



**Pro-Poor
Livestock
Policy
Initiative**



International
Farm Comparison
Network IFCN

A Review of Milk Production in India with Particular Emphasis on Small-Scale Producers

Torsten Hemme, Otto Garcia and Amit Saha



**A Living from
Livestock**

● **PPLPI Working Paper No. 2**

This is the second of a series of “Working Papers” prepared by the Pro-Poor Livestock Policy Initiative. The purpose of this series is to review issues affecting livestock development in relation to poverty alleviation.

The livestock sector plays a vital role in the economies of many developing countries. It provides food, or more specifically animal protein in human diets, income, employment and possibly foreign exchange. For low income producers, livestock also serve as a store of wealth, provide draught power and organic fertiliser for crop production and a means of transport. Consumption of livestock and livestock products in the developing countries, though starting from a low base, is growing rapidly.

The current document begins with a general overview of milk production in India. This is followed by a detailed study of dairy farming in Haryana State, particularly of the small-scale producers owning two to four milking animals who form the majority. The purpose is to assess their prospects for earning more from dairy farming, and to identify which areas of intervention in terms of management or policy are likely to be most favourable to them, and whether they are vulnerable to international competition. A further objective has been to evaluate the methodology developed by the International Farm Comparison Network (IFCN) which is based on the concept of ‘typical farms’.

It is hoped that the paper stimulates discussion and any feedback would be gratefully received by the authors and the Livestock Information and Policy Branch of the Animal and Production and Health Division of FAO.

About the Authors

Torsten Hemme (PhD): Head IFCN Dairy, Dairy economist at FAL-Federal Agricultural Research Center, Network management at Global Farm GbR, Germany.

Otto Garcia (M.Sc.): Dairy economist, PhD researcher University of Minnesota, USA.

Amit Saha (M.Sc.): Dairy economist, PhD researcher at National Dairy Research Institute, India.

The authors co-operate in the IFCN to analyse dairy farming systems world wide. For details contact IFCN@fal.de or have a look on www.ifcnnetwork.org.

Disclaimer

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or its authorities or concerning the delimitations of its frontiers or boundaries. The opinions expressed are solely those of the author(s) and do not constitute in any way the official position of the FAO.

Keywords

Costs of production, India, milk, policy, poverty reduction, small scale dairy, typical farms

Date of publication: 31 January 2003

For more information please visit the PPLPI website at: <http://www.fao.org/ag/againfo/projects/en/ppipi/home.html> or contact:

Joachim Otte, Project Coordinator, Pro-Poor Livestock Policy Facility
Food and Agriculture Organization, Animal Production and Health Division, Viale delle Terme di Caracalla, 00100 Rome Italy
Tel: +39 06 57053634 Fax: +39 06 57055749 Email: Joachim.Otte@fao.org or Livestock-Policy@fao.org

TABLE OF CONTENTS

1. Executive Summary	1
2. Overview - Milk Production in India	5
2.1 Indian Dairy in the Global Context	5
2.2 Recent Dairy Developments in India	6
2.3 Processing and Marketing Channels for Dairy Products	8
3. IFCN Analysis of the Dairy Sector in Haryana	11
3.1 Recent Dairy Developments in Haryana	11
3.2 Natural Conditions and Farm Structure in Haryana	12
3.3 Description of the Typical Farms in Haryana	14
3.4 Farm Comparison: Household Approach	17
3.5 Farm Comparison: Whole Farm Approach	19
3.6 Farm comparisons: Dairy Enterprise Approach	21
3.7 Margins in the Dairy Chain: Farmer to Consumer	25
4. Testing IFCN Methods for Small Scale Dairy Farming	28
4.1 Modelling Price Changes for Typical Dairy Farms	30
4.2 Modelling Production Practices for a Typical 2-Cow Farm (IN2)	32
4.3 Modelling Policy Impacts for a Typical 2-Cow Farm (IN2)	35
4.4 Risk Assessments for a Typical 2-Cow Farm	36
5. Conclusions for the Pro Poor Livestock Policy Project	38
5.1 Crucial Findings for Dairy Farming in Haryana	38
5.2 Contributions of IFCN Methods to the Pro-Poor Project	39

ANNEXES

A1. Methodological Background	41
A2. IFCN Method: Costs of Production Calculations	43
A3. Description of IFCN Result Variables	45
A4. Major Stakeholders in the India Dairy Industry	47
A5. Milk Production in India	48
A6. Illustration of the Dairy Production System for a Typical 2 Cow Farm (IN2)	49
A7. Seasonality of Income and Feed Sources for a Typical 2 Cow Farm (IN2)	50
A8. Marketing of "Milch Animals" in Haryana	51
A9. Description of the Dairy Chain Calculations	53
A10. Descriptions of the Price Sensitivity Scenarios	54
A11. Descriptions of the Simulated Scenarios for a Typical 2 Cow Farm (IN2)	55
A12. References	58

1. EXECUTIVE SUMMARY

Introduction

Milk production is a livestock enterprise in which small-scale farmers can successfully engage in order to improve their livelihoods. Regular milk sales also allow them to move from subsistence to a market based income. The main purpose of this study was to gain insight into the household and farm economics of small-scale dairy farmers in India, the country with the highest number of small-scale dairy farmers by far, and to obtain estimates of their costs of milk production so as to gauge their vulnerability to international competition. In order to ascertain possible developments in the dairy sector and to broadly identify areas of interventions that favour small-scale dairy producers, the study examines impacts of changes in prices, farm management and other market factors that affect small-scale milk production systems, the whole farm and related household income. A case study approach is used, the aim being qualitative insight rather than quantitative extrapolation.

Methodology

The state of Haryana, one of the major milk producing states in India, was chosen for this study. The methodology applied for the economic analysis was developed by the International Farm Comparison Network (IFCN) and utilises the concept of typical farms. Farm types are determined on the basis of the knowledge of regional dairy experts. One farm 'type' of each region is chosen to represent the size that is close to the statistical average. The other 'typical' farms defined represent larger farms to assess the economies of scale in the region or to represent different dairy production systems. Management levels on the typical farms are average to slightly above average compared to other farms of their type.

In the case of Haryana, typical farms were defined by (a) location of the farm, (b) farm size and (c) the production systems that make important contributions to milk production in Haryana state. Data was collected using a standard questionnaire and a computer simulation model, TIPI-CAL (Technology Impact and Policy Impact Calculations), was used for biological and economic simulations of the typical farms and for the analysis of hypothetical scenarios involving changes in factors affecting milk production. The farm input data and the related output figures were discussed and validated with local experts and farmers.

Results

Milk production in India and Haryana State

In 2001 India became the world leader in milk production, closely followed by the USA, with a production volume of 84 million tons. More than half of the milk is produced by buffaloes. India has about three times as many 'dairy' animals as the USA, the vast majority (over 80 percent) being kept in herds of 2 to 8 animals. Annual milk yield per dairy animal is about one tenth of that achieved in the USA and about one fifth of the yield of a New Zealand dairy cow.

In Haryana state, nearly five million tons of milk were produced in 2000, about 80 percent thereof derived from buffalo. Over the past five years, total milk production has increased by around 20 percent. Most of the growth has resulted from an increase in the number of crossbred cattle, whereas yield increases have been slight. Almost 90 percent of farms have less than one hectare of land and one to two dairy animals.

Analysis of 'typical farms' in Haryana

Based on IFCN methodology described four farm types have been identified as 'typical' and were subjected to the detailed analysis:

IN2: This farm represents a rural landless household with 2 buffaloes. The household consumes about 50 percent of its milk production while the rest is sold to the local milkman. This farm represents the vast majority of farms and is close to the average farm size in the area.

IN4: This farm is also located in a rural area but has 3.7 ha of land used for small grain crops. Four dairy animals (2 buffaloes and 2 cows) are kept. The milk is sold to a creamery in a town at 3 km distance.

IN22: This farm is located just in the periphery of a major city. It has 5.8 ha of land and keeps 22 dairy animals (18 cows and 4 buffaloes). Milk is sold to a local milk processing company under a multiyear contract.

IN37: This farm is located within a major urban area. It has no land and purchases all the feed for its 37 dairy animals (26 buffaloes and 11 cows). The milk is sold directly to the end consumer through its own creamery shop.

Although the large size of IN22 and IN37 is unusual and they may be considered as 'untypical' dairy farms in India, they represent the dairy segment with the highest growth rate in Haryana. Moreover their selection allows the analysis of economies of scale.

Dairy production systems

On all four farms the dairy animals are kept in tied stalls with no grazing. Milking is done by hand. Feed rations are based on agricultural by-products such as wheat straw, sugar cane tops, and weeds. All farms use some level of concentrate/compound feed. Buffalo are the main type of dairy animal, followed by crossbred cows, and finally local cattle. The family is in charge of the management of the farm and provides 100 percent of the farm labour on the two smaller farms whereas it provides at least 50 percent of the farm labour on the two larger ones. Production per dairy animal ranges from 800 to 3,676 kg/year (non fat corrected milk).

Household comparison

All farms have a more or less diverse income structure, income sources being the sale of milk, sale of cash crops, and off-farm employment. Annual household incomes range between 700 US\$ (IN2) and 8,200 US\$ (IN22).

Especially for farm IN2 the main cash income source is off-farm employment (70 percent). The net cash farm income just covers the farm cash costs and only contributes 7 percent to the household income. However, the non-cash benefits from the dairy obtained by the family in the form of milk and manure has a market value equivalent to 23 percent of household income.

Whole farm comparison

The returns from farming range from 200 US\$ to 28,000 US\$ per year. Net cash farm income closely follows the level of farm returns. The highest net cash farm income (8,100 US\$/year) is achieved by farm IN22.

The net cash income of farm IN2 is only 43 US\$ year. This is due mainly to the low share of milk sold and the interest rates paid for a loan from the milkman. The loan arrangement with the milkman also results in IN2 receiving the lowest milk price of

the four farms studied. It must be kept in mind, however, that IN2 obtains other services and support from the milkman, which are not otherwise accessible to subsistence farmers.

Comparison of the dairy enterprise - Costs of milk production

Farms IN4 and IN22, both having land to grow crops and forage, are able to produce milk at 15 US\$ per 100 kg. These farm types have the potential to compete with imports of dairy products and also to produce milk for export, provided international quality standards can be achieved and the dairy chain being internationally competitive.

The cost of milk production of farm IN37 is 50 percent higher (an additional 8 US\$ per 100 kg milk) than that of farms IN4, IN22. This is due to higher feed costs as a result of having to purchase all feed. However, the high milk price obtained (an additional 8 US\$ per 100 kg milk compared to IN22) compensates for the additional costs. IN37 fully covers its total production costs and should be economically viable in the long run.

The cost of milk production of farm IN2 amounts to 25 US\$/100 kg and is thus significantly higher than the cost incurred by farms IN4 and IN22. This can be explained by economies of scale, low milk yields and poor breeding management (one calf per buffalo only every second year). Without major improvements farm type IN2 will, in the longer run, have difficulties competing with the larger farm types. At the moment, however, the main purpose of IN2 is to produce milk for home consumption by converting practically free feedstuffs into milk, livestock, and fuel and secondly to provide the female members of the family with an income-generating activity.

As in small dairy farms in most other countries, farm IN2 will keep its dairy animals as long as alternative employment opportunities (at 0,2 US\$/hour in this case) are not available. Apart from these financial considerations, personal preferences of the people are likely to slow down the speed of structural changes in these subsistence milk production systems.

Dairy Chain in Haryana (preliminary estimates)

Consumer prices for fresh milk in the informal sector are slightly higher than in the formal sector. The prices paid to the farmer for milk with 6 percent fat are at the same level as the consumer price for milk containing 3 percent fat. The extracted cream value of 0,17 US\$/kg covers the processing and retail cost in the chain.

The margin for milk processing and retailing in Haryana amounts to around 50 percent of what the dairy chain in Europe covers to deliver the milk to the consumer. The highest margins (0,21 US\$/kg) in the chain are achieved by the milkman, while the lowest margins (0,06 US\$/kg) are made by farms that directly sell milk to consumers with a fat content of 6 percent and do not extract the cream.

Predicted assessment of changes in production conditions and risks

Methods used by IFCN for the analysis of structural and policy changes are applied to small scale dairy farming in Haryana to quantify the impact of various changes in prices, farm management, policy and also to estimate the impact of major risks on household income. The focus being on testing of the methodology, simplified scenarios were used, based mainly on observations and estimates made by the authors. The results can be summarised as follows:

Price sensitivity

The larger and more specialised farms are more sensitive to price changes than the smaller farms, where most of the milk is consumed by the household and which generate most of the income from off-farm activities.

Production practices/policy

Farm IN2 has the potential to reduce the cost of milk production to the level of the larger farms (IN4, IN22) and could thereby achieve a remuneration from dairying that is higher than the wage level in the area. This means that landless people in rural areas theoretically have the potential to run a profitable business, generate employment for family members, especially women, and could thus significantly improve their living conditions. For the improvement of the viability of farm type IN2, access to loans with reasonable interest rates as well as an increase of milk production (more animals in lactation and higher milk yield) are the most critical points.

Risk

The main risks identified by the farmers are not having an animal (buffalo) in lactation in any one year, the death of a lactating buffalo, having to pay for straw (which is the main feed source), and that the main income earner falls ill (and therefore cannot generate an off-farm income). Occurrence of any of the identified risks can lead to a reduction of household income by 50 percent. Occurrence of any of the four risks related directly to the dairy enterprise will lead to a reduction or cessation of this activity as the required investments financed with a loan at 50 percent interest are financially not viable.

Conclusions

The global livestock sector is changing rapidly. With a strong and growing demand and rapid institutional and macroeconomic policy changes, there is a significant danger that the poorer livestock producers will be crowded out and left behind. This could be prevented and, given the strong growth in demand for livestock products, engagement in livestock production could make an important contribution to global food security and poverty reduction.

This positive outcome will only occur, however, if an appropriate national and international policy framework is put in place. The question is: 'What is appropriate?' and 'How do we assess its appropriateness depending on specific factors?'

The IFCN methodology, applied by dairy economists in more than 20 countries, can be seen as a useful tool to quantify the economic situation of the small-scale, subsistence farms/households engaged in milk production. This is the case both for the current situation but also for specified policy and farm management scenarios. This potential for detailed impact assessment prior to implementation can assist in determining the most effective mix of support activities to be promoted by the Pro-Poor Livestock Policy Initiative.

2. OVERVIEW - MILK PRODUCTION IN INDIA

2.1 Indian Dairy in the Global Context

World Milk Production

In 2001 India became the world leader in milk production with a production volume of 84 million tons, followed closely by the USA.

'Dairy' Animals

Although achieving relatively similar total milk production, India keeps over three times the number of cattle as the USA. In addition, 94 million buffalo contribute to milk production in India.

Dairy Farm Structures

The vast majority (over 80 percent) of 'dairy animals' in India are kept in farms of 2 to 8 animals. While the average Indian 'dairy' herd consists of 2 animals, the average farm in the USA keeps 88 dairy cows while herds in New Zealand hold an average of 236 dairy cows.

Milk Yields

Average annual milk yields in the above mentioned countries suggest that one New Zealand dairy cow produces as much milk as five Indian 'dairy animals' while one dairy cow in the USA produces as much as ten Indian 'dairy animals'. This dramatic difference can be explained by various factors such as genetics, feeding, management, technology, etc. about which a great amount of scientific knowledge exists.

Milk Prices

India and New Zealand have very similar milk prices at about 18 US \$/100 kg FCM. The USA and countries of the European Union, Germany for instance, have various and generous farm subsidies which more than double the milk prices received by their farmers.

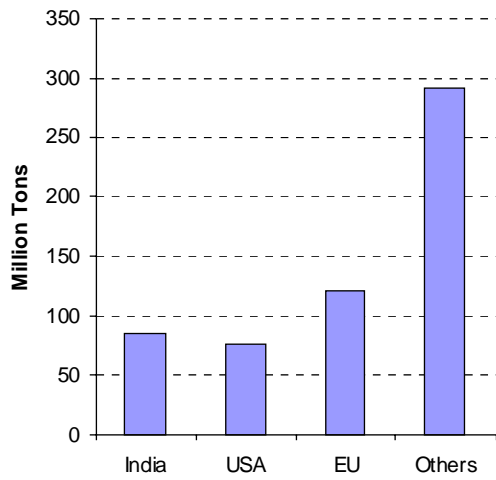
Milk Production per Capita

Due to its high human population and the comparatively low milk yield of its dairy animals, India has a very low per capita milk production. The opposite holds for New Zealand where milk yield per animal is high and human population is small.

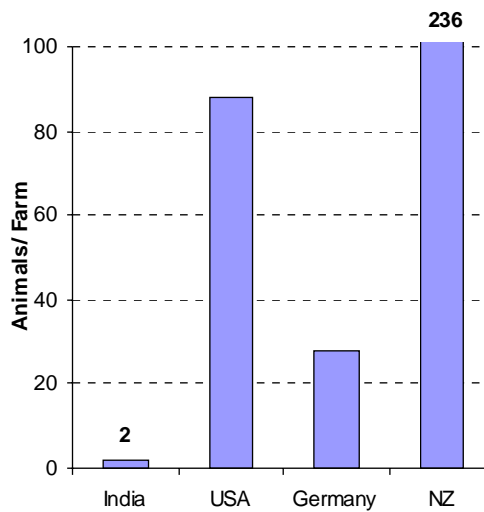
Explanations of variables; year and sources of data:

- Milk Production per Country(2000): IFCN Dairy Report 2002.
- Average Farm Size (2000): IFCN Dairy Report 2001.
- Milk Yields per Milch Animal (2000): IFCN Dairy Report 2001; and FAO Production Yearbook.
- Number of Animals (2000): FAO Production Yearbook.
- Farm Gate Milk Prices (2001): IFCN Dairy Report 2002.
- Milk Production per Capita (2001): IFCN Dairy Report 2002

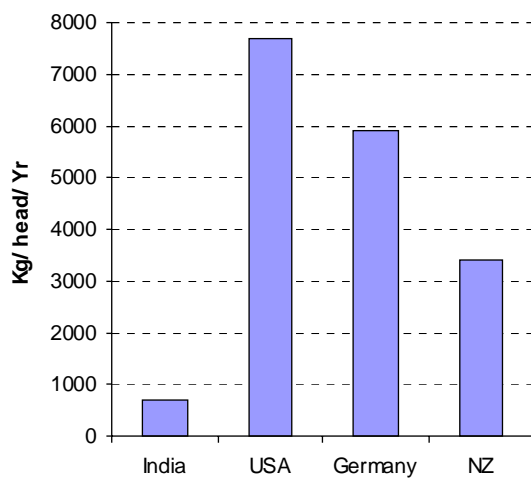
Milk Production per Country



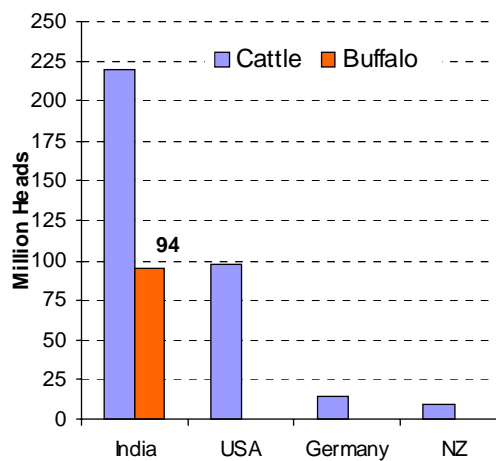
Dairy Farm Size



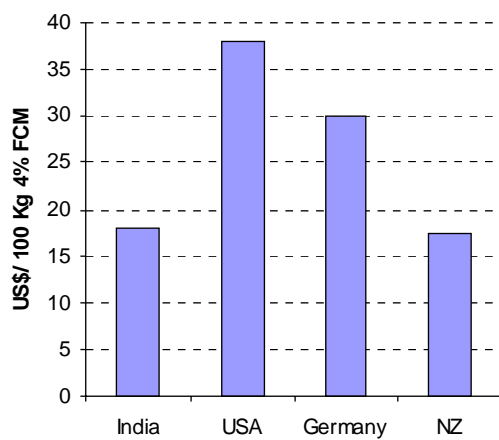
Milk Yields per Milch Animal



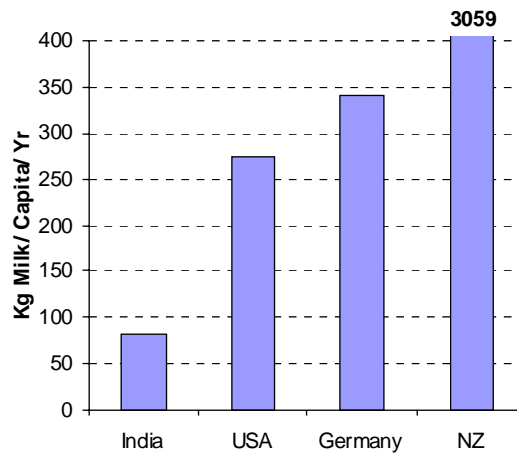
Number of Live Animals



Farm Gate Milk Prices (2001)



Milk Production per Capita



2.2 Recent Dairy Developments in India

Developments of Milk Production in India

2001 shows a production volume of 130 percent of that in 1995. Interestingly, milk production from buffalo, local cattle, and crossbred cattle has experienced virtually identical growth rates.

Regional Shares of the Indian Milk Production

While the Northern region has experienced a decline in its relative contribution to national milk production, the share contributed by the East has increased. The Southern and Western regions have maintained their position.

Development of the Daily Milk Yields

Between 1995 and 2000, daily milk yields have increased at a faster rate for local cattle (+34 percent) and buffaloes (+17 percent) than for crossbred cows, whose daily yields declined by 5 percent in the same period.

Development of the Numbers of 'Dairy Animals'

From 1995 to 2001, the number of local cattle has remained constant while the number of buffaloes and crossbred cows have increased by 10 percent and 50 percent respectively.

