximum price of 36.00 INR/kg is nearly three times higher than the minimum price of 12.5 INR/kg, which may reflect the impact of market locations in rural or urban areas. The remaining characteristics are discussed in comparison to the samples from Nepal in section 3.6.3.

Table 12: Descriptive statistics of Indian samples.

Characteristic	Unit	Minimum	Maximum	Mean	Standard deviation
Price	Indian Rupees (INR)/kg	12.50	36.00	22.55	6.39
Moisture content	%	8.1	12.8	9.8	1.1
Protein content	%	14.5	21.6	17.9	1.7
Fat content	%	0.4	0.8	0.6	0.1
CrudeFibre	%	4.1	7.0	5.3	0.9
Carbohydrates	%	59.6	66.0	62.2	1.6
Ash	%	2.4	5.1	3.7	0.7
Seedweight	g/100 seeds	4.1	13.6	6.9	2.5
Foreign matter	%	1.1	7.4	4.1	1.4
LBRatio	Ratio length to breadth	1.4	1.9	1.7	0.1
Water uptake	Ratio of weight increase	2.0	2.2	2.1	0.0
Swelling capacity	Ratio of volume increase	1.6	2.0	1.8	0.1
Colour diversity	%	0.3	0.9	0.5	0.2
N=45					

Table 13 shows the colour variation of Indian ricebean samples. The most frequent colour, like in Nepal, is yellow, with a mean share of 57% in all Indian samples, followed by brown and olive at 18% of all colours. Gray is the least frequent colour of ricebean from India.

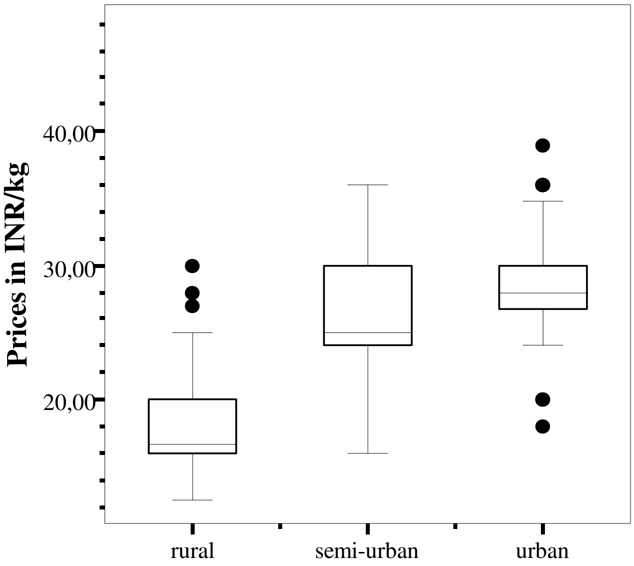
Table 13: Colour variation of ricebean samples from India in percentages of total sample.

Colour	Minimum	Maximum	Mean
Black	0	30	4
Brown	0	63	18
Gray	0	2	0
Olive	0	60	18
Red	0	20	3
Yellow	20	95	57
N: 45			

3.6.3 Pooling the samples from Nepal and India

A comparison of prices of ricebean samples from both countries requires a conversion of one currency into the other. Indian Rupees (INR)/kg are used as standard currency to combine and compare Nepalese and Indian ricebean samples. The box plot in Figure 7 depicts the median price of rural, semi-urban and urban areas in India and Nepal, where rural areas have the lowest, and urban areas the highest prices. The number of outliers indicated by the black dots rises as a result of the pooling of all samples.

Figure 7: Price levels in rural, semi-rural and urban areas in Nepal and India, January to March 2008.



A comparison of the mean values of all characteristics is shown in Table 14. At the given exchange rate (1 INR = 1.6 NPR), the mean ricebean price in Nepal is 3.56 INR/kg higher than in India. Though standard methods for measuring the characteristics were used, the fact that two laboratories were involved may have influenced the measurements. Thus, differences between Indian and Nepalese samples may also be due to a laboratory effect. The moisture content of about 10% of weight is similar for samples from Nepal and India. The protein content of the samples from Nepal is about 6 percentage points higher than value of samples from India. The protein content reported in other studies is about 20% of dry weight (AKROYED 1982, DUKE, 1981, FRANKE 1989, Table 2). The results for fat content vary by 100% based on the fat content of samples from Nepal. The mean proportion of crude fibre is a bit higher in samples from India, whereas the value of samples from India is comparable to results from other studies (AKROYED 1982, DUTTA 2000, KAUR 1992, Table 2). Carbohydrates and ash content are slightly higher in samples from Nepal. Seeds in samples from Nepal are bigger than seeds from India, as is indicated by the seed weight. Furthermore, the content of foreign matter was twice as high in samples from Nepal (8.1% of weight) than in samples from India (4.1% of weight). The mean L/B-Ratios show that ricebean from India have a more longish form. The mean water uptake ratios are similar for the samples from both countries. The volume increase through soaking measured as swelling capacity ratio indicates that ricebean from India gain more volume that ricebean from Nepal. The mean colour diversity of samples from Nepal is alike to the colour diversity of samples from India.

Table 14: Comparison of Indian and Nepalese samples.

Characteristic	Unit	Mean Nepal	Mean India
Price	Indian Rupees (INR)/kg	26.11	22.55
Moisture content	%	10.5	9.8
Protein content	%	24.7	17.9
Fat content	%	0.3	0.6
CrudeFibre	%	4.4	5.3
Carbohydrates	%	66.4	62.2
Ash	%	4.2	3.7
Seedweight	g/100 seeds	10.3	6.9
Foreign matter	%	8.1	4.1
L/B-Ratio	Ratio length to breadth	1.6	1.7
Water uptake	Ratio of weight increase	2.0	2.1
Swelling capacity	Ratio of volume increase	1.1	1.8
Colour diversity	%	0.6	0.5
N=153			

3.7 Outliers and omitted variables

The sample size of 153 ricebean samples from India and Nepal is small and the influence of single values that might be outlier can be large. Therefore, outliers have to be detected and excluded from the regression. The first step to detect outliers is the visual inspection by generating graphs or scatter plots and the inspection of minimum and maximum values in descriptive statistics (URBAN 2011). In the second step, Hebel values, referred to as central leverage values, were calculated. Hebel values are a measure of the impact that single observations have on the adaption of a regression function. The Hebel value is calculated by dividing the Mahalanobis-distance by N-1, where N is the number of samples. The Mahalanobis-distance measures how much a sample differs from the mean of all samples with regard to the dependent variable (URBAN 2011). Finally, 14 outliers - 6 Nepalese samples and 8 Indian samples - were identified and eliminated.

An assumption of regressions with Ordinary-Least-Squares (OLS) estimation is that the independent variables are not that means there is no multicollinearity between two or more independent variables. SPSS offers a collinearity diagnostics while running a regression analysis.

Therefore, a variance inflation factor (VIF) is calculated which should not exceed the value of 10 (URBAN 2011). The calculation of the VIF revealed that the two characteristics carbohydrates and water uptake capacity had to be eliminated. As water uptake capacity and swelling capacity both measure the impact of soaking, it was acceptable to eliminate one of them. Carbohydrates were calculated on the basis of the Weender analysis as residual from the total dry weight. Due to the fact that moisture, fat, protein, ash and crude fibre are determined in per cent of dry weight they can be subtracted from the total dry weight (ASP 1994). However, this common way of expressing carbohydrates may have caused the multicollinearity.

3.8 Estimated coefficients of hedonic price functions

Multivariate regression which applies ordinary-least square (OLS) estimation was used to test the hypothesis that the price of ricebean can be expressed as a function of quality characteristics. The acceptance of this hypothesis indicates that a great share of the ricebean price variation can be explained through the variation of quality characteristics. The statistical analyses were conducted with SPSS 15 statistics software.

A double-log function (see (7)) was chosen for the hedonic price function of ricebean to reflect the non-linearity of the relationship between quality characteristics and price. The advantage is that the estimated coefficient β indicates the elasticity of every characteristic. Thus, the results can be used as an index for breeders to asses *ex ante* the value of a new ricebean variety and breed an improved variety. Further, the log transformation of the variables provides a direct indication of the elasticities regardless of the units of each characteristic (JIMÉNEZ PORTUGAL 2004).

The equation is shown in (7) where P_i is the price of ricebean sample *i*, α is a constant, β_1 is the coefficient of characteristic *1*, e.g. fat and q_{1i} is the quantity of characteristic *1* in sample *i*. The last term μ represents the random error.

(7): $\ln P_i = \ln \alpha + \beta_1 \ln q_{1i} + \beta_2 \ln q_{2i} + ... + \beta_j \ln q_{ji} + \mu$

3.8.1 Regression results for Nepal

The model for Nepalese ricebean samples is shown in Table 15. According to our results the variables rural, urban, fat, seed weight, swelling capacity and the colour yellow have a significant influence on ricebean prices in Nepal. The market status variables, rural and urban, confirm earlier observations that prices of ricebean in rural areas are significantly lower than in the base category semi-urban. Further, prices in urban areas are significantly higher than in semi-urban areas.

Table 15: Estimated coefficients and interpretation for the hedonic model for Nepal.

Dependent Variable: Price in INR

Mean price Nepal: 26.11 INR/kg	**Unit**	**Mean value**	**Coefficients**		**T-values**
Constant			3.0899	***	4.7018
Rural[a)]	Dummy		-0.4705	***	-11.2041
Urban[a)]	Dummy		0.0849	**	2.1353
Moisture	%	10.5	-0.0269		-0.2010
Protein	%	24.7	0.1078		1.0847
Fat	%	0.3	0.1096	**	2.2659
CrudeFibre	%	4.4	-0.1802		-1.2423
Ash	%	4.2	-0.0556		-0.2893
Seedweight	g	10.3	0.1754	***	2.5536
Foreignmatter	%	8.1	-0.0141		-0.4833
L/B-Ratio	Ratio length/breadth	1.6	0.1989		1.2675
Swelling Capacity	Ratio volume increase	1.1	0.0622	*	1.5818
Black	%	2.0	-0.0043		-0.7222
Brown	%	14.0	-0.0001		-0.0185
Gray	%	10.0	-0.0035		-0.8384
Olive	%	10.0	0.0006		0.1577
Red	%	6.0	0.0004		0.0760
Yellow	%	57.0	0.0105	*	1.8721
Colour diversity	Herfindahl-Index	0.6	-0.0356		-0.6477
R^2: 0.81					
adj. R^2: 0.78					
emp. F-value: 21.9***					
N: 108					

***/**/* significant at 1; 5 or 10% significance level, a) Base: semi-urban

The adjusted R^2 indicates that 78% of the price variation could be explained through the characteristics that were included in the model. The F-value and the significance of the value at a level of $\alpha = 0.01$ confirms a relationship between ricebean characteristics and prices.

The coefficient of fat is positive and significantly preferred at a level of $\alpha = 0.05$. Seed weight is significant at a level of $\alpha = 0.01$ and has a positive coefficient. Thus, Nepalese consumers prefer bold seeds. Further, ricebean with high volume increase through soaking is preferred by Nepalese at a level of $\alpha = 0.10$. In addition, it is also apparent that consumers have a preference for yellow ricebean, as yellow has a significant positive influence on the price with an $\alpha = 0.10$.

3.8.2 Regression results for India

The estimated coefficients for the hedonic model for India are shown in Table 16. In the model for India 9 variables significantly influence the price. These are moisture, protein, fat, crude fibre, seed weight, black, brown, olive and the colour diversity. The dummies for the market locations in the Indian model are not significant due to small variations of ricebean prices between rural and semi-urban and urban regions (see Figure 6).

Protein, seed weight, crude fibre and the colour black are significant at a level of $\alpha = 0.01$ and have a positive coefficient, indicating that Indian consumers value these ricebean characteristics. As pulses are a good and cheap source of proteins, it is not surprising that consumers prefer high protein content. Like Nepalese consumers, Indians prefer large seeds rather than small ones. Crude fibre comprise mainly of cellulose and lignin that are fermented in the large intestine and metabolized into short-chain fatty acids, for instance. The fibre structure of cellulose and lignin means that crude fibre stays in the gastric passages for a longer period of time than simple carbohydrates such as sugar. Thus, crude fibres induce a continuing feeling of saturation over a long time period (ASP 1994). The preference of black ricebean may be caused by deductions that consumers make from the visible colour to invisible nutritional components (VON OPPEN 1978).

The Herfindahl-index has a negative coefficient, and is significant at a level of $\alpha = 0.05$. The negative value implies that consumers prefer colour diversity because the index gets smaller as colour diversity increases. The colour brown is disliked – its estimated coefficient is significant at a level of $\alpha = 0.10$ and is negative. The dislike of brown is difficult to interpret as well as the preference of black before.

Table 16: Estimated coefficients and interpretation for the hedonic model for India.

Dependent Variable: Price in INR				
Mean price India: 22.55 INR/kg	**Unit**	**Mean values**	**Coefficients**	**T-values**
Constant			-4.9878 **	-2.2168
Rural[a)]	Dummy		-0.0401	-0.3759
Urban[a)]	Dummy		-0.0211	-0.1863
Moisture	%	9.8	0.5952 *	1.4567
Protein	%	17.9	1.5278 ***	3.6693
Fat	%	0.6	0.4699 *	1.8879
CrudeFibre	%	5.3	1.0379 ***	4.2628
Ash	%	3.7	-0.0117	-0.0459
Seedweight	g	6.9	0.3114 ***	2.6843
Foreignmatter	%	4.1	0.0690	0.7290
L/B-Ratio	Ratio length/breadth	1.7	-0.2600	-0.4381
Swelling Capacity	Ratio volume increase	1.8	-0.1027	-0.0633
Black	%	4	0.0379 ***	2.7235
Brown	%	18	-0.0330 **	-2.1815
Gray	%	0	0.0245	0.5174
Olive	%	18	-0.0217 *	-1.6666
Red	%	3	-0.0084	-0.6024
Yellow	%	57	0.0709	0.5918
Colour diversity	Herfindahl-Index	0.5	-0.4782 **	-2.1192
R^2: 0.80				
adj. R^2: 0.66				
emp. F-value: 5.634***				
N: 45				

***/**/* significant at 1; 5 or 10% significance level, a) Base: semi-urban

The coefficients of fat, moisture and the colour olive are significant at a level of $\alpha = 0.10$. Fat may be preferred, as it provides more calories per kg than proteins or carbohydrates. Moisture is preferred by consumers in India whereas it has a negative coefficient in Nepal. However, other studies report a dislike of moisture, as it indicates that the seeds are not well-dried (ALTEMEIER ET AL. 1989).

The included variables for the Indian model could explain 66% of the price variation of ricebean, which is lower than for the Nepalese model this may be due to the fact that the number of samples collected in India was less than half of that collected in Nepal.

3.8.3 Combining the samples from Nepal and India

After running separate regressions for Nepal and India the data of both countries were pooled because we aimed at one breeding program for both countries. The estimated coefficients of the model for Nepal and India are shown in Table 17. In this model another dummy variable 'country' was introduced to differentiate between the samples from each country as these were analysed in different laboratories. Thus, the data from two laboratories were combined. The dummy was inserted to allow the model to adjust for the differences. However it was found that the country dummy was not significant.

In the overall model 8 variables are significantly influencing the price. These are rural, protein, fat, crude fibre, seed weight, L/B-Ratio, and the colours black and gray. Rural prices are significantly lower than semi-urban prices, but the impact for urban is not significant. Crude fibre and seed weight are significantly preferred ($\alpha = 0.01$). Protein, fat, L/B-ratio and black are also preferred, and show a positive coefficient with a significant impact on the price variation ($\alpha = 0.05$). The influence of the L/B-ratio first appears in the model for both countries. The positive coefficient of the L/B-ratio indicates that a longish form is preferred by consumers. Further, the colour gray is not favoured and the estimated coefficient is significant at a level of $\alpha = 0.10$.

The preference of black and the dislike of gray may show that these visible characteristics may reveal other cryptic ones to consumers, which have not been included in this analysis.

Table 17: Estimated coefficients and interpretation for the hedonic model for Nepal and India.

Dependent Variable: Price in INR

Nepal & India:	Unit	Mean values	Coefficients	T-values
Constant			0.6578	0.9517
Country	Dummy		0.0517	0.3011
Rural[a)]	Dummy		-0.2952 ***	-6.2551
Urban[a)]	Dummy		0.0514	1.0952
Moisture	%	10.3	0.1762	1.1340
Protein	%	22.7	0.2763 **	2.1037
Fat	%	0.4	0.1239 **	1.9407
CrudeFibre	%	4.7	0.3500 ***	2.3615
Ash	%	4	-0.1304	-0.9406
Foreignmatter	%	6.9	-0.0118	-0.3211
L/B-Ratio	Ratio length/breadth	1.6	0.4522 **	2.3344
Swelling Capacity	Ratio volume increase	1.3	0.0087	0.1819
Black	%	2.7	0.0133 **	2.0277
Brown	%	15.5	-0.0053	-0.9995
Gray	%	7	-0.0111 *	-1.9192
Olive	%	12.6	-0.0047	-1.0061
Red	%	5.2	-0.0029	-0.5000
Yellow	%	57	0.0074	0.9211
Colour diversity	Herfindahl-Index	0.6	-0.0820	-1.2112
R^2: 0.65				
adj. R^2: 0.60				
emp. F-value: 12.8***				
N: 153				

***/**/* significant at 1; 5 or 10% significance level, a) Base: semi-urban

3.9 Interpretation of estimated coefficients for the model of India and Nepal

Hedonic price analysis allows the calculation of implicit prices of characteristics. It assumes that product price variations are explained by the variation of amounts of characteristics. The implicit price of a characteristic is the product price difference of two products that are completely identical except for a marginal variation of that characteristic. Thus, the implicit price is equal to the first derivative of the hedonic function (8) with regard to the considered characteristic

(8): $p_i = p_i\left(z_{ij}\right)$

(9): $\dfrac{\partial p_i}{\partial z_{ij}} = p_j\left(z_{ij}\right)$

where, p_j is the implicit price of characteristic j (j = 1,2,…,m) such as protein.

We used a double-log function to estimate the implicit prices of ricebean characteristics. The regression coefficient β_j in (10) represents the elasticity of the product price with respect to the considered characteristic. This elasticity or implicit price indicates the proportional change in product price when the characteristic changes by one per cent (BROCKMEIER 1993).

(10): $\log p_i = \alpha + \sum_{j=1}^{m} \beta_j \log z_{ij}$

The following is an interpretation of the results from the hedonic model for India and Nepal that are shown in Table 17. This table also includes the average prices per kg of ricebean and the average values of metric characteristics. All interpretations assume under *ceteris paribus* condition.

Table 18: Interpretation of significant characteristics

Characteristic	**Coefficient**	**Price change in INR by 1% increase of characteristic** (mean price: 25.07 INR/kg)
Protein	0.3	0.08
Fat	0.1	0.03
Crude fibre	0.4	0.10
Seed weight	0.4	0.10
L/B-ratio	0.5	0.13

The impact that a one percent increase of a significant characteristic has on the price is shown in Table 18. For instance, protein is positively related to price; if protein is increased by one per cent, i.e. from the mean of 22.7% of dry weight to 22.9% then the price would increase by 0.3% the coefficient of protein. An increase of the mean price by 0.3% would raise the price from 25.07 INR/kg to 25.15 INR/kg. A 1% increase of crude fibre would mean an increase in the price of 0.4%. If the weight increases by 1% then the price would also go up by 0.4%. If the L/B ratio increases by 1% then the price would increase by 0.5%. The mean value of fat content in ricebean is 0.4% of dry weight and the fat coefficient with a value of 0.1 is small. Thus, fat is preferred, but an increase in fat content has only a small impact on the price. The coefficients for black and gray are even smaller than the coefficient for fat. Gray is negatively related to the price, i.e. decreasing the share of gray ricebean would increase the price.

3.10 The Consumer Preference Index for ricebean

The implicit prices of characteristics allow us to evaluate consumer acceptance of a new ricebean variety. The implicit prices in form of elasticities can be used to develop a Consumer Preference Index (CPI). With this index, breeders may assess the expected price of an improved ricebean variety at an early stage of the breeding process since quantities as small as 100 to 200 grams are sufficient to calculate the CPI.

The following section includes an evaluation of promising ricebean varieties by assessing their economic value. Ricebean varieties were selected by breeders from two regions in India and were analysed for their seed weight and protein content. 9 varieties were selected as promising from Jorhat in the state of Assam, and 3 varieties from Palampur in the state of Himachal Pradesh.

The CPI for each variety can be calculated as follows:

F 11: $CPI_i = \beta_1 z_{i1} + \beta_2 z_{i2} + \beta_j z_{ij}$

where, i represents the variety and j the analysed characteristic. If β_1 is the coefficient of seed weight for example, than z_{i1} is the seed weight of a variety. β_2 could be the coefficient of protein and z_{i2} is the amount of protein of the variety.

The analysis of the selected varieties was made at a stage at which the results of the hedonic price analysis were not finalized and not all significant characteristics were identified. But it was likely that seed size and protein content are important characteristics. Table 19 shows the evaluation of varieties from Jorhat. If only seed weight and protein are included in the index. The mean CPI of all 9 varieties is 7.8. For this example we would recommend all varieties that have a higher CPI than 7.8. The best varieties, which should be used for further breeding, are JCR-08-49, JCR-08-50, and JCR-08-12 because a high CPI indicates varieties that correspond to consumers' preferences.

Table 19: Consumer preference index for ricebean varieties of Jorhat, Assam, India.

Varieties	Seed weight (g)	Protein (%)	CPI
Coefficients	0.3658	0.2763	
PRR-2	6.73	15.30	6.69
RBD-1	5.85	17.50	6.98
Lrb-33	7.43	15.60	7.03
RBC-2	4.49	20.00	7.17
LBL-40-1	6.72	18.80	7.65
JCR-08-30	6.64	19.40	7.79
JCR-08-12	8.81	16.90	7.89
JCR-08-50	11.75	18.30	9.35
JCR-08-49	12.31	18.50	9.61
Mean	**7.86**	**17.81**	**7.80**

Table 20 shows three varieties from Palampur with their seed weights and protein contents. The variety that has the highest index and which is most preferred by consumers due to its characteristics is BRS-1. It is the only variety from Palampur that has an index above the mean CPI of 8.48. If breeders use this variety, they could possibly get a ricebean which is preferred over other varieties by consumers.

Table 20: Consumer preference index for ricebean varieties of Palampur, Himachal Pradesh, India.