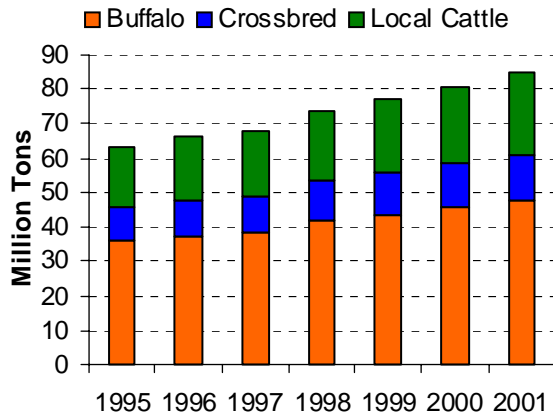
Development of Milk Prices

Over the past five years, milk prices in India have decreased from 22 to 18 US\$/ 100 Kg FCM (-18 percent). This decline in milk price is however mainly attributable to the devaluation of the Indian Rupee.

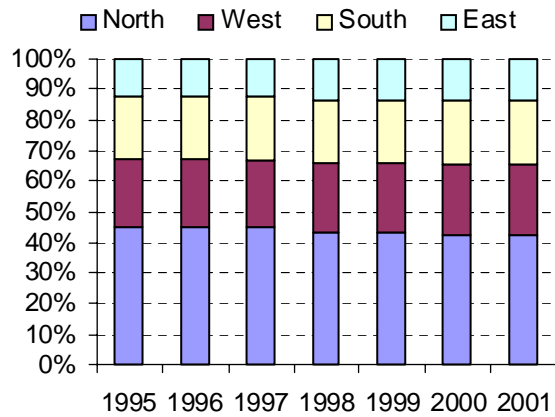
Explanations of variables; sources of data:

- Local Cattle: Original Indian 'milch' animals (mostly *Bos indicus*), which have a relatively low milk yield potential but are well adapted to local conditions.
- Crossbred: 'Milch' animals with varying degrees of a high potential dairy genes (*Bos taurus*; usually Holstein and Brown Swiss) and one of the many Indian breeds.
- Milk production: Government of India, 1999; Gupta, 1997; Sadhana's Dairy Yearbook, 2001.
- Regional Milk production: Government of India, 1997&1999; Gupta, 1997; Sadhana's Dairy Yearbook, 2001.
- Daily Milk Yields: Gupta, 1997; Sadhana's Dairy Yearbook, 2001.
- Number of Milch Animals: Gupta, 1997; Sadhana's Dairy Yearbook, 2001.
- Milk Price Development: IFCN Dairy Report 2002
- Regional Milk production: Government of India, 1997&1999; Gupta, 1997; Sadhana's Dairy Yearbook, 2001.

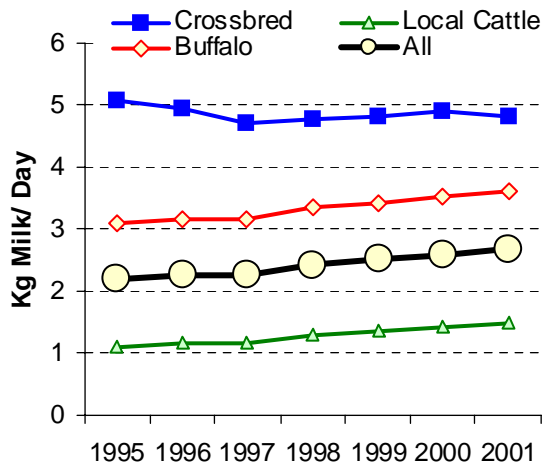
Milk Production



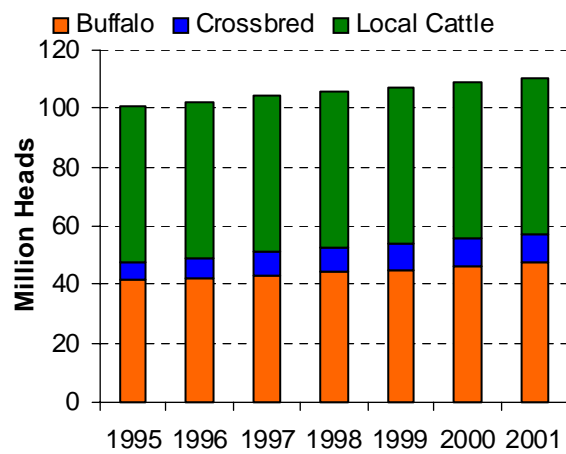
Regional Milk Production



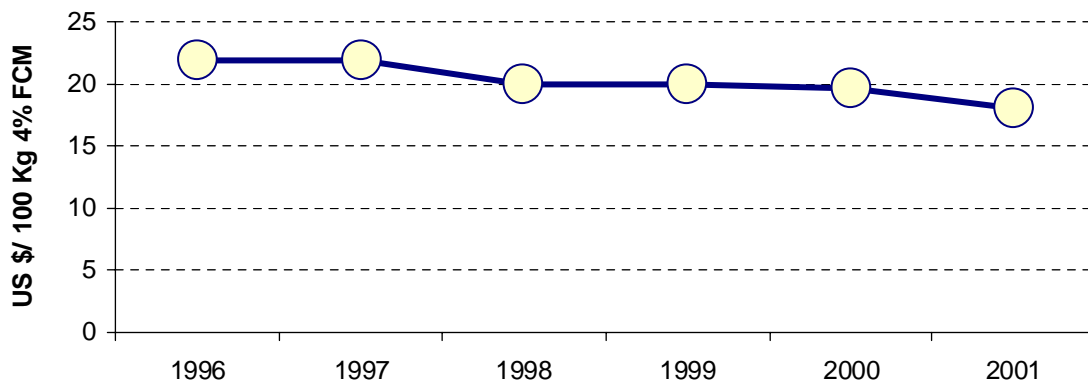
Daily Milk Yields



Number of Milch Animals



Milk Price Development



2.3 Processing and Marketing Channels for Dairy Products

It is estimated that around 15 percent of the milk produced in India is marketed through formal channels while the remaining 85 percent is informally handled.

Fluid milks are by far the most popular milk products. In the informal sector, the consumer has direct and daily contact with the creamery, milkman or farmer, and their own home containers are used for the transport of the milk purchased. In rural areas, whole buffalo milk is the preferred milk. In the formal sector, fluid milk is commonly sold in plastic bags of 0,5 and 1 kg. (Tetra pack 1-Ltr containers are rarely found in the state of Haryana, and if so usually with the brand-name Nestle).

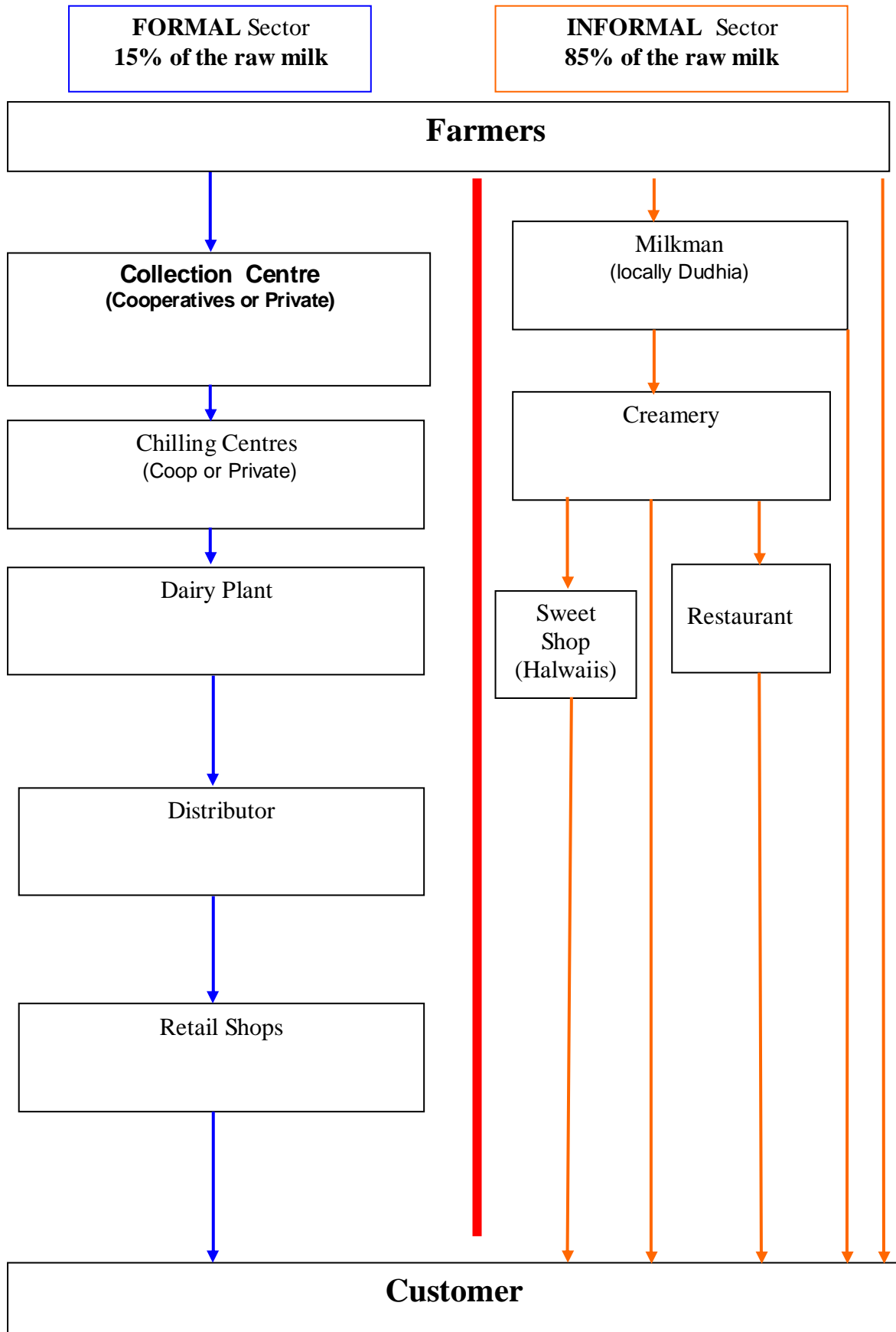
Creamless milk, called **Spreta**, is very well accepted and represents over 85 percent of the milk volume sold by either the creamery or milkman. The cream taken out (by the informal sector) is sold directly to households, restaurants, and sweet shops or converted into butter and ghee.

Milk processing is mainly carried out by the formal sector (production of butter, ghee, cheeses, yoghurt, etc.) and by some players in the informal sector such as sweet and tea shops, restaurants and households.

Milk flows between the formal and informal sectors, mainly as creamless milk sold by the creameries and or the milkmen to processing plants. Dairy plants will then remove some more fat and sell the remaining fluid milk as Double Toned milk (about 1,5 percent fat).

Rural consumers pay about the same price for whole milk (6 percent fat) as the urban consumer pays for very low fat milk (1,5 percent fat).

The diagram on the next page shows a simplified version of the main milk marketing channels in the formal and informal sectors.



3. ANALYSIS OF THE DAIRY SECTOR IN HARYANA

3.1 Recent Dairy Developments in Haryana

Milk Production

While the total milk volume obtained from local cattle decreased from 1995 to 2000, milk from buffaloes and crossbred cows increased by 23 percent and 76 percent over the same period. Despite the strong growth rate of milk production from crossbred cattle most of the milk in Haryana (approx. 80 percent) is still produced by buffaloes.

Development of Daily Milk Yields

Over the past five years, daily milk yields of local and crossbred cattle have decreased by 6 percent and 4 percent respectively while daily milk yield of buffaloes has increased by 7 percent.

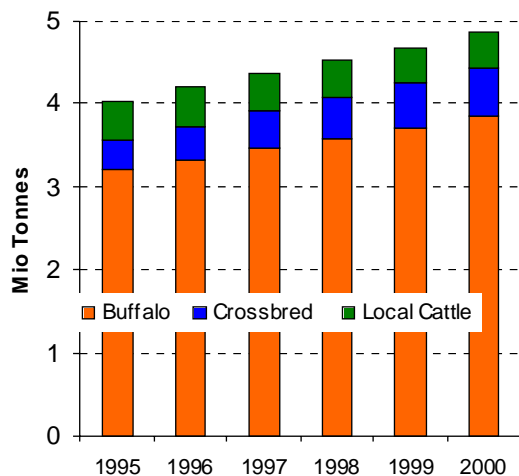
Types of 'Dairy Animals'

The numbers of buffaloes and crossbred cattle have increased by 18 percent and 84 percent while the number of local cattle is declining. Farmers thus seem to be replacing their local cattle with buffaloes and/or crossbred animals.

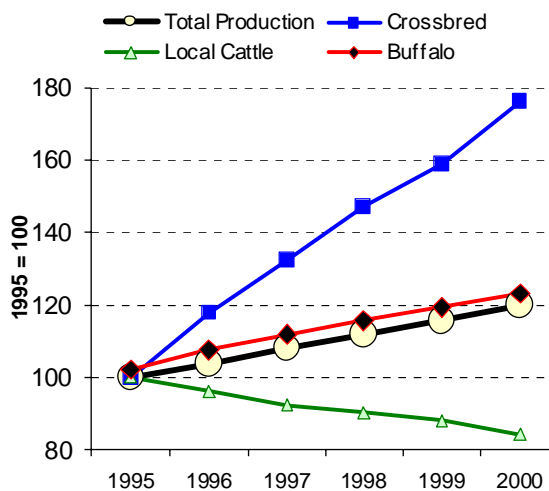
Explanations of variables; year and sources of data:

- Local Cattle: Original Indian 'dairy' animals (mostly *Bos indicus*), which have a relatively low milk yield but are well adapted to local conditions.
- Crossbred: Milch animals with varying degrees of a highly productive dairy genetics (*Bos taurus*; usually Holstein and Brown Swiss) and one of the many Indian breeds.
- Milk Production: Government of Haryana, 2001; and Government of India, 1999.
- Development of Milk Yields: Government of Haryana, 2001; and Government of India, 1999.
- Types of Milch Animals: Government of Haryana, 2001; and Government of India, 1999.

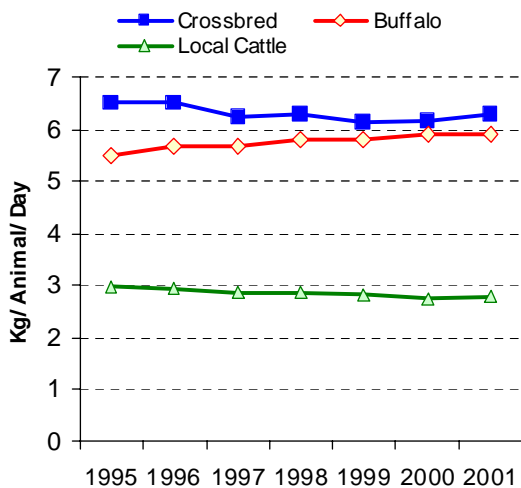
Milk Production



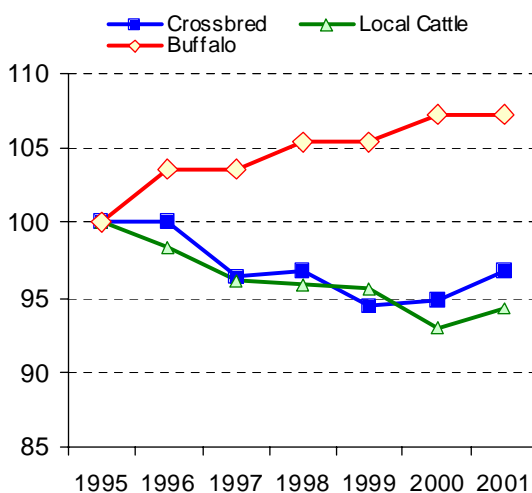
Growth of Milk Production



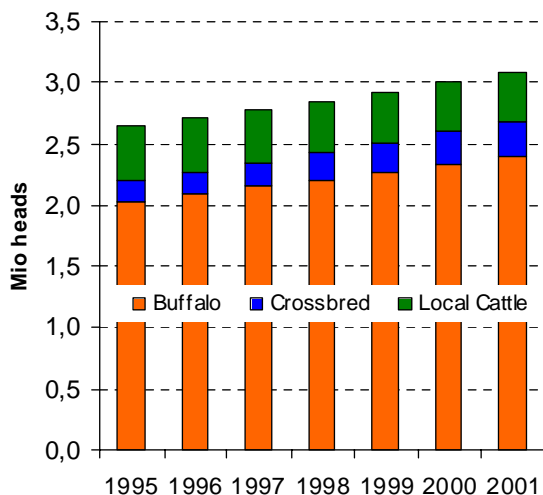
Daily Milk Yields



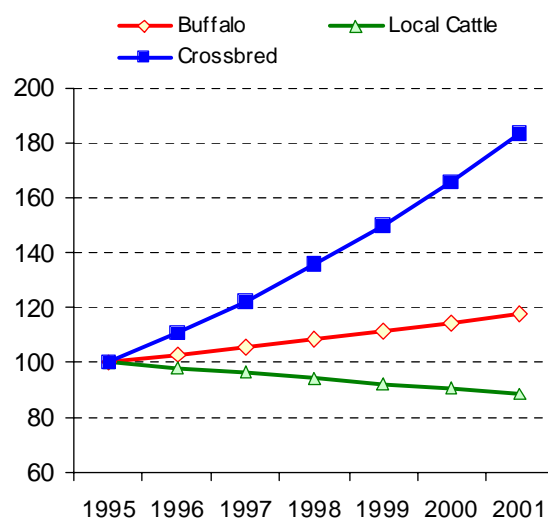
Growth of Milk Yields



Numbers of Milch Animals



Growth of Milch Animals



3.2 Natural Conditions and Farm Structure in Haryana

Natural Conditions

Temperature

Haryana experiences moderate and high temperatures throughout the year with only slight variation between seasons.

Rainfall

Summer is the rainy season in Haryana. However, the state has a good irrigation system, which makes farmers relatively independent of rainfall.

State Farmland Structure

Haryana counts on a total 4,421,200 hectares. From this, 80 percent (3,552,000 ha) are cultivated and about 65 percent (2,888,000 ha) are irrigated. Paddy (rice), (winter) wheat and sugarcane are the main crops in the irrigated zone (Mustard, cotton, and pulses in non-irrigated land). The irrigated land is found mostly on the eastern, northern and some parts of western Haryana. Lastly, canals and wells are utilised to irrigate 99.4 percent of the irrigated land in the state.

Farm Structure in rural areas (Survey of 6 villages)

As official statistics on the specific farm structure in Haryana do not exist but given that overall 98 percent of the Indian milk production takes place in rural areas, a survey of six villages in Haryana was undertaken to obtain some baseline information. Rural Haryana was divided into two major areas, irrigated and rainfed.

Farms in the Irrigated Area

About 90 percent of the dairy farms in the irrigated zones have one or two, usually two, 'dairy' animals and own up to one hectare of land. The remaining 10 percent of farms have an average herd size of 4 dairy animals. Only the two smaller farms included in this study are located in the irrigated area.

Farms in the Rainfed Area

Although farmers in this area have larger landholdings, the herds are smaller. Over 95 percent of the farms own between one and two dairy animals and the remaining 5 percent usually do not own more than three dairy animals. No farms from this area are included in this study.

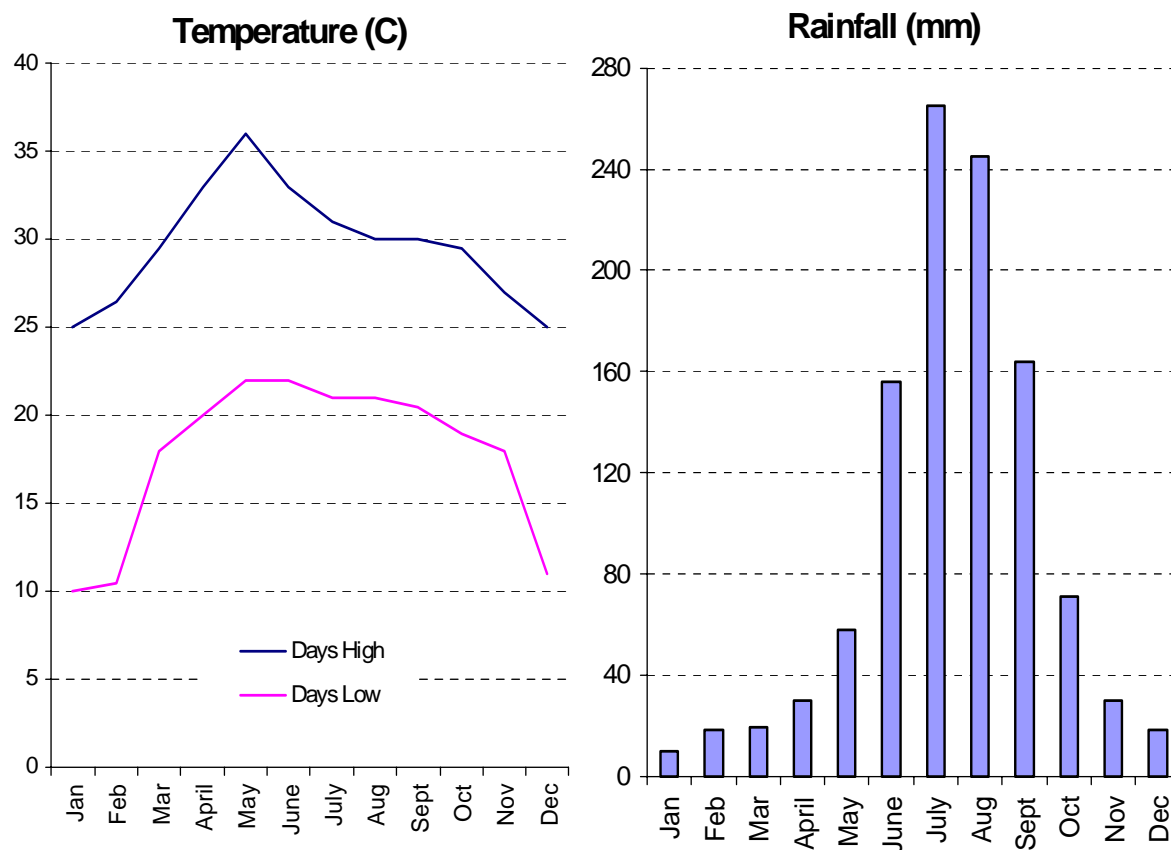
Farm selected for the analysis

The rural farms IN2 (landless) and IN4 (with land) represent the two milk production systems dominating rural Haryana and over 98 percent of the rural dairy farms.

The farms IN22 (peri-urban; with land) and IN37 (urban; without land) represent fast growing farm types in Haryana. Although urban and peri-urban areas were not surveyed, the inclusion of these farm types provides a valuable picture of the effects of economies of scale and location on Haryana dairy farm types.

Explanations of variables; year and sources of data:

- Temperature: IFCN Dairy Report 2002
- Rainfall: IFCN Dairy Report 2002
- Farm Structure: Survey of six villages in Haryana, 2002.



Farm Structure in Rural Haryana

	Number of Milch Animals			Land ha	% of farms
	Cross-bred	Local Cattle	Buffaloes		
Farm types on irrigated land					100%
IN2 (landless to marginal farmers)	0-1	0-1	1-2	0-1	89%
IN4 (medium to large farmers)	1-2	0	3-4	5-16	7%
IN4 (small farmers)	0	0	4	5	4%
Farms types on non-irrigated land					100%
IN2 (landless to marginal farmers)	0-1	0-1	1	0.5-3	54%
IN2 (small to larger farmers)	0	0	1-2	2-10	54%
IN3 (small farmers)	0	1	2	1.5 - 4.5	1%
IN3 (small farmers buffalo based)	0	0	3	2-6	3%

3.3 Description of the 'Typical' Farms in Haryana

In the Indian state of Haryana, four different farm types have been identified as 'typical' and one farm from each category has been analysed. In the following, each farm is briefly described. More details, especially about the dairy production systems, can be found on the table on the next page.

2-Cow Farm (IN2)

Location: Landless household that is located in a rural area.

Activities: The farm keeps 2 buffaloes and utilises crop residues and some purchased items (mustard cake, etc) for feeding. The family consumes more than 50 percent of the milk produced, while the surplus is sold to the local milkman (at lower than market price) as part of an annual loan agreement. The main source of income is off-farm employment, mostly as seasonal work on larger crop farms in the region. The main problem of this farm type is that buffaloes usually only lactate every other year.

4-Cow Farm (IN4)

Location: A farm in a rural area, close to a larger town, with 3.7 ha irrigated land.

Activities: The farm keeps 4 'dairy animals' (2 cows, 2 buffaloes). Seventy percent of the milk produced is sold in the nearby larger town via local vendors. The feed basis is formed by crop residues but to a considerable extent compound feed is also used. Besides dairy farming, off-farm employment and production of cash crops are important sources of income. Hiring out its machinery (tractor and ploughing equipment) also provides a seasonal income for the household.

22-Cow Farm (IN22)

Location: A farm in a peri-urban (suburban) area with 5.8 ha irrigated land.

Farm: Dairy farming is the main farm activity generating 75 percent of total returns. Production of cash crops provides the remaining 25 percent of household income (no off-farm employment). The farm keeps 22 'dairy animals' (18 crossbred cows, 4 buffaloes). The feed source is green fodder grown on the farm throughout the year and purchased compound feed. The milk is sold directly to dairy processors on a contract basis.

37-Cow Farm (IN37)

Location: A landless dairy farm that is located within a major urban area.

Farm: Dairy farming is the main farm activity (no off farm employment). The farm keeps 37 'dairy animals' (26 buffaloes, 3 local cows, 8 crossbred cows). Feed has to be purchased (green fodder, compound feed). The milk is sold directly to the consumers via the farm's own shop.

Farm		IN-2	IN-4	IN-22	IN-37
Land	Units ha	no land	3,7	5,8	no land
Dairy Enterprise					
Cows	no.	2	4	22	37
Breed	description	2 Buffaloes	2 Buffaloes, 2 Crossbreds	4 Buffaloes, 18 Crossbreds	local cows, 8 Crossbreds
Liveweight	kg	420	400	420	450
Milk yield	kg FCM/cow	980	2205	3859	2779
Fat and protein content	%	5,5% / 3,5%	5,5% / 3,5%	4,4% / 3,5%	6% / 3,5%
% milk sold	%	44%	69%	92%	76%
Land use Dairy enterprise					
Land use for dairy	ha	-	0,35	3,4	-
Milk produced per ha	Kg FCM / ha	-	8864	8448	-
Stocking rate	LU / ha	-	1,1	3,8	-
Labour					
Full time employees	persons	0	0	3	2
Share of family labour	% of total labour	100%	100%	36%	36%
Hours per milking cow	h / cow / year	900	578	241	264
Buildings					
Housing type	description	Mud house	Concrete house	Concrete house	Concrete house
Building(year built)	description	1995	1994	1996	1998
Milking					
Milking system	description	hand	hand	hand	hand
Milking times	per day	twice	twice	thrice	twice
Calves/ Animal/ Year	head	0,6	0,9	1	1
Length of lactation	days	280	295	300	200
Dairy company (far away)	km	3	3	5	2
Herd management					
Seasonality	yes / no	yes	yes	no	yes
Calving season	months	Sept - March	Sept - March	Jan - Dec	Sept - March
Dry period	months	10	4	2	0
Feeding times	per day	2	2	3	2
Average lactations	lact. per cow	5,0	4,0	6,3	1,9
Artificial insemination	yes / no	yes	yes	Holstein bull	Buffalo bull
Death rate	% cows	10%	8%	10%	10%
Culling rate	% cows	0% (33% are sold)	25%	16%	52%
Feeding					
Feeding system	description	stall fed Sugarcane tops+ weeds +straw	stall fed Fodder * + wheat straw MC or CSC ** + CF	stall fed Fodder * + wheat straw CF + com	stall fed Fodder * + wheat straw MC or CSC** + CF
Roughage feed source	description				
Concentrates Fed	description	MC or CSC **			
Concentrate use in total	t per cow	0,3	0,5	0,8	1,0
Concentrate input	g / kg FCM	279	216	198	365
Calf rearing					
Death rate of calves	% calves	25%	30%	10%	50%
Weaning period	months	9	9	4	6

Notes: * Fodder crops refers to Jowar (maize), Millets and Berseem.

** MC and CSC mean Mustard Cake and Cottonseed cake.

*** CF means Compound feed, which is a commercial balanced feed mixture.

3.4 Farm Comparison: Household Approach

Size of the Household - Labour Utilisation

The four farm families have five or six members, which corresponds well with the average family size in the region (six persons/family). Only family members from the smaller farms work off-farm. Although the data gathering of hours worked, their allocation to the dairy enterprise, and their valuation has proven difficult, these estimations show that the household IN2 provides a total of 4,760 working hours per year (38 percent for its dairy and 62 percent for off-farm employment). IN4 accumulates a total of 9,880 working hours (29 percent for off-farm work, 48 percent for crops, and 23 percent for dairy).

Household Income Levels

The household income includes the net cash farm income, the off-farm salary brought home and the value of manure (heating) and milk used in the household. The annual household incomes range from 700 US\$ (IN2) to 8,700 US\$ (IN22). The higher income of IN22 compared with IN37 is a result of a higher profit obtained per kg milk. Both farms sell approximately 80t of milk per year.

Household Income Structure

The relative importance of non-cash benefits is higher for the smaller farms. Especially for farm IN2, non-cash farm benefits account for 23 percent of household income, the main income source being the off-farm employment (70 percent). Interestingly, for IN2 the net cash farm income from the farm activities just covers the cash costs and only contributes 7 percent to the household income.

However, the non-cash benefits still matter for the larger farms and account for approximately 6 percent of the household income.

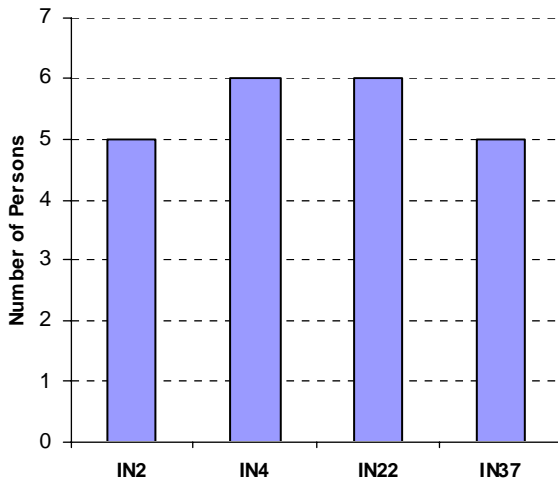
Household Living Expenses

The family living expenses increase with increasing farm/herd size and farm location, i.e. rural vs. (peri-)urban. All households are able to cover the family living expenses from the combined on and off-farm income. It should be mentioned that the family living on Farm IN2 on 500 US\$/year (100\$/person/year) lives under 'very poor' living conditions. The high living expenses of farm IN37 can be explained partially by the 'extended' family being composed of two marriages; i.e. the son (and farming partner) and his wife account for 38 percent of the total living expenses.

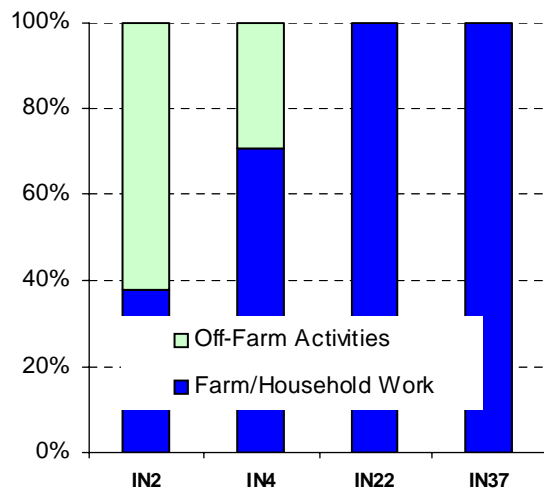
Explanations of variables; year and sources of data:

- Size of the household: People living together in one house
- Labour utilisation: Family labour used to generate income
- Household income: Includes cash and non-cash incomes from farm and off-farm activities
- Off-farm incomes: Includes all salaries for all family members
- Non-Cash Benefits: Value of manure (8.5 US\$/animal/year) & milk used by family
- Net cash farm income: Total farm receipts minus total farm expenses
- Household living expenses: Minimum annual cash expenses for the family to maintain the current living conditions.
- Exchange rate used: 1 US\$ = 47.23 Indian Rupees.
- Sources of Data: IFCN data collection based on expert estimations and statistics, year 2001.

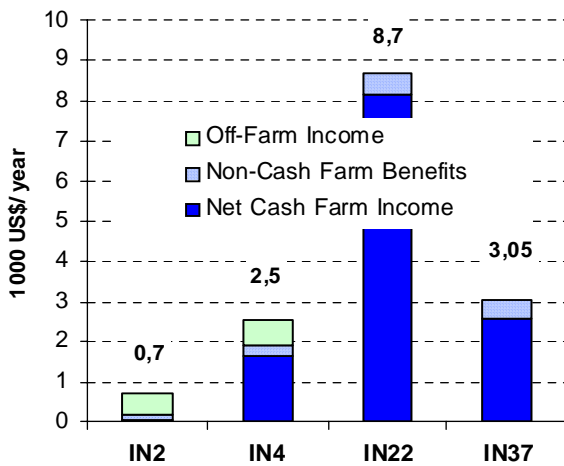
Size of Household



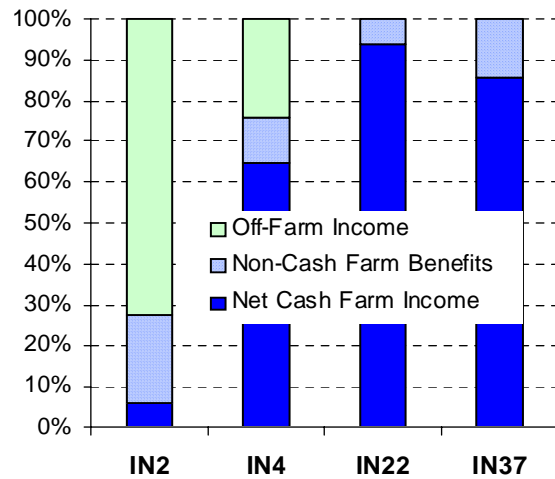
Labour Utilization



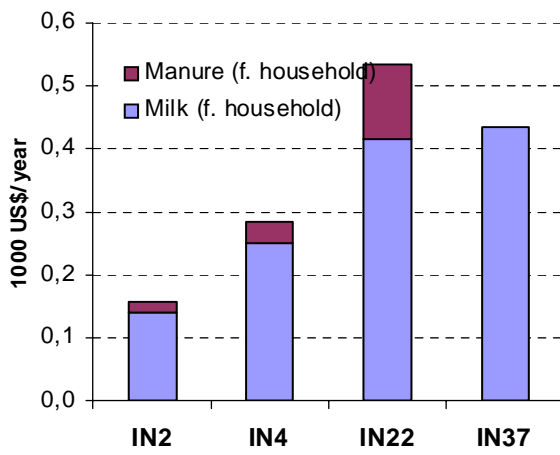
Household Income



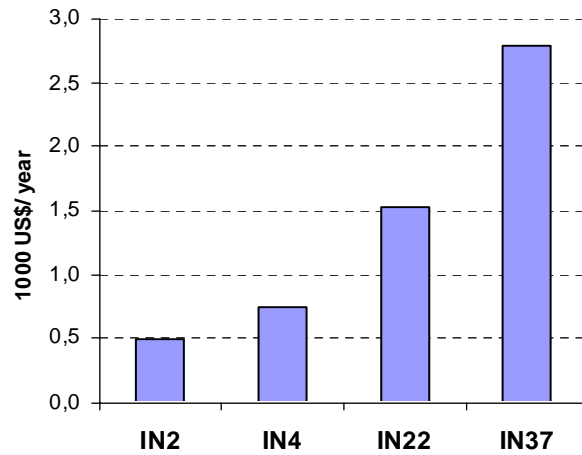
Income Structure



Non-Cash Benefits



Household Living Expenses



Farm Types

Farm Types

3.5 Farm Comparison: Whole Farm Approach

Farm Returns

Farm returns range from 200 to 28,000 US\$ per year. The low return of farm IN2 (of 200 US\$/year) is due to its small size, the low volume of milk sold (less than 50 percent of production), and finally the low milk price received as a consequence of a loan arrangement with the milkman. The difference in returns between farms IN22 and IN37 seems relatively low considering the difference in cow numbers. This surprisingly small difference in farm returns can be explained by the higher milk yield achieved on IN22, the higher share of milk sold and the cash crop activities of IN22.

Net Cash Farm Income (NCFI)

Net cash farm income mainly follows the level of farm returns, except for IN22 which achieves a significantly higher net cash income (8,200 US\$/year) in comparison to IN37 (6,100 US\$/year) despite higher farm returns of IN37. The higher net income of IN22 compared with IN37 is mainly a result of the higher profitability of milk production, as both farms sell approximately 80t of milk per year

The very low net cash farm income of IN2 (43 US\$/year) can be explained by the low share of milk sold, and the interest payments (50 percent interest rate) to the milkman, which result in a low milk price. The dependence of the farmer on the milkman collecting the surplus milk for the provision of a loan significantly influences his bargaining power and forces him to accept a milk price that is lower than that of the other farms.

Farm Assets

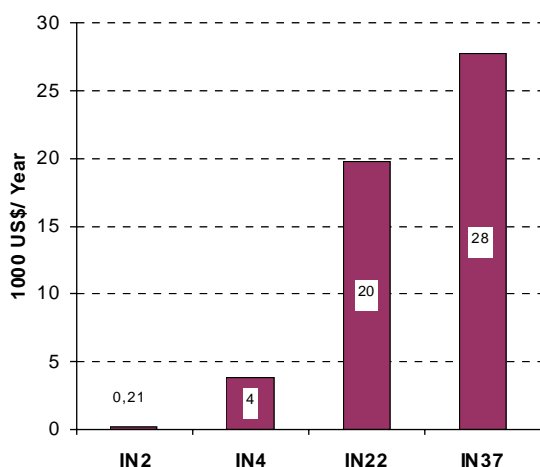
On a whole farm basis, land is the most important asset given that land prices are very high. Therefore, farms IN4 and IN22 have the highest value of assets, land representing 80 percent to 90 percent thereof.

Capital stock of the farms without land, IN2 and IN37, is much lower. On these farms, livestock constitute the main farm asset, accounting for 50 percent and 60 percent respectively.

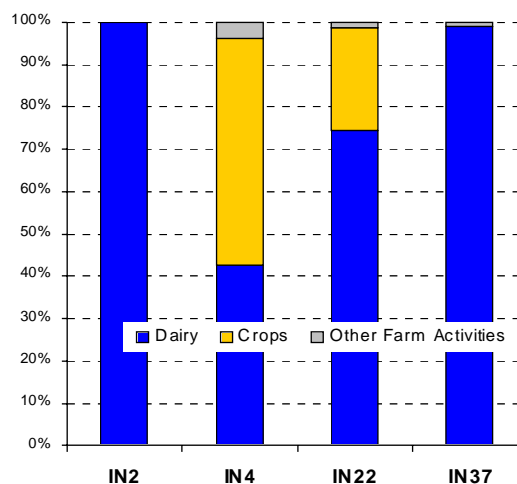
Explanations of variables; year and sources of data:

- Total returns: All cash receipts minus the balance of inventory (for example livestock).
- Returns to dairy: Milk, cull cows, heifers, calves, sale of manure, etc.
- Cash crops: Sale of surplus crops like rice, wheat, etc.
- Other returns: Dog raising, hiring out of machinery, selling fodder, etc.
- Net cash farm income (NCFI): Cash receipts minus cash expenses of the farm.
- Profit margin: Net cash farm income divided by total farm returns.
- Farm assets: All assets related to the farm (land, cattle, machinery, buildings, etc.)
- Exchange rate used: 1 US\$ = 47.23 Indian Rupees.
- Sources of data: IFCN data collection based on expert estimations and statistics, year 2001.

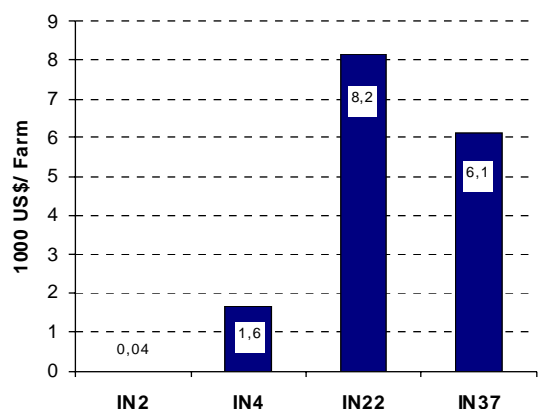
Total Returns of the Farm



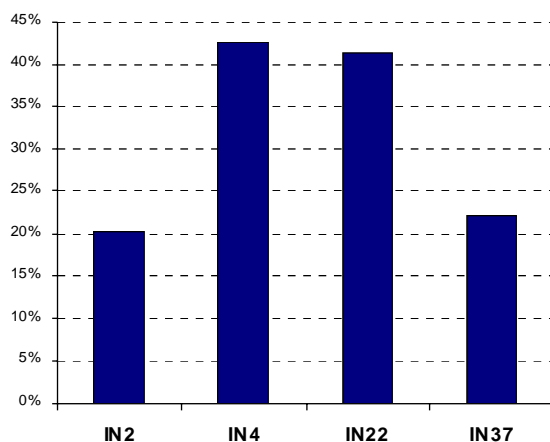
Return Structure



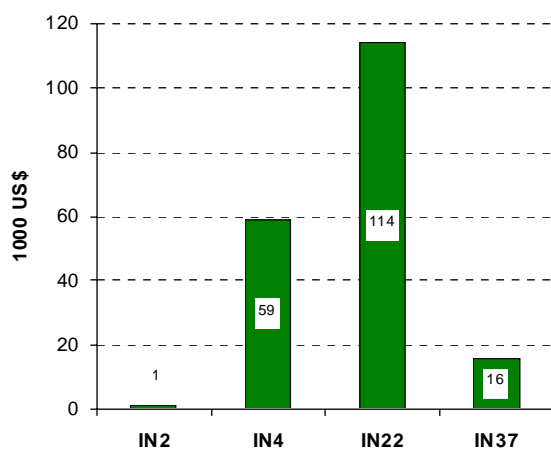
Net Cash Farm Income (NCFI)



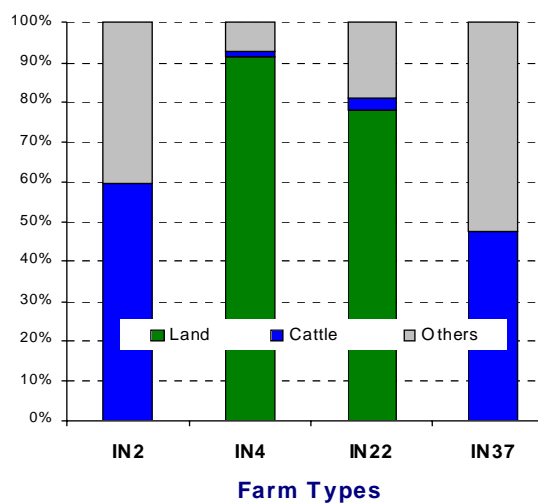
Profit Margin



Farm Assets



Asset Structure



Farm Types

Farm Types

3.6 Farm Comparison: Dairy Enterprise Approach

Cost of Milk Production

IN22 and IN4 have the lowest costs of milk production at 14 US\$ and 16 US\$ per 100 kg fat corrected milk (FCM). The higher production costs incurred by Farm IN37, 23 US\$ per 100 kg FCM, are mainly a result of the direct milk marketing activities (1,150 family labour hours above that of IN22). The production costs of Farm IN2, 24 US\$ per 100 kg milk, are significantly higher than those of Farms IN4 and IN22 due to very low annual milk yields and the very high labour input per litre produced.