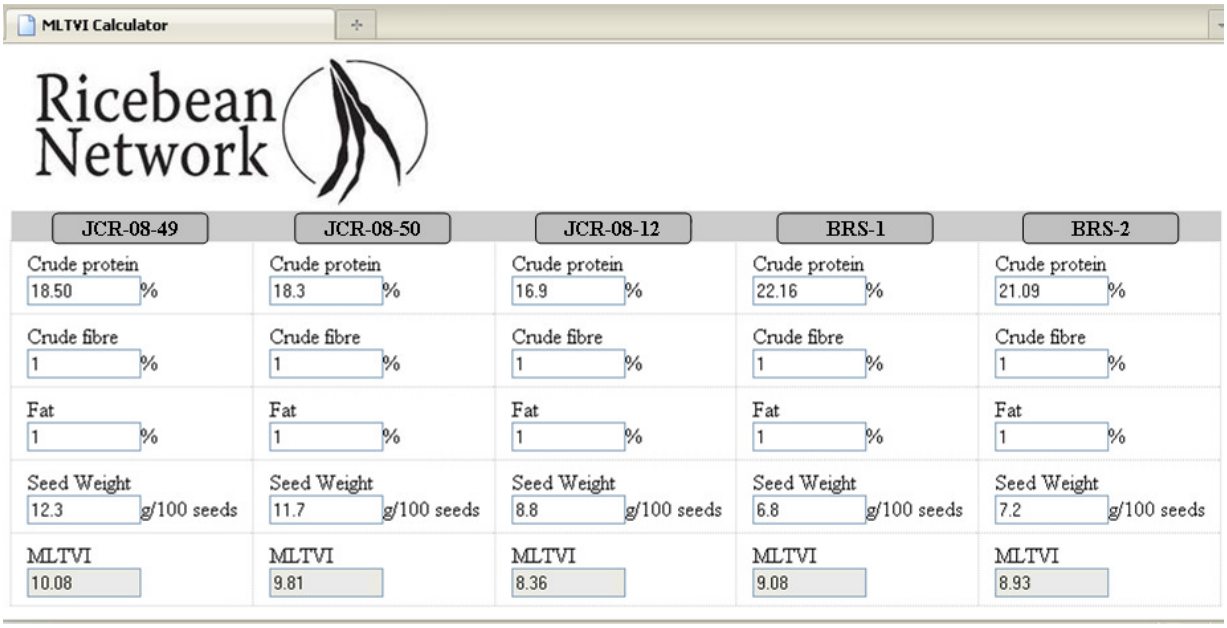
Varieties	Seed weight (g)	Protein (%)	CPI
Coefficients	0.3658	0.2763	
Nainy	6.40	21.80	8.36
BRS-2	7.20	21.09	8.46
BRS-1	6.80	22.16	8.61
Mean	**6.80**	**21.68**	**8.48**

3.11 The CPI calculator

To allow the comparison of ricebean varieties, a program was written to evaluate ricebean varieties by their parameter value of the significant characteristics. The CPI can be calculated by breeders via an internet browser, such as Firefox or Internet Explorer to run the program. The program facilitates the entry of the values of the characteristics that were found to influence the price of ricebean in the model for India and Nepal. These relevant characteristics are crude protein (%), crude fibre (%), fat (%) and seed weight (g/100 seeds). The program allows one to compare five ricebean varieties simultaneously. In addition, limits in the form of minimum and maximum values for each characteristic were determined to avoid errors.

Figure 8 shows a screenshot of the program. The characteristics of the best three ricebean varieties from Assam, JCR-08-49, JCR-08-50, and JCR-08-12, and the best two from Palampur, BRS-1 and BRS-2 were entered. Values for crude fibre and fat are missing. Thus, a value of one was entered for crude fibre and fat for all five varieties to facilitate a comparison. As a consequence, the calculated CPIs in Figure 8 cannot be compared to CPIs for which all four characteristics were determined.

Figure 8: CPI for five Indian ricebean varieties from Assam and Palampur.



In Figure 8 the CPI calculator evaluated the five ricebean varieties with respect to the amounts of crude protein, crude fibre, fat and seed weight that are preferred by consumers. The CPI for the ricebean is referred to as Market-based Legumes Traits Value-Index (MLTVI). On base of the CPI or MLTVI shown in the last row, the most preferred ricebean variety would be JCR-08-49, followed by JCR-08-50 and BRS-1.

3.12 Conclusion and discussion

The adequacy of a commodity for a certain use depends on its quality, which is defined by quality characteristics. Consumer perception and preferences determine which characteristics jointly define product quality. Only characteristics that are relevant for consumers influence their purchase decisions. Therefore, breeders should also consider consumers' perception of a product quality in addition to characteristics that make a variety or cultivar attractive for producers.

In the case of ricebean it is very important to identify relevant characteristics because it is quite heterogeneous. Ricebean varieties differ in size, colour and nutritional components, such as protein content.

The objective of the first part of this study was to provide breeders with an instrument to evaluate ricebean varieties with respect to quality characteristics that are relevant to consumers. For that purpose, we determined consumer preferences in India and Nepal. These characteristics could then guide the work of breeders. The method chosen for assessing consumers' preferences was hedonic price analysis. This analysis is based on Lancaster's (1966) study "New approach to consumer theory". The central idea is that goods are valued by consumers for their utility generating characteristics (LANCASTER 1966). Hence, consumers are not evaluating the product itself but its characteristics. The demand for a special characteristic is revealed through the demand for a product that contains that particular characteristic. If the amount of the demanded characteristic changes, the willingness-to-pay and the product price changes as well. The hedonic price analysis evaluates products on the basis of their heterogeneity. Therefore, it is possible to calculate implicit prices of characteristics which correspond to the price difference of two products that are identical, except for the considered characteristic.

Additionally, the hedonic analysis allows one to enter cryptic as well as evident characteristics. Cryptic characteristics, such as protein content or swelling capacity cannot be evaluated by consumers while purchasing ricebean, but these characteristics somehow also influence the perceived quality. Evident characteristics such as colour and size are visible. Both kinds of characteristics influence the perceived quality of a product. Thus, the results of the hedonic price analysis in form of implicit characteristic prices could be used by breeders to improve the quality and hence may increase the probability that the improved ricebean variety is more widely accepted by consumers.

In 2008, 153 ricebean samples were analysed for cryptic and evident characteristics in laboratories. The applicability of the hedonic price analysis was confirmed, as 60% of the price variation of ricebean samples in India and Nepal could be explained through the characteristics that were included. Four quality characteristics i.e. content of protein, crude fibre and fat and seed size were identified as being significantly related to the price.

The results of the hedonic price analysis were transferred into a program, referred to as the CPI calculator. This calculator allows breeders to select ricebean varieties by evaluating them with respect to the significant characteristics. The calculator facilitates an easy evaluation of ricebean varieties at an early stage, where small samples of 200 grams are sufficient to assess the characteristics.

Breeding for several characteristics including phenotypic and processing quality is difficult, and time and cost-consuming. The final evaluation of ricebean does not depend only on the set of significant characteristics. Due to the costs of breeding, breeders may only focus on some characteristics. In that case, a new ricebean variety should have large seeds and high protein content. These characteristics should be considered by breeders to increase the probability of consumers' acceptance.

In conclusion, the hedonic price analysis shows that there are certain quality characteristics of ricebean which can be objectively measured and which explain consumer preferences. Combining the results of the assessed quality characteristics with higher yield would probably lead to a rapidly accepted and desirable ricebean variety.

4 Markets and marketing options for ricebean

Orphan crops, such as ricebean, play an important role in the livelihoods of people in rural areas who rely on them for their food. Although ricebean is an important food crop for rural people, it has several weaknesses, such as low yield and lack of uniformity which research has only recently began to address.

Provided that breeders succeed in developing an improved variety that combines higher yields with characteristics desired by consumers, the next necessary step would be to introduce such an improved ricebean into pulse markets. A precondition for successful product introduction is a well-designed marketing strategy. Such a strategy must be based on a thorough analysis of the marketing system by which ricebean would be moved from producer to consumer. This includes the characterization of agents at every stage, identification of key transaction practices and marketing conditions. Moreover, market intelligence should be used to understand where product value is lost on the way from farmer to consumer, and where costs of transport, storage and transactions may be saved.

An agricultural marketing system can be defined as all activities and processes involved in moving a commodity from farmers to consumers. The pulse marketing systems in India and in Nepal are known to be fragmented, complex and even chaotic (WORLD BANK 2008). This complexity suggests that no single theoretical perspective is likely to be sufficient to describe and analyse the Indian and Nepalese marketing systems adequately. Therefore, four perspectives were selected in the hope of accommodating the complexity of the pulse marketing systems of the two countries. In particular, this study employs the perspectives of:

(i) market places;

(ii) market channels;

(iii) supply chains and networks, and

(iv) generalized market.

Each of the perspectives involves key concepts that have guided our empirical analysis of pulse and ricebean markets. The concepts of market places, channels, supply chains and networks and generalized markets are not perfectly separated from each other and there is some conceptual overlap. Therefore, the key concepts of the different perspectives were consolidated into what we call a ‘toolbox’. The toolbox represents a comprehensive perspective to describe and analyse the marketing system for pulses in India and Nepal.

Ricebean is grown in remote areas where semi-subsistence consumption prevails. Therefore, we start our analysis of the marketing system in Section 4.1.1 with the situation where sales of products does not occur, or occur only on a very small scale.

In the next Section 4.1.2, it is assumed that farmers produce a surplus which they sell on local markets. Market places are the first perspective of our toolbox. This section also introduces transaction costs that are always incurred with exchange and trade.

Food products like pulses usually pass several hands before they reach the final consumer. Thus, market places are often only one stage on the way from farmers to consumers. The whole sequence of market places, market intermediaries, processors and hawkers may be regarded as a channel that is presented in section 4.1.3. Members of channels are usually treated as anonymous to each other because their relationship is only transaction-based and relations that go beyond transactions are not considered in this perspective. Furthermore, the identity of persons is not considered in the channel perspective. Persons are solely distinguished by their function. While they are connected by the product flow, they are assumed to decide independently.

An advanced perspective for the path of a product is supply chains and networks (4.1.4) that are characterized by coordinated decisions between the agents. In contrast to channels, supply chains consider relations that go beyond transactions. These relations include, for example, joint coordination and information exchange.

The last perspective of our toolbox is the generalized market view in Section 4.1.5. The market view does not model flows of products and information. Information is transferred by prices and, similar to the channel perspective, all agents are treated as anonymous.

Section 4.2 presents our toolbox, which is used to analyse the pulse sector in India and Nepal.

The toolbox was applied in two steps. First, the total pulse sector in India and Nepal was investigated (Section 5.1) since the Indian and Nepalese pulse sectors constitute the environment in which an improved ricebean variety will be marketed.

In a second step, additional information about the ricebean marketing system was collected. For this purpose, interviews with Indian and Nepalese ricebean farmers and intermediaries were carried out in 2008 and 2009. The results regarding the cultivation practices and trade of ricebean are presented in Section 5.2.

Section 5.3 summarizes the key results and insights, and provides suggestions for the successful marketing of ricebean.

4.1 Frameworks for market description and analysis

Description always requires selection (SEN 1982). The base for the selection of the characteristics listed in Table 21 was an iterative process of knowledge accumulation over an extensive period of time. General knowledge about agricultural marketing systems was obtained from general market theory (GEERTZ 1978, LANDSBURG 2008, VARIAN AND BUCHEGGER 2007) and from a review of studies of agricultural marketing systems in developing countries (FAFCHAMPS ET AL. 2007, JAGANNATHAN 1987, MELLOR ET AL. 1968, SCOTT 1985, SCOTT 1995).

Specific information about the pulse and ricebean marketing systems in India and Nepal was obtained through field visits in the years 2008 and 2009. By switching repeatedly from theory and desk research to empirical field research, both became more focused - our theoretical basis as well as our attention to specific details of the real-world pulse marketing system.

Our toolbox was then derived from the characteristics in Table 21. Subsequently, it was used to describe and analyse the complex agricultural marketing system for pulses.

Some characteristics such as prices, sales volumes and margins are common to all four perspectives. Other characteristics such as transaction costs or weights and grades are common to three perspectives, whereas others yet are specific to only one perspective.

Any agricultural marketing system starts with the production of commodities by farmers. Many farmers in developing countries are however, subsistence or semi-subsistence farmers, and are incompletely integrated into the agricultural marketing system. These farmers are the starting point for our discussion.

Table 21: Perspectives and their core characteristics.

Market place[1]	Channel[2]	Supply chain & network[3]	Generalized market[4]
Prices			
Sales volumes			
Margins			
Transaction costs Weights & grades	Transaction costs Uniformity of weights & grades	Transaction costs Uniformity of weights & grades	
	Marketing costs (transport, storage, milling) Flows of products & money	Costs management Type & number of relations among agents (product, money, information)	
Number of buyers and sellers Type (e.g. village, assembly) Frequency (permanent, periodic) Infrastructure & facilities (e.g. roads, toilets, water, phones) Price finding mechanism Activities of traders			
	Stages/ levels/ tiers Sequence of stages Functions of stages		
		Type & number of agents Process coordination within the chain Inventory management Distribution of benefits, risks Leader (chain captain) Permanence of co-operation	
			Supply Demand Import/ Export Elasticities (own & cross price, income) Taxes and tariffs Price developments, price pattern Market form

[1] Scott (1985); [2] Bowersox (1986), Stern (1996); [3] Cooper (1993), Lambert (2000), Wassermann (1994); [4] Landsburg (2008), Varian (2007)

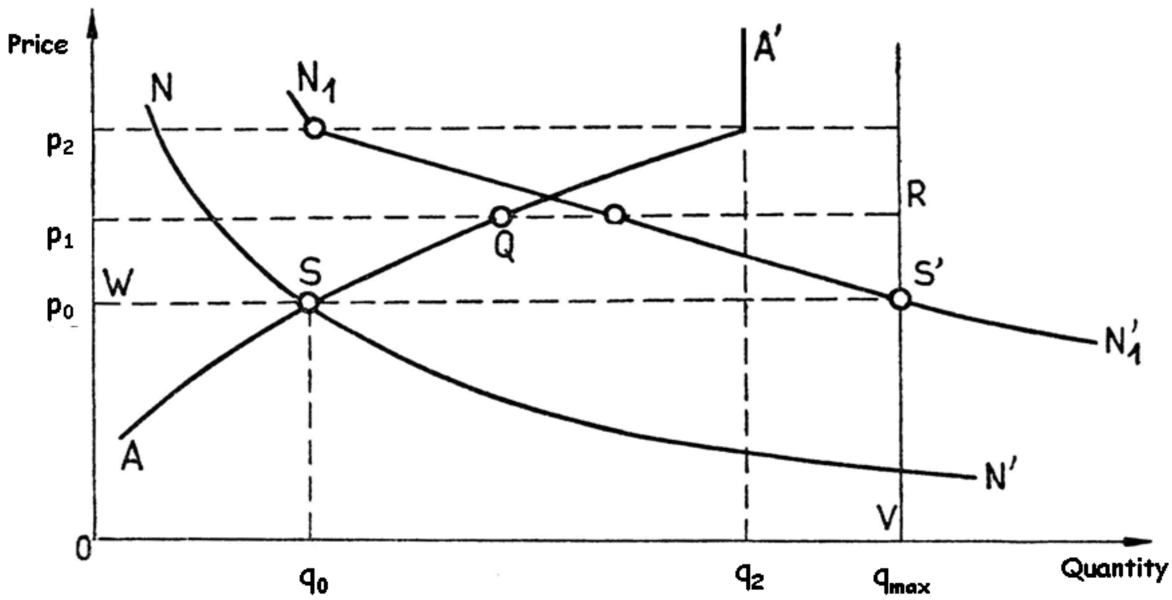
4.1.1 Subsistence households

Due to large distances to markets many ricebean farmers consume nearly all of their production. Schneider (1972) developed a model that analyses an individual producer's decision to keep or sell a product. This model is used to explain subsistence ricebean farming in India and Nepal.

Consider a farmer who has harvested all his ricebean and has to decide whether and how much to sell. The model is short-term since it considers only one production period. The farmer is assumed to be fully rational. Transaction costs, costs of transport and the uncertainty regarding market prices are not considered in the model of Schneider.

The model divides the total quantity demanded of a farm-produced good, such as ricebean, in producer's own demand and the quantity demanded by others. The model shows the relationship of the quantity that is traded by producers and market prices.

Figure 9: Model of subsistence households.



Adapted from: Schneider 1972, p. 330

The total quantity of ricebean that is produced by the farmer is given by q_{max} in Figure 9. The farmer is assumed to retain a minimum quantity of ricebean for home consumption, this quantity is equal to the difference of q_{max} and q_2.

The market supply of ricebean is represented by the curve AA'. The curve assumes that the market supply rises with prices up to the quantity of q_2. The kink in AA' at q_2 represents the assumption that the quantity (q_{max} - q_2) is always retained for home consumption irrespective of its markets price p. The market supply curve, AA' of the farmer can also be interpreted as the inverse curve of his own demand. The quantity of own demand is given by the difference between AA' and q_{max} and increases as the price decreases.

The market demand by consumers other than farmers is shown by the curve, NN', which slopes down towards the right.

Figure 9 shows that the farmer would sell quantity q_0 for price p_0 and keep q_{max} - q_0 (represented by the vertical line SS'). If the price rises from p_0 to p_1 the farmer would sell more ricebean and keep less for his own consumption. The farmer would increase the quantity supplied to the market up to q_2 for the price of p_2 but he would not sell more than q_2 even if the price rise above p_2. At p_2 the farmer supplies the maximum quantity he is willing to sell of q_{max} - q_2 to the market. This implies that he keeps the minimum own demanded quantity of q_{max} - q_2. Thus, all prices below p_2 decrease the quantity supplied to the market and increase the farmer's home consumption.

Total demand is calculated by adding up the farmer's own demand and the quantity demanded by non-farmers. The total demand is depicted by the curve, $N_1N'_1$, in Figure 9. The market clears at p_0 at the intersection of total demand, $N_1N'_1$, and the vertical line VR at the point S'. Note that VR indicates the total available amount of the relevant commodity (SCHNEIDER 1972).

Schneider's (1972) model shows how farmers distribute their production among own demand and market demand depending on the price. This model is essential to understand and analyse the ricebean trade in India and Nepal since it starts with subsistence farmers.

4.1.2 Market places

Section 4.1.1 highlighted the determinants of a farmer's decision to sell or not to sell what they have produced. We are assuming now that farmers are actually selling some or all of their products which leads us to the perspective of market places.

A market place can be described as a public gathering at a given location where people meet at a certain time to buy and sell (PORTER 1995).The analysis of market places is a standard element of agricultural marketing system analysis. Many studies about local traders and markets have been carried out by geographers and anthropologists whose main interests usually are the timing and historical origin of markets, the roles of ethnic groups and the meaning of local markets for social relations among market participants (EICHER AND BAKER 1992). In that literature, market places are usually described in terms of location, frequency, activities of traders, and physical and institutional infrastructure. As these terms have already successfully been used to describe market places we also include them into the analysis. The characteristics of the market place terms in India and Nepal are presented in the following section.

Depending on their location, market places are often classified into village, assembly, and urban markets. Village markets, also referred to as rural or primary markets, are used by famers to sell their commodities directly to consumers or village traders. Only small quantities of a commodity are usually traded here. Assembly markets are frequented by farmers and wholesalers who trade large amounts of commodities. In urban markets, commodities are traded on retail or wholesale level.

The frequency of markets can be periodic, e.g. once a week or continuous. Most rural and assembly markets have a periodicity of a fixed interval of days. Urban markets are mostly permanent markets (TRACEY-WHITE 2003).

The main activities of farmers and traders on markets are information-gathering, price negotiation, measuring, inspecting, buying and selling. In addition, there are activities that are not directly linked to transactions but are conducted on markets, for instance assembling, cleaning, processing, and packaging of products (SCOTT 1985).

The physical infrastructure of market places includes roads, cold storage facilities, stalls, grading machines, access to telephones, electricity, water, drainage, public toilets, and pest control (FAFCHAMPS ET AL. 2007). The institutional infrastructure of market places includes market rules, market policy to enforce these and the usage of standard weights and grades.

In this study, we go beyond the pure description of market places by explaining that market places are arrangements that reduce trading costs. From the economic point of view, “Markets exist to facilitate the transfer of ownership of goods from one owner to another” (COLMAN AND YOUNG 1989, p. 167). Trading on market places is facilitated when trading costs are reduced.

Trading costs include:

(i) transaction costs;

(ii) transport costs;

(iii) handling and processing costs, and

(iv) storage costs.

The elements of trading costs and their implication for market places are explained subsequently.

4.1.2.1 Transaction costs

Transaction costs occur when property rights of a product change hands. Coase (1937) recognized that there are costs to using the market mechanism. He introduced these costs as transaction costs into economics. Demsetz (1968) defines transaction costs as: “the cost of exchanging ownership titles”. Dahlman (1979) classifies transactions costs into (i) search and information costs, (ii) negotiation and decision costs, and (iii) monitoring and enforcement costs.

Barzel (1982) analyses transactions costs with regard to measurement costs. Measurement costs occur when the quality attributes of goods are determined through inspection. He argues that if information would be free of cost, attribute levels and defects could be identified effortlessly at the time of transaction. But product information is costly and attained by measuring attribute’s levels.

Descriptive market characteristics that influence transaction costs are the price-finding mechanism, the concentration in time of the buyer and seller, the use of standard measures, grades and labelling.

There are three general price-finding mechanisms. The first is posted prices. If traders post the prices of their products, they provide important information to customers and suppress price negotiation which reduces transaction costs. The second mechanism is the usage of auctions held at market places to facilitate a quick price-finding. Auctions are important when large amounts of perishable products have to be sold. The dominant price-finding mechanism on market places in India and Nepal is bilateral bargaining (WANG 1993, BESTER 1993). The influence that bilateral bargaining has on transaction costs is linked to the numbers of sellers and buyers on a market place.

Further, limiting the opening times of markets to certain periods, such as a set day, may also help to reduce traders' transaction costs. This effect, which we explain in more detail below, is likely to be particularly important in markets that are attended by small numbers of traders and where periodic trading helps to concentrate the few.

The impact of periodic trading can be explained with a model for markets with small numbers of buyers and sellers. When the number of traders attending a market at a given place and date are small, the supply and demand curves that represent the traders' willingness to buy and sell are not smooth curves. Rather, the curves involve steps that represent the differences between buyers' willingness-to-pay and sellers' willingness-to-accept (VARIAN AND BUCHEGGER 2007).

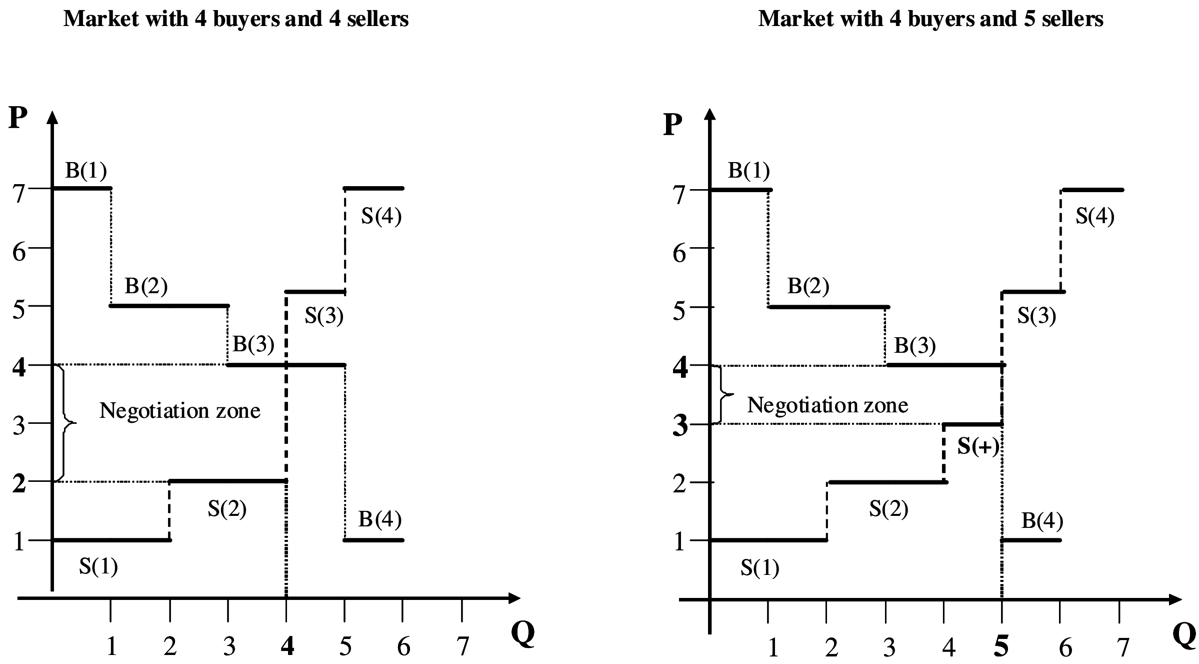
The price on which traders will settle is then indeterminate and must be found in bilateral price negotiations. Negotiations require time and constitute a transaction cost and it is reasonable to expect that the transaction costs increase with the difference between a sellers' willingness-to-accept and a buyers' willingness-to-pay. This negotiation zone is likely to be inversely proportional to the number of traders attending a market place at a given trading period.

Figure 10 represents a market with small numbers of buyers and sellers. The market on the left side of Figure 10 consists of four sellers S(1) - S(4) and four buyers B(1) - B(4). Seller (1) is prepared to sell 2 units of the good if the price p equals 1 or higher; similarly seller (2) is prepared to sell 2 units for a price $p \geq 2$. The demand curve which represents the buyers' willingness-to-pay for certain quantities is similarly constructed.

This market would clear when 4 units of the good are traded at a price from the interval $2 \leq p \leq 4$. At $p = 2$ supplier S (1) and S (2) would provide buyers B (1), B (2) and B (3) with 4 units and no producer surplus would accrue to seller S (2). At price $p = 4$, in contrast, no consumer surplus would accrue to buyer B (3). In this case, the negotiation zone would be determined by the willingness-to-pay of buyer B (3), who is the marginal buyer, and the willingness-to-accept of seller S (2), who is the marginal seller.

If an additional seller S (+) joins this market (on the right side of Figure 10) who is prepared to sell one unit of the good at price $p = 3$, three changes occur. First, the demand by the marginal buyer can now be fully satisfied. As a consequence, the total quantity traded increases from 4 to 5 units. Moreover, the negotiation zone shrinks from 2 units to 1 unit. It is plausible to expect that traders will, in general, find a mutually agreed price more quickly when the negotiation zone is reduced. We therefore can expect that transaction costs, which include the opportunity cost of the time spent on price negotiation, will be reduced when the number of traders present at a market place is increased because of limits on the periods when a market is open for trading.

Figure 10: Impact of few buyers and sellers.



Transaction costs are further influenced by the usage of grades, standard weights, and labels (this is explained below). Information about the quality of a product is obtained through inspection which, in turn, results in measurement costs. Measurement costs belong to transaction costs and an increase of measurement costs raises transaction costs as well. They can be reduced if quality standards in the form of grades are used. Grades transfer accurate information and decrease the need for repeated measurement and inspection by consumers (BARZEL 2002).

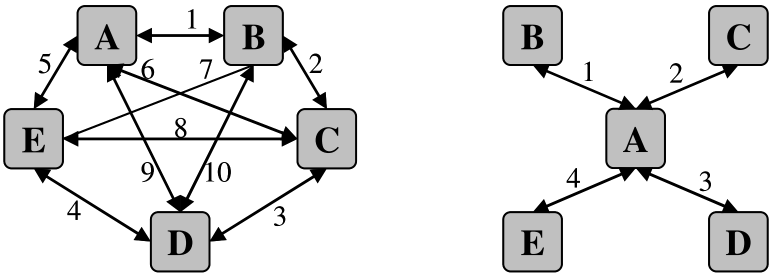
The gathering of information about the quantity of a product is improved if standardized weights are used. Unstandardized measures such as volume units (cups, tins) and different weight units are difficult to compare. If sellers use different volume units and weights the inspection costs for consumers rise which also implies higher transaction costs for consumers. Restricted comparability of volume units hampers the gathering of information. Thus, transaction costs are reduced if standard weights are used on markets.

Branding products may serve as a guarantee for product quality. If product quality is assured through a brand, then the measurement cost for buyers are reduced or even eliminated. As the brand can be used for several transactions, from farmers over wholesalers and retailers to consumers, measurement costs are eliminated several times over. Thus, transaction costs are also reduced (BARZEL 1982).

4.1.2.2 Transport costs

The second element of trading costs is transportation costs. Transportation costs are influenced by market places because they gather people at one place. The advantage of such a centralized exchange is shown in Figure 11.

Figure 11: Decentralized and centralized exchange.



(a) Decentralized exchange without a marketplace

(b) Centralized exchange on a market place

Source: Bowersox 1981

Panel (a) of Figure 11 shows a decentralized exchange between five agents (A-E) from different places. Each agent is assumed to offer a different commodity, and each agent desires all of the five commodities produced. If the agents want to engage in market they would have to travel to the respective places. The sum of the necessary transports of the five agents to the respective places is calculated as: 0.5 [n (n-1)], where *n* denotes the number of agents. Thus, the decentralized exchange in panel (a) requires 10 transports. However, if all agents (A-E) gather in one location like a market place they would reduce the number of necessary transports to n-1, which is equal to 4. This is shown in panel (b) of Figure 11. Thus, market places reduce the number of necessary transports, and thus the transport costs.

4.1.2.3 Handling costs

The third element of trading costs is handling costs. Handling costs are reduced if markets offer a physical infrastructure that prevents losses, which could also occur due to handling practices. Market infrastructure could reduce losses by providing a sanitary environment and facilities to maintain the quality of products such as refrigerators. Stalls are a hygienic alternative to the dirty ground and also protect products from the sun. Drainage, pest control and public toilets provide a sanitary environment which also reduces losses. Access to telephones allows access to information about prices and potential purchasers, which reduces the lead time of products to reach the final consumer (FAFCHAMPS ET AL. 2008). Roads improve the access to markets, which means decreased time and better conditions for transport. This reduces handling costs and also transport costs (JACOBY 2000).

4.1.2.4 Storage costs

The last element of trading costs is storage costs. Storage is used to carry over periodic market surpluses. Storage is associated with losses and costs. Losses of agricultural products during storage range from 3% to 40%, averaging at around 25%. The costs of storage are influenced by the storage form (granaries, bag warehouses, silos) and the stored product (EICHER AND BAKER 1992). Market places reduce or eliminate storage costs because farmers can sell surpluses that exceed their home consumption instead of storing these products.

The last Section presented the perspective of market places and their characteristics. Market places are one of four perspectives that are included to develop the toolbox, which is then used to analyse the agricultural marketing systems. The perspective of market places includes three characteristics that all perspectives have in common: the prices of the traded commodities, the sales volumes, and the margins received by traders. Beside these three characteristics, following are other characteristics of the market place perspective considered for our toolbox:

- transaction costs;
- standard weights and grades;
- number of buyers and sellers;
- infrastructure;
- type;
- frequency;
- price-finding mechanism, and
- activities of traders.

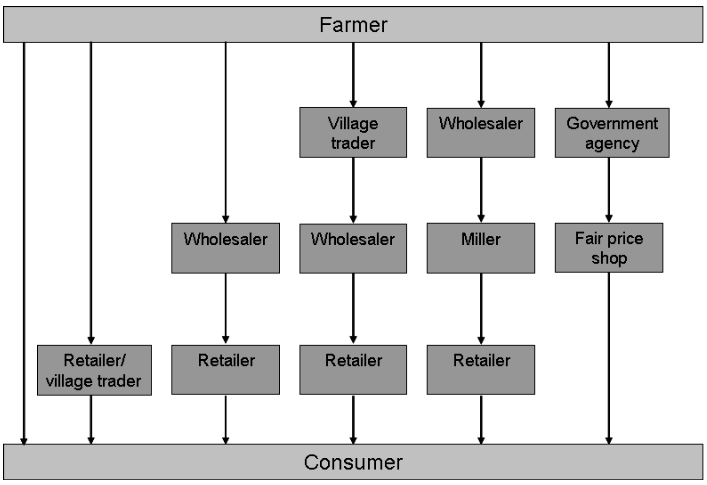
4.1.3 Market channels

The analysis of market channels provides systematic knowledge of the flow of goods and services from their origin (farmer) to their final destination (consumer) (MENDOZA 1995). The channel perspective treats trading partners as anonymous. Relationships that go beyond product exchange are not considered in this perspective.

Usually, the analysis of market channels considers the identification of agents that are merged into stages based on their similar function. The stages, also referred to as levels or tiers, involved in handling agricultural commodities typically are farmers, retailers, wholesalers, brokers, commission agents, processors and consumers. Furthermore, governmental agencies may also be involved, e.g. agencies that provide market information, implement commodity grades and enforce regulations (RHODES 1983).

Channels are visualized in the form of a flowchart that contains two main flows - the product flow that moves from farmers to consumers and the flow of money which moves in the opposite direction (STERN ET AL. 1996, BOWERSOX ET AL. 1980). Figure 12 presents some simplified market channels as a product flow chart. The channel configuration may vary between products, locations, usage of products and time (season).

Figure 12: Product flow in market channels.



Source: McCarthy 1968

Each stage of the channel performs marketing functions (ACHARYA AND AGARWAL 2004), which are shown in Table 22. Detailed information about marketing functions and different classifications of these functions are provided by THOMSEN 1951, CONVERSE ET AL. 1959, and KOHLS AND UHL 1985. The exchange functions of buying and selling are activities that are directly involved in the transfer of titles of goods. The physical functions storage, transport, processing and packaging are necessary to handle, move and transform products. The facilitating functions permit a smooth, cost-saving exchange. The individual functions in Table 22 are not always linked to a particular stage some may be carried out at several stages, e.g. buying, selling, transport, and storage. Other functions may be carried out only once, e.g. packaging and processing.

Table 22: Marketing functions along a channel.

Exchange functions	Physical functions	Facilitating functions
Buying	Storage	Standardisation & grading
Selling	Transport	Financing
	Processing	Risk bearing
	Packaging	Market intelligence

Source: Rhodes 1983

In carrying out these functions, agents are compensated financially because they add value to the product. Thus, each stage of a channel is associated with a mark-up on the farm price that increases with each stage it passes (MENDOZA 1995).

The sum of all mark-ups along a channel from farmer to consumer constitutes the farm-retail price spread or the total marketing margin. The margin includes marketing costs and additional income (SHEPHERD AND FUTRELL 1982).

Once the marketing costs are identified, it is possible to assess where costs can be reduced to make a market channel more efficient (CRAWFORD 1997). Acharya (2004) and Crawford (1997) identified several factors that influence marketing costs and the efficiency of a market channel. Among others they include the perishability of products, quantity and quality loss during storage and transport, and the extent of grading.

The deterioration of highly perishable products and quantity as well as quality loss during storage and transport may be reduced if physical infrastructure and facilities, such as cooling and pest control are available.

The influence of grading on marketing costs and therefore on the efficiency of market channels could also be explained through transaction costs. Without grading, the costs of determining product quality rise for buyers and sellers alike, and transaction costs increase. Grading and the use of uniform grades over the whole channel would decrease marketing costs and improve channel efficiency.

To summarize, the market channels perspective adds the following elements to the toolbox:

- stages and their functions;
- sequence of stages;
- marketing costs;
- uniformity of weights and grades, and
- flows of product and money.

In addition, the channel perspective might also be useful for identifying those stages at which value could be added by processing or grading.

4.1.4 Supply chains

Supply chains and the previously presented perspective of market channels are both concerned with the flow of a product from its source to the final consumer. This becomes apparent by this definition of supply chains: “A supply chain is a set of three or more organizations linked directly by one or more of the upstream or downstream flows of products, services, finances, and information from a source to a costumer” (TRENT 2004).

The main difference between market channels and supply chains is that agents in supply chains coordinate their decisions and actions instead of autonomous decisions and actions in market channels. The coordination of all agents from farmer to consumer requires management, and this is referred to as supply chain management (SCM). “Supply chain management then, involves proactively managing the two-way movement and coordination (that is, the flows) of goods, services, information, and funds from raw material through end user” (TRENT 2004). Improvements through SCM are realized by saving costs through leaner inventory and shorter lead times while serving high quality products and services for the end consumer (EVANS ET AL. 1995). SCM is also an instrument that facilitates the traceability of commodities from the producer to the final consumer (GAMPL 2006).

Coordination requires information exchange over several stages. This was first shown by Forrester (1961), who demonstrates that small variations of the demanded quantity can induce a large increase of variation of demanded quantities in subsequent stages of the supply chain

(FORRESTER 1961). This effect, referred to as the *bullwhip-effect* occurs due to time lags and autonomous decisions of agents without coordination and information exchange. When information is unavailable, each agent has an incentive to keep a safety stock that buffers unexpected changes in the quantity demanded (LEE ET AL. 1997).

SCM requires that firms coordinate their actions. This implies that relations between firms go beyond pure exchange relations. A distinction is usually made between horizontal and vertical coordination. Coordination is vertical when firms of the same stage in a supply chain coordinate their activities and vertical when firms of different stages in a chain coordinate their actions. The range of vertical coordination reaches from strategic alliances and contracts over quasi-vertical integration and tapered vertical integration to full vertical integration (SPORLEDER 1992). The advantage of coordination is that the costs of using the market mechanism referred to as transaction costs can be avoided (HOOBS 1996). But vertical coordination also involves costs for administration and organization. Thus, firms should coordinate their actions if the costs of coordination are lower than transaction costs.

SCM contains three core elements: i) the supply chain configuration ii) the supply chain business processes and iii) the supply chain management components (LAMBERT AND COOPER 2000). The first element is the configuration of a supply chain which is less a chain than a network. It contains all types of firms at each stage and also the links between these firms. The supply chain configuration includes the number of all involved stages and the number of agents at each stage, which may include farmers, transport companies, wholesalers, retailers and the final consumers (LAMBERT AND COOPER 2000).

An instrument to analyse the configurations of supply chains is the network model based on graph theory. "A social network consists of a finite set or sets of actors and the relation or relations defined between them." A relation is the "collection of ties of a specific kind among members of a group" (WASSERMANN AND FAUST 1994, p. 20). Applying network models and the connected SNA on supply chains provides: (i) network diagrams (ii) quantitative measures that describe network-related attributes of individual network members and (iii) quantitative and qualitative measures of the whole network (MÜLLER ET AL. 2007).

The second core element of supply chains is business processes. Typical for the supply chain perspective is to view the entire chain as a set of interrelated processes that are intended to achieve shared objectives. Processes include, for example, product development, order fulfilment and procurement. Supply chain processes can cross inter- and intra- organizational boundaries. That means processes do not have to run in one firm only (COOPER ET AL. 1997a).

The third core element of the supply chains is the management component. These components are affected by the management and integrate processes into the entire supply chain. Lambert (2000) identified nine management components:

- planning and control;
- work structure;
- organization structure;
- product flow facility structure;
- information flow facility structure;
- management methods;
- power and leadership structure;
- risk and reward structure, and
- culture and attitude.

These management components are explained within the following comparison of traditional market channels (4.1.3) and supply chain management.

Cooper and Ellram (1993) developed a comparison (Table 23) between traditional market channel management and SCM. Since our toolbox also includes market channels and SCM, a comparison would emphasize the difference between autonomous decisions in channels by anonymous agents and coordinated exchanges in supply chains. The elements in Table 23 are explained from top to bottom.

The inventory in a traditional market channel and storage levels are planned independently by every agent. The supply chain approach uses a chain-wide inventory management to reduce redundant inventories.

In supply chains costs should also be considered over the whole chain. In market channels single agents minimize their costs. The chain-wide cost evaluation facilitates additional savings because some chain members may have conditions, rates or taxes which generate competitive advantages for the whole supply chain.

The time horizon of supply chain relations is extended in comparison to channels. Relationships in channels are short-term because they are over when the transaction is completed. SCM requires a longer time period because the coordination often involves additional investments in information and operation systems. These investments for cooperating are only profitable over a time period that lasts longer than the transaction.

Information sharing and monitoring are crucial for the coordination and planning in supply chains and should not only be limited to current transactions like in market channels. The information should flow down the chain from producer to consumer and upwards in the opposite direction (COOPER AND ELLRAM 1993).

The amount and focus of coordination is different in channels and supply chains. Market channel analysis is usually unconcerned about the coordination of activities between agents that belong to a channel whereas coordination among agents is a major concern of supply chain analysis. SCM implies that all agents of the chain coordinate their activities. Thus, there are more contacts of different management levels of functions and the contacts are more frequent compared to traditional channels (COOPER ET AL. 1997b).

Table 23: Comparison of traditional channel management and supply chain approach.

Element	Traditional channels	Supply chains
Inventory management	Independent	Channel-wide
Total cost approach	Minimize firm cost	Channel-wide cost efficiencies
Time horizon	Short term	Long term
Amount of information sharing and monitoring	Limited to needs of current transactions	As required for planning and monitoring processes
Coordination	Single contact for transaction	Multiple contacts
Joint planning	Transaction based	On-going
Compatibility of corporate philosophies	Not relevant	Compatible at least for key relationships
Breadth of supplier base	Large to increase competition and spread risk	Small to increase coordination
Channel leadership	Not needed	Needed for coordination focus
Sharing of risks and rewards	Each on its own	Shared over long time

Source: Cooper 1997

Joint planning in supply chains goes beyond the scope of single transactions and delivery times between neighboured companies in a channel. Joint planning in supply chains develops over years and affects processes like material flow and product development; it involves many members of the chain.

The compatibility of corporate philosophies brought up in Table 23 refers to mean agreements on the basic direction of the supply chain. Compatibility eases coordination and long-term relationships. The compatibility of corporate philosophies is rather unimportant for transactions in market channels.

Members in traditional channels often have a wide breadth of suppliers to increase competition and to decrease the risk of missing products if one supplier cannot deliver. SCM implies a reduced breadth of suppliers to achieve a closer management and coordination of fewer relationships (COOPER AND ELLRAM 1993).

The situations wherein a supply chain needs to nominate a leader (referred to as chain captain (COOPER AND ELLRAM 1993) or firms get a leading function due to their size or economic power (MENTZER ET AL. 2001) are discussed in the literature.

The sharing of risks and rewards over a period longer than a transaction requires close relationships and the willingness to achieve a win-win situation for every agent. Traditional channels cannot balance risks and rewards because the relationships are short-term and the agents act relatively independently and opportunistic (COOPER AND ELLRAM 1993). SCM employs risk prevention practices such as quality certification, supplier development and improved forecasting. Furthermore, risk managing practices such as many supply sources and safety stocks are noted in literature (TRENT 2004), but these practices are contradictory to the small breadth of the supplier base and lean inventory of SCM (COOPER AND ELLRAM 1993).

In summary, the contribution of SCM and supply networks to our toolbox is presented. Like all other perspectives, SCM also involves product prices, sales volumes and margins. Also, transaction costs are considered because the agents in a supply chain co-operate in order to reduce transaction costs. Standard weights and grades for agricultural commodities are also important in a supply chain to reduce the costs of inspection and consequently the transaction costs over the whole chain.

The analysis of agricultural marketing systems from the supply chain and network perspective adds the following objects of investigation to the toolbox:

- type and number of agents;
- type and number of links among agents;
- processes and their coordination;
- cost and inventory management among agents;
- distribution of benefits and risks, and
- permanence of co-operation.

4.1.5 Generalized market

The generalized market view can be seen as a perspective that includes market places, channels and supply chains as well as networks. Like in market places and channels, involved agents are treated anonymous to each other. In generalized markets, all information is comprised of prices. A market is ruled by the laws of supply and demand.

Supply is the relationship between varying quantities offered for sale at changing prices at a certain time and location (KOHLS AND UHL 1985). A special feature of agricultural products is that the production that is supplied to the market is often reduced by the share for home consumption (section 4.1.1). The quantity supplied by farmers minus the share for home consumption is the marketed surplus.

Demand is the relationship between purchased quantities of a product and the price of that product. For ordinary goods, the lower the prices, the more the amount that will be bought (KOHLS AND UHL 1985).

If we assume that the generalized market is limited to a country, then the domestic supply and demand, and consequently domestic product prices are affected by imports from, and exports to foreign markets. Thus the perspective of generalized markets should include imports and exports.

Another important characteristic of products on generalized markets are elasticities. In general, elasticities express consumers' and producers' reactions to price changes for single products. By definition, elasticity is the proportional change of the quantity supplied or demanded divided by the proportional price change. Values above 1 indicate elastic supply and demand, whereas values below 1 indicate inelastic supply or demand (SAMUELSON AND NORDHAUS 1998). The income elasticity reflects the change in demand when consumers' incomes change. Income elasticities of necessary commodities are quite small because people have to buy these, regardless of price. Luxury goods in contrast, have a high income elasticity. Another category of goods are inferior products. The demanded quantity of inferior goods decreases with increasing income (MANKIW 1999). The cross price elasticity of demand reveals whether two products are substitutes (value > 1), like tea and coffee or complementary goods (value < 1) like tea and sugar (KOESTER 2005).