Return Structure

The returns per 100 kg FCM produced range from 18 US\$ to 27 US\$. This range is mainly attributable to differences in milk prices obtained, which can be explained by the marketing system (direct marketing for IN37 vs. selling to a milkman IN2), the share of buffalo milk (low in IN22) and the distance to an urban area (rural farms IN2 and IN4). Non-milk returns are fairly similar and result from the sale of livestock (heifers and cull cows), the sale of manure and from hiring out-machinery in the case of IN4.

Cost Structure

On the smaller farms, the main component of the production costs are the opportunity costs. Thus, for Farm IN2 only 27 percent of the production costs are cash expenses. Larger farms employ workers, use more purchased feed instead of crop residues and other inputs that increase the cash costs significantly.

The observed economies of scale are significant and basically driven by labour costs. Farm IN4 has one third of the labour costs per litre of milk compared to the smallest Farm, IN2, but still twice the labour costs incurred by Farm IN22.

Farm Income

All four farm types cover their production costs from the *profit and loss account* and produce a positive farm income. Per 100 kg milk this income is quite high, 11US\$, on the small farms (IN2; IN4). On all farms the profit margin is very high at 30 percent and 50 percent of the farm returns.

Entrepreneurial Profit and Return to Labour

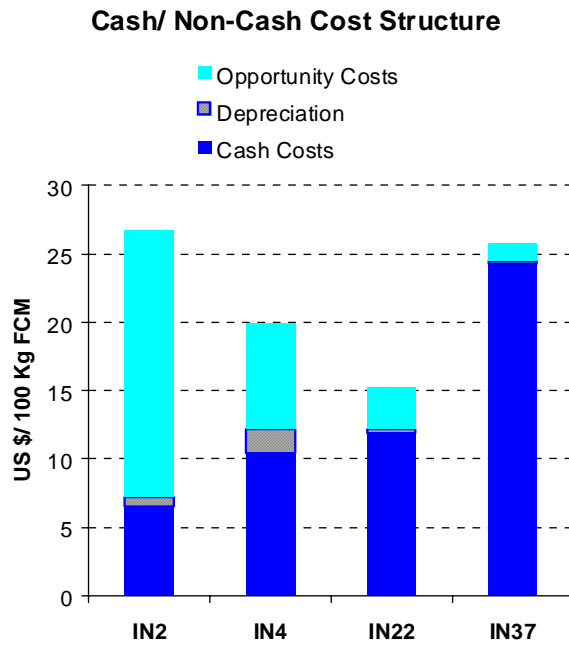
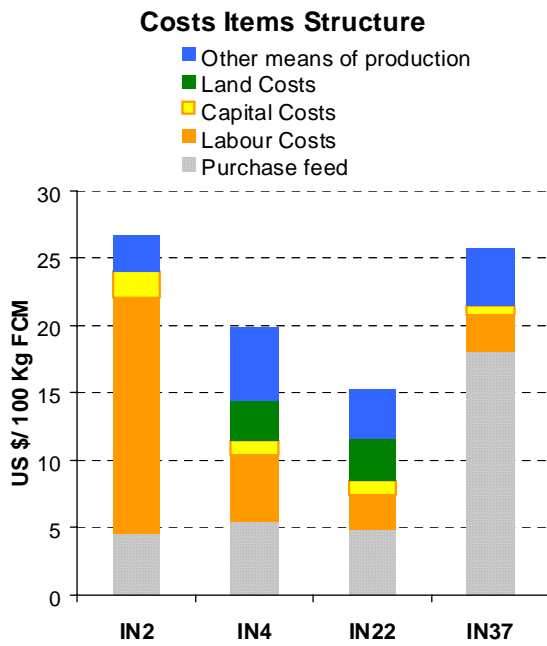
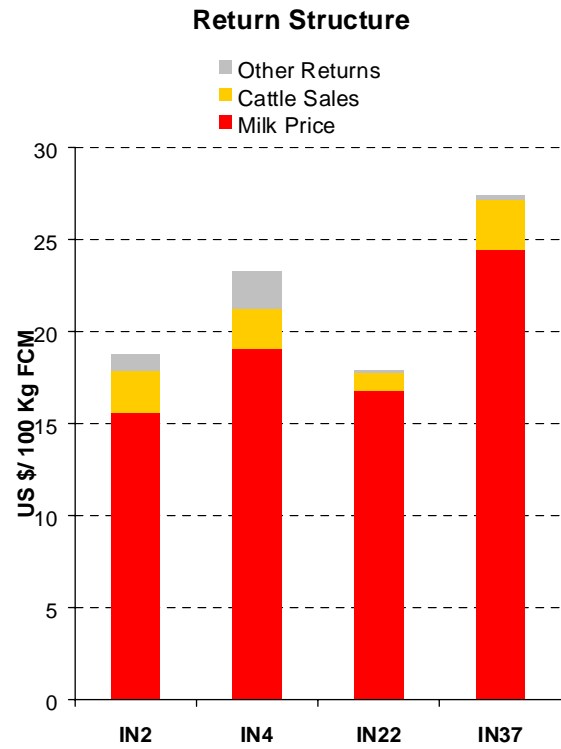
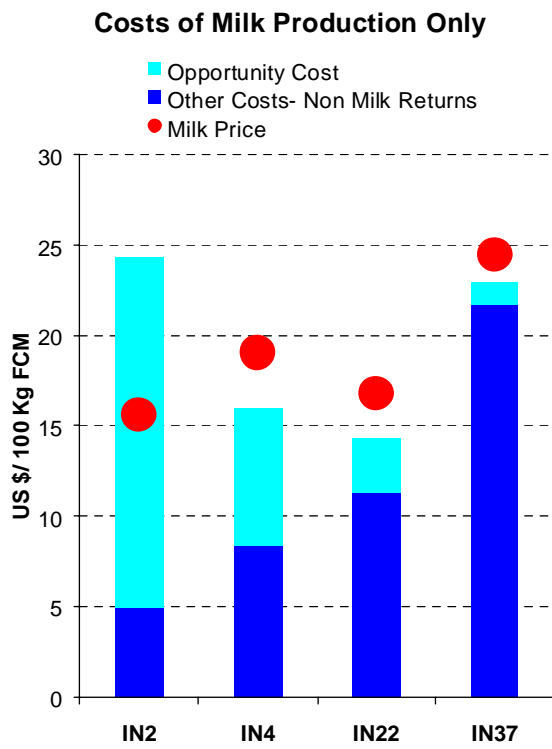
Apart from Farm IN2, the farms cover their full economic costs and generate an entrepreneurial profit of 2 US\$ and 4 US\$ per 100 kg milk. The return to labour (wage level earned by working on the dairy farm) is higher than the wage level in the area around the farms. Farm IN-2 does not cover its full economic cost.

Conclusions for Farm Type IN2

Without major improvements, farm type IN-2 will have difficulties competing with the larger farm types in the long run. However, as in most other countries, farmers will keep their cows as long as alternative employment opportunities (0.2 US\$/hour) are not available.

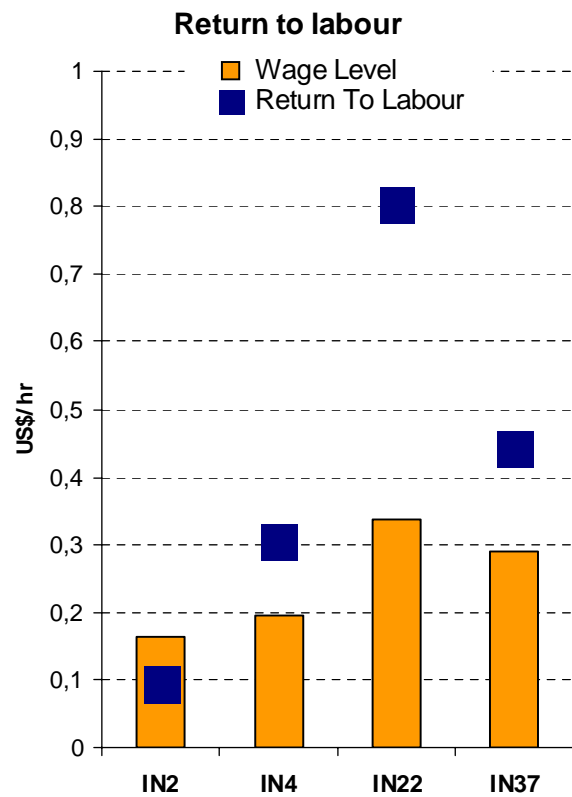
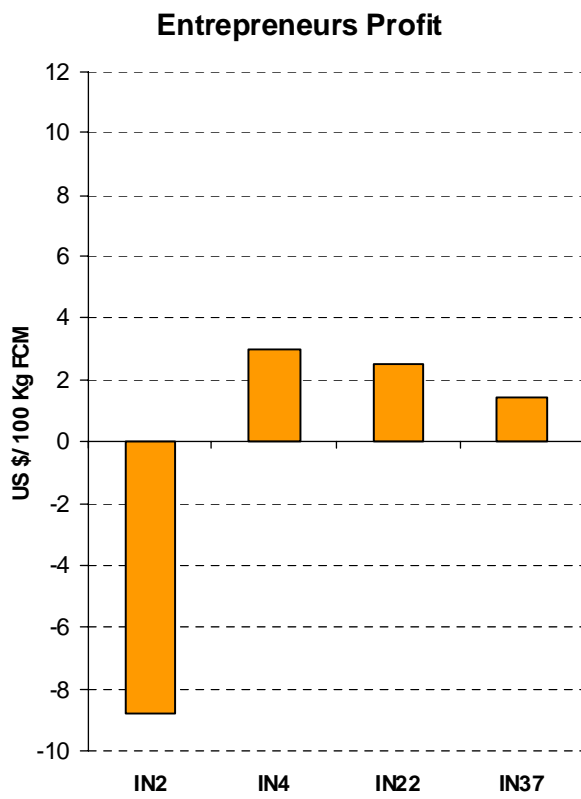
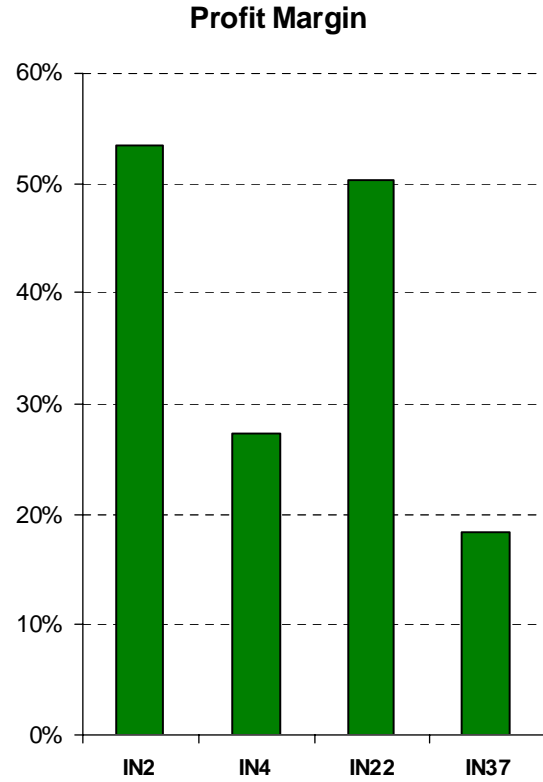
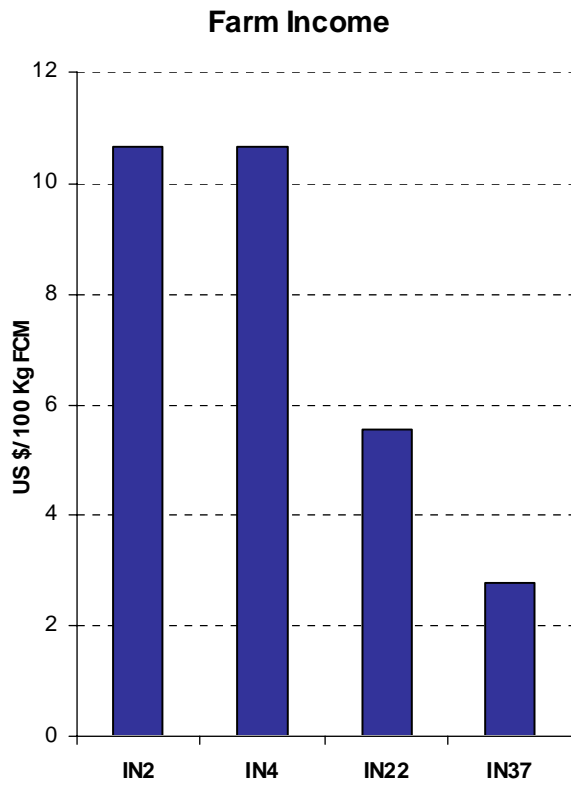
Explanations of variables; year and sources of data:

- Explanations variables and IFCN method: s. Annex 2 and 3
- Other returns: All farms manure value (sold, home use); IN4 hiring out machinery; IN37 trading of forage
- Sources of data: IFCN data collection based on expert estimations and statistics, year 2001.



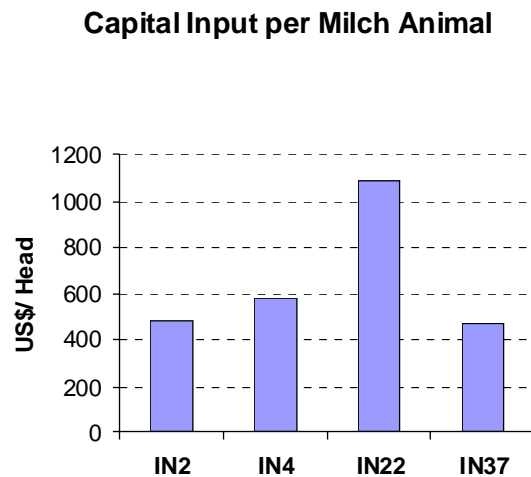
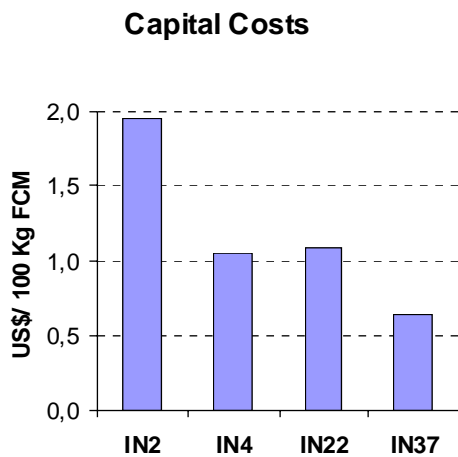
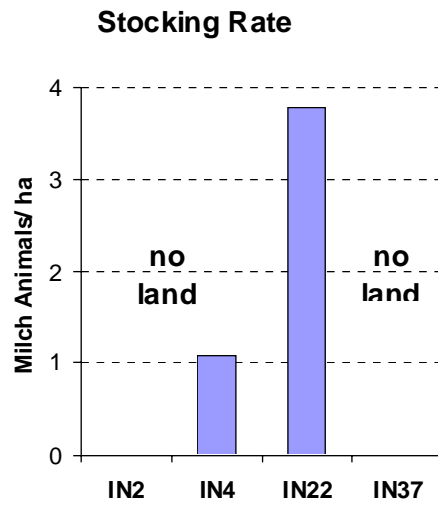
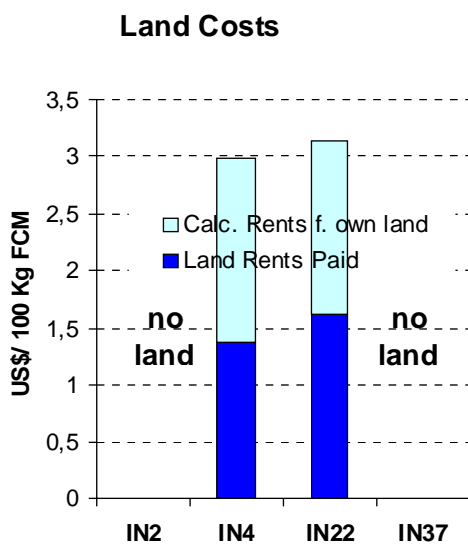
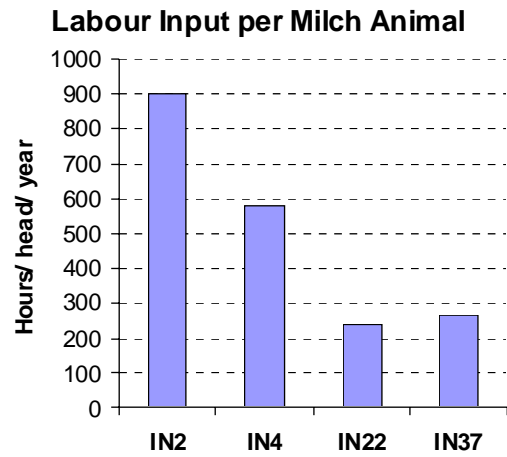
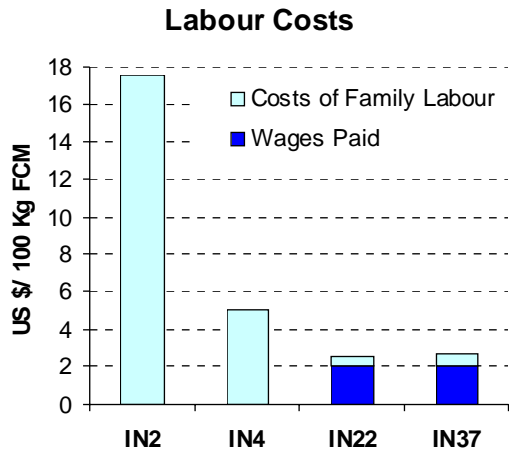
Farm Types

Farm Types



Farm Types

Farm Types



Farm Types

Farm Types

3.7 Margins in the Dairy Chain: Farmer to Consumer

In this section, the margins in the dairy chain are analysed. This is done for fresh milk and five different dairy chains found in Karnal, Haryana. Each channel is assumed to purchase one Kg 6% fat milk from the farmer, process it into its most popular milk and fresh cream, if applicable. This standardisation allows to compare all channels up to a point. Although there is a strong value adding business for both fresh milk and cream, this is out of the scope of this analysis. Therefore, this analysis should be seen as an exploratory exercise intended to support other sections of this study.

The Dairy Channels

Co-op 1.5 %: Co-operative buying milk at 6 percent fat and selling at 1.5 percent fat.

Co-op 3 %: Co-operative buying milk at 6 percent fat and selling at 3 percent fat.

Creamery 3%: Private processor, small scale, buying milk at 6 and selling at 3 percent fat.

Milkman 3%: Private person, collecting milk at 6 percent fat and selling at 3 percent fat.

Direct sale 6%: Dairy farms, like IN37, selling directly to the consumer with 6 percent fat.

The 'Co-op' represents the formal sector while the others represent informal channels.

Farmer Milk Prices

Milk prices paid by the co-operatives are slightly lower (9% lower) than the prices paid by the 'creameries'. The milkman pays the lowest milk price to farmers, but covers the collection and transportation costs incurred by taking the milk to town and home delivery. In most cases, for small farmers in rural areas, the milkman is the only channel to sell milk.

Consumer Milk Prices

The formal sector receives slightly lower consumer prices than the informal sector. By having a more conveniently located point for delivering milk to the customers (often daily home delivery), the informal sector can demand a premium for its milk. The higher price of 'direct sale at 6 percent' and the lower price of 'Co-op 1.5' reflect the difference in the fat content of the milk sold to the consumer.