On generalized markets all product information are included in prices. There are several factors that influence the prices of agricultural products. One is the government that does so through price supports, controls and trade policies. For instance, price ceilings and price floors prohibit by law that markets prices fall below a given amount or rise above a certain value. Price floors, such as the minimum support price in India, are used to support farm prices and farmers' incomes. Both floors and ceilings set prices at which the market will not be cleared. Price floors are usually higher than the market price and will lead to more supply than demand. Price ceilings are below market prices and lead to a higher demand (KOHLS AND UHL 1985).

Additionally, agricultural prices often show patterns such as price cycles and seasonal price variations. Agricultural price cycles are regular price variations induced through cyclic increase and decrease of agricultural supply. Seasonal price variations are regularly caused by seasonality of demand, production and marketing (RHODES 1983). Seasonal price changes occur when farmers sell all crops immediately after harvest. The abrupt increase of the supplied quantity results in decreasing prices (KOHLS AND UHL 1985).

The price formation referred to as pricing in markets is influenced through market forms which also reflect the strength of competition. Perfect competition implies, among other characteristics, a large number of buyers and sellers. Thus, type and strength of competition is affected by the number of sellers and buyers in a market (RHODES 1983). Stackelberg (1952) introduced a classification of markets as shown in Table 24. The classification is based on the number of sellers and buyers (KOESTER 2005).

Table 24: Market differentiation according to the number of buyers and sellers.

Seller \ Buyer	Many	Few	One
Many	Polypoly	Oligopsony	Monopsony
Few	Oligopoly	bilateral Oligopoly	limited Monopsony
One	Monopoly	limited Monopoly	bilateral Monopoly

Source: Koester 2005

Analysing and describing the agricultural marketing systems from the generalized market perspective would add following characteristics into the toolbox:

- quantity supplied;
- quantity demanded;
- imports/exports;
- elasticities;
- market form;
- taxes, tariffs, regulations, and subsidies, and
- price developments and price pattern.

4.2 The toolbox

Sections 4.1.2 to 4.1.5 presented the perspectives that enter the toolbox which is employed to analyse and describe the complex agricultural marketing systems in India and Nepal. The toolbox includes observable characteristics from all four perspectives and is shown in Table 25.

The toolbox is applied in two steps. First, the marketing system of pulses in India and Nepal is investigated (section 5.1.1 and 5.1.2) because an improved ricebean variety would be marketed in this sector. To this end, scientific literature, information from government publications and websites and data bases were reviewed.

In the second step, additional information about ricebean marketing systems was collected by means of interviews (Section 5.2). The interviews were carried out with Indian and Nepalese ricebean farmers and intermediaries in the years 2008 and 2009.

Table 25: Toolbox to analyse and describe the agricultural marketing system in India and Nepal.

Market place	Channel	Supply chain & network	Generalized market	Toolbox
Prices	Prices	Prices	Prices	Prices
Sales volumes	Sales volumes	Sales volumes	Sales volumes	Sales volumes
Margins	Margins	Margins	Margins	Margins
Transaction costs Weights & grades	Transaction costs Uniform weights & grades	Transaction costs Uniform weights & grades		Transaction costs Uniform weights & grades
	Marketing costs Flows of products & money	Costs management Type & number of relations		Marketing costs & management Flow of products, money, information as relations
Number of buyers and sellers Type Frequency Infrastructure & facilities Price finding mechanism Activities of traders				Number of buyers and seller per market place Type of market places Frequency of market places Infrastructure of market places Price finding mechanism Activities of traders
	Stages/ levels/ tiers Sequence of stages Functions of stages			Stages Sequence of stages Functions of stages
		Type & number of agents Process coordination within the chain Inventory management Distribution of benefits, risks Leader (chain captain) Permanence of co-operation		Type & number of agents Process coordination within the chain Inventory management Distribution of benefits, risks Leader (chain captain) Permanence of co-operation
			Supply Demand Import/ Export Elasticities Taxes and tariffs Price developments & pattern Market form	Supply Demand Import/ Export Elasticities Taxes and tariffs Price developments & pattern Market form

5 The market for ricebean: A niche market embedded in the market for pulses

5.1 The marketing system of pulses in India and Nepal

5.1.1 Pulse market and marketing in India

India is the largest producer, consumer, and importer of pulses in the world (CHANDRASHEKHAR 2007). India accounts for 25% of the global pulse production and 27% of the global pulse consumption (PRICE ET AL. 2003).

About 60% of agricultural land in India is rain-fed and in addition to pulses, oilseeds and coarse cereals are grown on this kind of land (GOVERNMENT OF INDIA 2006a). Usually pulses are grown in only one of the two seasons, i.e. *kharif* (May to October) or *rabi* (November to April) season. Pigeonpea, black gram, green gram, horse gram, and ricebean are grown in the warm, rainy *kharif* season. Legumes of the cold *rabi* season are chickpea, lentil, and dry peas. Four-fifths of Indian farmers save their seeds from their previous harvest to use in the following season (PRICE ET AL. 2003). This means that the majority of farmers do not purchase improved seeds of plant varieties.

Out of total agricultural land, 11% is used for pulse production. Table 26 shows detailed information about this land. The most important pulses are chickpea, with an area of 7.58 million hectares, and a production of 6.91 million tonnes, pigeonpea with 3.79 million hectares and 3.09 million tonnes and lentils with 1.47 million hectares and 0.91 million tonnes. In total, pulses are cultivated on 23.86 million hectares and 15.12 million tonnes were harvested (GOVERNMENT OF INDIA 2008).

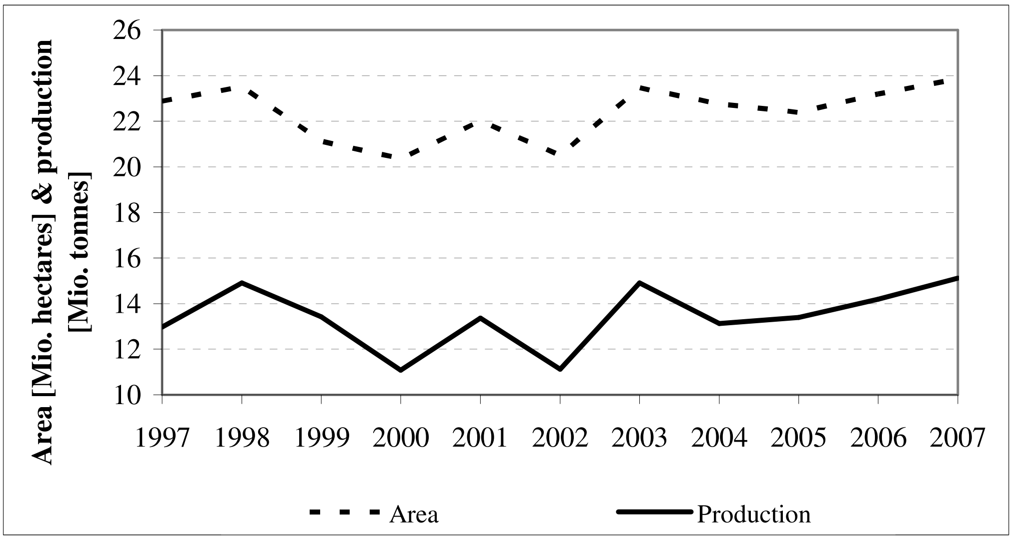
Table 26: Area and production of the three most important and total pulses in India, 2007.

Most important pulses	Area (million hectares)	Production (million tonnes)	Proportion of total pulse production (%)
Chickpea	7.58	6.91	46
Pigeonpea	3.79	3.09	20
Lentil	1.47	0.91	6
Total	23.86	15.12	72

Source: Government of India 2008

The development of pulse area and production from 1997 – 2007 is presented in Figure 13. It shows that the level of area under pulses and the level of the quantity produced has changed very little since 1997.

Figure 13: Development of area under pulses and produced amount in India, 1997 to 2007.



Source: Government of India 2008

The proportion of harvested pulses that farmers sell is referred to as marketed surplus ratio (MSR). The MSR varies heavily. The MSR of the most important pulses are shown in Table 27. Chickpea growers sold an estimated share of 94% of their harvest and kept only 6% for home consumption and for seed. Farmers who grow black gram and green gram are only selling about half of their harvest from these gram crops. Chickpea and pigeonpea might have a higher MSR, because there are already varieties with high yield and fewer disadvantages, such as pests or indeterminate grow.

Table 27: Marketed surplus ratio of important pulses in India, 2005-06.

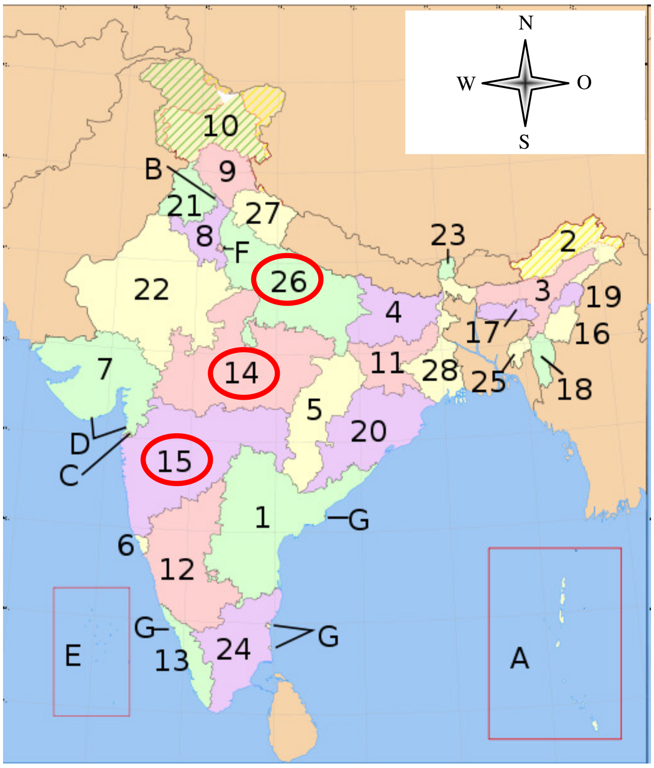
Pulse	Marketed Surplus Ratio in %
Chickpea	94
Pigeon pea	78
Lentil	66
Green gram	56
Black gram	49

Source: Government of India 2008

Madhya Pradesh, Uttar Pradesh and Maharashtra are the three most important pulse production states of India's 28 states with shares of around 20% of total national pulse production (GOVERNMENT OF INDIA 2004a). For the geographical location of these states, see the map in

Figure 14. Madhya Pradesh, Uttar Pradesh, and Maharashtra are labelled with the numbers 14, 26 and 15, respectively.

Figure 14: The Indian states.

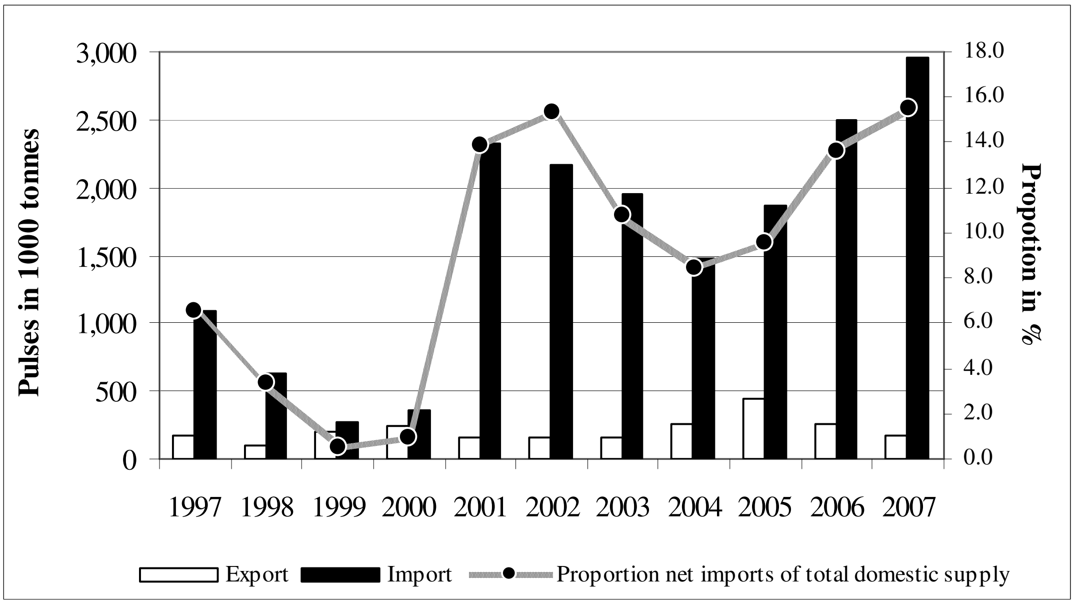


1 Andhra Pradesh	**15 Maharashtra**
2 Arunachal Pradesh	16 Manipur
3 Assam	17 Meghalaya
4 Bihar	18 Mizoram
5 Chhattisgarh	19 Nagaland
6 Goa	20 Orissa
7 Gujarat	21 Punjab
8 Haryana	22 Rajasthan
9 Himachal Pradesh	23 Sikkim
10 Jammu and Kashmir	24 Tamil Nadu
11 Jharkhand	25 Tripura
12 Karnataka	**26 Uttar Pradesh**
13 Kerala	27 Uttarakhand
14 Madhya Pradesh	28 West Bengal
A Andaman and Nicobar	E Lakshadweep
B Chandigarh	F National Capital
C Dadra and Nagar Haveli	G Puducherry
D Daman and Diu	

Source: Wikipedia 2010

In addition to the supply from domestic production pulses are imported into India. The imported and exported quantities of pulses in India are shown in Figure 15. Furthermore, this figure shows the proportion of net imports in domestic supply, whereas the domestic supply is the sum of domestic production and net imports of pulses. The proportion of net imports was low in 1999 and 2000 with values around 1% of total domestic supply and increased to 15% in 2002. Afterwards the proportion of net imports decreased from 2002 to 2004 and reached the level of about 15% of total domestic supply again in 2007. Since 1990, India is a net-importer of pulses. The major pulse exporting countries are the USA, Canada, France, China, Argentina, Turkey, Myanmar and Mexico. In 2007, India imported pulses with a value of $60 million from the U.S. and is the largest importer of U.S. pulses (USDA 2009). Since 1999, there are no longer quantitative restrictions on imports and they are subject to tariff (SATHE AND AGARWAL 2004).

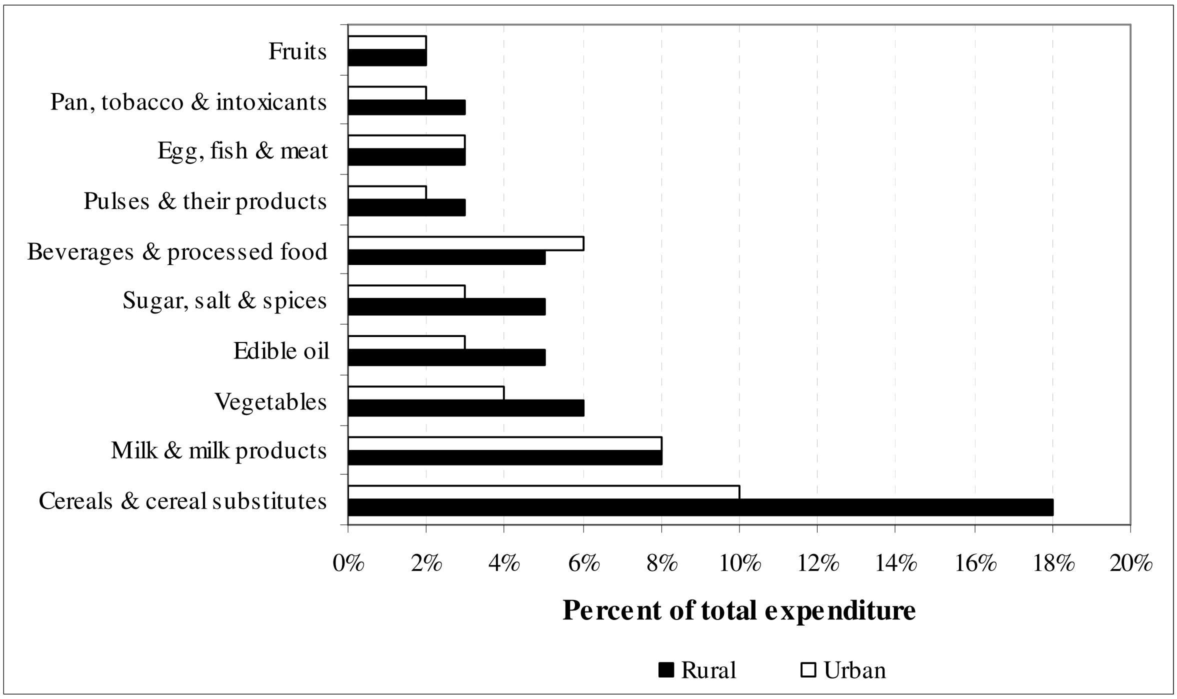
Figure 15: Import and export of pulses in India, 1997 to 2007.



Source: FAOSTAT 2010 and Government of India 2008

The influence of pulses in Indian diets is depicted in Figure 16. People in rural India spend about 55% of their total expenditures on food and about 3% pulses. People in urban areas spend 43% of their total expenditures on food and 2% of their expenditures for pulses (GOVERNMENT OF INDIA 2006b).

Figure 16: Consumers expenditure for food items in rural and urban India, 2004 to 2005.



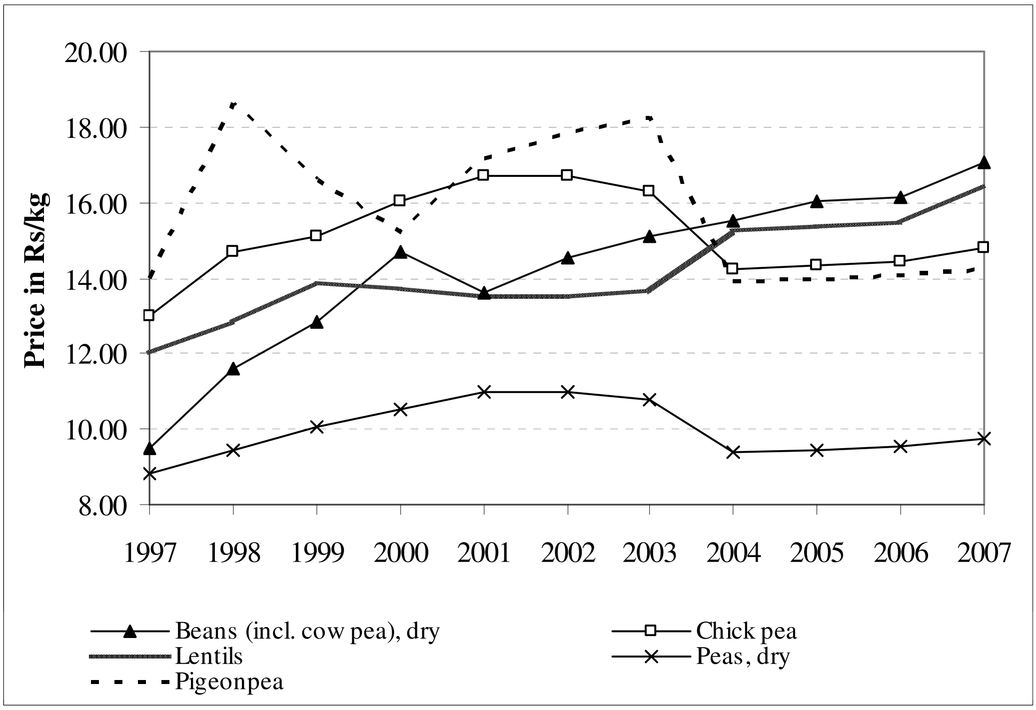
Source: Government of India 2006b

The Indian population is growing every year by about 1.6%, whereas the pulse production is stagnating or even declining (see Figure 13) (ALI AND KUMAR 2007). Although pulses are imported to India, the net availability of pulses has decreased. The net availability is defined as: = gross production - seed, feed, waste – exports + imports +/- change in stocks.

The Survey "Agricultural statistics at a Glance" (2004) reports a steady decrease in the net availability of pulses per capita and day. In 1951, 60.7 grams of pulses were available for each person per day. In the recent past (2001 to 2003), the net availability declined to 31.4 grams of pulses per capita and day (GOVERNMENT OF INDIA 2004b).

Figure 17 presents nominal producer prices of important pulses. According to the FAO's definition (Annex 3), ricebean is included in the class of "bean, dry" under its previously designation *Phaseolus calcaratus*. Figure 17 shows no clear trend for nominal farm-gate prices of peas, pigeonpeas and chickpeas from 1997 to 2007. Only the price of the class "beans, dry" that includes ricebean increased from 9.47 INR/kg in 1997 to 17.08 INR/kg in 2007.

Figure 17: Nominal producer pulse prices in India in INR/kg, 1997 to 2007.



Source: FAOSTAT 2010

Instead of nominal producer prices Table 28 shows annual growth rates of deflated wholesale prices of pulses and some other commodities. Pulse consumption declined by 0.9% per year from 1980 to 2000, which may be partially explained by the annual increase in pulses prices by 2.1% of the previous year price. The prices of wheat and rice also increased, but at a much lower rate of 0.4% and 0.5% of the previous year price, respectively.

Table 28: Annual growth rates of deflated wholesale prices, 1980-2000.

Commodity	Annual growth rates of deflated wholesale prices, 1980-2000 in %
Pulses	2.1
Wheat	0.4
Rice	0.5
Milk	0.6
Edible oil	-1.0

Source: Price 2003

The demand for pulses is positively correlated with income. Kumar (2007) calculated an income elasticity of 0.2 for pulses in India. That means, if the income increases by 1% the demand for pulses rises by 0.2%. But despite rising incomes in India, the consumption of pulses per capita is decreasing (KUMAR 2007). This might be explained by the fact that the share of income spend for pulses decreases with increasing incomes. People with higher incomes substitute pulses by vegetables or fruits.

Indian consumers are very price-sensitive, as shown by the price elasticities of demand in Table 29. Note especially the group of very poor people (see group I) in rural areas, who would decrease their pulse consumption by 0.8% when prices increase by 1% (MITTAL 2006).

Table 29: Own price elasticities of demand for pulses.