The Cream Business

Most marketing channels extract cream from the milk bought from the farmer. This cream is either sold directly (by the informal sector) or further processed into butter or Ghee (by the formal sector). The calculation of a processor buying milk at source looks like this:

0.23 US\$/kg Purchase of milk from the farmer (6 percent fat),

0.24 US\$/kg Sale of milk to the consumer (3 percent fat),

0.17 US\$/kg Sale of extracted cream (30 % fat) to the consumer (0.1 kg * 1.7 US\$/kg)

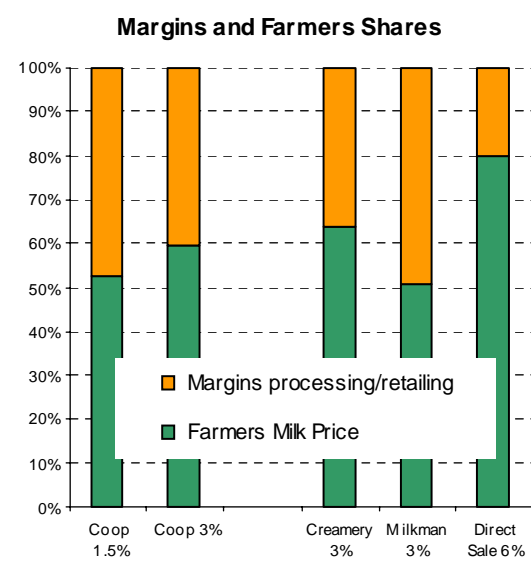
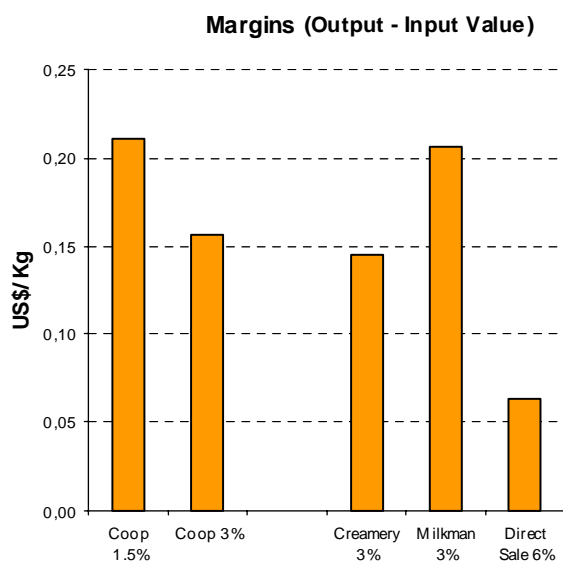
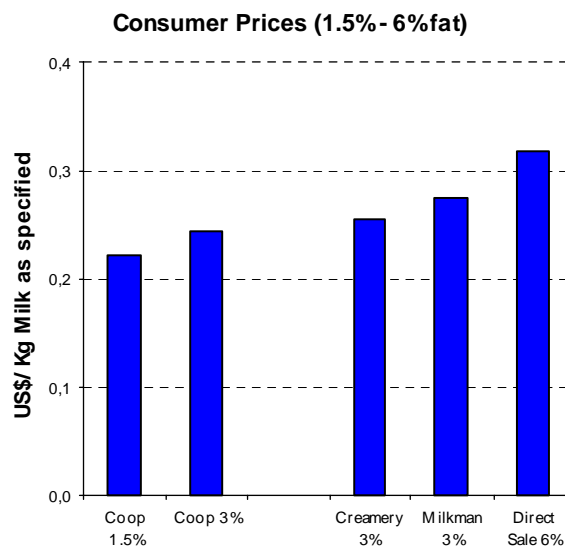
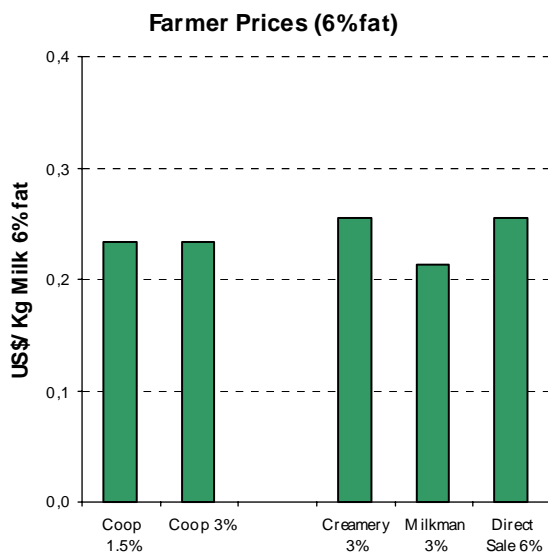
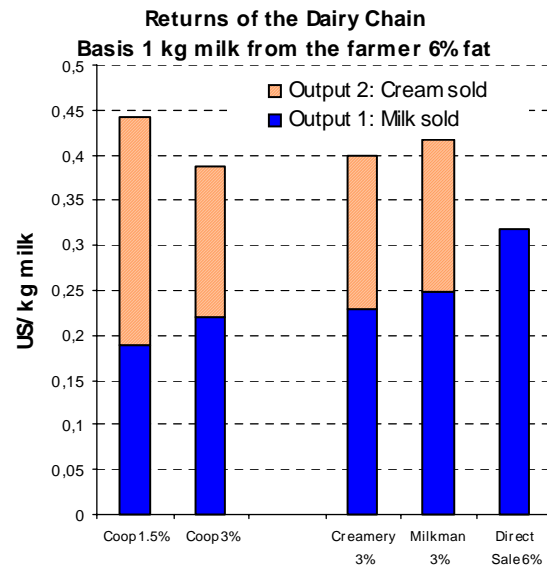
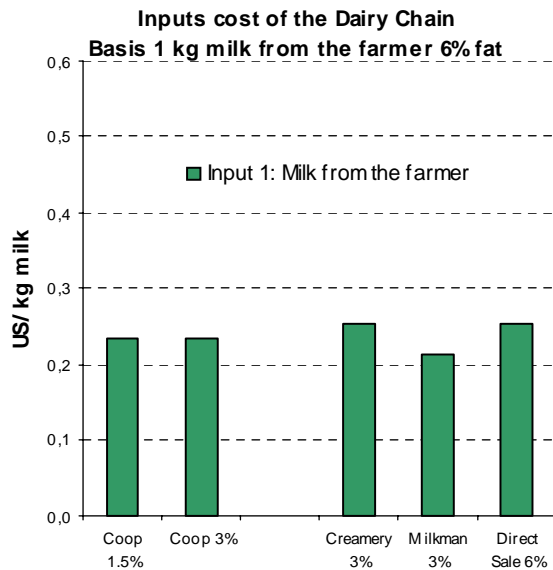
Thus, the price paid to the farmer for milk with 6 percent fat is similar to the price the consumer pays for milk with 3 percent fat. The cream extracted by the processor covers the processing cost and the retail margin in the dairy chain.

Margins (Consumer Prices - Input Value of Raw Materials)

The margins for milk processing and retailing vary between 0.06 to 0.21 US\$/kg milk. The co-operative's 1,5% fat milk receives the highest margins. Farms selling the milk directly have the lowest margin as they do not participate in the 'cream business'. The margins of the co-operative and the milkman with 0.21 US\$/kg milk are similar. These margins observed in Haryana are half the margins of the dairy chains in Europe (0.3 to 0.5 US\$/kg)

Explanations of variables; year and sources of data:

- Value of raw material input: Farm gate price of whole milk. (Details: see Annex 9).
- Margin: Represents transport, processing and retail costs.
- Source of data: Personal Communications (Interviews, October 2002).



4. TESTING IFCN METHODS FOR SMALL-SCALE DAIRY FARMING

The aim of this chapter is to evaluate the usefulness of IFCN methods (Model TIPI-CAL, standard IFCN data collection, etc.) to quantitatively assess the impact of changes in the dairy farm environment. Examples would be changes in market prices, farm management practices & technology adoption, and changes in dairy policy. Furthermore, the potential adverse effect of major risks affecting small-scale dairy farming in Haryana are assessed. The focus being on the evaluation of the method, simplified scenarios, mainly developed by the authors, were used.

The chapter is divided into four sections as follows:

4.1 Modelling Price Changes

This section explores the impacts of different prices for milk, livestock and labour on household income.

4.2 Modelling Changes in Production Parameters and Farm Capital

This section examines the outcomes of improvements in milk yield and reproductive performance (one calf per year), as they may result from improved production practices, as well as an increase in farm capital resulting in no loan repayment. Furthermore, the situation of a very well-managed 2-cow farm (IN2-Top) is simulated.

4.3 Modelling Policy Impacts

The detailed specifications of a policy scenario are complex as the policy instruments have to be specified and their presumptive impacts on market conditions and on farm-level decisions have to be estimated. This section broadly evaluates four policy domains that are likely to have an important bearing on dairy farming. These are: credit resulting in modified interest rates; research and advisory activities leading to improved production efficiency (higher milk yield); reorganisation of the dairy chain with ensuing higher producer milk prices; and policies that lead to either farm growth or abandonment of dairy farming.

4.4 Modelling Risk

The main risks faced by small scale dairy farmers in Haryana were identified through conversations with farmers and professional farm advisors. The four risks ranked highest are modelled in this section. These risks are: 'No Lactation' - neither of the two dairy animals became pregnant in the previous year; 'Buffalo Dies' - the lactating animal dies; 'Pay Straw' - the main feed source, straw, will not be available for free; and 'Man Ill' - that the head of household falls ill, is unable to work and therefore cannot earn off-farm income.

Result Variables

The estimated 'household income' is taken as the indicator for the standard of living a family can achieve. The calculated 'cost of milk production' is used as indicator for the competitiveness of any farm type while the 'return to labour' estimates how competitive / attractive the 'salary' obtained from dairy farming is compared with other employment opportunities.

The calculations under Section 4.1 were carried out for all four farm types while the other sections focus on the typical two cow farm (IN2) as this is the farm with the lowest household income and as it represents the dominant farm type in Haryana and possibly India.

Finally it should be stressed again that this component of the study focuses on method testing and that therefore simplified scenarios are used.

4.1 Modelling Price Changes for Typical Dairy Farms

Scenario Description

Milk price:	Modification of milk price by +20 percent and - 20 percent
Livestock prices:	Modification of prices for all classes of livestock by +20 percent and - 20 percent
Wages:	Modification of local wages by +20 percent and - 20 percent

The estimated effects do not take into account any adjustments the farmer might make to adapt to the new situation. Details of the scenarios are shown in Annex A10.

Sensitivity to Changing Milk Prices

Changes in milk prices have the largest effect on the farm economics. The change of income from the dairy enterprise resulting from the assumed milk price change range from +/-30 percent for farm IN2 to +/-170 percent for the larger farm IN37. The difference in impact between the farms can be explained by the differences in profit margins (low in IN37, high in IN2). As IN2 consumes most of the milk within the household and obtains most of its income from off farm employment, the household income is less sensitive to milk price changes in comparison with the larger and more specialised households.

Sensitivity to Changing Livestock Prices

Changes in livestock prices (+/-20 percent) result in changes in the income of the dairy enterprise in these farms by up to 7 percent. Higher livestock prices entail higher returns from selling animals. As livestock receipts are a relatively high proportion of the dairy income of farm IN2 this farm is more sensitive to a change in livestock prices than the other farms. Income of farm IN37 slightly decreases with higher livestock prices due to its purchasing of lactating animals and selling of dry cows.

Sensitivity to Changing Wage Levels

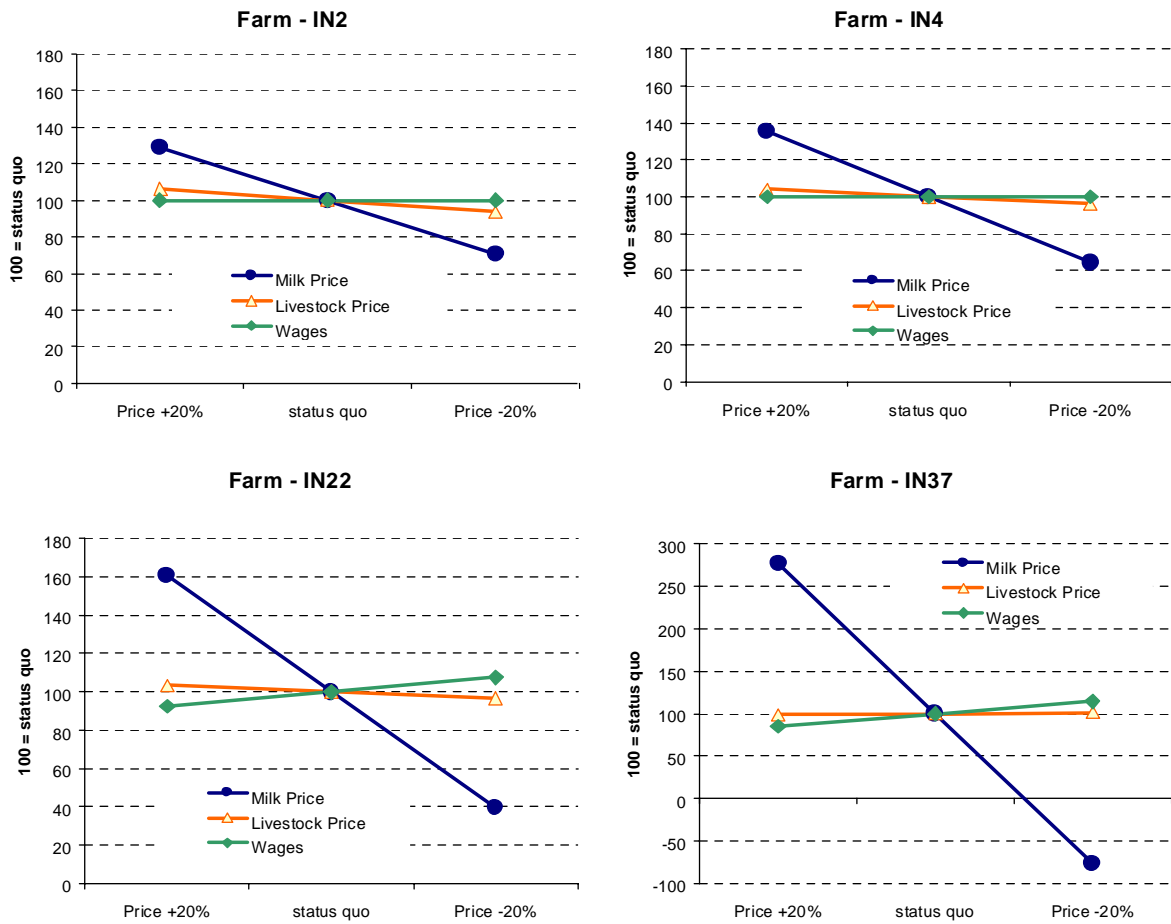
As the two smaller farms do not use hired labour their farm income is not affected by changes in the local wage levels. Although farm income of the two larger farms reacts similarly to a change in wages, i.e. it decreases with increasing wage levels, farm IN22 is less sensitive to an increase in wages than IN37, mainly because of its higher (labour) productivity.

Wage levels affect the dairy incomes of the two larger farms much more significantly than the simulated changes in livestock prices.

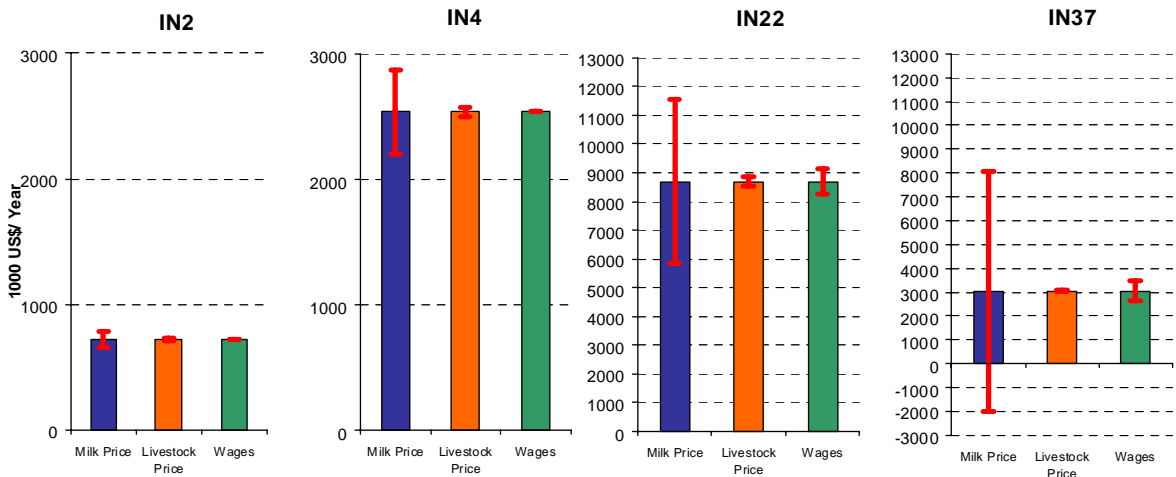
Explanations of variables; year and sources of data:

- Income of the dairy enterprise: Receipts + non cash benefits - expenses - depreciation
- Household income: Includes cash and non-cash incomes from farm and off-farm activities.
- Status quo: Current prices (see Chapter 3).
- Exchange rate used: 1 US\$ = 47.23 Indian Rupees.
- Sources of data: IFCN data collection based on expert estimations and statistics, year 2001.

Income of the Dairy Enterprise per 100 kg milk (Index)



Income of the Household in US\$ per year



4.2 Modelling Effects of Improved Production Practices for a Typical Two-Cow Farm (IN2)

Scenario Description (Details of the assumptions are presented in Annex A11)

Yield: The farm reaches a 20 percent increase in milk yield per buffalo without any additional input. This gain is achieved by improving farm management.

Loan (Equity): Farm IN2 has more equity and does not need the loan from the milkman. This leads to not having to make interest payments and receiving a better milk price.

2Lact: Improved reproductive performance leading to a calf per buffalo per year and consequently moving from one to two lactations per year, thus doubling milk production.

IN2-Top: A top managed farm with two dairy animals that achieves two lactations of 1,890kg each per year.

Cumulative: This is a combination of the first three scenarios.

Indicator: Household Income

All scenarios show an increase in income ranging from 60 to 500 US\$/year. In scenarios 'IN2-Top' and 'Cumulative' the changes in productivity result in a near doubling of household income.

The combination of the changes of individual components has a higher impact on household income than the addition of the scenarios 'Yield', '2Lact' and 'Loan'. This can be explained by the multiplying link between the variables: More milk per animal * more animals in lactation * higher milk price. Thus, minor improvements in a number of items can accumulate to a significant overall impact on farm and household income.

Indicator: Costs of Production

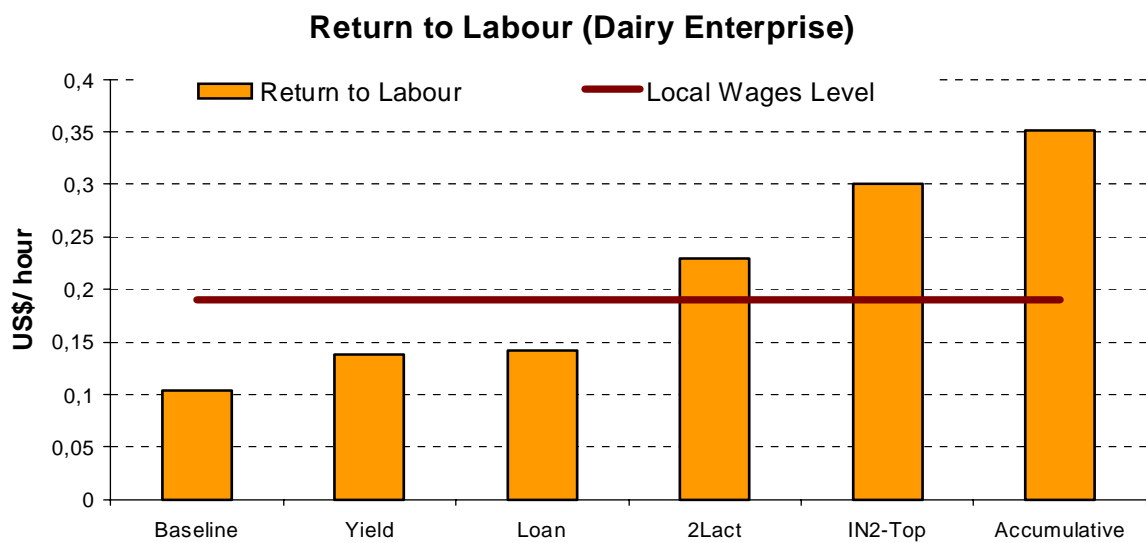
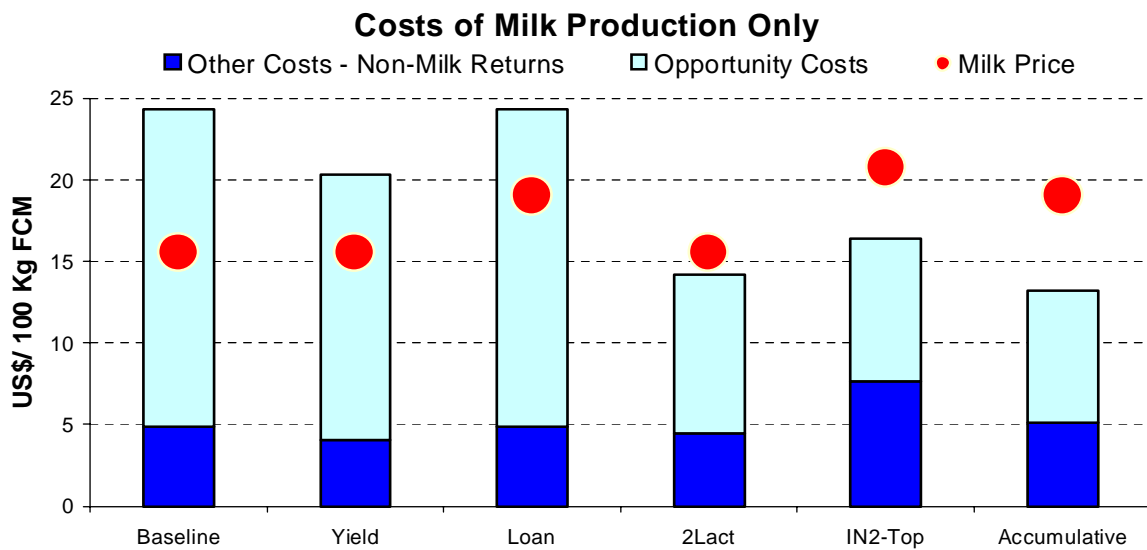
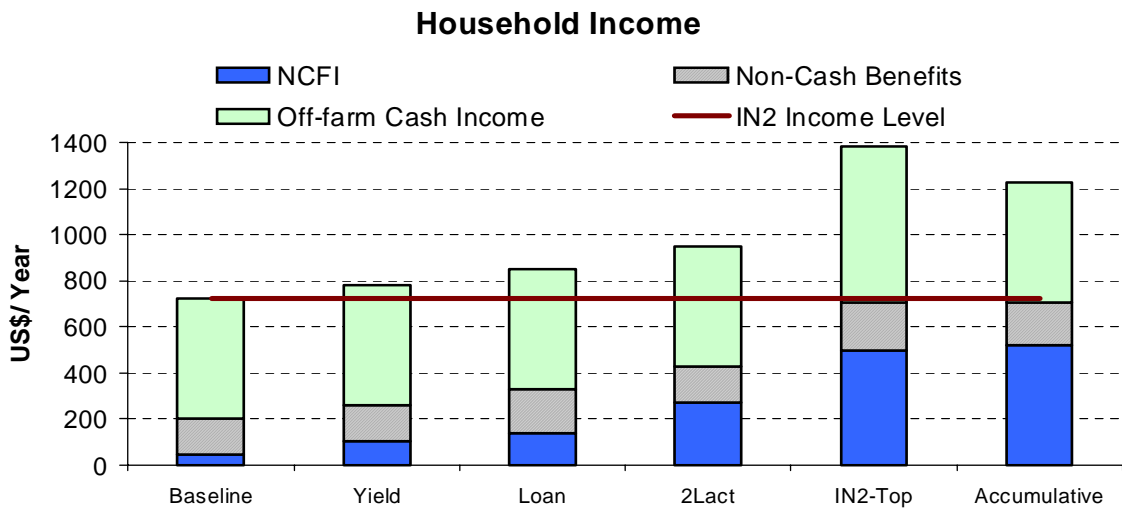
In the scenarios '2Lact' and 'IN2-Top', costs of milk production are reduced by around 40 percent and reach a level of 15 US\$/100 kg which is comparable with the production cost of the larger farms in Haryana (IN4, IN22). This cost of milk production is also very close to the production costs in New Zealand and Australia. Thus, farms that reach the level of productivity of '2Lact' and 'IN2-Top' farms have a basis to compete against imports of dairy products. In the scenario '2Lact', milk production of the farm is doubled and the amount of milk sold is nearly triple compared with the baseline scenario.

Indicator: Return to Labour

In order to compete with other farm or off-farm activities in the longer run, the 'wages' the family earns through the dairy enterprise (return to labour) should be at least equal or higher than the wage level in the region. Currently, farm IN2 (baseline) obtains a return to labour or 'wage' of 0.1 US\$/h, which is half the wage level in the region. Under the IN2-Top scenario farm labour reaches a return to labour or 'wage' of 0.3 US\$/h, a 'wage' which makes dairy farming very lucrative.

Explanations of variables; year and sources of data:

- **Baseline:** Reference scenario - Typical IN2-farm situation as observed (see Chapter 3)
- **Household Income:** Includes cash and non-cash incomes from farm and off-farm activities.
- **Cost of Milk Production Only:** All costs of the dairy enterprise - non-milk returns (sale of livestock, manure, etc.). The cost bar is divided into opportunity costs and other costs.
- **Return to Labour / Wages earned on the farm:** Entrepreneurs profit plus labour costs (wages paid plus opportunity costs) divided by total labour input.
- **Sources of Data:** IFCN data collection based on expert estimations and statistics, year 2001.



4.3 Modelling Policy Impacts for a Typical Two-Cow Farm (IN2)

Scenario Description (Details are shown in Annex A11)

Loan (interest rate): The farmer gets access to capital at a lower annual interest rate (15 percent instead of 50 percent) from a bank and benefits from a higher milk price as a result of improving his bargaining power vis-à-vis the milkman.

Efficiency: Annual milk yield per buffalo is increased from 1,600 to 1,920 litres through better access to knowledge, improved genetics, etc. without additional production cost.

Farm size: The dairy herd expands from two to four buffaloes and uses an additional 1,088 hours of family farm labour to run the farm.

Dairy chain: Due to efficiency gains in the dairy chain the farm obtains a 15 percent higher milk price.

Quit50%/ Quit100%: The household stops dairy farming and is able to shift 50 percent / 100 percent of the labour used for farm work to off-farm work.

Cumulative: This scenario combines the effect of 'Loan', 'Efficiency' and 'Farm size'.

Indicator: Household Income

Household income increases by 70 to 340 US\$ per year for the various scenarios. The scenario 'Loan' shows a strong impact on the farm income. This is due to the concurrent increase in milk price. Only doubling herd size would have a bigger impact on household income than changing the loan terms. However, the relationship farmer-milkman deserves a deeper evaluation before drawing any firm conclusion.

Withdrawing from dairying would only be sensible when the household can 'sell' all its labour previously devoted to the dairy enterprise on the local labour market. If this is not possible, the 'Farm Size' and 'Loan' scenarios offer a better chance to improve the living standard.

Indicator: Costs of Production

Based on the specified scenarios, the cost of production can be reduced by 20 percent down to 20 US\$ per 100 kg milk. Under the 'Cumulative' scenario a cost level of 17 US\$ per 100 kg milk can be reached. Interestingly, the increase in farm size from two to four animals does not have a significant effect on production cost as productivity of the system (yield per cow, percentage of cows in lactation) is not improved.

Indicator: Return to Labour

None of the scenarios analysed bring the dairy enterprise into a situation where it can, in the longer run, compete with other farm and off-farm activities. Only the accumulation of the effects leads to a sufficient improvement of the return to labour.

Explanations of variables; year and sources of data:

- Baseline: Reference scenario - Typical IN2-farm situation as observed (see Chapter 3)
- Household income: Includes cash and non-cash incomes from farm and off-farm activities.
- Cost of milk production only: All costs of the dairy enterprise - non-milk returns.
- Return to labour: Wages earned on the farm.
- Sources of data: IFCN data collection based on expert estimations and statistics. year 2001.

4.4 Risk Assessments for a Typical Two-Cow Farm

Scenario Description (Details shown in Annex A11)

The following situations have been identified by small-scale dairy farmers in Haryana as the major risks related to dairy and household economics:

No-Lact: Neither of the two buffaloes became pregnant in the previous year and consequently no buffalo is lactating. Furthermore the farmer is not able to exchange a dry animal for a lactating animal.

Buff-Die: One of the buffaloes dies and the farmer has to buy a lactating buffalo. To do this, he takes a loan from the milkman.

Pay-Straw: The farm does not have access to straw for free and has to purchase straw at the same price as farm IN37.

Man-III: The man, who is the main income earner, becomes ill and is not able to earn any off-farm income for one year.

Indicator: Household Income

The risks identified reduce the household income by up to 50 percent. In scenario 'No-Lact', the farm must use 20 percent of its off-farm income to cover farm expenses. Moreover, the farm has to buy milk for home consumption. In scenario 'Buff-Die' the family would need to borrow 2.5 to 3 times the loan taken annually under normal circumstances. This means that 50 percent of the family off-farm income would have to be used to pay the loan and its interest. The household income is severely affected in the case of the main income earner falling ill since he alone earns 71 percent of the off-farm income and over 50 percent of the entire household income.

Indicator: Costs of Production

The risk scenarios affecting milk production lead to a significant increase in production costs. In the case of 'Buff-Die' it has to be questioned whether an investment in another buffalo is economically viable. If the farmer has to pay a price for the straw used, the production costs rise by 40 percent. In this case the milk price just covers the cash expenses.

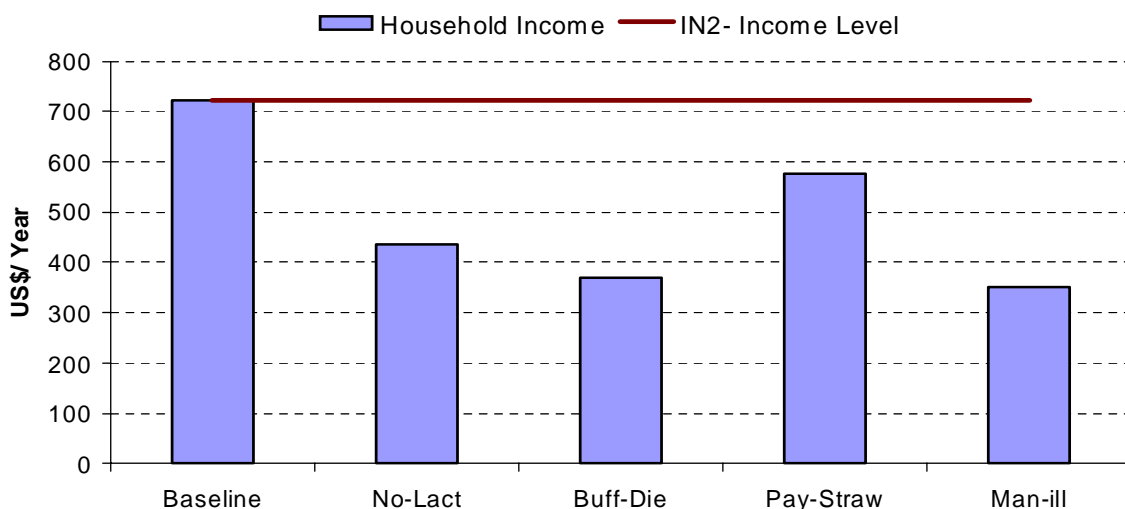
Indicator: Return to Labour

Under these risk scenarios, return to labour would fall below zero. Without major changes in the production system a continuation of the dairy enterprise might not be economically viable.

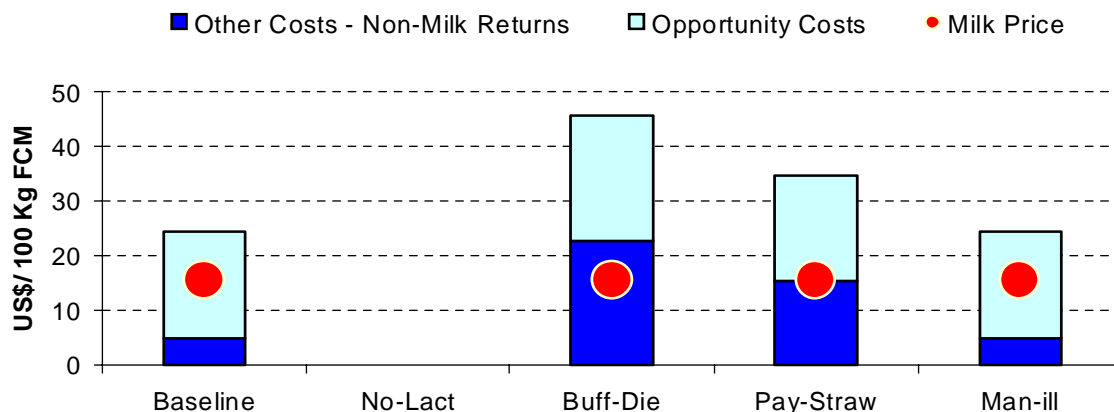
Explanations of variables; year and sources of data:

- Baseline: Reference scenario - Typical IN2-farm situation as observed (see Chapter 3)
- Household income: Includes cash and non-cash incomes from farm and off-farm activities.
- Cost of milk production only: All costs of the dairy enterprise - non-milk returns.
- Return to labour: Wages earned on the farm:
- Sources of data: IFCN data collection based on expert estimations and statistics, year 2001.

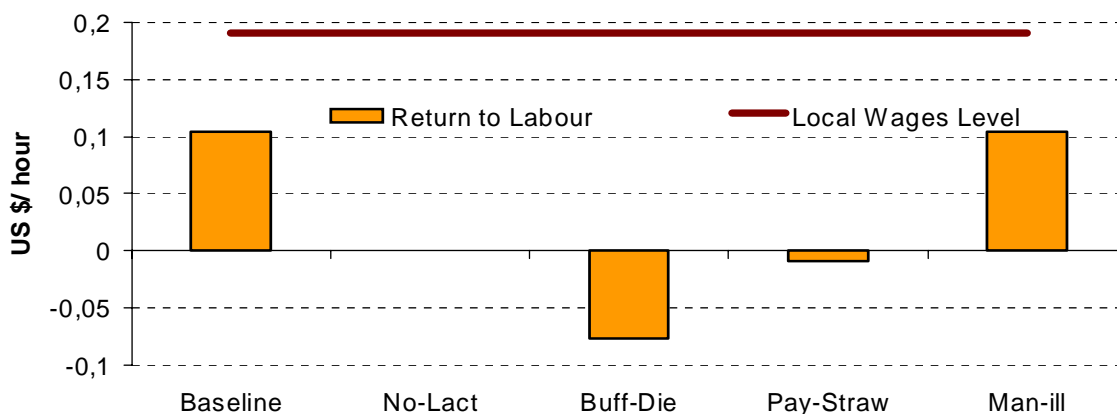
Household Income



Costs of Milk Production Only



Return to Labour (Dairy Enterprise)



5. CONCLUSIONS

5.1 Dairy Farming in Haryana

Household Activities and Income Levels

The mix of household activities varies significantly and household income of the four farms ranges from 700 US\$ on IN2 to 8,700 US\$ per year on IN22. In the case of IN2 the income per household member is 140 US\$ per year. Off-farm income is the main source of household income on the smaller farms (72 percent on IN2). Moreover, the non-cash benefits such as the use of manure for heating and milk for home consumption account for 10 percent to 20 percent of household income on these farms. In the case of IN2 the non-cash benefits are higher than the cash farm income. All farms are able to cover their living expenses from the income generated. Living expenses increase with farm size and proximity to the city.

Competitiveness of Dairy Farming

Farms IN4 and IN22, both having land to grow crops and forage, are able to produce milk at 15 US\$ per 100 kg. These farm types have the potential to compete with imports and also to produce milk for export provided international quality standards can be met and provided the marketing chain is also competitive.

The cost of production of farm type IN2, 25 US\$/100 kg, is significantly higher than that of IN4 and IN22. This can be explained by economies of scale, low milk yield and poor breeding management. Without major improvements farm type IN2 will, in the long run, have difficulties competing with the larger farm types.

Dairy Chain in Haryana (Preliminary Estimates)

Consumer prices for fresh milk in the informal sector are slightly higher than in the formal sector. The prices paid to the farmer for 6 percent fat milk is very close to the consumer price for 3 percent fat milk. The extracted cream value of 0.17 US\$ covers the processing and retail cost in the dairy chain.

The margin for processing and retailing in India is around half of the margin covered by the dairy chain in Europe to bring the milk from producer to consumer. The highest margins (0.23 US\$/kg) in the chain are achieved by the milkman while the lowest margins (0.07 US\$/kg) are made by the farmer who sells milk at 6 percent fat directly, without previously extracting the cream.

Potential for Typical Two-Cow Farms (IN2)

Farm type IN2 has the potential to reduce milk production costs to 15 US\$/100 kg and to reach a salary level on the dairy enterprise that is higher than the wage level in the area. This means that landless people in rural areas have an option to run a profitable business, generate employment for family members, especially women, and to significantly improve their living conditions. This conclusion is the result of simulations of improved production methods, better farm financing, milk marketing, dairy policies and the analysis of a very well managed two-cow dairy farm.

For the realization of this potential of farm type IN2 access to loans with reasonable interest rates and higher milk production (more animals in lactation and higher milk yield) are the most important changes. Better conditions for loans and a higher farm milk output would also diminish the two main risks facing farm type IN2.

5.2 Contributions of IFCN Methods to the Pro-Poor Initiative

The global livestock sector is rapidly changing. With a strong growth in demand for livestock products, particularly meat and milk, and rapid institutional and macroeconomic policy changes, there is a significant danger that poor livestock keepers will be crowded out and left behind. This could be prevented and livestock could make an important contribution to global food security and poverty reduction.

This potential will only be realised, however, if an appropriate policy framework is put in place both nationally and internationally. An important question is: 'What is appropriate?' and 'How can the appropriateness be assessed given the specificity of particular circumstances?'

IFCN methods can play a role in promptly providing sound, detailed and relevant information to answer the above types of questions as they relate to the dairy sector. Briefly described, IFCN methods have been used for the following analytical tasks:

- **Status quo analysis of farms/households**

The IFCN has developed an analytical framework currently applied in 24 countries to analyse dairy farms and the related household. This type of analysis identifies the strengths and weaknesses of dairy farm types and countries. Moreover, the degree of international competitiveness required to compete with imports or to penetrate export markets can be quantified.

- **Estimation of the potential of farms/households**

The IFCN framework can be used to estimate the potential of a household/farming system by scenario calculation and analysis of top managed farms. Before deciding on the best mix of support interventions, the question whether there is a theoretical chance for a particular farm type in the future can be answered.

- **Evaluation of *ad hoc* effects of farms/households**

By having detailed information of a set of 'typical' farms in different countries the impact of sharp changes in the framework conditions, such as changes input prices and / or output prices, inflation, interest rates, exchange rates etc., can be rapidly quantified.

- **Evaluation of the best mix of support activities for farms/households**

There are various options to support households/farms, such as policy instruments, farm management support, risk management tools, etc. The quantification of the impact of a single measure as well as the cumulative impact of various interventions can help to develop an efficient mix of support activities for the development of small-scale dairy farming.

- **Monitoring and validation of the impacts of the activities of the Pro-Poor Initiative**

The IFCN methods can be used to monitor the developments in countries/farm types and provide feedback about what targets are or are not reached by the Initiative.

- **Provision of knowledge and tools for farm economists in developing countries**

The IFCN is an open scientific forum for the exchange of ideas and the creation of knowledge. Experience shows that the participating researchers both benefit from having access to this knowledge and utilise it to provide support to farmers in their own countries.

Dealing with the Complexity of Farm/Household Economics

The IFCN method of data collection is very focused on regions or farm types and can provide results within a short time frame (1 to 6 months). Data gathering can be achieved with reasonable input of resources and plausible results are produced by

having immediate feedback and cross-checking of figures with the farmers and the experts in the country.

The analytical framework allows for the extraction of a large number of result variables for the household, the farm and the dairy enterprise. Moreover, the effect of several non cash benefits can be quantified, which is particularly important for subsistence farmers.

A1. METHODOLOGICAL BACKGROUND

In this chapter, we will present the methods and sources of information used to collect data about the Indian dairy sector and how the costs of production for the selected typical production systems are calculated.

This project has followed the framework used by the International Farm Comparison Network (IFCN). IFCN is a world-wide association of agricultural researchers, advisors and farmers. These participants select typical agricultural systems in key production regions in their individual countries. In 2002, the number of participating countries extended to 24 countries that represent 74 percent of the world milk production.

Within this scientific Network, FAL-Federal Agricultural Research Centre (Germany) through its Institute of Farm Economics and Rural Studies is acting as the co-ordination centre for scientific issues.

The central objectives of IFCN are:

1. To create and maintain a standardised infrastructure through which production data of the major agricultural products (milk, beef, wheat, sugar, etc.) and from major producing regions of the world can be effectively compared and discussed.
2. To analyse the impact of the structure of production, technology applied and country-specific policies on the economic performance of agribusinesses, their costs of production and global competitiveness.

In order to achieve these objectives, IFCN employs the following methods and principles:

Direct contact with the production protagonists. A team of advisors and farmers is put together to set up the typical production models and to revise the final results. This approach brings the results closest to reality.

The principle of 'Total Costs'. IFCN considers both direct costs and margins, and the indirect (fixed) costs (i.e. depreciation and interests of the infrastructure used) and the opportunity costs for owned assets and production factors (i.e. family labour, land, capital).

A single and homogeneous method is utilised to calculate the costs of production for all participating countries. The IFCN standard is not the only truth, but a) it is scientifically correct, b) it includes all the existing production costs, and c) it creates transparency and international comparability in the arena of costs of agricultural production. Each IFCN member and client can reorganise the costs at his convenience and present them in the particular format of his country while he maintains an internationally comparable set of results.

The concept of setting (regional) typical agricultural models. A team of country experts, advisors and producers is formed to identify and set up the typical regional production models for each agricultural product. Typical production models must represent the common production structures in the region or country.

In the case of dairy production, for example, a working team composed of advisors, consultants and producers is formed as a panel. The first working step is to define the typical milk production systems of the major dairy regions in country. This model may be a 4-cow farm, feeding mostly cut grasses to fully confined animals, combine milk production with some other agricultural activities such as wheat and rice production in 3 ha of irrigated owned land, and milking is done by hand twice a day.

The second working step is to collect all the needed information from these typical models. For this, IFCN has developed a standard questionnaire. It is crucial that these data collected should neither reflect an individual farm (too many particularities may hurt the ability to generalise the results) nor be an arithmetic average (an average does not show much about the technology and the economics involved). The typical model should rather represent real and common situations of the region and show clearly the predominant technology and infrastructure. Such models will be preferred by analysts.

The model TIPI-CAL (Technology Impact and Policy Impact Calculations) is utilised for the simulations of these typical models and the calculations of their costs of production. TIPI-CAL can be easily shared with all IFCN members since it is a spreadsheet in MS-Excel. This model is a combination of production (physical data) and accounting (economic data). TIPI-CAL also consists of both a structure of costs of production and a simulation component (without optimisation). The simulations can be done for a period of up to 10 years in order to evaluate the growth, investments, policies or market conditions. For each year, TIPI-CAL produces a 'Profit and Loss Account', a balance and cash flow statement.

Allocation of costs of production. When the typical milk production systems have several agricultural activities besides dairy, fixed costs and expenses (i.e. depreciation) are distributed to each activity according to their use. For example, the depreciation of the machinery, which is used, for the dairy and the crop enterprises is allocated according to the hours worked in each.

Data about farm and off-farm household economics. IFCN takes into account all activities of the typical production systems, plus all the off-farm incomes and expenses realised by the owner and his family. This more complete picture of the typical model is necessary to obtain reliable information about the current economic situation of the model (and the household) and about the future of the farm (simulations).

All the methods and principles above have been applied in this project. Full panels were not set up since these models have already been part of the IFCN activities for the year 2002. The IFCN fieldwork experience supports that the analysis of costs of production shows no significant difference between the participation of one advisor and a 'full panel'. Therefore, it was decided that an IFCN scientist first visit each and every model, talk with the owners to collect project-specific information, analyse the data and then have the results cross-checked by local experts and farmers.