	I very poor	II moderately poor	III non-poor lower	IV non-poor higher
Urban	-0.784	-0.738	-0.597	-0.406
Rural	-0.775	-0.686	-0.545	-0.334

Source: Kumar 1998 after Price 2003

Although the dry weight of pulses contains about 20% proteins, they are not substituted by other protein-rich foods such as fish and meat (PRICE ET AL. 2003). Substitutes for pulses are cereals, fruits, vegetables and milk products. In particular, the lower prices of cereals, compared to pulses, lead to that substitution. Ricebean is mainly used for dal cooking - it would be substituted by other pulses like chickpea, lentils, green gram, black gram, cowpea and peas.

India's agricultural sector has undergone drastic changes since the 1970s. Over the years India's main intention was to protect its domestic agriculture from international competition (AGBOLA 2004). In the 1970s and 1980s, Indian policy aimed at self sufficiency in pulses. The Government of India implemented tariffs, quotas and quantitative restrictions on imports, price controls, import licensing and marketing restrictions. In the 1990s, India reformed its trade policy to foster economic growth. This included a reduction in tariffs, quotas, import and export restrictions, abolishment and/or lowering of marketing restrictions and the floating of the exchange rates (AGBOLA AND DAMOENSE 2005).

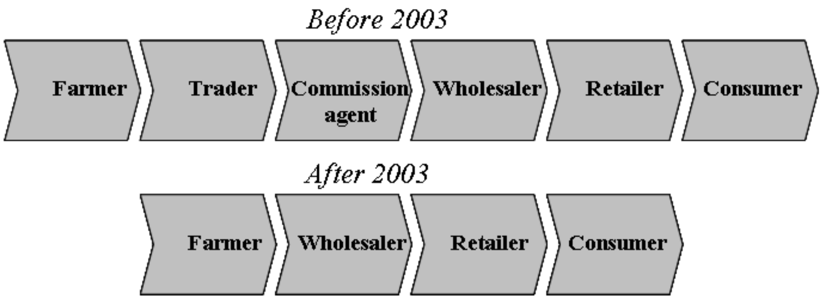
In 2003, the Commission for Agricultural Costs and Prices announced a minimum support price (MSP) for some pulses which should operate as price floor. The agency associated with the implementation of the MSP is the National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) (SATHE AND AGARWAL 2004). So far, the MSP had no impact on domestic market prices of pulses because the MSP is generally less than the market prices (MOE ET AL. 2008) and a price floor that is set below the market price has no influence (MANKIW 1999).

Before the liberalization of pulse market the supply chain of farm produces was a result of an act implemented by the Agricultural Produce Marketing Committee (APMC) in the 1950s and 1960s. This act stipulated that the government set up market yards, so called *mandis,* in various cities (KUMAR AND PATWARI 2008). Retailers and processors had to buy agricultural commodities on *mandis* from commission agents or wholesalers, and it was prohibited for them to buy directly from farmers. Farmers also had to use *mandis* to sell their produce to traders, commission agents, and wholesalers. The APMC act was amended in 2003. Two major changes were implemented: (i) retailers and processors were allowed to buy directly from farmers thereby bypassing the *mandis* and (ii) contract farming was permitted. Farmers however, could still sell on *mandis*. The impact of the amended AMPC act on the supply chain for farm produces is shown in Figure 18 (UNKOWN 2004).

In 2006, there were about 7,500 *mandis* in India. The *mandis* are usually close to important production centres and towns. These wholesale markets are an important selling point for farmers in India. Nevertheless, farmers complain about poor market facilities, high fees to enter the markets, long distances, cheating traders, and limited access to market information (FAFCHAMPS ET AL. 2008).

Further, there are about 22,000 to 27,000 rural periodic agricultural markets and about 15% of these rural periodic markets are regulated (GOVERNMENT OF INDIA 2006a).

Figure 18: Supply chain of farm produce before and after the amended AMPC act of 2003.



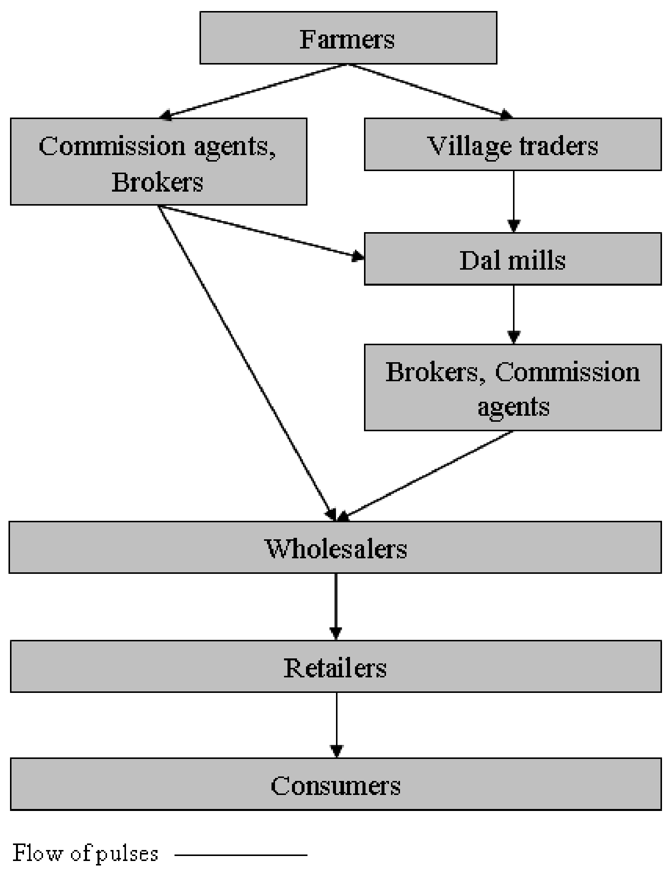
Source: after Kumar 2008

Figure 19 depicts a possible market channel for pulses in India. Govindan (2001) estimated that about 85% of Indian pulses are sold through the shown channel. Price (2003) and Govindan (2001) identify the following stages in the pulse sector in India: farmers, commission agents (or village traders), brokers, wholesalers, millers, retailers, and consumers (PRICE ET AL. 2003).

The first stage consists of the farmers who grow pulses. The majority of Indian farmers are characterized as small-scale, with an average farm size of 1 hectare or less. Since 1970, the number of marginal and small farmers is on the rise. On the top level, farmers have to decide whether they sell their pulses to a commission agent on a market (e.g. *mandi*) or to a village trader.

Marginal and small farmers produce small quantities of pulses that have to be assembled at the next stage by village traders or commission agents. Commission agents, brokers and wholesalers typically take a margin of 1-1.5% of the product value for transportation, handling, storage, and processing (GOVINDAN 2001).

Figure 19: Market channel for pulses in India.



Source: Mueller et al. 1990, Govindan 2001

Wholesalers usually sell to retailers at a minimum of one bag which is equal to 50 kg or 100 kg. Retailers may add value to pulses by cleaning and sorting them. Generally, retailers sell pulses loose to consumers and more rarely packaged in bags of 0.5 kg to 1 kg. Indian retailers may add a mark-up of about 45% of wholesale prices (GOVINDAN 2001).

A further stage in the market channel of pulses are the mills. Mills are needed to decorticate and split pulses. Decorticated pulses have their hard hulls removed. The dehulled pulses are then splitted and sold as dal. Some pulses, such as chickpea, black gram and green gram are also milled into flour. Most mills are small and use highly labour-intensive, old technologies (PRICE ET AL. 2003). The milling industry is, however, not relevant for ricebean, because ricebean is usually sold as whole grain.

The influence of grades on trading costs has been discussed in section 4.1.2.1. There is no uniform objective grading in the Indian pulse sector. Some traders categorize pulses in "Fair to Average Quality" (FAQ) or "Special Quality" (SQ) but the classification is based on subjective visual inspection (GOVINDAN 2001). The class "special quality" (SQ) was defined by some foreign suppliers and domestic wholesalers, but the distinction between FAQ and SQ is informal and subjective. About 80% of traded pulses are classified as FAQ (PRICE ET AL. 2003).

The share of branded pulses that is traded in India is very small. Brands could reduce transaction costs because they may serve as a guarantee for product quality. Assured quality reduces consumer's inspection costs. Further, there are no large companies or national level brands in the pulse sector. Large companies were put off by governmental regulations like the regulation of stock limits and credit restrictions on the pulse trade introduced by the Reserve Bank of India. Another negative factor for large companies is the small-scale pulse mills (GOVINDAN 2001).

There are no large, dominant companies in the pulse sector in India. There are many wholesalers and other intermediaries, many small farmers that grow pulses, and many consumers who buy pulses. Hence, the Indian pulse sector is a polypoly at all market stages.

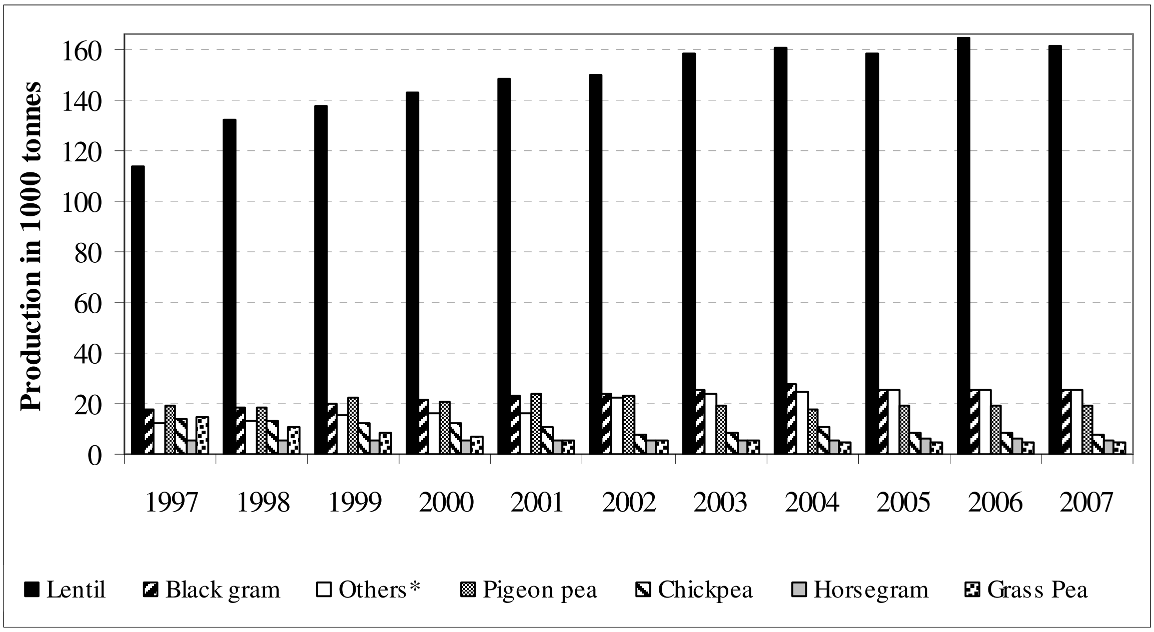
The main characteristics of the Indian pulse market may be summarized as follows. Domestic pulse production in India is smaller than domestic demand. The production of pulses is stagnating or declining, although the Indian population is growing. Therefore, pulses are imported to India in increasing quantities. Chickpea, pigeonpea and lentils are the most important pulses grown in India. The surplus of the harvest that is sold varies from pulse to pulse. Rural Indian consumers spend about 3% of their total expenditures on pulses, and urban consumers 2%.Very poor rural consumers decrease their pulse consumption by 0.8% if prices rise about 1%. The market channel for pulses involves seven stages: farmers, commission agents (or village traders), brokers, wholesalers, mills, retailers, and consumers.

5.1.2 Pulse market and marketing in Nepal

Agriculture, the major economic sector, contributes about 40% towards the national gross domestic production. About 80% of Nepalese households depend on agriculture (SHRESTHA 2005). Nepal has an area of 147,181 square kilometres of which about 20% is used for agriculture and 10% of the total agricultural land is used for pulse production (GOVERNMENT OF NEPAL 2004).

Like in India, pulses are usually grown in only one of the two seasons, i.e. *kharif* (May to October) or *rabi* (November to April) season. Most Nepalese farmers rely on their own stocks of pulses for seeds for the following year. Only 1% of farmers exchange seeds with other farmers (WORLD FOOD PROGRAM; EUROPEAN UNION 2005).

Figure 20: Pulse production in Nepal, 1997 to 2007.



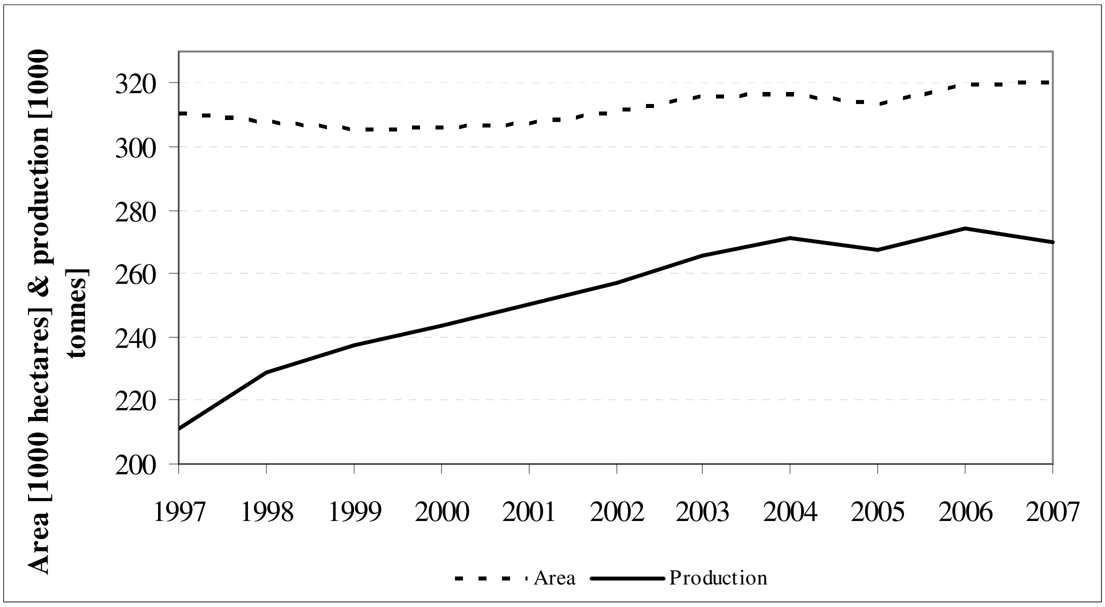
* Field pea, Cowpea, Broad bean, Phaseolus, Masyng, Mungi etc.

Source: Government of Nepal 2008

The major pulses grown in Nepal and the development of their quantities produced from 1997 to 2007 are shown in Figure 20. Lentil was the most important pulse in Nepal in 2007 followed by black gram and the group 'others' which includes the ricebean which is known as *Masyng* in Nepal (GOVERNMENT OF NEPAL 2008).

Figure 21 presents the total pulse production and the area under pulses from 1997 to 2007. The area utilized for pulse production varies over a small range from about 310,000 to 320,000 hectares, whereas pulse production increased from 211,000 tonnes in 1997 to 269,000 tonnes in 2007. This was possible because average yields of pulses increased from 0.6 t/ha to 0.8 t/ha.

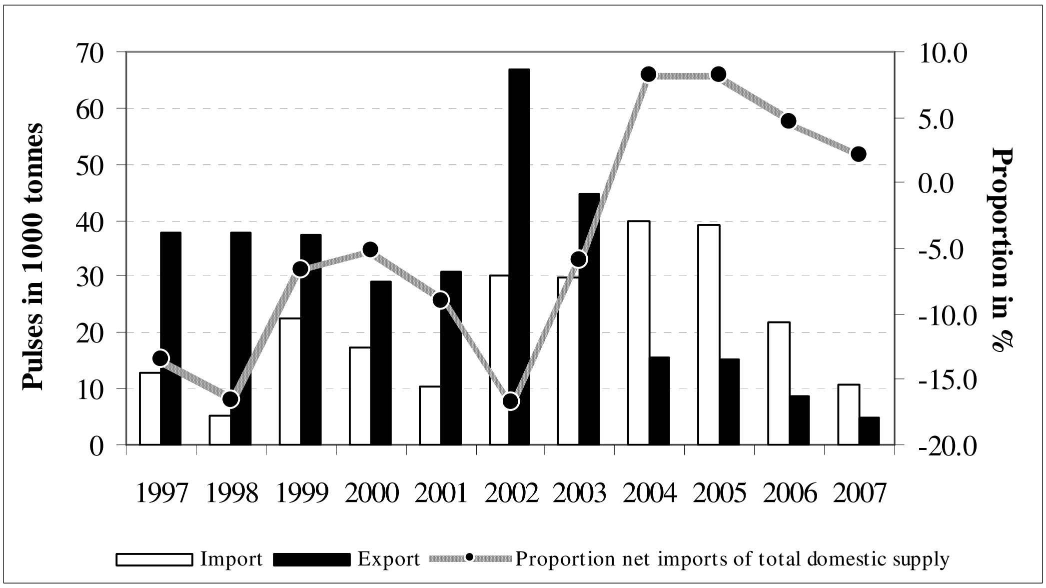
Figure 21: Development of area under pulses and pulses produced in Nepal, 1997 to 2007.



Source: Government of Nepal 2007

Until 2003, Nepal was a net-exporter of pulses (see Figure 22). Since 2004, the pulse imports into Nepal exceed the exports. The negative proportions of net imports of total domestic supply also show that Nepal was a net exporter until 2004. The proportion of net import in total domestic supply decreased from about 8% in 2004 and 2005 to about 2% in 2007. Lentil, as a major exportable agricultural product, has been a regular source of foreign exchange earnings. The cultivation of lentil has been increasing because of its potential at home and abroad, and there is a strong world market demand for lentils from Nepal. Bangladesh, Singapore, Sri Lanka, Germany, Korea, UK, and Indonesia are major importers of lentils from Nepal (TRADE AND EXPORT PROMOTION CENTRE 2009).

Figure 22: Import and export of pulses in Nepal, 1997 to 2007.



Source: FAOSTAT 2010

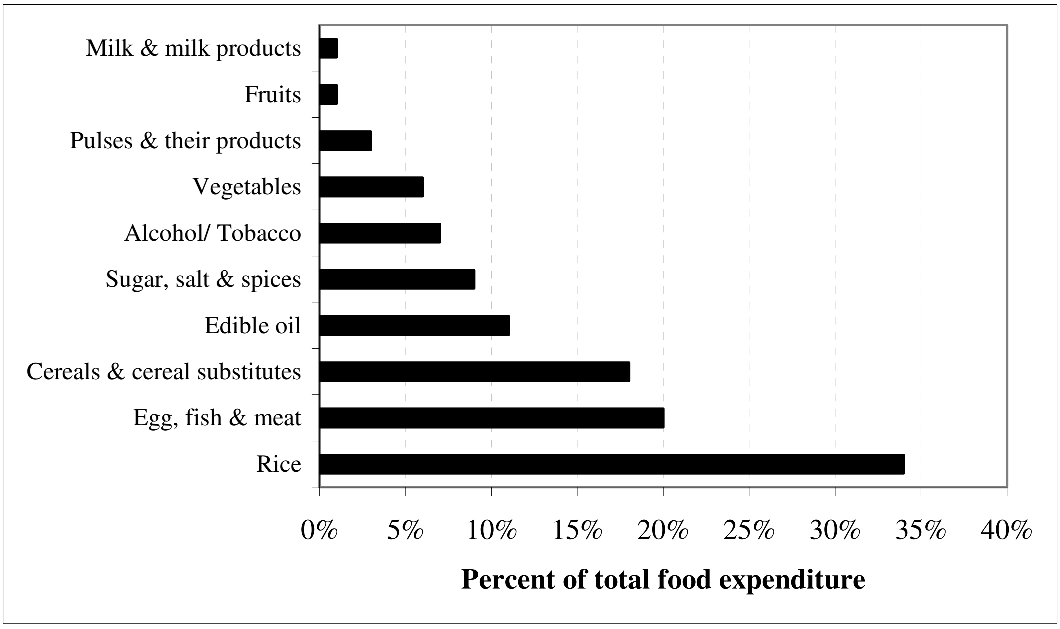
The role of pulses in Nepalese diets is shown in Figure 23. People in Nepal spend about 50% of their expenditures on food. Nepalese spend about 20% of their food expenditure for non-vegetarian food, such as eggs, fish and meat. This share is higher than the expenditure share for non-vegetarian food in India where it is only about 6% (Figure 16). About 30% of the food expenditures are spend on rice and only about 3% on pulses.

The net availability of pulses in gram per capita and day in Nepal rose from 20 grams to 25 gram from 1997 to 2005. Although the net availability of pulses has risen in Nepal, it is still about 10 grams lower than in India.

The development of nominal retail prices of black gram, pigeonpea, green gram (broken) and lentils (broken) from 1997 to 2003 is depicted in Figure 24. All prices have risen over the period of 6 years. In 2003, lentil (the major exportable pulse) is the cheapest pulse and green gram the most expensive one.

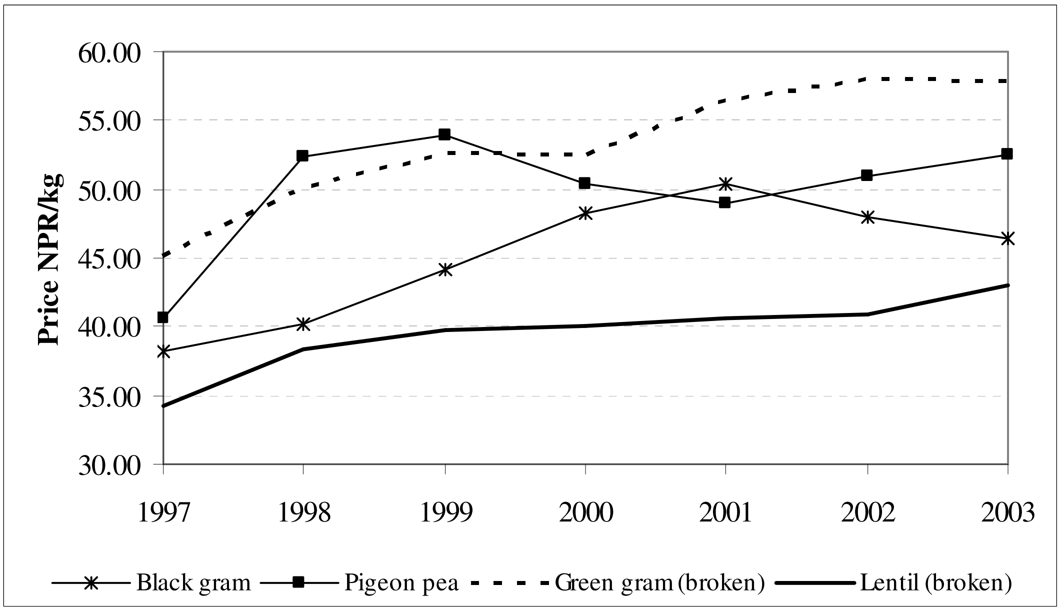
The income elasticity of pulses is 0.3; that means that an increase of income by 1% would lead to an increase in the quantity demanded of pulses by 0.3% (KUMAR 2007). As in India, ricebean is mainly used for dal and hence it is a clear substitute for pulses that are used for dal as well.