The analysis of costs of production and the competitiveness of the typical models are found in part 4.5. The graphs follow the same structure as those in the 'IFCN Annual Dairy Report'. The main objectives of this report are a) to analyse the main typical milk production systems in the state of Haryana, India and b) to assess the impacts of risks and changes made to key farm variables on the economics of the small-scale-dairy-farm household. This report shows the comparative world position of the Indian dairy industry, a comparison of the costs of production for the main milk production systems in Haryana, and a modelling chapter.

The modelling chapter utilises the simulation capability of TIPI-CAL in order to assess the effect of changing prices (for all models), policies, production practices and technology, and farm risks assessments for the small-scale dairy model.

For more information about IFCN, visit www.ifcnnetwork.org and www.ifcndairy.org

A2. IFCN METHOD: COSTS OF PRODUCTION CALCULATIONS

Cost Calculation

The cost calculations are based on dairy enterprises that consist of the following elements: Milk production, raising of replacement heifers and forage production and / or feed purchased for dairy cows and replacements.

The analysis results in a comparison of returns and total costs per kilogram of milk. Total costs consist of expenses from the profit and loss account (cash costs, depreciation, etc.), and opportunity costs for farm-owned factors of production (family labour, own land, own capital). The estimation of these opportunity costs must be considered carefully because the potential income of farm owned factors of production in alternative uses is difficult to determine. In the short run, the use of own production factors on a family farm can provide flexibility in the case of low returns when the family can chose to forgo income. However, in the long run opportunity costs must be considered because the potential successors of the farmer will, in most cases, make a decision on the alternative use of own production factors, in particular their own labour input, before taking over the farm. To indicate the effects of opportunity costs we have them separated from the other costs in most of the figures.

For the estimations and calculations the following assumptions were made:

Labour costs

For hired labour, cash labour costs currently incurred were used. For unpaid family labour, the average wage rate per hour for a qualified full-time worker in the respective region was used.

Land costs

For rented land, rents currently paid by the farmers were used. Regional rent prices provided by the farmers were used for owned land. In those countries with limited rental markets (like NZ), the land market value was capitalised at 4 per cent annual interest to obtain a theoretical rent price.

Capital costs

Own capital is defined as assets, without land and quota, plus circulating capital. For borrowed funds, a real interest rate of 6 per cent was used in all countries; for owner's capital, the real interest rate was assumed to be 3 per cent.

Quota costs

Rent values were used for rented or leased quota. Purchased quota values were taken as being the annual depreciation of values from the profit and loss accounts.

Depreciation

Machinery and buildings were depreciated using a straight-line schedule on purchase prices with a residual value of zero.

Adjustments of fat content

All cost components and forage requirements are established to produce FCM (fat corrected milk with 4.0 percent fat).

Adjustment of VAT

All cost components and returns are stated without value added tax (VAT).

Adjustment of milk FCM 4 percent

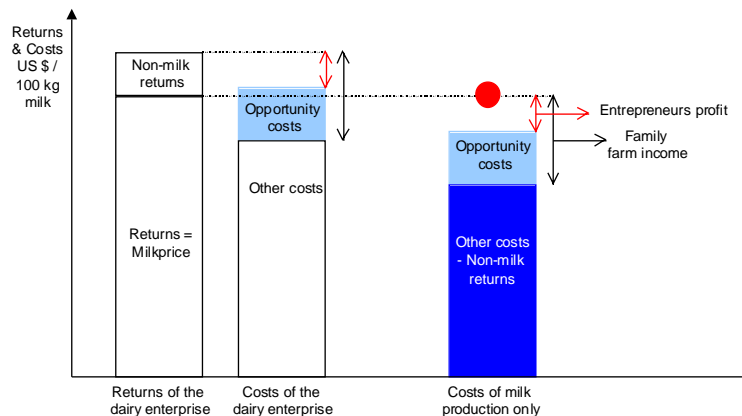
The milk output per farm is adjusted to 4 percent fat. Formula: FCM milk = (milk production * fat in percent*0.15) + (milk production*0.4)

Farm Economic Indicators (IFCN Method)

+ Total receipts =		
+ Crop (wheat, barley, etc.)		
+ Dairy (milk, cull cows, calves, etc.)		
+ Government payments		
- Total expenses =		
+ Variable costs crop		
+ Variable costs dairy		
+ Fixed cash cost		
+ Paid wages		
+ Paid land rent		
+ Paid interest on liabilities		
= Net cash farm income		
+ Non cash adjustments =		
- Depreciation		
+/- Change in inventory		
+/- Capital gains / losses		
= Farm income (Family farm income in Dairy Report 2001)		
- Opportunity costs =		
+ calc. interest on own capital		
+ calc. rent on land		
+ calc. cost for own labour		
= Entrepreneurs profit		

A3. DESCRIPTION OF IFCN RESULT VARIABLES

Cost of Milk Production Only



Method

The total costs of the dairy enterprise are related to the total returns of the dairy enterprise including milk and non-milk returns (cattle returns and direct payments). Therefore the non-milk returns have been subtracted from the total costs to show a cost bar that can be compared with the milk price. The figure beside explains the method.

Other costs: Costs from the P&L account minus non-milk returns (cattle returns and direct payments, excl. VAT).

Opportunity costs: Costs for using own production factors inside the enterprise (land * regional land rents, family working hours * wage for qualified workers, capital: Own capital * 3 percent).

Returns of the dairy enterprise:

Milk price: Average milk prices adjusted to fat corrected milk (4 percent excl. VAT).

Cattle returns: Returns selling cull cows, male calves and surplus heifers + /- livestock inventory (excl. VAT).

Other Returns: Selling/home use of manure

Costs by costs items

Costs for means of production: All cash costs like fuel, fertiliser, concentrate, insurance, maintenance plus non-cash costs like depreciation for machinery and buildings (excl. VAT).

Labour costs: Costs for hired labour + opportunity costs for family labour.

Land costs: Land rents paid + calculated land rents for owned land.

Capital costs: Non-land assets * interest rate (equity * 3 percent, liabilities * 6 percent).

Quota costs: Payments for rented quota and depreciation for quota bought.

Cash and non-cash costs

Cash Costs: Cash costs for purchase feed, fertiliser, seeds, fuel, maintenance, land rents, interest on liabilities, wages paid, vet + medicine, water, insurance, accounting, etc (excl. VAT).

Depreciation: Depreciation of purchase prices for buildings, machinery and quotas (excl. VAT).

Opportunity costs: Costs for using own production factors (land owned, family labour input, equity).

Economic Results of the Dairy Enterprise

Farm income per farm: Returns minus costs from P&L account of the dairy enterprise.

Farm income per kg milk: Farm income per farm (dairy enterprise) / milk production

Profit margin: Share of farm income on the total returns: Farm income divided by the total returns.

Entrepreneurs profit: Returns minus costs from P&L account of the dairy enterprise - opportunity cost allocated to the dairy enterprise.

Net cash farm income: Cash receipts minus cash costs of the dairy enterprise or: Farm income + depreciation

Return to labour: Entrepreneurs profit plus labour costs (wages paid plus opportunity costs) divided by total labour input.

Average wages on the farm: This figure represents the gross salary + social fees (insurance, taxes, etc.) the employer has to cover. Calculation: Total labour costs (wages paid plus opportunity costs) divided by the total hours worked. To calculate this the number of hours worked by the employees and the family has been estimated by experts.

Labour input: The estimation of hours worked and the valuation of these hours is extremely difficult especially in family farms. In the IFCN network this method will be intensively discussed and improved during the next workshops.

Labour costs: Paid wages and opportunity costs for own labour of the dairy enterprise.

Land costs: Paid land rents and opportunity costs for own land (calculated rent) of the dairy enterprise.

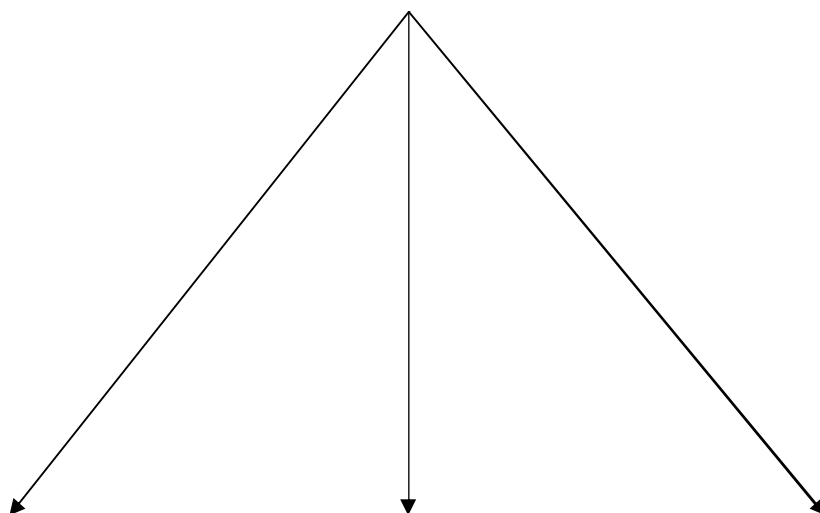
Stocking rate: Number of cows / ha land.

Capital costs: Paid interests and opportunity costs for own capital (excluding land capital and quota capital). For equity 3 percent and for liabilities 6 percent interest rate is used in all countries. This reflects the method of "capital using costs" developed by Isermeyer 1989.

Capital input: Total Assets (land, buildings, machinery, cattle)/ number cows

A4. MAJOR STAKEHOLDERS IN THE INDIA DAIRY INDUSTRY

Central and State Government
National Dairy Development Board (NDDB)
National Cooperative Dairy Federation of India Ltd. (NCDFI)

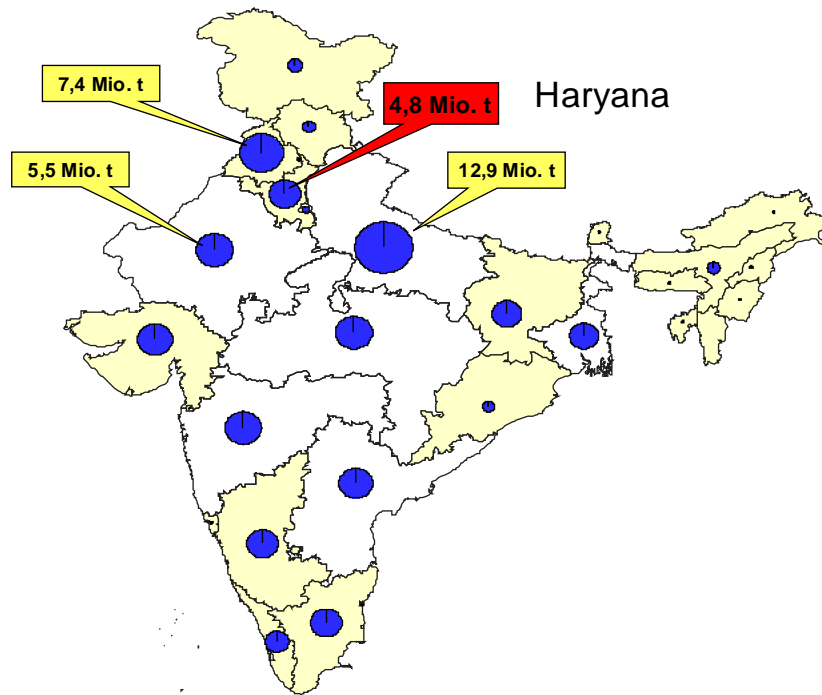


Production Sector	Processing Sector	Marketing Sector
Milk Producers	Milk Processors	Marketing Channels
<ol style="list-style-type: none"> 1. Smallholders 2. Large Producers 3. Peri-urban Dairy Farms 4. Commercial Dairy Farms 5. Institutional Dairy Farms 	<ol style="list-style-type: none"> 1. Co-operatives Sector 2. Private Sector 3. Government Milk Schemes 4. Joint Sector (Govt. & Pvt.) 5. Informal Sector (Halwais) 	<ol style="list-style-type: none"> 1. Private Companies 2. State Co-operatives 3. Milk Marketing Federations 4. Wholesalers and Retailers 5. Informal Sectors (Dudhias, Contractors, Milk Producers)

Source: Sharma (2002)

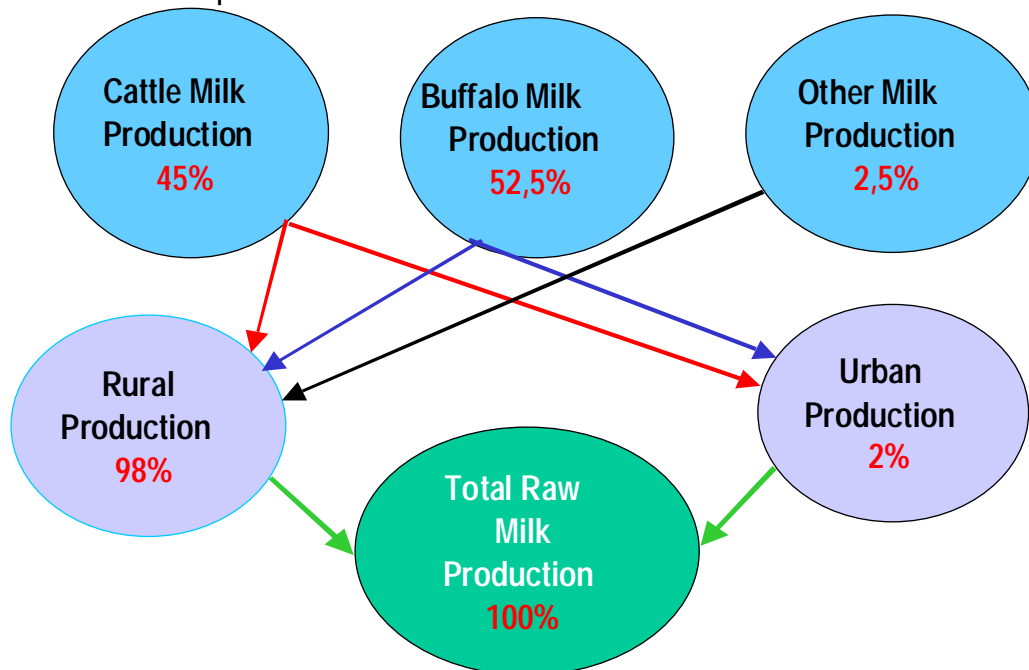
A5. MILK PRODUCTION IN INDIA

Milk Production by State



Source: FAO Production Yearbook (2001)

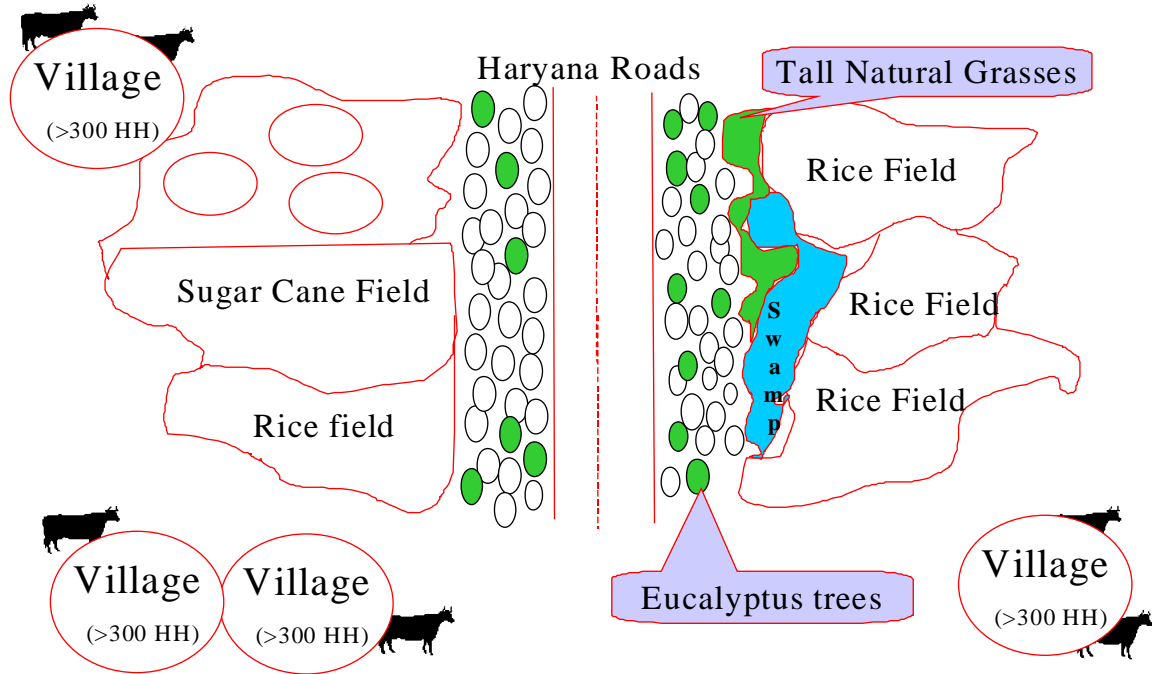
Rural vs. urban milk production



Source: Gupta (1997)

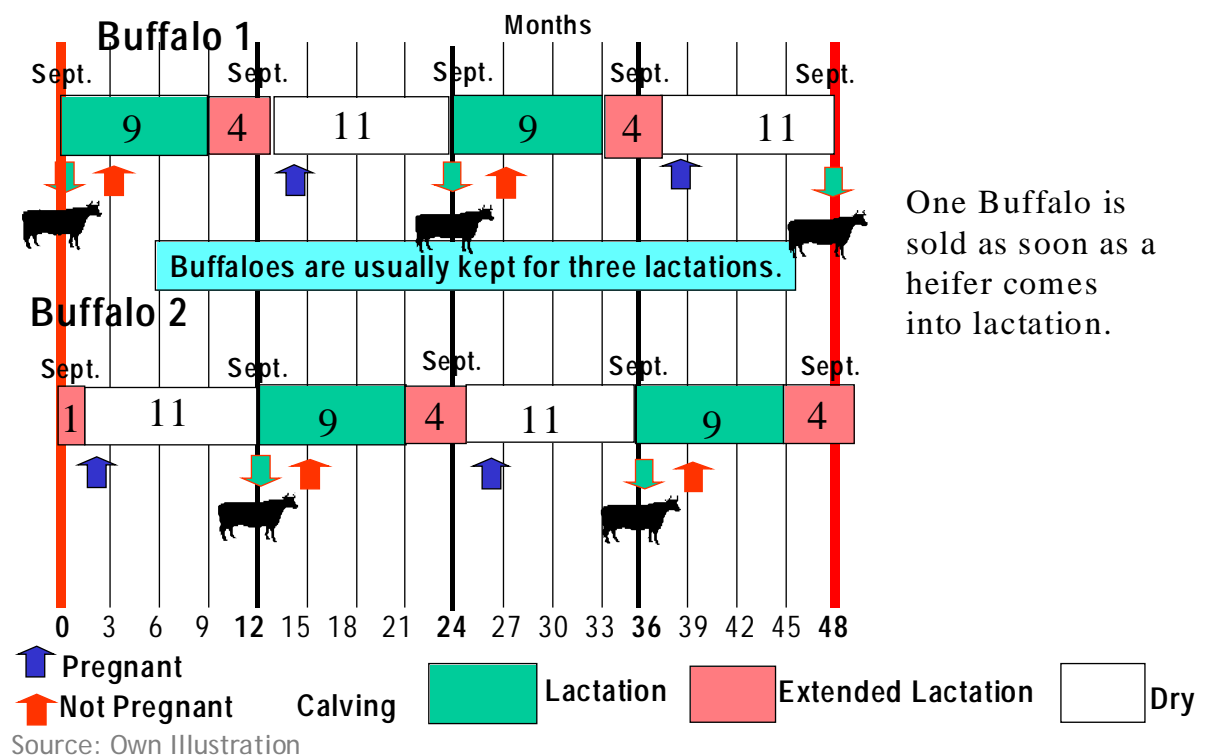
A6. ILLUSTRATION OF THE DAIRY PRODUCTION SYSTEM FOR A TYPICAL TWO-COW FARM (IN2)

Production Surroundings for a Typical 2-Milch-Animal Farm



Source: Own Illustration, Note: HH means Household

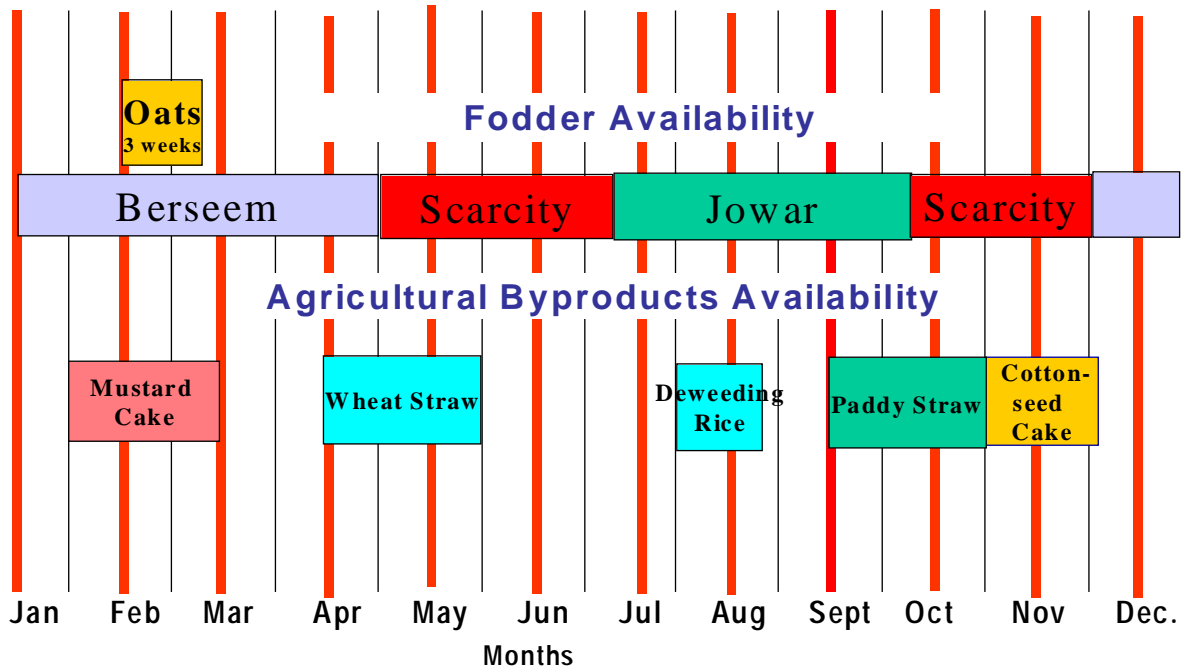
Seasonal Issues for a Typical 2-Milch-Animal Farm



Source: Own Illustration

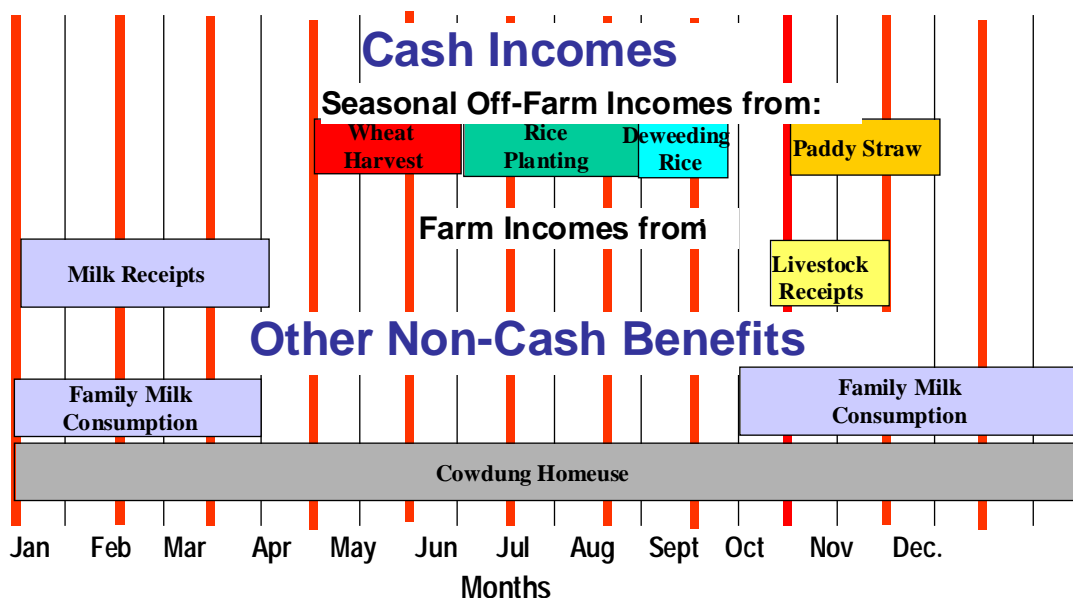
A7. SEASONALITY OF INCOME AND FEED SOURCES FOR A TYPICAL TWO-COW FARM (IN2)

Feed Availability during the Year



Notes: Berseem is a type of Clover; Jowar is a Millet-like plant.
Source: Own Illustration.

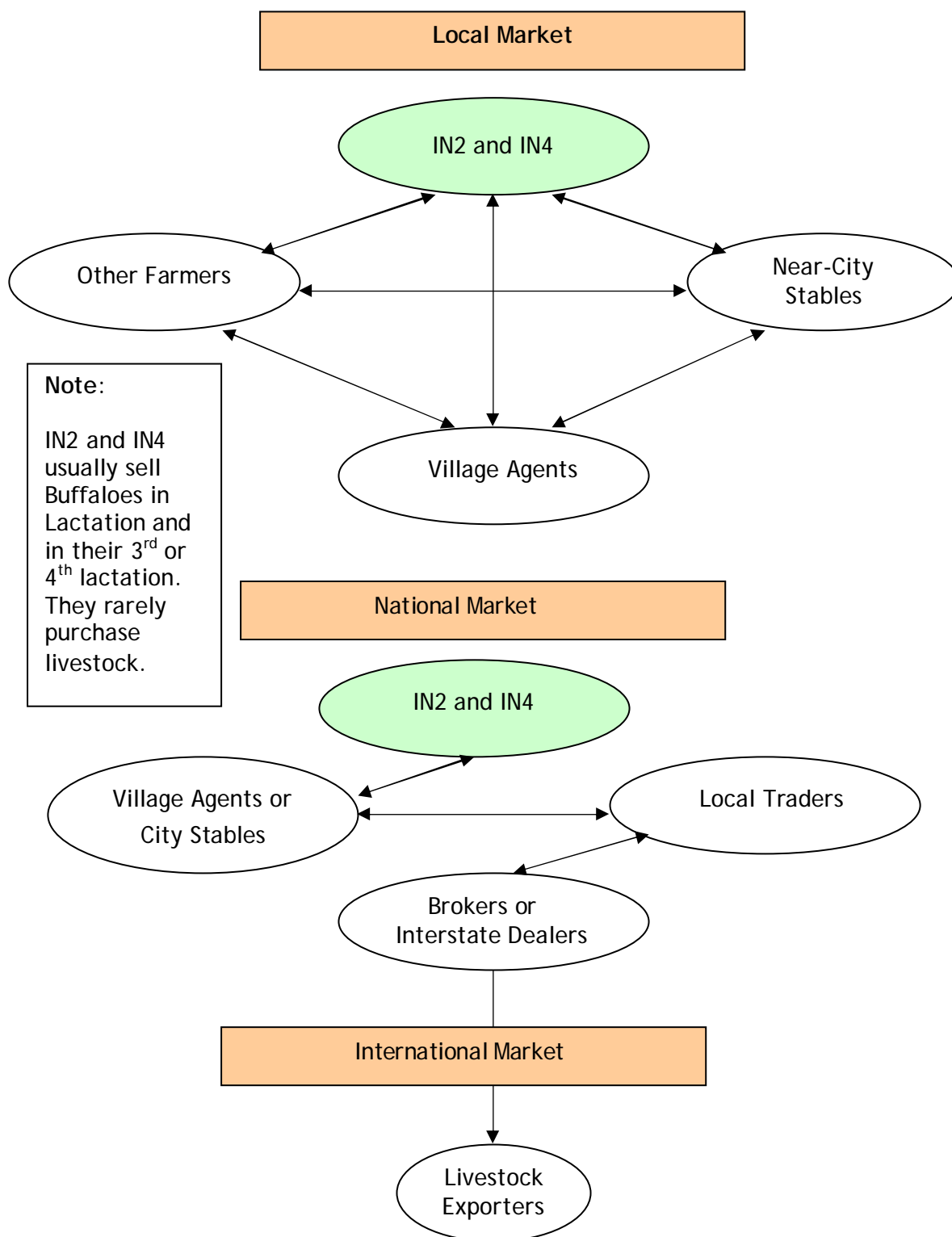
Simplified Picture of Cash and Non-Cash Benefits during the Year



Note: Loan is repaid with milk during first 3 months of lactation (so no Milk Receipts).
Source: Own Illustration

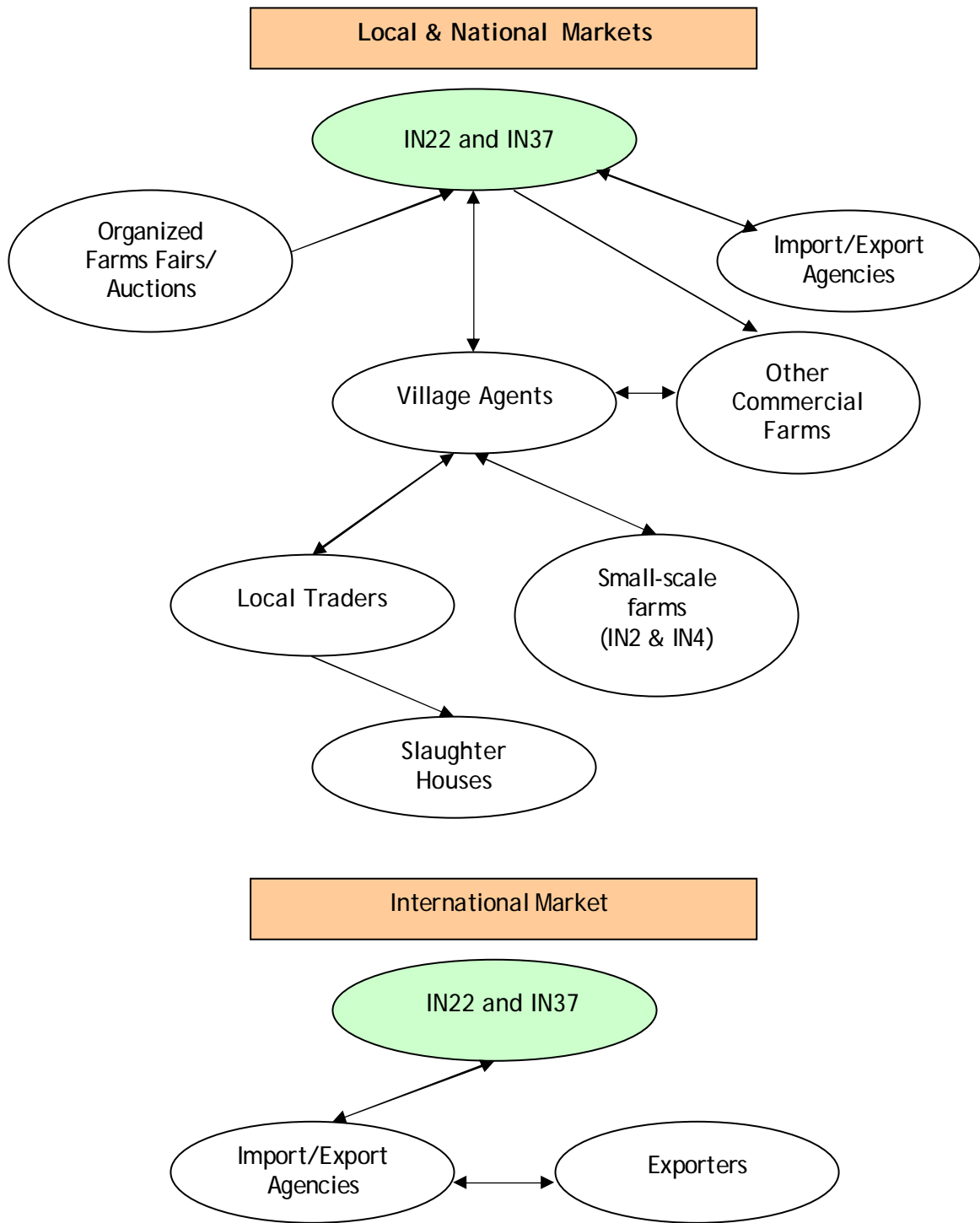
A8. MARKETING OF "MILCH ANIMALS" IN HARYANA

Livestock Marketing for a Typical IN2 and an IN4 Farm



Source: Own Illustration

Livestock Marketing for a Typical IN22 and an IN37 Farm



Note:
 IN22 has an expensive Holstein bull and raises its own heifer.
 Unlike IN22, IN37 prefers to purchase lactating animals and sell dry ones.

Source: Own Illustration

A9. DESCRIPTION OF THE DAIRY CHAIN CALCULATIONS

Variables	Units	Formal Milk Channels		Informal Milk Channels		
		Coop 1.5%	Coop 3%	Creamery 3%	Milkman 3%	Direct Sale 6%
Dairy Processing activities based on 1 kg milk bought from the farmer						
INPUTS						
Input 1: Milk from the farmer						
Quantity	Kg	1	1	1	1	1
Fat Content	% estimation	6%	6%	6%	6%	6%
Protein Content	% estimation	3,5%	3,5%	3,5%	3,5%	3,5%
Purchase Price	US\$/ Kg	0,23	0,23	0,25	0,21	0,25
SUM OF ALL INPUTS	US\$	0,23	0,23	0,25	0,21	0,25
OUTPUTS						
Output 1: Milk sold	Description	Double Toned	Toned	Creamless	Creamless	Whole
Quantity	Kg	0,85	0,90	0,9	0,9	1
Fat Content	%	1,5%	3%	3%	3%	6%
Protein Content	% estimation	3,1%	3,5%	3,5%	3,5%	3,5%
Consumer Price	US\$/ Kg	0,22	0,24	0,25	0,28	0,32
Output 2: Cream sold						
Quantity cream	Kg	0,150	0,100	0,100	0,100	0,000
Fat content of cream	%	30%	30%	30%	30%	0
Quantity of fat	Kg	0,030	0,030	0,030	0,030	0
Consumer price for cream	US\$/ Kg	1,7	1,7	1,7	1,7	0
SUM OF ALL OUTPUTS	US\$	0,44	0,39	0,40	0,42	0,32
MARGINS						
Sum of all Returns	US\$	0,44	0,39	0,40	0,42	0,32
-Farmers Milk Price	US\$	0,23	0,23	0,25	0,21	0,25
FINAL MARGINS	US\$	0,211	0,156	0,14	0,21	0,06
Notes:						
1- All channels employ various processing/marketing procedures, we chose the most commonly applied and the best described by the interviewees.						
2- Fat content for (fluid) Milks varies greatly due mainly to poor regulation and quality control and a strong consumer demand for (fluid) milks.						
Source: Prices and processing channels from personal communication, fat and protein contents based on assumptions from the Authors.						

A10. DESCRIPTIONS OF THE PRICE SENSITIVITY SCENARIOS

Milk Prices (US \$/ Kg milk)

Farms	1st Scenario Status quo	2nd Scenario -20%	3rd Scenario (plus) 20%
IN2	0.190	0.152	0.228
IN4	0.233	0.186	0.280
IN22	0.178	0.142	0.214
IN37	0.318	0.254	0.382

Livestock Prices (US \$/ Kg Liveweight)

Farms	1st Scenario Status quo	2nd Scenario -20%	3rd Scenario (plus) 20%
IN2	0.302	0.242	0.362
IN4	0.479	0.383	0.575
IN22	0.470	0.376	0.564
IN37	0.348 *	0.278 *	0.418 *
	0.435 **	0.348 **	0.522 **
	0.468 ***	0.374 ***	0.562 ***

All farms sold animals, but only IN37 bought in 13 lactating animals.

* selling dry and culled animals; ** selling breeding heifers; and *** buying lactating animals.

Wages Prices (US \$/ hr)

Farms	1st Scenario Status quo	2nd Scenario -20%	3rd Scenario (plus) 20%
IN2	No hired labour	No hired labour	No hired labour
IN4	No hired labour	No hired labour	No hired labour
IN22	0.161*	0.129	0.193
IN37	0.146 *	0.117	0.175

* Wages prices = total costs for hired labour/ total number of hours of hired labour.

A11. DESCRIPTIONS OF THE SIMULATED SCENARIOS FOR A TYPICAL TWO-COW FARM (IN2)

Description of the Production Practices and Technology Scenarios

		Baseline	Milk Yield	Loan	2 Lactations	IN2-Top	Accumulative
Farm Variables							
	Units						
Herd Composition	Animal Types	2 Buffaloes	2 Buffaloes	2 Buffaloes	2 Buffaloes	1 Cow + 1 Buffalo	2 Buffaloes
Yield (6% Fat)	Kg/ head/ year	1600	1920	1600	1600	1890	1920
Lactating Animals	Head/ year	1	1	1	2	2	2
Compound Feeds	Kg/ head/ day	0	0	0	0	1,6	0,5
Milk Hauling Costs	US\$/ 100 Kg	0	0	0,6	0	0	0,6
Capital Variables							
Loan	US \$/ year	119	119	0	119	0	0
Interest Rate	%	50	50	0	50	0	0
Labour Variables							
Farm Labour Input	Family hour/ yea	1800	1800	1800	1800	2000	1800
Prices Variables							
Milk Price	US\$/ Kg Milk	0,19	0,19	0,23	0,19	0,25	0,23

Assumptions:

- 1- Taking a loan from the milkman leaves the farmer with little power to negotiate milk price.
- 2- Milk yield is increased by making efficiency gains in farm management and genetics used.
- 3- The Accumulative scenario incorporates all the changes seen in the previous (3) scenarios.
- 4- IN2-Top represents a well-managed local farm, which also incorporates a Crossbred cow (as a new technology).

Description of the Policy Scenarios

		Baseline	Loan	Efficiency	Dairy Chain	Specialization	Accumulative	Quit 50%	Quit 100%
Farm Variables									
	Units								
Herd Composition	Animal Types	2 Buffaloes	2 Buff.	2 Buffaloes	2 Buffaloes	4 Buffaloes	4 Buffaloes	No Animals	No Animals
Yield	Kg/ head/ year	1600	1600	1920	1600	1600	2000	0	0
Lactating Animals	Head/ year	1	1	1	1	2	2	0	0
Compound Feeds	Kg/ head/ day	0	0	0	0	0	0	0	0
Input Fixed Expenses	US \$/ year	11,65	11,65	11,65	11,65	23,29	23,29	0	0
Machinery Value	US \$	25	25	25	25	25	25	0	0
Buildings Value	US \$	169	169	169	169	169	169	0	0
Milk Hauling Costs	US\$/ 100 Kg	0	0,6	0	0	0	0,6	0	0
Capital Variables									
Loan	US \$/ year	119	119	119	119	119	119	0	0
Interest Rate	%	50	15	50	50	50	15	0	0
Labour Variables									
Own-Farm Labour Input	Family hr/ year	1800	1800	1800	1800	2880	2880	0	0
Off-Farm Labour	Family hr/ year	2960	2960	2960	2960	2960	2960	3.860	4760
Prices Variables									
Milk Price	US\$/ Kg Milk	0,19	0,23	0,19	0,22	0,19	0,23	0	0
Household Variables									
Living Expenses	US \$/ year	487	487	487	487	487	487	680	680

Assumptions:

- 1- Taking a loan from the milkman (50% interest rate) also ties the farm milk to low price. The loan at 15% interest allows farmer to sell milk at market price.
- 2- Milk yield is increased by making efficiency gains in farm management and genetics used.
- 3- The Accumulative scenario incorporates all the changes seen in the previous (4) scenarios.
- 4- Quitting dairying assumes that family sells 50 and 100% of its previous dairy labour at market price.
- 5- Higher family living expenses for the Quitting scenarios reflects the value of milk and fuel (manure) that family must buy.

Description of the Main Risk Scenarios

		Baseline	No Lactation	Lactating Buffalo Dies	Pay Straw	Man ill
Farm Variables						
	Units					
Yield	Kg/ head/ year	1600	0	1350	1600	1600
Lactating Animals	Head/ year	1	0	1	1	1
Purchased Animals	Heads	0	0	1	0	0
Sale of Animals	Heads	1	0	0	1	1
Capital Variables						
Loan	US \$/ year	119	119	278	119	119
Interest Rate	%	50	50	50	50	50
Labor Variables						
Own-Farm Labour Input	Family hr/ year	1800	1800	1800	1800	1800
Off-Farm Labour	Family hr/ year	2960	2960	2960	2960	960
Prices Variables						
Milk Price	US\$/ Kg Milk	0,19	0	0,19	0,19	0,19
Wheat Straw	US\$/ t	0	0	0	25,4	0
Household Variables						
Living Expenses	US \$/ year	487	657	487	487	243,5
Family Milk Consumption	Kg/ year	730	730	438	730	730

Assumptions:

- 1- No lactation; farmer gets no loan to complete purchase price of a lactating Buffalo; and family milk consumed is added to living expenses.
- 2- Lactating buffalo dies; loan (US\$ 159) is taken to buy a lactating one; family consumed less milk to pay debt.
- 3- Farmer must pay for straw at market price.
- 4- The head of the household gets sick and cannot work on and off the farm. Family living expenses must and somehow can be reduced.

A12. REFERENCES

Chapter 1: Summary

Chapter 2: India Dairy

- 1 FAO (1997) FAO Production Year book 1997, FAO, Rome
- 2 IFCN Dairy Report 2001
- 3 IFCN Dairy Report 2002
- 4 Government of India (1997) Basic Animal Husbandry Statistics, AHS Series-6, Department of Animal Husbandry and Dairying, Ministry of Agriculture, Krishi Bhawan, New Delhi, pp. 9 - 148
- 5 Government of India (1999) Basic Animal Husbandry Statistics, AHS Series-7, Department of Animal Husbandry and Dairying, Ministry of Agriculture, Krishi Bhawan, New Delhi, pp. 9 - 148
- 6 Gupta, P.R. (1997) Dairy India, New Delhi
- 7 Sadhana (2001) Sadhana's Dairy Year Book, 2000-01, M/s Sadhana Publishers and Distributors, Ghaziabad, New Delhi, India

Chapter 3: Haryana Dairy

- 8 IFCN Dairy Report 2002
- 9 Government of India (1999) Basic Animal Husbandry Statistics, AHS Series-7, Department of Animal Husbandry and Dairying, Ministry of Agriculture, Krishi Bhawan, New Delhi, pp. 9 - 148
- 10 Survey of Six Villages in Haryana (July 2002) Unpublished and Obtained through IFCN India Representative
- 11 Government of Haryana (2002) Statistical Abstracts Organization. Economic and Statistical Organization, Planning Department, Haryana
- 12 IFCN Internal Databases
- 13 Personal Communications (2002) Interviews with farmers, veterinarians, local milkmen, and creamery owners, September and October 2002

Chapter 4: Testing IFCN Methods for Small Scale Dairy Farming

- 14 IFCN Methods and Internal Databases
- 15 Personal Communications (2002) Interviews with farmers, veterinarians, local milkmen, and creamery owners, September and October 2002

Annexes

- 16 Sharma, V.P. *et al.* (2002) Critical Issues for Poor in the India Dairy Sector on the Threshold of a New Era. Livestock Industrialisation Project: Phase 1. (An IFPRI-FAO Project)