Figure 23: Consumers expenditure for food items in Nepal.



Source: World Food Program 2005

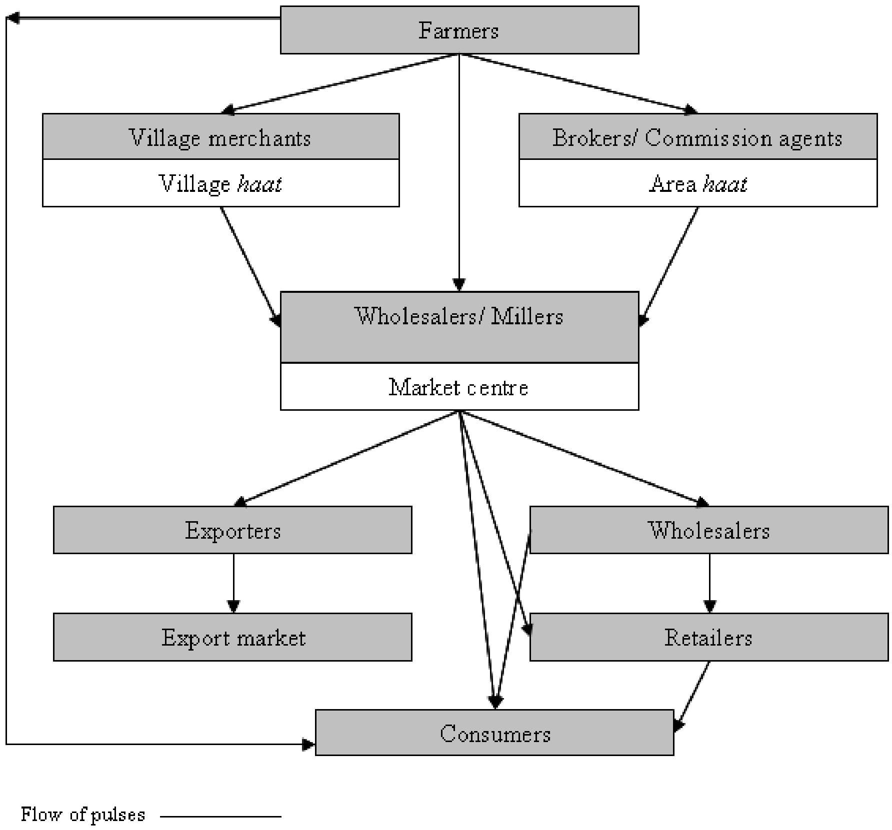
Figure 24: Development of nominal retail prices in Nepal, 1997 to 2003.



Source: Government of Nepal 2003

The stages of the pulse market channel in Nepal are shown in Figure 25. On the first stage are farmers. The majority of farmers in Nepal grow their crops on very small farms. Holdings with a size from 0.2 to 1.0 hectares account for more than 50% of the total holdings. Moreover, most farms under pulse cultivation are between 0.2 - 2 ha in size. The channel through which pulses are traded in Nepal is similar to the channel in India. Farmers can sell to traders or commission agents who supply wholesalers or mills. Retailers purchase from wholesalers and sell to consumers.

Figure 25: Market channel of pulses in Nepal



Source: Khathiwada 1988

As in India, pulse markets are polypolistic, with many buyers and sellers at each stage of the market channel.

To summarize, Nepal produces about 270,000 tonnes of pulses annually for about 28.6 million people. Until 2003, the country was a net-exporter of pulses, however, since 2004, the quantity imported exceeds the quantity exported. The most important pulses are lentil, black gram and the group of 'others' which also includes ricebean. Nepalese consumers spend about 3% of their food expenditures on pulses, which is somewhat lower than in India. Price elasticities of demand are not known for pulses in Nepal, but pulse consumption is positively related to household income. The market channel for pulses in Nepal involves farmers, commission agents (or village merchants), brokers, wholesalers, mills, retailers and consumers.

5.2 Exploration of ricebean markets in India and Nepal

The previous section has described and analysed the agricultural marketing systems in terms of characteristics from. In this section, specific information obtained through field visits is used to describe and analyse the pulse and ricebean marketing systems.

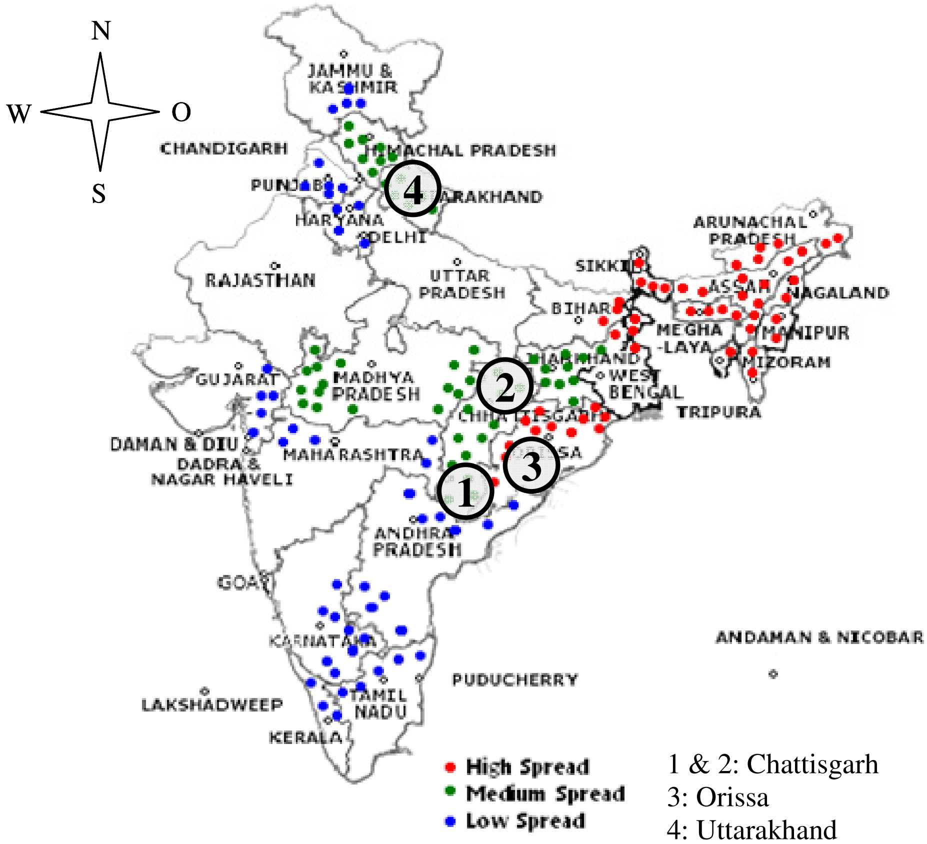
5.2.1 Market data collection

Data were obtained from interviews with farmers and intermediaries from all market stages, and by observing transaction practices at organized legumes markets. The interviews in Nepal and India were conducted over two years. In 2008, interviews were conducted from January to March. Further field work was carried out in India and Nepal from January to February 2009.

The interviews were conducted in regions where ricebean is grown. The regions were selected using a report by Indian and Nepalese researchers which documented the distribution of ricebean (GAUTAM 2007).

Figure 26 shows the regions where we conducted surveys in India. The Indian state Uttarakhand - labelled with ‘4’ was visited in 2008 and 2009. In Orissa, Chattisgarh, and Madhya Pradesh interviews were carried out in 2008. In Nepal (Figure 27) interviews were conducted in areas in which ricebean samples were collected in 2008. In 2009 farmers and traders in West Nepal were surveyed.

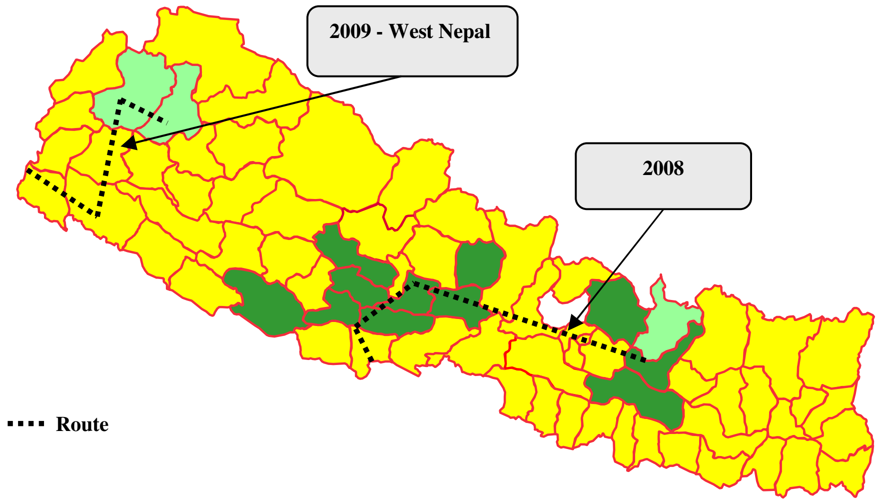
Figure 26: Regions surveyed in India, 2008 and 2009.



1 & 2: Chattisgarh
3: Orissa
4: Uttarakhand

Source: Gautam 2007

Figure 27: Regions surveyed in Nepal, 2008 and 2009.



Source: Gautam 2007

5.2.2 Surveys

In 2008, 95 semi-structured interviews were conducted (Table 30). Key questions were asked of all who were interviewed, however, additional responses and thoughts were also recorded. Questions first asked in English were translated in Nepali, Hindi or in a local language such as Oriya in the Indian state Orissa. Answers were translated into English and written down. All interviews were assisted by researchers who translated or someone was employed to translate local languages. The interviews provided in-depth information about the trade of ricebean from farmers or retailers. In 2009, a more standardized survey was developed based on the information of the previous year. In this year, 35 farmers and 53 intermediaries were interviewed (Table 30). The responses of both years were then combined.

Table 30: Interviews from January to March 2008 and January to February 2009.

	2008	2009	India	Nepal	Total
Farmer	32	35	51	16	67
Intermediaries	63	53	67	49	116
∑	95	88	118	65	183

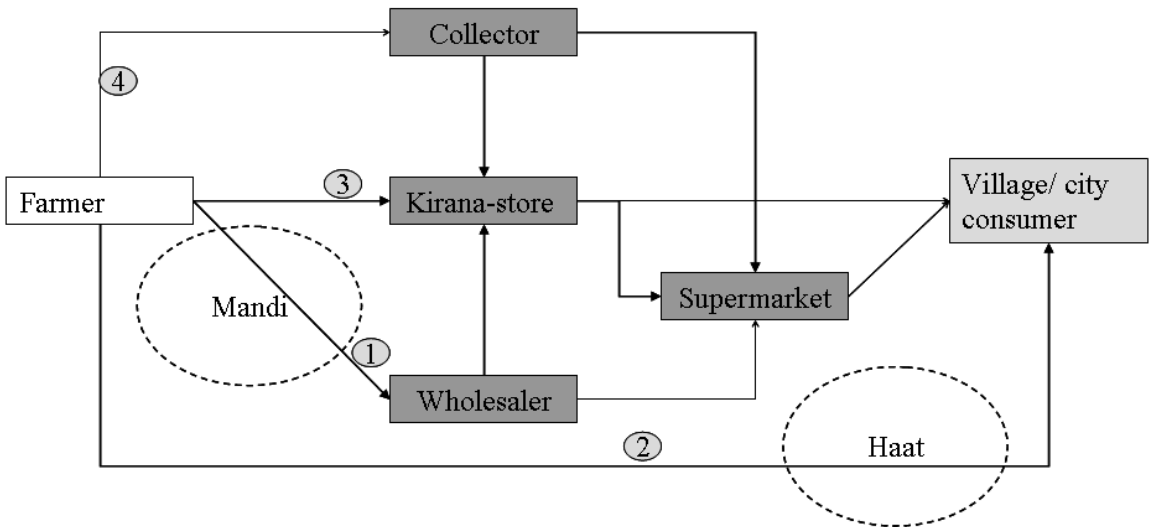
The method we used to scrutinize the way of ricebean from farmer to consumer in each region was as follows: First, we had to find an entry point into the ricebean market channel, this could be a farmer or a trader, who sells or grows ricebean. Traders could be identified by checking their assortment, but farmers could only be found by asking famers directly or references from third parties such as traders or consumers. Once an entry point into the local channel was found, one could identify further agents of the market channel.

The description and analysis of the ricebean channel starts with a rough overview of stages and their sequence. Then characteristics and activities of farmers are described because they are in the beginning of the channel. The second part provides information about the intermediaries who represent all involved stages between farmers and consumers. Intermediaries in the ricebean channel are collectors, wholesalers and retailers such as *kirana*-stores and supermarkets.

5.2.3 Market agents and configuration of the ricebean channel

Four different channels were identified through which farmers can sell ricebean in India and Nepal. The channels are shown in Figure 28 and some may include identical stages.

Figure 28: Ricebean channels in India and Nepal.



Farmer as producer of ricebean is shown on the left side of Figure 28 in a white box. The intermediaries are represented by dark grey boxes and the end-consumer by light grey boxes. Label (1) in Figure 28 represents the channel in which farmers are selling ricebean to wholesalers. Farmers can sell ricebean on market places (*mandis*) or to wholesalers directly. Farmers were also selling ricebean via retail markets referred to as *haats*. This channel is represented by the label (2). At *haats* farmers sell directly to consumers. Via channel (3) farmers sell to *kirana* stores and supermarkets. *Kirana* stores are permanent retail outlets similar to neighbourhood “mom and pop” stores. *Kiranas* can be specialised in selling certain goods such as pulses. However, usually they trade in almost everything from food to hygiene products to toys. Supermarkets also operate on the retail stage. They have emerged rapidly in developing countries in the last decade (REARDON ET AL. 2003, MINTEN 2008). In this study, supermarkets were identified as a source of ricebean for consumers in Nepal but not in India. In channel (4) farmers to sell ricebean to commission agents also called collectors.

5.2.3.1 Farmers in India and Nepal

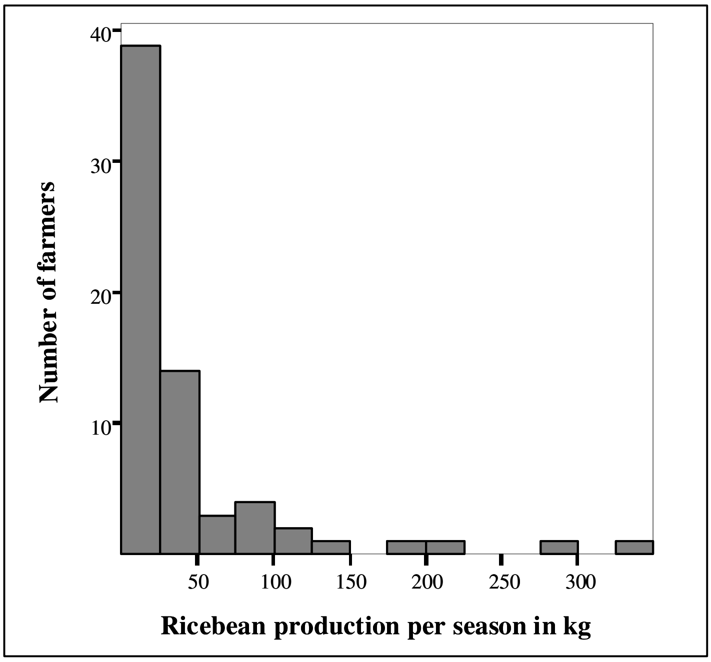
We found several cultivation forms of ricebean. It may be grown as sole crop or mixed crop with maize, cowpea or kidney bean. Farmers may grow ricebean on plain crop plots, which is seldom done; or on slopes, terrace borders, field borders or bunds which are small hills or banks that restrict water entry from one field into another. Ricebean is sometimes planted by dibbling seed into small holes or by broadcasting the seed. The very tall varieties need some support on which the plant may climb, or they hang on terraces and field borders.

Table 31: Ricebean yield per farmer and quantity of seeds sown in India and Nepal, 2008 and 2009.

Farmers'	N	Minimum	Maximum	Mean	CV in %	Median
Harvest in kg	67	0.5	350	44.1	149	20
Seeds in kg	66	0.1	25	2.3	170	2
Ratio yield/seeds	66	0.1	200	29.6	131	16

Nearly every region in India has its own land units. Sometimes these units have the same names but represent a different quantity of m². Therefore, we do not report yields in units per hectare. Instead, the harvested quantity and sown seeds per farmer is shown. The harvested quantity of ricebean per farmer and the seed used vary considerably (Table 31). However, the mean and median of yield per farmer indicates that most of them harvest small quantities.

Figure 29: Number of farmers by their quantity of ricebean produced.



All farmers that were asked about their source of seeds answered that they used their own seeds from the previous year. Thus, a seed exchange between farmers or with seed companies may not exist in the case of ricebean. Figure 29 shows that most ricebean farmers harvest only small quantities (< 50 kg) of ricebean in one season.

Farmers were also asked about their post-harvest practices for ricebean. All of the interviewed farmers stated that they dry and clean ricebean after harvesting and about one third also sorted them. About 70% of the interviewed farmers have facilities to store ricebean and one third protects it against pests while in storage. Many farmers use home remedies, such as ash, for this purpose.

Table 32 shows the proportion of farmers in India and Nepal that sell ricebean, indicating that more than half (57%) of the interviewed farmers in India and Nepal do not sell any part of their ricebean harvest. However, there are huge differences between Nepal and India. In Nepal 88% of the farmers stated that they sell ricebean and in India only 29% of the farmers sold part of their ricebean crop. If farmers are not selling ricebean, they keep it for their own consumption and as seed.

Table 32: Shares of respondent farmers that sell ricebean, India and Nepal.

Sell ricebean	India		Nepal		Total	
	N	%	N	%	N	%
Yes	15	29	14	88	29	43
No	36	71	2	13	38	57
Total	51		16		67	

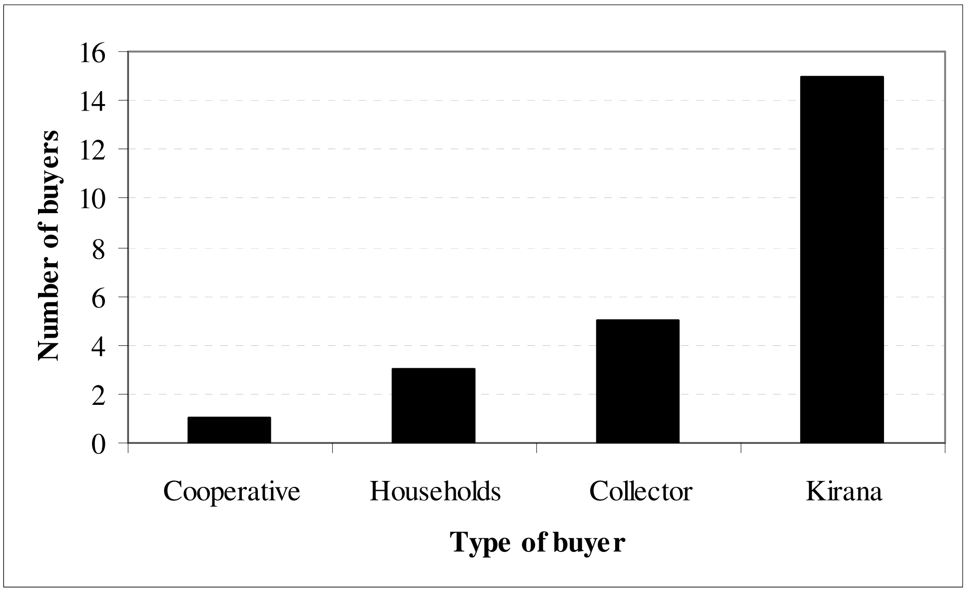
Table 33 shows that none of the famers sold all of the ricebean produced because the maximum proportion of the total yield that is sold, i.e. the marketed surplus, is 95%; that means the interviewed farmers kept at least 5% of the harvested quantity for home consumption and as seed.

Table 33: Marketed surplus and sold quantities of ricebean, India and Nepal, 2008 and 2009.

	N	Minimum	Maximum	Mean
Marketed surplus in % of yield	68	0	95	27
Quantity of ricebean sold in kg	68	0	290	25
Distance to market in km	27	0	80	15

The mean marketed surplus of 27% of the harvested quantity indicates that most of the ricebean produced is used for home consumption. The distance that farmers have to travel to sell ricebean varies considerably (Table 33). Some farmers can sell to their neighbours or have a local market in their village. Others had to travel as far as 80 km to the nearest market. In one case, a farmer from Ramechhap in Nepal needed two days to travel to the next market. Figure 30 shows to whom the surveyed farmers were selling ricebean. The most frequent buyers of ricebean are *kiranas*. Usually, farmers go directly to *kiranas* to sell ricebean and other crops. Farmers probably prefer to sell to *kiranas* because these shops offer a wide range of products from food-stuff to toiletries.

Figure 30: Importance of farmers' buyers of ricebean, as reported by farmers in India and Nepal, 2008 and 2009.



Thus farmers can sell their crops and buy things they need themselves in one trip. Some farmers also sold to neighbouring households. None of the interviewed farmers sold to wholesalers; however this does not mean that wholesalers do not buy ricebean from farmers. We interviewed wholesalers that purchased ricebean from farmers but they could not recall where their ricebean suppliers had come from. One of the farmers in Nepal stated that he sold his harvest to a cooperative.

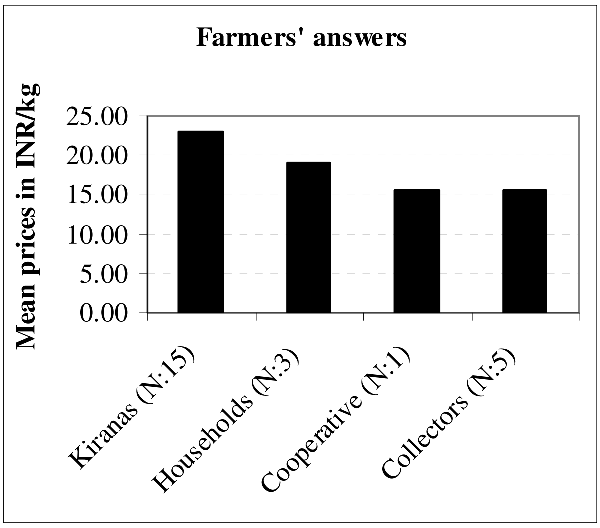
To compare the prices (Table 34) that farmers received, it was necessary to convert Nepalese Rupees (NPR) into Indian Rupees (INR). The conversion factor of 0.60 from Nepalese Rupees into Indian Rupees was constant in 2008 and 2009. The difference of mean prices that farmers receive for one kg ricebean between India and Nepal is small (1.70 INR/kg). However, the price range between the lowest price and the highest price a farmer received for a kg of ricebean is large. In India, the highest price accounts for more than 300% of the lowest price.

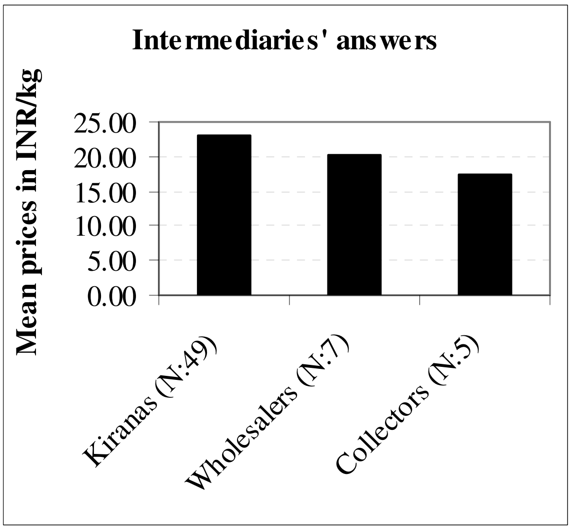
Table 34: Farmers' sales prices for ricebean in India and Nepal, 2008 and 2009.

	Price INR/kg		
	Minimum	**Maximum**	**Mean**
India	11.00	35.00	20.76
Nepal	13.13	29.69	19.06
N: 14			

A possible explanation for the large range of farm-gate prices is that farmers are selling ricebean to several stages which are wholesalers, collectors and *kiranas*. The left panel of Figure 31 shows responses of farmers about prices they get per kg ricebean. *Kiranas* are paying the highest prices to farmers, whereas collectors are paying lower prices. The right panel of Figure 31 shows prices that interviewed *kiranas*, wholesalers and collectors are paying for ricebean to farmers. The responses of farmers and intermediaries about ricebean prices that farmers receive were almost equal.

Figure 31: Average prices received by farmers from different ricebean buyers, India and Nepal, 2008 and 2009.





In the structured interviews in 2009 farmers were also asked which sources they use to acquire information about pulses. We also asked them which media they prefer for this purpose. The results are shown in Table 35. The most important information source for farmers is friends and relatives, and 85% of the interviewed farmers get their information from them. Other sources most frequently cited were farmers and *kiranas*.

The results of this study are also sustained by other studies from India. Fafchamps (2008) reported that farmers' sources of information about prices, post-harvest activities and quality management are mostly other farmers. There are agricultural officers who should spread information to enhance production and marketing, but many farmers do not trust them (FAFCHAMPS ET AL. 2008). Table 35 also shows that from the four presented media farmers only use phones to exchange information about pulses. The use of the internet, TV, radio and newspapers may be limited due to their widespread absence in remote areas.

Table 35: Sources and media of information about pulses prices.

Information sources of farmers	%	Media	%
Friends & relatives	85	Phone	10
Farmers	75	Internet	0
Kiranas	50	TV, radio	0
Collectors	20	Newspaper	0
Wholesalers	20		
Processors	0		
Consumers	0		
Ministry of agriculture	0		
Research institutes	0		
N:20			

5.2.3.2 Intermediaries in India and Nepal

In this study, four stages were identified: collectors, wholesalers, supermarkets, and *kiranas*. As ricebean is not processed, there were no mills or other processing firms involved.

Table 36: Number of interviewed intermediaries per stage, 2008 and 2009.

Country	Supermarkets	Kiranas	Wholesalers	Collectors
Nepal	3	32	13	1
India	0	56	4	6
	3	88	17	7

Table 36 presents the number of intermediaries interviewed in Nepal and India. Supermarkets that sold ricebean were found only in Nepal. Supermarkets in Nepal, as everywhere in the world, employ fixed posted prices. Many use cash registers with a barcode scanner and sell most of their products, including ricebean, packaged. The physical and institutional infrastructure of supermarkets is well-developed. They have cold storage facilities, running water, and they use uniform weights.

Kiranas in India and Nepal usually do not post their prices and bargaining is common. Unprocessed food, such as ricebean, wheat or flour, is sold loose. Cash registers are mostly absent. The infrastructure of *kiranas* comprises stalls and racks to display commodities, whereas pulses and other grains are sold loose from sacks. Standard weights are uncommon in *kiranas*.

On market places, such as *mandis* and *haats* farmers sell to wholesalers, collectors or directly to consumers. Bilateral bargaining is the common price-finding mechanism and products are sold loose. Some market places have physical infrastructure facilities, such as stalls, but many simply sell commodities on the ground. Moreover, cold storage facilities, running water or grading machines are rarely available. Uniform weights are regularly missing at these market places and volume units such as cups or tins are used; sometimes even stones are used for weighing. The number of buyers and sellers at a market place varies across locations. Markets in rural areas are attended by fewer buyers and sellers than markets in urban areas.

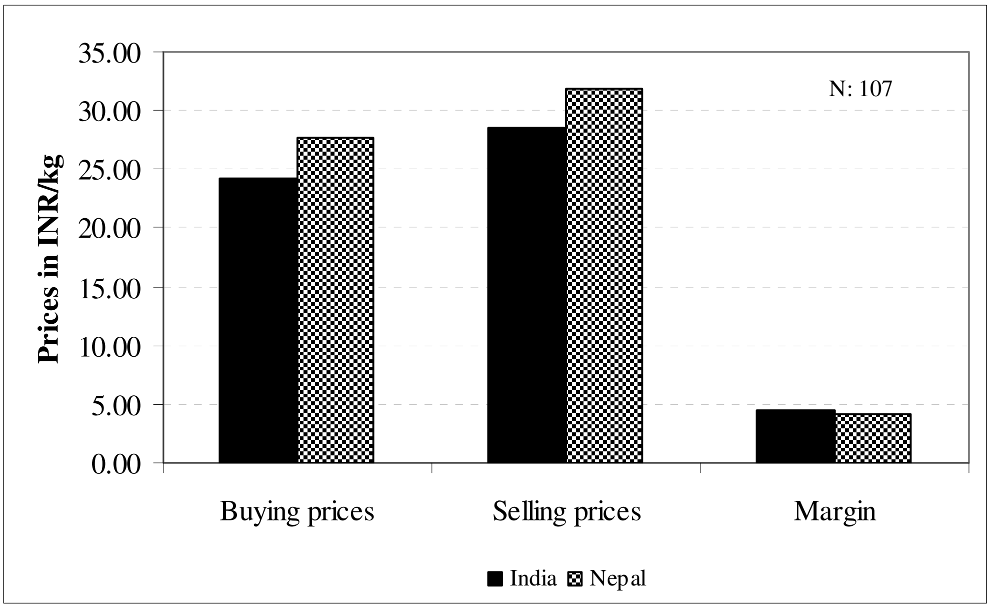
Figure 32: *Kiranas*: Ramechhap Nepal, January 2008 and Nainital, India, January 2009.

Figure 33: Market places in Nepal: Ramechhap, January 2008 and Butwal, February 2008.

Supermarkets sell on average 164 kg ricebean per month, whereas *kiranas* sell about 80 kg per month. Wholesalers sell the largest mean quantities of 2000 kg per month.

Figure 34 shows the price differences of the mean buying and selling prices of ricebean and the estimated margins. In comparison to India, intermediaries in Nepal pay higher prices for ricebean and sell it at higher prices to their customers. The mean ricebean margin in India is 19% of the buying price and 15% in Nepal.

Figure 34: Price differences of ricebean between India and Nepal.



Costs accrue at every stage of the marketing channel and there are several mark-ups on the price from farmers to consumers. Farmers sell ricebean for about 20.00 INR/kg (Table 34) in Nepal and India. The stages in Figure 35 are arranged according to the mean buying and selling prices of ricebean. Starting with the lowest prices on the right side, the following ranking emerges: collectors, wholesalers, supermarkets and *kiranas*. Collectors are buying and selling ricebean for the lowest prices but they have the highest margin of 25% of the buying price which corresponds to 4.25 INR/kg. Wholesalers offer and buy ricebean for the second lowest prices and generate a margin of 11% of the buying price. *Kiranas* have the highest mean buying and selling prices and a margin of 17%. Supermarkets offer cheaper ricebean than *kiranas* and have the lowest margin of 10% (2.50 INR) of the ricebean buying price.

The flow of ricebean was already shown in Figure 28. The next part provides a detailed analysis of the ricebean flow in India and Nepal. We asked intermediaries from which stage they purchase ricebean and to which stage they sell it. To depict the product flow, it is necessary to document the sales and purchases at every stage.

Figure 35: Price levels at various ricebean stages in India and Nepal.

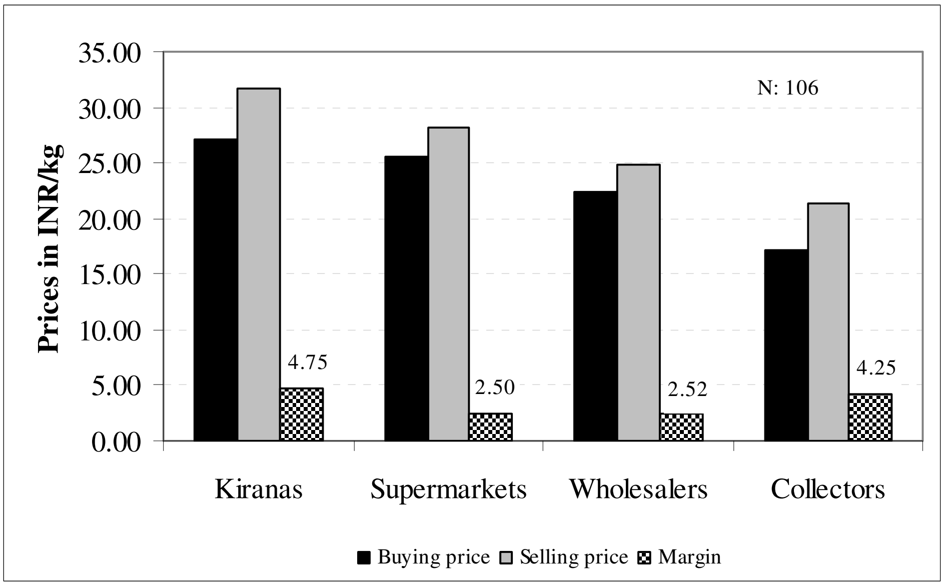


Table 37 shows the stages from which supermarkets, *kiranas*, wholesalers, and collectors procure ricebean. It is common for intermediaries to have several sources for ricebean thus there are more multiple responses. The first column contains the sources (sellers) of ricebean and the remaining four columns show how many respondents at each stage procure ricebean from the listed sources which are farmers, wholesalers, collectors and *kiranas*.

Two of the three supermarkets that had been surveyed buy ricebean from wholesalers, however, one also procured ricebean from a *kirana*. It was shown in Figure 35 that *kiranas* are the most costly source of ricebean. Perhaps supermarkets revert to *kiranas* when wholesalers are not able to supply ricebean. Since there are several important festivals in Nepal that are closely connected to the consumption of ricebean (ANDERSON 2007) supermarkets may want to offer ricebean during these times due to the satisfy consumers' demand.

Table 37: Sources of ricebean for each stage in Nepal and India.

	Supermarkets (N:3)		**Kiranas (N:87)**		**Wholesalers (N:17)**		**Collectors (N:7)**	
	Responses		*Responses*		*Responses*		*Responses*	
Source	N	%	N	%	N	%	N	%
Farmers	0	0	52	50	7	29	5	71
Wholesalers	2	67	34	33	7	29	1	14
Collectors	0	0	14	14	10	42	1	14
Kiranas	1	33	3	3	0	0	0	0
Sum	3		103		24		7	

Half of the *kiranas* that were interviewed buy ricebean directly from farmers which corresponds with the results from the interviews with farmers (Figure 30). One reason could be that farmers receive the highest prices for ricebean from *kiranas* (Figure 31). Wholesalers have a wide range of sources for ricebean. They buy directly from farmers or collectors or even from other wholesalers - but their main source is collectors. As can be expected, the major source for collectors is the farmer. The work of a collector can be described as follows: he receives an order from his client, then he and his client agree on quantities and prices, after which he goes to villages to purchase the required quantities of pulses.

Table 38: Purchasers of ricebean for each stage in Nepal and India.

	Supermarkets (N:3)		**Kiranas (N:87)**		**Wholesalers (N:17)**		**Collectors (N:7)**	
	Responses		*Responses*		*Responses*		*Responses*	
Purchaser	N	%	N	%	N	%	N	%
Households	3	100	72	86	10	38	3	33
Farmers	0	0	0	0	0	0	0	0
Wholesalers	0	0	3	4	1	4	3	33
Collectors	0	0	1	1	0	0	0	0
Kiranas	0	0	8	10	15	58	3	33
Sum	3		84		26		9	

Table 38 shows the purchasers of ricebean. To do this, intermediaries were asked to whom they sell ricebean. The buyers of ricebean in supermarkets and *kiranas* are mainly households which are the final consumers. Only one surveyed *kirana* was also delivering ricebean to a collector. Three sold ricebean to wholesalers and eight sold to other *kiranas*. Wholesalers mainly serve *kiranas,* but they also sell directly to consumers. The clients of collectors are *kiranas*, households and wholesalers.

Figure 30 shows that the most important buyers of farmers are small retail stores, *kiranas*. The most important buyers of ricebean in *kiranas* are households (Table 38). The dominant channel through which the major quantity of ricebean is traded starts with farmers that sell to *kiranas* who sell to the final consumers.

Intermediaries were also asked which sources they use for information about pulses, e.g. prices, quality or new varieties. The responses to that question are shown in Figure 36. Collectors were not included, since they did not answer that question and supermarkets were not included because of the small number of cases. The main source of information for *kiranas* was wholesalers, followed by other *kiranas*. Wholesalers get their information from many sources from which none seems to be preferred.

Figure 36: Information sources used by ricebean intermediaries in India and Nepal.

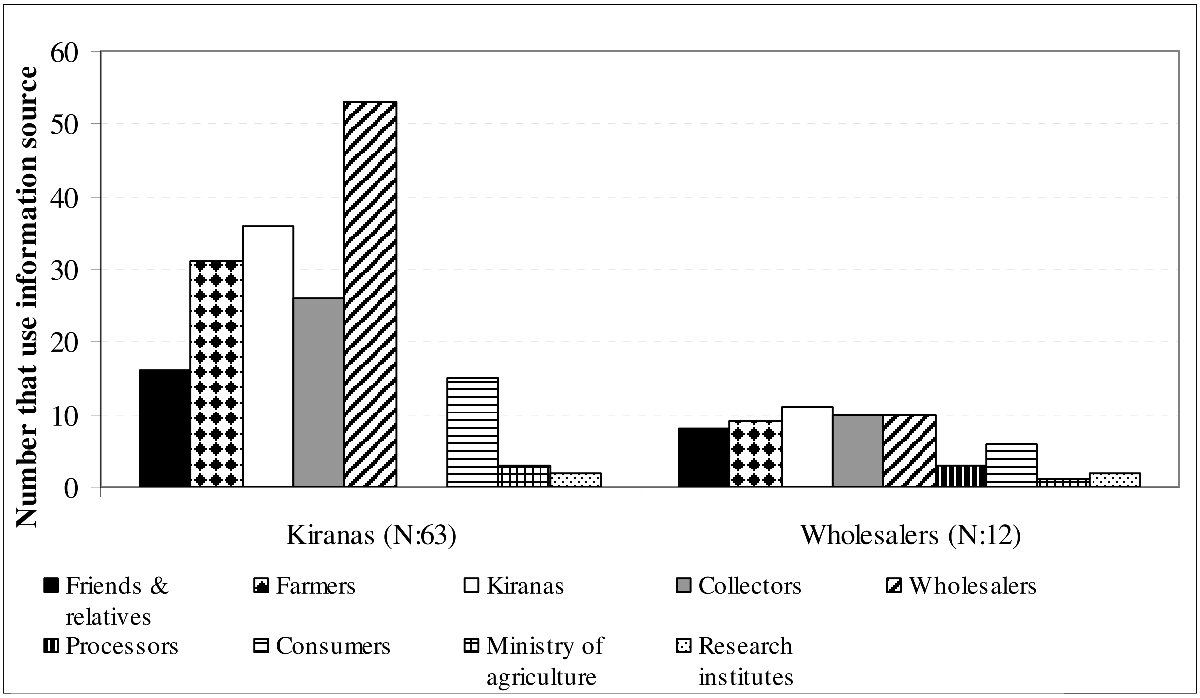
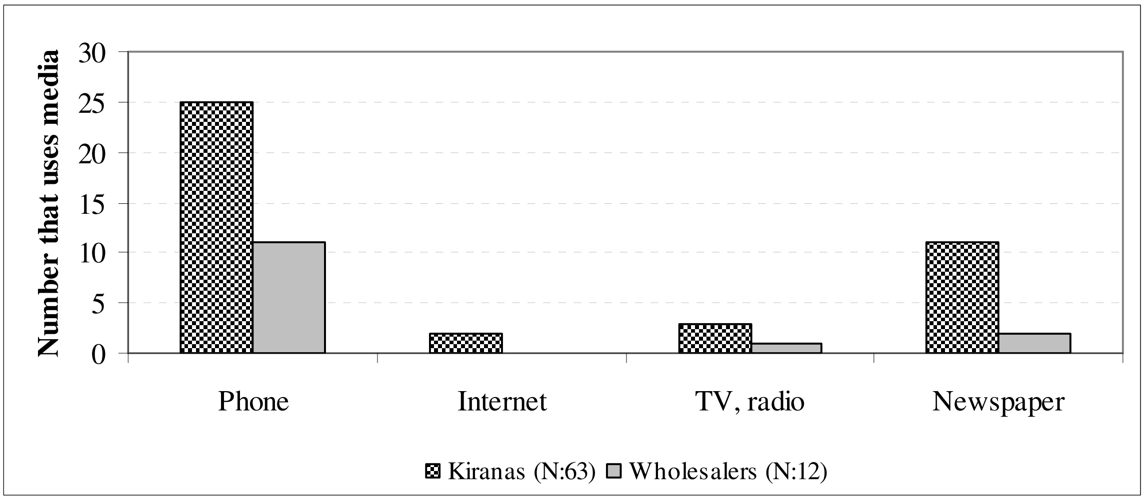


Figure 37 shows the media that were used by intermediaries to get information about pulses. Obviously, phones are important for supermarkets, *kiranas* and wholesalers. Newspapers are used as an information medium about pulses by *kiranas* and wholesalers. The internet, TV and radio are rarely used to get information about pulses.

Figure 37: Information media of ricebean intermediaries in India and Nepal.



5.2.4 Major findings of ricebean marketing in India and Nepal

The yield per farmer, ratio of yield to seeds and cultivation forms of ricebean vary widely. Yields per farmers range from 0.5 kg to 350 kg. On an average, farmers harvest 44 kg of ricebean in one season.

The main post-harvest activities are drying, cleaning and storing. About 43% of all 67 farmers that were interviewed sell ricebean, but none of them sold all his ricebean and all retained a portion of the produce for home consumption and for seed. The average marketed surplus is about 30% of the production. The price range between the lowest and the highest price farmers received is large. The lowest price was 11 INR/kg and the highest price 35 INR/kg. This range might be explained by different prices farmers receive from the stages to which they sell ricebean. Mostly farmers sell ricebean to *kiranas*. Friends, relatives and other farmers are the most important information sources for farmers.

The interviews with intermediaries revealed that there are four stages of intermediaries within the ricebean channel: collectors, wholesalers, *kiranas* and supermarkets. Ricebean is never graded and it is often sold in non-standardized weights or units of volume. In Nepal, buying and selling prices were higher than in India, but the margin of 15% of the buying prices in Nepal is lower than in India where it was 19% in India. Price levels increased from collectors to wholesalers and to supermarkets, and *kiranas* had the highest ricebean prices. The most important source of ricebean for all stages are farmers. The analyses of the ricebean flow between the stages showed that there is no regular sequence of stages through which ricebean reaches consumers. The dominant channel is that farmers sell ricebean to *kiranas* which serve the final consumer.

5.3 Discussion and implications

The toolbox contains various methods for describing and analyzing marketing systems. We have applied the tools to the analysis of the complex and fragmented marketing systems for pulses and for ricebean in India and Nepal. Our tools proved to be sufficiently powerful and versatile for the job at hand and we are now in a position to outline a marketing strategy for a new improved ricebean product.

Our analytical tool helped us to identify and describe market places where ricebean is traded, to describe the marketing channel through which it passes on its way from producers to consumers, and to identify key characteristics of the generalized markets on which ricebean is traded. We failed, however, to identify supply chains that are jointly managed by traders. Throughout the rural pulse markets relationships among traders are limited to bilateral transactions and supply chains, with their more comprehensive exchange of information and their attempts to coordinate actions among traders are, as yet, absent from these markets. A strategy for introducing ricebean in India and Nepal may therefore not rely on the actions of a few influential agents whose position in the chain would allow them to stimulate demand and spread information about a newly designed ricebean product.

Our finding that we cannot rely on supply chains for the introduction of a new ricebean product in India and Nepal is not unusual. Other authors (e.g. WORLD BANK 2008, WOODS 2004) also concluded agricultural marketing systems in developing countries are far removed from being integrated supply chains. In contrast, markets in developing countries are characterized by poor information flows and spot transactions dominate long-term buyer-seller relationships. Woods (2004) observed, however, that supply chain management would be desirable in developing countries in order to allow markets to cope with new developments in food markets, such as greater product variety, improved product quality, more cost-effective transport, and increasing consumer sensitivity to quality. In addition, products for export often have to meet quality standards and traceability requirements that are difficult or impossible to meet unless the product is traded in a supply chain where product information is reliably passed on together with the product. In the absence of such supply chains for ricebean, the product would seem to be unsuitable for export to countries with advanced integrated supply chains.

The marketing system of ricebean is hampered by two main obstacles tied with each other. One the one hand ricebean is not homogenous in its phenotypic characteristics. Due to the heterogeneity in colour and seed size many consumers do not perceive ricebean as a product. This also becomes clear as ricebean has several different names in the local languages based on its appearance. The development of a marketing strategy without having a product can be seen as an uphill struggle. On the other hand ricebean is mainly traded within poor agricultural marketing systems in rural areas in India and Nepal. These are characterized by simple physical and institutional infrastructure. The latter includes the usage of standard weights and grades. Ricebean is often sold in volume units such as cups and tins instead of using weight units such as kilogram or gram. These non-standardized volume units hamper the comparability of prices per unit for buyers and increase their transaction costs.

Currently, ricebean production is concentrated in remote rural areas. This translates into low production levels, high shares of subsistence consumption, and low shares of marketed surpluses. Ricebean growers produce, on average, only about 40kg of ricebean per season. Remoteness from consumer markets and weak demand for ricebean translates into low farmgate prices and farmers who we have interviewed sold ricebean for 20 INR/kg, much below the prices they received for chickpea or pigeonpea, which fetched around 40 INR/kg. Our model of subsistence household demand showed that the marketed surplus of a subsistence product is determined by the farmgate price of the product. The average share of marketed ricebean of 27% of farmers' production corroborates the results of our model. Low and variable production level in combination with high subsistence consumption shares result in small and variable market arrivals of ricebean and the crop is only of marginal importance for pulse traders at all stages of the pulse marketing channel. The level of marketed surplus would probably be increased if ricebean yields were enhanced by breeding and if its price were increased through higher demand and lower marketing costs.

The demand for ricebean may be enhanced if ricebean were more uniform than it is. At present ricebean is a botanical name for a certain species of pulses but it is not a uniformly used name for an identifiable food crop. Because of its highly divers appearance – ricebean can be of many colour and shapes – many consumers cannot reliably identify ricebean as such. These consumers are unlikely to become buyers and demand is weakened. This problem could be allayed if breeders succeeded in developing an improved ricebean variety with a uniform appearance that consumers can recognize but the uniform appearance could also be considered in the marketing strategy.

A uniform appearance could also be achieved by grading ricebean. Grades are a scheme of classification based on attributes that are observable for consumers, such as size and colour. There are two reasons to use grades, to homogenize commodities and make them comparable without inspection by buyers (BARZEL 1982, SHEPHERD AND FUTRELL 1982). Second, grades are used to penetrate markets by offering a unique quality or food safety aspects. This purpose of grading is frequently observed in high income economies (REARDON ET AL. 2001). The influence of grades on transaction costs was discussed in depth in Section 4.1.2.1.

If grades were implemented for ricebean, they should meet several desirable attributes. Grades should be user (consumer) oriented and easy to recognize. Moreover, the determination and interpretation of the characteristics on which the grades are based should be accurate and uniform. The product attributes used and the terminology used should uniform over the whole marketing channel from farmers to consumers. Each grade should include enough of the average production to be a meaningful class (KOHLS AND UHL 1985).

Observation of transactions on market places or in stores showed that standard weights are often missing and measures of volume, such as cups and tins are used instead. Non-standardized measures hamper the comparability for buyers of product prices and they increase buyers' transaction costs. As it is unrealistic to force intermediaries to use standard weights and to control the usage ricebean could be packaged and each package has the same weight. If ricebean are sold in packages of standard weight, e.g. one kg it would also be possible to provide additional information (e.g. origin, recipes).

Dorward (2006) claimes that the less mature trader systems in developing countries have two fundamental problems: low volumes of marketed production and poor information flow. Our results indicate that the information flow might be improved by the usage of mobile phones because intermediaries answered that the phone is the most important medium, whereas there was no differentiation between mobile phones and fixed lines. The impact of mobile phones on agricultural markets and marketing in developing countries is pervasive (JENSEN 2007). Thus mobile phones may be used to transmit information about ricebean, e.g. changing prices in different markets, existence of sellers and buyers in certain location and times and product quality. The most important information source about pulses for intermediaries is the stage of wholesalers. This indicates that wholesalers might be used to distribute information about a new ricebean variety along the market channel.

6 Summary

The rural populations in India and Nepal depend on a variety of little-known crops for their food security. There have been few efforts of scientists to improve the yield of these "orphan crops". We analysed if and which characteristics of ricebean are relevant for consumers and therefore influence consumers' willingness-to-pay and we analysed the agricultural marketing systems in India and Nepal in which ricebean is traded.

An improved variety should have higher yields, but further quality improvements are usually desirable, as well. Therefore, it was necessary to identify an instrument that determines the relevant quality characteristics of ricebean to develop a variety which is accepted by Indian and Nepalese consumers. The benefit that the rural population would gain from an improved variety and the acceptance in markets would probably be enhanced by a ricebean variety with higher yield which also meet consumers' preferences.

The hedonic price analysis was chosen as an adequate instrument to determine the relevant product characteristics at reasonable costs and time inputs. It has been applied several times to identify relevant characteristics of food products (WAUGH 1928, BROCKMEIER 1993, LADD AND SUVANNUNT 1976) and also to derive implications for breeding (VON OPPEN 1978, PECHER 2000, JIMÉNEZ PORTUGAL 2004). The hedonic price analysis assumes that price differences of products, such as ricebean, emerge due to varying quantities of quality characteristics that are relevant for consumers. The influence of characteristics on market prices was estimated by multivariate regression analysis with price as dependent variable and the objectively measured characteristics as independent variables. Price and the independent variables were entered in logarithmic form. This allows us to interpret the calculated coefficients of significant characteristics as price elasticities. The elasticities can be used by breeders to assess ricebean varieties and are combined into an index, referred to as Consumer Preference Index (CPI).

More than 160 ricebean samples were collected from markets in India and Nepal. Hedonic price functions were estimated for India and Nepal separately, and then for both countries combined. The samples from each country were analysed in local laboratories. The data obtained from the laboratories were combined, and a dummy variable was used to allow the model to adjust for differences between the countries. In addition, a dummy variable was used to differentiate between samples from rural, semi-urban, or urban markets. The hedonic price function for the joint data from both countries could explain 60% of the price variations. Characteristics that significantly influence the price are seed size, crude fibre content, protein, and as fat content. These four characteristics were included in a web-based CPI calculator to evaluate ricebean varieties.

The determination of relevant ricebean characteristics was the first step towards improving ricebean quality and increasing the probability of market acceptance in India and Nepal. Moreover, the improved variety has to be introduced into the Indian and Nepalese market. To facilitate a successful market introduction a detailed investigation of the agricultural marketing systems in India and Nepal was conducted. Therefore the four theoretical perspectives of (i) market places (ii) market channels (iii) supply chains and networks and (iv) generalized markets were used to assess most of the relevant aspects and particularities about the marketing of pulses, especially of ricebean. The key concepts of the different perspectives were consolidated into a 'toolbox' that was used to analyse and describe the marketing system for pulses in India and Nepal. Sources used for information and data about the agricultural marketing systems were scientific literature, databases and government publications as well as websites. Moreover, interviews with ricebean farmers and traders were also conducted.

In India, the production of pulses is stagnating or declining while the population is growing. In 2007, 15 million tonnes of pulses were produced in India and about 3 million tonnes were imported. Chickpea, pigeonpea and lentil are the most important pulses grown in India (GOVERNMENT OF INDIA 2008). Nepalese farmers produce about 270,000 tonnes of pulses per year. Until 2003, Nepal was a net-exporter of pulses; since 2004 the quantity imported exceeds the quantity exported. The most important pulses are lentil, black gram and the group of "other" pulses that includes ricebean (GOVERNMENT OF NEPAL 2008). The market channel for pulses in general involves six stages: farmers, commission agents or brokers, wholesalers, mills, retailers and consumers (MUELLER et al. 1990, GOVINDAN 2001, KHATHIWADA 1988)

The interviews with farmers and intermediaries showed that most of the ricebean farmers in India and Nepal produce small quantities of ricebean with an average of 40 kg ricebean per farmer and season. About 40% of ricebean farmers sell ricebean with an average marketed surplus of about 30% of the production. Six stages were identified in the ricebean market channel: farmers, collectors, wholesalers, supermarkets, *kiranas* and consumers. Farmers sell to collectors, wholesalers and *kiranas*.

The main problem is the heterogeneity of ricebean in phenotypic characteristics, e.g. form, colour and size. The usage of grades to create uniform classes could alleviate this problem and decrease transaction costs for buyers (BARZEL 2002).

To summarize, the application of the hedonic price analysis confirmed that several evident and cryptic characteristics are relevant for consumers' purchasing decisions. These could be used to develop an improved ricebean variety that would be rapidly accepted in the market. The investigation of the agricultural marketing system revealed particularities that should be considered for a successful market introduction of such an improved ricebean variety.

7 German summary

Ein großer Teil der ländlichen Bevölkerung in Entwicklungsländern, wie Indien und Nepal ist auf eine Vielzahl wenig bekannter Nutzpflanzen, sogenannte „orphan crops“, angewiesen, um ihre Existenz zu sichern. Trotz ihres Beitrags zur Subsistenzsicherung wurden „orphan crops“ in der Vergangenheit von der Forschung kaum berücksichtigt und folglich gab es nur wenige Anstrengungen zur züchterischen Verbesserung der Sorten. Eine dieser „orphan crops” ist die Reisbohne (*Vigna umbellata*).

Die vorliegende Arbeit untersucht den potenziellen Beitrag einer verbesserten Reisbohnensorte zur Ernährungssicherung in marginalen Gebieten. Die Akzeptanz einer verbesserten Sorte ist umso wahrscheinlicher, je höher ihre Erträge sind, und je besser sie den Präferenzen der Konsumenten entspricht. Die Präferenzen der Konsumenten wurden unter der Annahme ermittelt, dass die Unterschiede der Marktpreise von Reisbohnen, auf Märkten in Indien und Nepal, auf Qualitätsunterschieden beruhen. Unter Verwendung der hedonischen Preisanalyse wurde geprüft, ob die Preisunterschiede durch kryptische und evidente Qualitätsmerkmale erklärt werden können, um daraus Verbraucherpräferenzen abzuleiten, die eine Grundlage für weitere Züchtung bilden kann. Für die Analyse wurden 167 Reisbohnenproben von Märkten in Indien und Nepal herangezogen. Der Zusammenhang zwischen Preisen und Qualitätseigenschaften wurde mit einer Regressionsanalyse anhand der „Kleinste-Quadrate-Methode“ geschätzt, in welche die abhängigen und unabhängigen Variablen in logarithmierter Form in die Gleichung eingingen. Die ermittelte hedonische Preisfunktion für Indien und Nepal konnte 60% der Preisvariationen erklären, wobei große Bohnen und hohe Protein-, Rohfaser- und Fettgehalte signifikant von den Verbrauchern bevorzugt werden. Die Koeffizienten der gemessenen Qualitätseigenschaften lassen sich als direkte Preiselastizitäten interpretieren und können zu einem Züchtungs-Index zur Beurteilung der Reisbohnensorten zusammengefasst werden. Durch die Nutzung des Index können Züchter Informationen über preisbeeinflussende Merkmale der Reisbohne ableiten und die Akzeptanz neuer Sorten im Markt prognostizieren.

Da eine verbesserte Reisbohnensorte sich nicht automatisch verbreiten wird, bedarf es einer Marketingstrategie zur Markteinführung. Vorraussetzung für eine Marketingstrategie ist die genaue Analyse der Vermarktungssysteme für landwirtschaftliche Güter, durch die die Reisbohne vom Produzenten zum Konsumenten gelangt. Um das komplexe und fragmentierte Vermarktungssystem in Indien und Nepal zu untersuchen wurde eine aus vier Perspektiven bestehende „Toolbox“ erstellt, die eine umfassende Beschreibung und Analyse ermöglicht. Dafür wurden die Konzepte der Marktplätze, Absatzkanäle, Supply Chains und der generellen Märkte einbezogen. Datengrundlagen zur Analyse und Beschreibung der Vermarktungssysteme waren wissenschaftliche Quellen, Datenbanken und Befragungen von Händlern und Landwirten.

Auf dem Weg der Reisbohne vom Produzenten zum Konsumenten werden in der Regel vier Handelsstufen durchlaufen: Auftragshändler („collectors“), Großhändler, und auf der Einzelhandelsstufe Supermärkte und *Kiranas* (kleine „Tante Emma“ Läden). Allgemein ist kein fest strukturierter Weg der Reisbohnen zwischen den Stufen ermittelt worden, da Reisbohnen zwischen allen Stufen und oft auch in beide Richtungen gehandelt werden. Die Analyse der Befragungen ergab, dass Großhändler bei der Weitergabe von Informationen über Hülsenfrüchte eine große Rolle spielen und somit auch bei der Einführung einer verbesserten Sorte einbezogen werden sollten.

Die Ermittlung der Konsumentenpräferenzen im Zusammenhang mit der Untersuchung des Vermarktungssystems konnte wichtige Informationen für die Züchtung und Markteinführung einer verbesserten Reisbohnensorte beitragen.

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9 Annex

Annex 1: Average value of all characteristics for Nepal and India

Characteristic	Unit	Minimum	Maximum	Mean	Standard deviation
Price Nepal & India	Indian Rupees (INR)/kg	12.50	39.00	25.07	6.3
Moisture	%	8.1	15.5	10.3	1.1
Protein	%	14.5	32.2	22.7	4.2
Fat	%	0.1	0.8	0.4	0.2
CrudeFibre	%	3.6	7.0	4.7	0.7
Carbohydrates	%	58.1	72.0	65.2	3.4
Ash	%	2.4	5.1	4.0	0.5
Seedweight	g/100 seeds	4.1	19.4	9.3	3.3
Foreign matter	%	1.1	19.3	6.9	3.5
LBRatio	Ratio length to breadth	1.4	2.1	1.6	0.2
Water uptake ratio	Ratio of weight increase	1.7	2.2	2.0	0.1
Swelling capacity ratio	Ratio of Volume increase	1.0	2.0	1.3	0.3
Colour diversity	Herfindahl-Index	0.3	1.0	0.6	0.2
N = 153					

Annex 2: Correlation matrix of quantitatively measured characteristics in log form

N:153	Prices in INR	Moisture	Protein	Fat	Crude Fibre	Ash	Seed weight	Foreign matter	L/B Ratio	Swelling capacity
Prices in INR	1									
Moisture	0.011	1								
Protein	0.250**	0.108	1							
Fat	-0.255**	-0.228**	-0.643**	1						
CrudeFibre	-0.079	-0.148	-0.492**	0.509**	1					
Ash	0.158	0.058	0.235**	-0.326**	0.137	1				
Seedweight	0.493**	0.027	0.353**	-0.481**	-0.452**	0.117	1			
Foreignmatter	-0.043	0.091	0.338**	-0.375**	-0.241**	0.262**	0.069	1		
LBRatio	0.039	0.193*	-0.153	0	0.052	0.019	-0.314**	-0.027	1	
Swelling capacity	-0.254**	-0.231**	-0.753**	0.868**	0.560**	-0.391**	-0.486**	-0.504**	0.073	1
**	Correlation is significant at the 0.01 level (2-tailed).									
*	Correlation is significant at the 0.05 level (2-tailed).									

Annex 3: Classes of pulses of the Food and Agriculture Organization of the United Nations (FAO)

FAOSTAT CODE	*COMMODITY*	*DEFINITIONS, COVERAGE, REMARKS*
0176	**BEANS, DRY** *Phaseolus spp.*: kidney, haricot bean *(Ph. vulgaris);* lima, butter bean *(Ph. lunatus);* adzuki bean *(Ph. angularis);* mungo bean, golden, green gram *(Ph. aureus);* black gram, urd *(Ph. mungo);* scarlet runner bean *(Ph. coccineus);* rice bean *(Ph. calcaratus);* moth bean *(Ph. aconitifolius);* tepary bean *(Ph. acutifolius)*	Only species of Phaseolus should be included, though several countries also include certain types of beans. Commonly classified as Vigna (angularis, mungo, radiata, aconitifolia). In the past, these species were also classified as Phaseolus.
0187	**PEAS, DRY** garden pea *(Pisum sativum); field pea (P. arvense)*	
0191	**CHICK-PEAS** chickpea, Bengal gram, garbanzos *(Cicer arietinum)*	
0197	**PIGEON PEAS** pigeon pea, cajan pea, Congo bean *(Cajanus cajan)*	
0201	**LENTILS** (Lens esculenta; *Ervum lens*)	
0211	**PULSES NES** Including inter alia: lablab or hyacinth bean *(Dolichos spp.);* jack or sword bean *(Canavalia spp.);* winged bean *(Psophocarpus tetragonolobus);* guar bean *(Cyamopsis tetragonoloba);* velvet bean *(Stizolobium spp.);* yam bean *(Pachyrrhizus erosus);*	Vigna spp. other than those included in 0176 and 0195 Other pulses that are not identified separately because of their minor relevance at the international level. Because of their limited local importance, some countries report pulses under this heading that are classified individually by FAO.

Annex 4: Questionnaire prepared for farmers

Farmer

1. Name:________________________ Location: ________________________Date:

2. Total area: _______________m²

Pulse	**Yield**	**Sold kg**	**Price Rs/kg**	**Buyer**

Buyer can be: Households (other farmer), wholesaler, retailer, collectors

3.Do you have any storing facilities?Yes / No

4.How much can you store (in kg or 50 kg sacks)? _______________________

5.Which of these sources of knowledge and price information are you using?

Source			
1.Friends, relatives		2.Phone	
3.Farmers		4.Internet	
5.Other traders		6.TV, radio	
7.Collectors		8.Ministry of agriculture	
9.Wholesaler		10. Research institutes	
11. Processors		12. Other:	
13. Consumers		14. Newspaper, bulletins	

6.Who are the most influencing agents regarding selling, price setting and information flow?

agents	strong	medium	weak	no influence
farmers				
collectors				
wholesalers				
retailers				
consumers				

7. Do you grow ricebean? ***Yes / No***

If yes, *if no go to question* 26.

8. Ricebean: area in m²_______ Yield in kg per season________ Kg sown out? ______

9. Cropping system & sowing type ____
10. Time for ricebean: men & hours/days for:
    a. Ploughing_____ planting_____, weeding_____, stacking_____, harvest____
11. Salary of a man/day and price for a bullock to plough?__________________________
12. Home consumption? _______________% or _____________kg
13. Do you go to the market to sell ricebean? Yes / No
14. If Yes, name and distance of the market_______________________________________
15. Who are the buyers of ricebean?
    a. Retailer___ Households___ Wholesaler ___ Collector__
    b. Name and location of the three most important______________________________
    c. Do they stay the same? ________________
16. Present selling price for ricebean? ________________________Rupee/ kg
    a. Highest price?_______Rs/kg __________________period____ sold kg/month
    b. Lowest price? _______Rs/kg __________________period____ sold kg/month
17. When are the most ricebean sold? ________________________period _______ Rs/kg
18. How do you get your seeds for the next year? ______________________________
19. What are your own preferences concerning following criteria for ricebean?
    a. Colour____
    b. Mixed or separated colours____
    c. Seed size ____
    d. Purity ____
    e. Damages ____
20. How is ricebean treated after harvest?
    a. Drying____, cleaning______, sorting_____, protection against pests_______
21. Do you have any pest problems with the storage of ricebean? Yes / No
22. What kind of? ____
23. Do you have special storage practices? _________________________________
24. Why don't you grow more ricebean? ____________________________________
25. What dishes are prepared from ricebean? ________________________________

If, No:

26. Reason for not growing ricebean? ____

Annex 5: Questionnaire prepared for intermediaries

Trader (retailer, collector, wholesaler)

1. Name: ____________________ Location: ___________________Date:________
2. Stage: _______________________used units: _____________

3. .	Rs/kg		Rs/kg		Rs/kg
Desi chickpea		Ricebean			
Kabuli chickpea		Lentil			
Cowpea		Horse gram			
Mung		Pea			
Urd		Soybean			
Kidney bean		Pigeon pea			

4. Sold kg per month of all pulses? ____
5. Do you have any storing facilities? Yes / No
6. How much can you store (in kg or 50 kg sacks)? ______________________________
7. Which of these sources of knowledge and price information are you using?

Source			
1. Friends, relatives		2. Phone	
3. Farmers		4. Internet	
5. Retailers		6. TV, radio	
7. Collectors		8. Ministry of agriculture	
9. Wholesalers		10. Research institutes	
11. Processors		12. Newspaper, bulletins	
13. Consumers		14. Other:	

8. What kind of information regarding pulses is exchanged over which source?

information	yes	no	source (1-14)
Prices			
Quality			
Demand			
Supply			
Weather			
Treatment of beans when stored			
New and preferred varieties			
New technologies, fertilizers			
Other:			

9. Who are the most influencing agents regarding price setting and information flow?

agents	strong	medium	weak	no influence
farmers				
collectors				
wholesalers				
retailers				
consumers				

10. Are there regulations or controls by the government for pulses? Yes/No
11. Which?____
12. **Do you sell ricebeans? Yes/ No (If no go to question 33.)**
13. Ricebean season?(from-till)________________________________
14. Sold kg per month of ricebean? ____________________________
15. Present buying price of ricebean? ___________________________
16. Present selling price of ricebean? ___________________________
17. Highest price?________Rs/kg ____________________period ________sold kg/month
18. Lowest price? ________Rs/kg ____________________period ________sold kg/month
19. Month with the highest sold amount? Price? ____________month ___________Rs/kg
20. Source of procurement for ricebean? (farmer, wholesaler, collector, other retailer)
    a) Source _______________________________ Number? ____________
    b) Location & distance of the 3 most important: ______________________
    ____
    c) Do they stay the same? Yes / No
21. Who is buying ricebean? Households__ Retailer__, Other____________________
22. How many kg at once? __________ How many times in a season? ______________
23. Which criteria's are you using to choose ricebean?

Criteria	**Yes/ no**	***Preferences?***
Seed size		
Colour		
Mixed or separated colours		
Purity/ cleanliness		
Price		
Sufficient quantity		
Free from insects		
Free from fungus		
Others:		

24. Do you add value by: cleaning_____, sorting_____, or grading_____ricebean?
25. How is ricebean presented? (sacks in kg, bags in gram)____________________
26. If, they are packed, who did that? ____
27. Where are these ricebean grown? (location, distance)__________________________

____

28. How where they transported and by whom?_________________________________
29. Do you have any pest problems with the storage of ricebean? Yes / No
30. What kind of? fungus ___ beetles ___ other _____________________
31. What are you doing against beetles, fungus? _________________________________
32. Do you know recipes or preparations of ricebean? _____________________________

____

If no,

33. What are the reasons not to offer ricebean?___________________________________

____

34. Are consumers asking for ricebean? Yes / No

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